World Sustainability Series

Walter Leal Filho
Robert W. Marans
John Callewaert *Editors*

Handbook of Sustainability and Social Science Research

Springer

World Sustainability Series

Series editor

Walter Leal Filho, Hamburg, Germany

More information about this series at http://www.springer.com/series/13384

Walter Leal Filho · Robert W. Marans
John Callewaert
Editors

Handbook of Sustainability and Social Science Research

Springer

Editors
Walter Leal Filho
Faculty of Life Sciences
HAW Hamburg
Hamburg
Germany

and

Manchester Metropolitan University
Manchester
UK

Robert W. Marans
Institute for Social Research
University of Michigan
Ann Arbor, MI
USA

John Callewaert
Graham Sustainability Institute
University of Michigan
Ann Arbor, MI
USA

ISSN 2199-7373 ISSN 2199-7381 (electronic)
World Sustainability Series
ISBN 978-3-319-67121-5 ISBN 978-3-319-67122-2 (eBook)
https://doi.org/10.1007/978-3-319-67122-2

Library of Congress Control Number: 2017951421

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

Many scholars perform high-quality research on matters related to sustainability. Yet, there are relatively few events where a multidisciplinary overview of research efforts and projects has taken place, and where research scholars from across the spectrum of the social sciences have had the opportunity to come together to discuss research methods, research findings, or exchange ideas about ongoing and future research opportunities focusing on sustainability.

It is against this background that the “Sustainability and Social Science Research Symposium” was organized by the University of Michigan, in cooperation with the Inter-University Sustainable Development Research Programme (IUSDRP), Manchester Metropolitan University, HAW Hamburg and a number of institutions of higher education active in this field.

The aims of the symposium were as follows:

i. to provide social science researchers focusing on sustainability an opportunity to present and discuss their work (e.g., empirical work, case studies, teaching and learning innovations, applied projects, etc.);
ii. to foster the exchange of information, ideas, and experiences acquired in the execution of research projects, especially initiatives which have influenced behavior, decision-making, or policy;
iii. to discuss methodological approaches and projects which aim to offer a better understanding of sustainability across society and economic sectors; and
iv. to network the participants and provide a platform so they can explore possibilities for further cooperation.

Last but not least, a further aim of the event was to document and disseminate the wealth of experiences on sustainability and social science research. To that end, this peer-reviewed “Handbook of Sustainability and Social Science Research” has been produced. The publication introduces the results of research, field studies, and projects around social science research on matters related to sustainability, and introduces new and innovative thinking on how social sciences influence sustainability and vice versa.

The book is structured in three main parts. Part I explores the connections between sustainability and the social sciences. It includes discussions of key paradigms and analytical concepts, explores policy applications, and considers new approaches to education and economics. Part II highlights research and findings from an array of behavioral interventions and participant engagement efforts covering topics such as climate change, resource conservation, renewable energy, social justice, and green citizenship. Part III provides several examples of innovative methodological approaches and evaluation strategies such as cognitive mapping, brainstorming, online surveys, instructional modules, and sustainability assessments.

We thank the authors for their willingness to share their knowledge, know-how, and experiences, as well as the many peer reviewers, which have helped us to ensure the quality of the manuscripts. We also thank Dr. Mihaela Sima for her hard work and for all her help in the organization of the event and production of this book.

Enjoy your reading!

Hamburg, Germany/Manchester, UK — Walter Leal Filho
Ann Arbor, USA — Robert W. Marans
Ann Arbor, USA — John Callewaert
Winter 2017/2018

Contents

Part II Research and Behavioral Interventions

Part III Methods and Evaluation Strategies

Part I
Exploring the Connections: Sustainability and Social Science Research

Interplays of Sustainability, Resilience, Adaptation and Transformation

Jennifer L. Johnson, Laura Zanotti, Zhao Ma, David J. Yu, David R. Johnson, Alison Kirkham and Courtney Carothers

Abstract

This chapter analyzes the complex interplays between and among *sustainability*, *resilience*, *adaptation* and *transformation*, key paradigms and analytical concepts that have emerged from the human-environmental interactions, social-ecological systems, and global environmental change literatures. Specifically, this chapter provides a summary of how these key paradigms and analytical concepts have evolved over time and synthesizes current debates about their interplays. Our findings reveal certain theoretical synergies between and among *sustainability*, *resilience*, *adaptation* and *transformation*, as well as epistemological tensions and practical tradeoffs when actions are taken to promote ostensibly desirable attributes of social-ecological systems through on-the-ground actions. These findings highlight the need for scholars, practi-

J.L. Johnson · L. Zanotti · A. Kirkham
Department of Anthropology, Purdue University, 700 W. State Street, Suite 219, West Lafayette, Indiana 47907-2059, USA

Z. Ma (✉)
Department of Forestry and Natural Resources, Purdue University, 195 Marsteller Street, West Lafayette, Indiana 47907-2033, USA
e-mail: zhaoma@purdue.edu

D.J. Yu
Lyles School of Civil Engineering, Purdue University, 550 Stadium Mall Drive, West Lafayette, Indiana 47907-2051, USA

D.R. Johnson
School of Industrial Engineering, Purdue University, 315 N. Grant Street, West Lafayette, Indiana 47907-2023, USA

C. Carothers
Courtney Carothers: College of Fisheries and Ocean Sciences, University of Alaska Fairbanks, 1007 W. 3rd Avenue, Suite 100, Anchorage, Alaska 99508-1936, USA

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*, World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_1

tioners and policy makers to be explicit about the normative assumptions associated with *sustainability*, *resilience*, *adaptation* and *transformation* as they complement or contradict each other in local contexts, and how they may affect or be affected by the characteristics of and processes within local communities. Such understanding will be crucial for moving towards developing adaptation or transformation interventions that maximize the achievement of sustainability or resilience policy goals and minimize potential negative outcomes on both human well-being and environmental conditions.

1 Introduction

In recent decades, *sustainability* and *resilience* have emerged as two key paradigms within human-environmental interactions, social-ecological systems, and global environmental change literatures. From the 1987 Brundtland Report on Sustainable Development to the recent formulation of Sustainable Development Goals in a 2015 United Nations (UN) resolution, sustainability has become central to many international development policies and programs. A parallel development can be seen with respect to resilience, another key paradigm that has guided the international development communities arguably since the 1980s (Brown 2014). More recently, scholars, development practitioners and policy makers have paid more attention to the synergies between sustainability and resilience. This is evidenced in the final report of the 2010 UN High-Level Panel on Sustainability, entitled “Resilient People, Resilient Planet” (Galaz et al. 2012), and the 2016 International Union for the Conservation of Nature (IUCN) World Conservation Congress Hawai’i Commitments, which call for the promotion of sustainable livelihoods through improving ecosystem resilience. Beyond conservation, there is a growing desire within the global policy community to formulate science-based, multi-scalar, multi-faceted, and holistic solutions to global challenges in general (Biermann 2014; Galaz et al. 2012; Saunders 2015). Such desire has supported the rapid development of funding calls, interdisciplinary centers, and synergistic activities worldwide that rely on sustainability and resilience as two theoretical paradigms within which global challenges are described, understood, analyzed, and addressed.

Related to the paradigms of sustainability and resilience are *adaptation* and *transformation*, two key analytical concepts nested within them, and the associated capacities (*adaptability* and *transformability*) of actors in a social-ecological system that influence *adaptation* and *transformation* processes (Walker et al. 2004). As global environmental change, particularly climate change, becomes an increasingly visible area of concern in the scholarly, policy and public domains, the academic literature on adaptation to climate change and global environmental change in general has proliferated over the past 30 years. Specifically, a growing amount of work in this area focuses on the vulnerability, adaptive strategies, and adaptive capacity of rural, and more recently urban communities, in both the Global North and Global South (Burnham and Ma 2016; Eakin et al. 2017). Adaptation as a policy goal has also been largely incorporated into development initiatives worldwide by various government agencies and international organizations (Conway 2011). However, as communities around the world increasingly face unprecedented changes, some scholars have argued that adaptation within current social-ecological systems along may not be sufficient to effectively address global environmental change (Colloff et al. 2017; Gillard et al. 2016). Instead, these scholars argue that transformational changes may be needed to enable current social-ecological systems to shift to different kind of systems, or to create fundamentally new systems altogether (Gillard 2016; Pelling et al. 2015; Redman 2014; Walker et al. 2004). Despite these debates about the hierarchical relationship between adaptation and transformation, both concepts have been used to guide policy actions for achieving sustainability and resilience goals.

Within these scholarly and policy contexts, this article provides a summary of how the key paradigms and analytical concepts of *sustainability*, *resilience*, *adaptation* and *transformation* have evolved over time; synthesizes the current debates about the interplays between and among these paradigms and concepts; charts the synergies and contradictions between and among these paradigms and concepts; discusses future directions for defining and achieving desired change; and, identifies the associated challenges and opportunities within both scholarly and policy domains. Importantly, recent scholarly discussions have identified power dynamics and epistemological frictions as underexplored and undertheorized areas in human-environmental interactions, social-ecological systems, and global environmental change literatures (Brown 2014; Cote and Nightengale 2012). Drawing from these critiques, in this chapter we consider how analyzing synergies and contradictions can further reveal tensions between normative and descriptive dimensions of these key paradigms and analytical concepts, which often become particularly noticeable when applying them to address real-world problems. Explicitly considering the normative dimensions of *sustainability, resilience*, *adaptation* and *transformation* enables us to better understand the applications and limitations of these key paradigms and analytical concepts, identify opportunities for improving interdisciplinary collaborations, and consider different approaches to minimize unintended policy and program outcomes. It further allows us to demonstrate the dominance of sustainability science and resilience thinking in human-environmental interactions, social-ecological systems and global environmental change literatures, and suggests that neither *sustainability* nor *resilience* should be considered the universal paradigm within which adaptation and transformation can be understood and applied.

2 Overview of Paradigms and Concepts

2.1 Sustainability as a Paradigm and Policy Goal

Once a fairly radical notion, sustainability is now a mainstream paradigm invoked by scholars, activists, governments and multi-national corporations alike. Sustainability as a site of global concern emerged in the second half of the 20th Century alongside growing recognition of the detrimental environmental and human-health impacts associated with industrial growth in the Global North, as well as growing economic inequalities between the industrialized and less-industrialized nations in the Global South. The notion was first popularized in the then-controversial Club of Rome report, *The Limits to Growth* (Meadows et al. 1972), which articulated the existence of ecological limits to population and economic growth. This report called for transformative change—both in ideology and in practice—to sustain humanity at large into the future. The most frequently cited definition of sustainability in contemporary scholarly and policy-based literatures is a definition of a different term altogether: sustainable development. The 1987 Brundtland Commission report defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). Less quoted is the second part of this definition, which identifies two key concepts and further integrates a needs-based approach within the core features for sustainable development: "the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs" (WCED 1987).

The term sustainability is now so ubiquitous across social, environmental and economic domains as to seemingly no longer require definition for operationalization. The ubiquity of sustainability invites competing interpretations and has generated numerous quantitative approaches for measuring the sustainability of a given system, making it difficult to evaluate the success or failure of sustainability-focused policies and programs due to a lack of consensus on measurement criteria. Although the flexibility of the term may have contributed to an increase in the number, diversity and scope of actors and domains of application, it has garnered critique for resulting in little more than "a listing of any societal objectives that agents happen to think important" (Brand and Jax 2007), leading some scholars to declare the end of its usefulness altogether (Benson and Craig 2014). Popular and widespread approaches to sustainability also tend to equate sustainability with sustainable development (Gonzalès and Parrott 2012; Walker et al. 2006). For example, Derissen et al. (2011, p. 1121) describes sustainability as capturing "basic ideas of intergenerational justice when human well-being depends on natural capital and services." As such, sustainability seems to be uncritically commensurate with economic growth and market-based approaches to conservation. Further, Derissen et al.'s description of sustainability overlooks the portion of the Brundtland definition that draws attention to present-day global inequalities.

Instead, this definition privileges an undifferentiated approach to "human well-being" that fails to acknowledge power relations or intragenerational justice concerns. In other words, the ubiquity of a generalized definition of sustainability and sustainable development has important implications for how the Global North and the Global South are treated at sites of global governance and, relatedly, their ability to address sustainability and sustainable development.

In addition to increased acceptance of the paradigms of sustainability and sustainable development, sustainability has also been generally accepted as a normative concept from its induction (Anderies et al. 2013; Derissen et al. 2011; Hicks et al. 2016), that is, sustainability is a good thing that individuals and institutions ought to strive to foster. From this perspective, sustainability is characterized more as a process, as well as a policy goal (Berkes et al. 2003). For example, Eakin et al. (2017, p. 186) redefines sustainability as a "normative decision process involved in steering a system to a preferred state." We find the normative assumptions associated with sustainability coupled with the increasingly widespread appeal of sustainability as a policy goal problematic. When sustainability is assumed to be a good thing and is uncritically embraced, important questions about who and what will be sustained, how sustainability will be operationalized on the ground, and what other short- and long-term outcomes that communities might desire, may be overlooked.

Despite criticisms of the utility of sustainability as a policy goal, initiatives promoting sustainability and sustainable development remain widespread, and different interpretations and applications of sustainability and sustainable development continue to emerge. For example, sustainability science is a research framework developed in the early 2000s, in part, as a reaction to the emerging prominence of sustainability and sustainable development as a dominant paradigm, and as a response to the need to develop an approach that "transcends the concerns of its foundational disciplines and focuses instead on understanding the complex dynamics that arise from interactions between human and environmental systems" (Clark 2007, p. 1737). Importantly, as noted above, sustainability, writ large, was not originally tied to notions that necessitate development or growth, and sustainability science scholars sought to return to the definition of the capacity of a system to persist in time (Costanza and Patten 1995).

And yet, the widespread resonance of the paradigm and its internalization in a variety of scholarly and applied domains have not resulted in the kind of transformative change that was initially considered necessary to achieve sustainability, as described in the Club of Rome report. Indeed, the very same institutions that were first held up as culpable for their unsustainable practices have successfully internalized criticisms and remolded themselves as working at the vanguard of environmental sustainability, including the private sector and international financial institutions (Benson and Kirsch 2010; Goldman 2006). The underlying drivers of sustainability challenges—for example, increasing use of fossil fuels, seemingly unending consumer demand, the rising production of less durable goods, and growth in the global economy overall—have not been sufficiently addressed. Sustainability in global environmental governance and policy worlds is carried out mostly as business as usual. Sustainable development, widely embraced, tends to narrow the focus on intergenerational equity (rather than intragenerational), and as a policy mechanism, tends to obscure attention to equity, power and justice which were initially central concerns of early proponents of sustainability itself (Agyeman et al. 2002).

2.2 Resilience as a Paradigm and Policy Goal

Resilience, like sustainability, has become a commonplace term and paradigm from which to consider planetary concerns. Resilience thinking, resilience theory, or resilience paradigm refers to a cluster of concepts related to multiple stable states of self-organized systems and the interplay of persistence and reorganization involving these system states (Carpenter and Brock 2008, Duit et al. 2010). Resilience thinking was seeded in the field of ecology through the seminal work of Holling (1973; "ecological resilience") and has been popularized over the last 20 years through the subsequent works of scholars who advocate a social-ecological systems approach that encompasses a resilience conceptual framework and adaptive cycle metaphor (Folke 2006; Gunderson and Holling 2002; Gotts 2007; Walker et al. 2004). Resilience in this context reflects the amount of shock a system can absorb without flipping into an alternate regime or stability domain (Barnett 2001; Folke 2006; Perrings and Brock 2009). A related conceptual framework was developed independently in the field of engineering with a focus on how built systems and environments can be designed to reduce the sensitivity of their performance to perturbations. Specifically, resilience in this context (i.e., "engineering resilience") was traditionally focused on the rate of recovery or speed of bouncing back to a single stable state that a system is designed to exhibit after experiencing a perturbation (Bergen et al. 2001; Holling 1996; Hollnagel et al. 2006; Pimm 1984).

Over time, discussions about resilience in both contexts have been evolving, starting in the social-ecological systems literature and later in the built environment literature (Folke et al. 2003, 2004; Haigh and Amaratunga 2010). Specifically, engineers from different disciplines have recently recognized that resilience goes beyond the initial 'bounce back' and singular equilibrium state (Davoudi 2012). Some have further argued for tiered definitions of resilience (Anderies 2014; Hassler and Kohler 2014a; Moffatt 2014). For example, at the systems scale, resilience "offers a means to address the long-term evolution of the built environment" (Hassler and Kohler 2014b, p. 121) which allows effective conceptualization of adaptation and transformation of built environments; while at the scale of physical infrastructure, resilience is better used as a design principle (e.g., Bosher and Dainty 2011; Coaffee 2008; Hollnagel et al. 2006) which addresses "timescales and redundancy" (Hassler and Kohler 2014b, p. 121) and provides "clear feedback on its performance to allow for learning and adjustment" (Hassler and Kohler 2014b, p. 123).

Before such developments in the built environment literature, social-ecological systems scholars first started incorporating new approaches to modeling ecosystems, moving away from a single equilibrium approach to a non-linear model and emphasizing the temporal and spatial dynamics that often unfold across periods of change and the critical transitions among multiple stable states (Folke 2006). In this paradigm, a resilient social-ecological system is one that has the capacity to absorb disturbance and experience shocks while retaining essentially the same function, structure, feedbacks, and therefore identity, through reorganization (Walker et al. 2004, 2006). In other words, resilience is achieved through adapting or transforming in response to social-ecological change in ways that strive to support or continue to support human well-being (Biggs et al. 2015; Chapin et al. 2010; Hassler and Kohler 2014b). Moreover, resilience can be further classified into general resilience and specified resilience (Folke et al. 2010). General resilience refers to the general capacity of a system to deal with both expected and unexpected disturbances. Hence, a system's ability to adapt or transform in response to social-ecological change and uncertainty is an important indicator of general resilience. Specified resilience, in contrast, focuses on the capacity of a system to maintain a specific function in relation to a set of disturbances. The perspective of specified resilience is embodied by the three core questions that one should ask in a resilience framework: resilience *of what*, resilience *to what*, and resilience *for whom* (Carpenter et al. 2001; Lebel et al. 2006). These three questions demand an analyst to be explicit about the potential tradeoffs involved in taking a resilience approach. That is, decisions about making *x* resilient to *y* because this matters to stakeholder group *z* must be made ahead of time. However, such decisions may potentially privilege some stakeholders over others, or cause the system to be more vulnerable to a different set of disturbances (Ingalls and Stedman 2016). Although the concept of resilience per se does not address normative considerations (i.e., a system state, whether good or bad to human well-being, can still be resilient), managing for specified resilience necessarily involves making normative decisions—the resilience of *x* to *y* for group *z* is a good thing and preferred over the resilience of *p* of *q* for group *r*.

The resilience paradigm has gained traction as a framework enabling the integration of social, economic, ecological and other considerations into conceptualizing pressing planetary problems and as a systems-based approach to modeling and managing human-environmental relations (Liu et al. 2007). Like sustainability and sustainable development, resilience thinking has been incorporated in key sites of policy making and decision making, most importantly the UN Framework Convention on Climate Change. Resilience thinking also circulates in other international, national, subnational and community-level policy processes and goals. For example, the 2014 Intergovernmental Panel on Climate Change conceptualized a resilient system not only as "the capacity of… systems to cope with a hazardous event or trend or disturbance… in ways that maintain their essential function, identity, and structure" but also as a system that maintains "the capacity for adaptation, learning, and transformation" (Xu et al. 2015, p. 2).

On the practical side, scholars and policy makers employ resilience as an analytical tool for identifying changes taking place in a complex system, describing key interactions among actors at different scales, and quantifying system attributes that are important for the functioning of the system, enabling the development of simulation models and decision-support tools that facilitate dynamic, adaptive management rather than static optimization (Fiksel 2006; Park et al. 2013; Thapa et al. 2010). This resilience-based analytical tool has been applied to understanding ecosystem degradation (e.g., Hughes et al. 2010; Silliman et al. 2012); water management in agricultural, peri-urban, and urban landscapes (e.g., Gordon et al. 2010; Muller 2007; Wardekker et al. 2010); catastrophe management and disaster recovery (e.g., Adger et al. 2005; Park et al. 2013; Zhou et al. 2010); and a variety of other global challenges (Falkenmark and Rockström 2010; Speranza et al. 2014).

Despite its popularity and advancements over time, the resilience paradigm has been critiqued on a variety of fronts. Most prominently, the resilience paradigm is considered by some scholars to be “anti-social” because of its perceived failure to incorporate meaningful considerations of the dynamic nature of social systems, despite the growth of literatures addressing the complexity of coupled human and natural systems and of social-ecological changes (Cote and Nightingale 2012, p. 476). Specifically, the different and often competing definitions of and approaches to resilience arguably warrant attention (Cote and Nightingale 2012). As the concept of resilience has expanded into interdisciplinary circles and attempted to include and incorporate socio-cultural factors, it has faced consistent criticisms within the social sciences and humanities (Olsson et al. 2015) as well as within conservation biology (Newton 2016). Attempts at modeling social systems require data that capture cross-scale linkages, emergent properties, non-linear dynamics and uncertainty within social systems, which is generally lacking, as well as the incorporation of social, political and cultural variables that are methodologically complex and mathematically sophisticated (Domptail et al. 2013; Kottack 1999; Leenhardt et al. 2015). Consequently, modeling social systems proves challenging and often ineffective in capturing social dynamics in a robust and rigorous way. Despite concerted efforts to engage in analyses of social systems, such as those presented by the Resilience Alliance, there are persistent difficulties associated with translating findings in anthropology and allied disciplines into applied contexts, and with reluctance among scholars and practitioners to do this in the first place (Kottack 1999; Olsson et al. 2015).

The work of Elinor Ostrom, Fikret Berkes, Johan Colding, Carl Folke, those involved in the Resilience Alliance, and others has sought to develop and enhance the social-systems aspect of resilience thinking, especially in relationship to governance and the policy dimensions of resilience (e.g., Anderies et al. 2004, 2013; Berkes et al. 2003; Berkes and Folke 1998; Boyd and Folke 2012; Folke et al. 2010; Ostrom and Janssen 2005; Partelow 2016). Although much scholarship on social-ecological systems has been produced, tensions regarding the conceptual flexibility of resilience among scholars and policy makers who embrace resilience still persist. On one hand, many scholars find that flexibility and conceptual vagueness undermine the practical application of resilience, making it difficult to incorporate concerns of equity, power and justice into the development of models that describe the complexity of social-ecological systems. On the other hand, the conceptual flexibility is seen by many as necessary for advancing interdisciplinary research and collaboration in specific contexts (Strunz 2012).

2.3 Adaptation and Transformation: Continuum or Dichotomy?

Adaptation and transformation are often used to describe means to achieve sustainability or resilience goals. Empirically, analyses of adaptation have mainly focused on individual agents and groups, whereas analyses of transformation have mainly focused on systems as bounded or nested wholes. Generally speaking, both concepts refer to some kind of adjustments or changes in a system's structure, function or processes to cope with internal and external stressors. Such adjustments or changes include but are not limited to the adoption of new management practices or technologies, formation of new governance systems or institutions, shifts in cultural values, and relocation. Distinctions between whether a given adjustment or change is defined as an adaptation or transformation hinge on whether adjustments allow a system to retain core system functions and characteristics (adaptation) or shift into a new system altogether (transformation). In other words, whether an actual or proposed adjustment or change is considered adaptation or transformation depends on what boundaries analysts have conceptually drawn around a given system, what components they determine to be relevant, and what scales they use for their analyses (Anderies et al. 2013). For example, transformation could imply multiple, evolving adaptation processes at various scales (O'Brien et al. 2015), while others argue that managing a complex system may require transformation of sub-systems thus transformation can also be an essential part of a complex system's adaptive response to change (Rickards 2013).

Adaptation research has a long history with a particular focus on how human communities respond to ongoing environmental change, particularly climate change. Starting in the 1980s, scholars began to examine how agricultural producers deal with climate variability, particularly in non-industrialized nations. Since the 2000s, adaptation to climate variability and change has been formally incorporated into agricultural and international development programs worldwide (Burnham and Ma 2016). The integration of adaptation in agricultural research and agriculture-oriented development programs is not singular; this is reflective of similar trends that have taken place within scholarship on forestry management and fisheries (e.g., Adger 2000; Adger et al. 2001; Bele et al. 2013; Davidson et al. 2003; Keenan 2012; Kelly and Adger 2000; Miller et al. 2010a).

While adaptation was initially conceptualized as behavioral response to environmental change, framing of adaptation has evolved within the scholarly literature to mean a process of reducing vulnerability, and more recently a pathway of change and response (Burnham and Ma 2017; Fazey et al. 2016; Pelling 2011; Wise et al. 2014). Despite these conceptual developments, so far the majority of empirical research on adaptation has treated adaptation as incremental behavioral response to proximate causes of vulnerability (Burnham and Ma 2016). Current adaptation policies also tend to focus on reactive, local, short-term adaptations, and are generally ineffective in promoting practices and structural changes necessary for adapting to long-term environmental change and various uncertainties (Colloff et al. 2017; Stafford Smith et al. 2011). Opponents of this behavioral approach to adaptation argue that changes in global environmental conditions and social goals are likely to transform social-ecological systems in ways that are unprecedented and unpredictable to scholars and policy makers (Nelson et al. 2007; Wise et al. 2014). Thus, viewing adaptation as part of pathways of change and response will better enable understanding of various forms of uncertainty, risk and opportunity facing individuals, groups and communities, and can produce insights important for developing and implementing adaptation interventions that allow people to manage multiple stressors simultaneously (Burnham and Ma 2017). This emerging discussion about adaptation pathways is also linked to an increasing attention to the importance of enabling transformational adaptation to long-term, large-scale, non-linear and uncertain changes (Abel et al. 2016; Kates et al. 2012; Thornton and Comberti 2017; Wise et al. 2014). In a way, adaptation is about staying on the current pathway of change and response, while transformation is about shifting into a different pathway or creating a new one (Folke et al. 2016).

Several binary conceptualizations have been used to describe adaptation and transformation. For example, adaptation has often been referred to as either autonomous or planned. The key difference between this dichotomy is the space where adaptation is generated, with autonomous adaptation being internally initiated by individuals within a community and planned adaptation being initiated from outside the community (e.g., Burnham and Ma 2016; Moser and Ekstrom 2010). In the case of transformation, two forms of transformation have been noted in the literature. The first is a deliberate process "initiated by the people involved", and the second is a forced process "by changing environmental or socioeconomic conditions" (Folke et al. 2010, p. 5). Whether transformation is deliberate or forced depends on the level of transformability of the social-ecological system in question (Folke et al. 2010). Recent work has highlighted that the boundaries between these binary concepts are fuzzy, and that analytical reliance on them can be counter-productive; as with critiques to sustainability and resilience, such binary conceptualizations may mask the social processes that shape adaptive and transformative practices and strategies (e.g., Agrawal 2009; Osbahr et al. 2008).

3 Synergies, Current Debates, and Opportunities for Moving Forward

Building upon our summary of the progression of sustainability, resilience, adaptation and transformation in both the scholarly and policy domains, below we further explore the interplays between and among these key paradigms and analytical concepts. Specifically, as an interdisciplinary group of scholars, we examined recent discussions about the complex interactions between sustainability and resilience paradigms and between the concepts of adaptation and transformation, as well as the relations between adaptation/transformation and sustainability/resilience. In this section, we pay particular attention to the synergies and tensions within the literatures on human-environmental interactions, social-ecological systems and global environmental change in order to take stock of current debates, identify practical tradeoffs that may be prohibitive towards achieving desired policy goals, and further advance the translatability of these paradigms and concepts across disciplinary and interdisciplinary fields.

Specifically, as sustainability and resilience have emerged as dominant paradigms guiding recent scholarly and policy efforts, there have been discussions and debates about whether these two paradigms are complementary or incompatible (Armitage et al. 2012; Miller et al. 2010b; Turner II 2010; Redman 2014). The extent to which systems, landscapes or communities fit within the boundaries of one or both paradigms has also become central to debates about the value and appropriate use of them. Some scholars see a clear connection between sustainability and resilience, and for them, the key question is whether and to what extent one informs or influences the other (Gonzalès and Parrott 2012; Strunz 2012). As Derissen et al. (2011), Gunderson and Holling (2002) and Leach et al. (2010) have noted, resilient systems may not necessarily be sustainable, but social-ecological systems must be resilient in order to achieve sustainability. Some authors further argue that sustainability represents a desirable human development goal and resilience thinking is the way to achieve this goal (Xu et al. 2015). As recently stated by Folke et al. (2016, p. 6), "if human well-being is a central goal of sustainability, its dependence on a resilient biosphere has to be accounted for, a necessity that has become more and more obvious."

While some scholars continue to argue for and empirically demonstrate the use of resilience as an analytical tool to measure sustainability, others have posited that the conceptual emphases and assumptions of the two paradigms are potentially incompatible or, at least, not explicitly overlapping. For example, the resilience paradigm does not customarily address intergenerational or intragenerational equity, the former being a noted core component to achieving sustainability (Redman 2014). In this case, resilience is rejected as the championed paradigm based on conceptual and methodological inadequacies towards addressing equity, power, justice or other social concerns. Xu et al. (2015) also argue that resilience approaches are faulted for their minimal treatment of culture or cultural capital, which is sometimes integrated as a "fourth pillar" of sustainability work. On the other hand, some argue that sustainability is too diluted and unclear as a policy goal despite decades of trying to determine sustainability metrics, and they believe that resilience represents a more powerful framework for conceptualizing pressing environmental challenges and guiding policy initiatives to advance the governance of such challenges (Duit et al. 2010). However, as the resilience community continues to evolve, many have expanded the concept of resilience to be a boundary object that represents a way of thinking about the dynamics of complex systems, similar to the way sustainability has been used as a boundary object, thus losing its relative advantage over sustainability as a paradigm (Anderies et al. 2004; Brand and Jax 2007). In some contexts, sustainability and resilience have become two sides of the same coin in terms of how they have been deployed to achieve natural resource management or global environmental governance goals. Some scholars have argued that when one moves from ecological science into social science the "meaning of resilience gets diluted and increasingly unclear" as well, because the term is used "with many different intentions" and "with a very wide extension" (Brand and Jax 2007). This further draws attention to the epistemological tensions inherent in the sustainability science and resilience thinking approaches to human-environmental problems, which remain centered on systems-based approaches, rather than adopting relational approaches commonly used within the social sciences (Cote and Nightingale 2012).

It is worth noting that most discussions about sustainability and resilience have placed a stronger emphasis on how resilience contributes to sustainability but little on how sustainability contributes to resilience. In a way, sustainability has been accepted as a policy agenda, while the debates are still ongoing about whether resilience should remain an analytical framework nested within broader sustainability science approaches or a parallel paradigm guiding future scholarly and policy endeavors (Brand and Jax 2007; Redman 2014; Xu et al. 2015). Underlying these debates is a "general agreement that we can ill afford to consider humans separately from nature," but a disagreement on which paradigm is best suited to address challenges emerging from the coupled human and natural systems (Berkes 2004, p. 623).

We in fact urge against continued efforts to defend either paradigm as universally appropriate or applicable. Instead, we encourage further investigation of the temporal, spatial and institutional boundaries of sustainability and resilience in the context of particular systems. Such context-specific investigations will enable practitioners and policy makers to: (1) better understand how sustainability and resilience can be used as policy or programmatic goals in particular systems; (2) become more aware of the temporal, spatial and institutional considerations necessary for setting sustainability-focused or resilience-focused goals; and (3) make decisions better informed by considerations of potential tradeoffs that may occur resulting from setting sustainability or resilience goals.

Debates are also ongoing with respect to the definition, scale and scope of adaptation and transformation. Many scholars view transformation as a non-linear, abrupt adaptive response to social-ecological change, as opposed to a linear, incremental adaptive response (Dow et al. 2013; Nelson et al. 2007, Wilson et al. 2013). Some further argue that positioning transformation as an end of the adaptation spectrum creates a more conducive environment for policy makers to consider transformational change as an alternative to incremental change, rather than viewing transformation as something entirely different and beyond their reach (Pelling et al. 2015). Others have pointed out a fundamental difference in the nature of adaptation and transformation, with the former focusing on the maintenance of the function, structure, feedbacks and identity of an already existing current social-ecological system and the latter focusing on the creation of a new system altogether (Feola 2015). Because of such difference, they further argue that although some system characteristics (e.g., human capital development, social networking, and leadership) are important for enabling both adaptation and transformation, additional conditions (e.g., critical self-reflection and creative innovation) need to be met in order for transformation to occur (Apgar et al. 2015). Failure to recognize this difference privileges incremental changes and hinders policy innovations. As such, debates about the similarities and differences between adaptation and transformation have yet to be settled. Further, it is unclear if gaining universal consensus on the relationship between adaptation and transformation would in fact contribute to the development of effective policy solutions. We argue that one way to advance adaptation and transformation research, practices and policy is to place an emphasis on documenting and analyzing when, where, why, and how each concept has been operationalized and what intended and unintended outcomes may have occurred as a result of various adaptation or transformation processes. This work can contribute to a more generalized understanding of system boundaries, components and scales often associated with successful adaptation or transformation processes as part of larger policy programs.

Beyond discussions about the sustainability-resilience and adaptation-transformation interplays, there are also fruitful intersections and possible frictions between these key paradigms and analytical concepts. Ultimately, the question has been to what extent adaptation and transformation can be situated within the sustainability and resilience paradigms (Gallopín 2006; Karpouzoglou et al. 2016). In previous theoretical and empirical research, the concept of adaptation has been operationalized mainly within the sustainability paradigm. Particularly, as adaptive governance and adaptation to change have become desired pathways to achieve goals of human well-being, scholars have pointed out the synergies between adaptation and sustainable development, and various policy initiatives have been developed to explicitly bring the two together (Burnham and Ma 2016; Eisenhauer 2016). Some even go as far joining the terms, proposing sustainable adaptability (Hernández-Delgado 2015). While the synergies between adaptation and sustainability are reassuring, the original Club of Rome report reminds us that the sustainability paradigm emerged from the perceived need for societal transformation (not adaptation) to sustain humanity at large into the future (Meadows et al. 1972).

Despite the early transformational goals of the sustainability paradigm, the concept of transformation has rarely been operationalized as a sustainable development strategy. Instead, transformation has mainly been discussed within the context of resilience, although the extent to which transformation fits within the resilience paradigm is also up for debate. While some scholars argue that transformability is an inherent and vital characteristic of resilient systems (Feola 2015; Folke et al. 2010; Walker et al. 2004), others draw sharp distinctions between transformation and resilience, which they consider a form of adaptive maintenance to sustain the existing social-ecological system (Pelling 2011; Wilson et al. 2013). The former group of scholars argue that transformation describes fundamental shifts in the existing social-ecological system, which requires the system to have "the capacity to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable" (Walker et al. 2004, p. 1). Therefore, transformation results in fundamentally different "forms of capital, diversity in landscapes and seascapes and of institutions, actor groups, and networks, learning platforms, collective action, and support from higher scales in the governance structure” (Folke et al. 2010). As such, transformation lies beyond the domain of using single- or multi-equilibria approaches to sustain the resilience of a particular social-ecological system (Walker et al. 2004). As society increasingly faces unprecedented changes and as effective responses to these changes often require both adaptation and transformation, one might wonder if a shift away from debating the theoretical relationships between adaptation/transformation and sustainability/resilience would accentuate or attenuate policy efforts to enhance human well-being and environmental conditions (Gillard 2016). We suggest that scholarly and policy communities should move beyond considerations of which analytical concept can be better operationalized within which key paradigm, and instead focus on two empirical questions: (1) how does adaptation or transformation contribute to achieving sustainability- or resilience-focused policy or program goals? And (2) how would setting sustainability- or resilience-focused policy or program goals shape possibilities for future adaptation and transformation?

We find that the most prominent debate within the literature is an epistemological one, wherein sustainability and resilience paradigms and adaptation and transformation concepts are conceptualized differently as either descriptive or normative. While sustainability has been largely accepted as a normative paradigm, there is no concensus on whether resilience is a descriptive or normative dimension of social-ecological systems. Although resilience thinking began as early as the 1970s, resilience grew to prominence within a time when concerns were surfacing that “sustainability” had already lost its theoretical and practical cache. Whereas sustainability and sustainable development were characterized as normative from their inception, resilience was initially characterized as a descriptive concept, which was, and indeed still is promoted as a strength of the resilience paradigm (Brand and Jax 2007; Holling 1973; Walker et al. 2006). Thus, resilience, understood in a non-normative, positivistic sense, was often put advanced instead of sustainability as a policy goal. However, in recent years the descriptive legacy of resilience has been increasingly challenged and the normative nature of resilience has been increasingly recognized (Brand and Jax 2007; Brown 2014; Folke et al. 2010; Gillard 2016).

What becomes defined as resilience, or a resilient system, is too often based on implicit notions of what desirable states of systems are and who is in the position to decide what counts as desirable. Regardless of whether sustainability or resilience is applied as a policy goal in a particular system, questions of equity, power and justice follow. For both sustainable and resilient systems, it is increasingly recognized that defining system boundaries, components and desirable attributes are not value-less endeavors. These determinations are shaped by methodological tools, theoretical concerns, and disciplinary and interdisciplinary norms. Such determination is often made by outside experts—scholars, scientists, and policy makers—and rarely incorporates the paradigms, practices and concerns of local and/or indigenous residents who live their daily lives within these theorized systems on their own terms (Benessia et al. 2012; Berkes 2007; Thomas et al. 2016). More than simply a topic of scholarly debate, differing expert and local notions of the geographical and conceptual scope of relevant and desired system characteristics have real-world implications (Johnson 2009; Johnson and Bakaaki 2016; Olsson et al. 2006; Yu et al. 2014).

Further, "as resilience travels from being a descriptive—and initially a rather precise—concept in ecology to become a normative notion in society (and policy), it becomes increasingly vague and wooly, whereas the descriptive origin somehow gets lost" (Olsson et al. 2015, p. 6). Cote and Nightingale (2012, p. 478) also point out that as resilience is adopted as a broad policy goal, it "plays an important heuristic role in shifting the focus away from the quantitative availability of resources, and towards the scope of available response options" and it "offers a dynamic and forward looking approach to human-environmental change" that places emphasis on "unpredictability, change and complexity across scales." Some argue that the fuzziness of resilience in these contexts has hindered improvements in policy development and implementation (Davidson et al. 2016). Others, though, have been more lenient on resilience within policy, noting that, "even when ill-defined, it encourages policy makers to think deeply about ecosystems as dynamic, multiscaled and socially linked systems" (Sinclair 2016, p. 390).

This ongoing debate about the normativity of sustainability and resilience provides a possible avenue for coalescing the two paradigms. As previously discussed, applying a specified resilience framework to a system requires practitioners and policy makers to make normative decisions about enhancing the resilience of *x* to *y* for group *z* (Carpenter et al. 2001; Lebel et al. 2006). As such, a resilience-focused policy or program may privilege some value, output or system over others or make a system more resilient to one type of disturbances at the expense of increased vulnerability to other types of disturbances, leading to disagreements about what tradeoffs are acceptable for whom (Ingalls and Stedman 2016). In this context, focusing on resilience alone would be insufficient, and a normative decision-making framework would be necessary for helping practitioners and policy makers to engage all stakeholders and facilitate discussions and negotiations. As suggested by Anderies et al. (2013), the sustainability paradigm can meet this challenge—as a boundary object it could offer a decision-making framework that emphasizes intergenerational, intragenerational and interspecies equity and that can be used to guide decisions about tradeoffs (Domptail et al. 2013). In this way, resilience and sustainability can be complementary—sustainability over time requires specified resilience at particular points in time, and decision making about specified resilience can be guided by the normative sustainability framework.

More broadly, considering the normative dimensions of the sustainability and resilience paradigms also allows scholars, practitioners and policy makers to recognize that transformations towards more tenable and desirable systems may already be in progress in some places, for some people, rather than viewing the collapse of a particular social-ecological system as the teleological end point of systems change. This also relates to an increasing recognition of adaptation and transformation as normative rather than descriptive concepts in recent years (Hahn and Nykvist 2017; Leach et al. 2012; Pelling et al. 2015; Westley et al. 2011). As Smit et al. (1999) suggest, any effort to promote adaptation needs to first answer three questions: (1) what is being adapted to? (2) who or what adapts? (3) how does adaptation occur? Similarly, we argue that questions such as why transformation is needed, what transformation should look like, who makes these decisions, and how the transformed system will function ought to be addressed prior to the implementation of any transformative strategies whether as part of a sustainability- or resilience-focused policy or program.

As society's needs for solving complex global problems increase, it is critical to be explicit about: (1) the descriptive criteria that can be used to measure the sustainability and resilience of a given system, and (2) the normative assumptions involved in choosing specific adaptation and transformation strategies, the trade-offs associated with implementing such strategies, and their multi-scalar implications for achieving sustainability and resilience goals. In particular, there is a need for scholars, practitioners and policy makers to reflect on the often-unstated normative assumptions and choices involved in developing and implementing policy programs so that intended outcomes are maximized and potential negative outcomes of designed adaptive and transformative changes for sustainability and/or resilience are minimized.

4 Conclusion

In the past 20 to 30 years, there have been significant advances towards better understandings of *sustainability*, *resilience*, *adaptation* and *transformation* in the scholarly literatures of human-environmental interactions, social-ecological systems, and global environmental change. In this chapter, we provided a summary of how these key paradigms and analytical concepts have evolved over time, synthesized the current debates about the interplays between and among these paradigms and concepts, charted the synergies and contradictions between and among these paradigms and concepts, discussed future directions for defining and achieving desired change, and identified the associated challenges and opportunities within both scholarly and policy domains.

Specifically, this chapter demonstrates that the debates about the compatibility between resilience and sustainability as scientific paradigms or targeted policy goals have persisted over time. Yet, many scholars, practitioners and policy makers continue to advance these paradigms as boundary objects in order to address pressing governance problems despite their "fuzziness." Similarly, key debates around adaptation and transformation reveal different theorizations of the two concepts, with some scholars positioning both on the same continuum while others arguing that the two processes are fundamentally different (i.e., adapting to maintain existing social-ecological systems vs. transforming to create new systems). Underlying these debates is a general agreement that human well-being must be considered in conjunction with environmental conditions in the policy domain, but which paradigm or process is best suited to address challenges emerging from the coupled natural and human systems is yet to be determined (Berkes 2004).

This chapter also shows, while there is some compatibility between and among the paradigms and concepts, epistemological tensions remain prominent and formulate real concerns about the resulting tradeoffs and potential policy and program outcomes. In other words, many current debates are in fact centered around the descriptive and normative dimensions of the paradigms and concepts. One way that these epistemological tensions can be approached is by incorporating a normative sustainability framework to guide decisions about tradeoffs associated with applying a specified resilience approach towards analyses of a particular system. Ultimately, it is important for scholars, practitioners and policy makers to be explicit about not only the descriptive criteria that can be used to measure the sustainability and resilience of a given system, but also the normative assumptions involved in using specific adaptation and transformation strategies for achieving sustainability and resilience goals. As such, analyses that hone in on the normative and descriptive dimensions of policies and programs will be crucial for moving a step further towards developing transformative adaptation interventions for promoting resilient and sustainable communities—or what Bennett et al. (2016) identifies as "bright spots" of transformative change.

Finally, we argued that opportunities for moving forward with the current debates about sustainability, resilience, adaptation and transformation reside in systematic, context-specific investigations of how these paradigms and concepts have been applied in different systems, which will inform generalizations of principles and practices based on sound empirical evidence. Specifically, we saw a need for further investigating and contrasting the contexts within which sustainability and resilience have been used as policy goals, and the temporal, spatial and institutional boundaries used for setting such goals. We also saw a need for standardizing the documentation and analyses of when, where, why, and how adaptation and transformation have been operationalized and what intended and unintended outcomes may have occurred resulting from various adaptation or transformation processes. Together, these endeavors will allow the scholarly and policy communities to move beyond theoretical discussions about which analytical concepts can be better operationalized within which key paradigms and to address epistemological tensions between normative and descriptive dimensions of these paradigms and concepts. With such endeavors, the scholarly and policy communities will be able to ask questions with high policy relevance, namely how adaptation or transformation at different scales contribute to achieving sustainability or resilience goals and how setting sustainability or resilience goals shape the possibilities for future adaptation and transformation.

References

Abel, N., Wise, R. M., Colloff, M. J., Walker, B. H., Butler, J. R. A., Ryan, P., et al. (2016). Building resilient pathways to transformation when "no one is in charge": Insights from Australia's Murray-Darling Basin. *Ecology and Society, 21*(2), 23.

Adger, W. N. (2000). Social and ecological resilience: Are they related? *Progress in Human Geography, 24*(3), 347–364.
Adger, W. N., Kelly, P. M., & Ninh, N. H. (2001). *Living with environmental change: Social vulnerability, adaptation and resilience in Vietnam*. London, UK: Routledge.
Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockström, J. (2005). Social-ecological resilience to coastal disasters. *Science, 309*(5737), 1036–1039.
Agrawal, A. (2009). Local institutions and adaptation to climate change. In R. Mearns & A. Norton (Eds.), *The social dimensions of climate change: Equity and vulnerability in a warming world* (pp. 173–197). Washington, DC: World Bank Publications.
Agyeman, J., Bullard, R. D., & Evans, B. (2002). Exploring the nexus: Bringing together sustainability, environmental justice and equity. *Space and Polity, 6*(1), 77–90.
Anderies, J. M. (2014). Embedding built environments in social-ecological systems: Resilience-based design principles. *Building Research & Information, 42*(2), 130–142.
Anderies, J. M., Janssen, M. A., & Ostrom, E. (2004). A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society, 9*(1), 18.
Anderies, J. M., Folke, C., Walker, B., & Ostrom, E. (2013). Aligning key concepts for global change policy: Robustness, resilience, and sustainability. *Ecology and society, 18*(2), 8.
Apgar, M. J., Allen, W., Moore, K., & Ataria, J. (2015). Understanding adaptation and transformation through indigenous practice: The case of the Guna of Panama. *Ecology and Society, 20*(1), 45.
Armitage, D., Béné, C., Charles, A. T., Johnson, D., & Allison, E. H. (2012). The interplay of well-being and resilience in applying a social-ecological perspective. *Ecology and Society, 17*(4), 15.
Barnett, J. (2001). Adapting to climate change in Pacific Island countries: The problem of uncertainty. *World Development, 29*(6), 977–993.
Bele, M. Y., Tiani, A. M., Somorin, O. A., & Sonwa, D. J. (2013). Exploring vulnerability and adaptation to climate change of communities in the forest zone of Cameroon. *Climatic Change, 119*(3–4), 875–889.
Benessia, A., Funtowicz, S., Bradshaw, G., Ferri, F., Raez-Luna, E. F., & Medina, C. P. (2012). Hybridizing sustainability: Towards a new praxis for the present human predicament. *Sustainability Science, 7*(Suppl 1), 75–89.
Bennett, E. M., Solan, M., Biggs, R., McPhearson, T., Norström, A. V., Olsson, P., et al. (2016). Bright spots: Seeds of a good Anthropocene. *Frontiers in Ecology and the Environment, 14*(8), 441–448.
Benson, M. H., & Craig, R. K. (2014). The end of sustainability. *Society & Natural Resources, 27*(7), 777–782.
Benson, P., & Kirsch, S. (2010). Capitalism and the politics of resignation. *Current Anthropology, 51*(4), 459–486.
Bergen, S. D., Bolton, S. M., & Fridley, J. L. (2001). Design principles for ecological engineering. *Ecological Engineering, 18*(2), 201–210.
Berkes, F. (2004). Rethinking community-based conservation. *Conservation Biology, 18*(3), 621–630.
Berkes, F. (2007). Understanding uncertainty and reducing vulnerability: Lessons from resilience thinking. *Natural Hazards, 41*(2), 283–295.
Berkes, F., & Folke, C. (1998). *Linking social and ecological systems: Management practices and social mechanisms for building resilience*. Cambridge, UK: Cambridge University Press.
Berkes, F., Colding, J., & Folke, C. (2003). *Navigating social-ecological systems: Building resilience for complexity and change*. Cambridge, UK: Cambridge University Press.
Biermann, F. (2014). *Earth system governance: World politics in the Anthropocene*. Boston, MA: MIT Press.
Biggs, R., Schlüter, M., & Schoon, M. L. (2015). An introduction to the resilience approach and principles to sustain ecosystem services in social-ecological systems. In: *Principles for*

building resilience: Sustaining ecosystem services in social-ecological systems. Cambridge, UK: Cambridge University Press.
Bosher, L., & Dainty, A. (2011). Disaster risk reduction and 'built-in' resilience: Towards overarching principles for construction practice. *Disasters, 35*(1), 1–18.
Boyd, E., & Folke, C. (2012). *Adapting institutions: Governance, complexity and social-ecological resilience*. Cambridge, UK: Cambridge University Press.
Brand, F. S., & Jax, K. (2007). Focusing the meaning(s) of resilience: Resilience as a descriptive concept and a boundary object. *Ecology and Society, 12*(1), 23.
Brown, K. (2014). Global environmental change I: A social turn for resilience? *Progress in Human Geography, 38*(1), 107–117.
Burnham, M., & Ma, Z. (2016). Linking smallholder farmer climate change adaptation decisions to development. *Climate and Development, 8*(4), 289–311.
Burnham, M., & Ma, Z. (2017). Multi-scalar pathways to smallholder adaptation. *World Development*. In print.
Carpenter, S. R., & Brock, W. A. (2008). Adaptive capacity and traps. *Ecology and Society, 13*(2), 40.
Carpenter, S., Walker, B., Anderies, J. M., & Abel, N. (2001). From metaphor to measurement: Resilience of what to what? *Ecosystems, 4*(8), 765–781.
Chapin, F. S., Carpenter, S. R., Kofinas, G. P., Folke, C., Abel, N., Clark, W. C., et al. (2010). Ecosystem stewardship: Sustainability strategies for a rapidly changing planet. *Trends in Ecology & Evolution, 25*(4), 241–249.
Clark, W. (2007). Sustainability science: A room of its own. *Proceedings of the National Academy of Sciences of the United States of America, 104*(6), 1737–1738.
Coaffee, J. (2008). Risk, resilience, and environmentally sustainable cities. *Energy Policy, 36*(12), 4633–4638.
Colloff, M. J., Martín-López, B., Lavorel, S., Locatelli, B., Gorddard, R., Longaretti, P., et al. (2017). An integrative research framework for enabling transformative adaptation. *Environmental Science & Policy, 68,* 87–96.
Conway, D. (2011). Adapting climate research for development in Africa. *Wiley Interdisciplinary Reviews: Climate Change, 2*(3), 428–450.
Costanza, R., & Patten, B. C. (1995). Defining and predicting sustainability. *Ecological economics, 15*(3), 193–196.
Cote, M., & Nightingale, A. J. (2012). Resilience thinking meets social theory: Situating social change in socio-ecological systems (SES) research. *Progress in Human Geography, 36*(4), 475–489.
Davidson, D. J., Williamson, T., & Parkins, J. R. (2003). Understanding climate change risk and vulnerability in northern forest-based communities. *Canadian Journal of Forest Research, 33*(11), 2252–2261.
Davidson, J., Jacobson, C., Lyth, A., Dedekorkut-Howes, A., Baldwin, C., Ellison, J., et al. (2016). Interrogating resilience: Toward a typology to improve its operationalization. *Ecology and Society, 21*(2), 27.
Davoudi, S. (2012). Resilience: A bridging concept or a dead end? *Planning Theory & Practice, 13*(2), 299–333.
Derissen, S., Quaas, M. F., & Baumgärtner, S. (2011). The relationship between resilience and sustainability of ecological-economic systems. *Ecological Economics, 70*(6), 1121–1128.
Domptail, S., Easdale, M. H., & Yuerlita, (2013). Managing socio-ecological systems to achieve sustainability: A study of resilience and robustness. *Environmental Policy and Governance, 23*(1), 30–45.
Dow, K., Berkhout, F., Presnton, B. L., Klein, R. J. T., Midgley, G., & Shaw, M. R. (2013). Limits to adaptation. *National Climate Change, 3,* 305–307.
Duit, A., Galaz, V., & Ebbesson, J. (2010). Governance, complexity, and resilience. *Global Environmental Change, 20,* 363–368.

Eakin, H., Bojórquez-Tapia, L. A., Janssen, M. A., Georgescu, M., Manuel-Navarrete, D., Vivoni, E. R., et al. (2017). Urban resilience efforts must consider social and political forces. *Proceedings of the National Academy of Sciences of the United States of America, 114,* 186–189.
Eisenhauer, D. C. (2016). Pathways to climate change adaptation: Making climate change action political. *Geography Compass, 10*(5), 207–221.
Falkenmark, M., & Rockström, J. (2010). Building water resilience in the face of global change: From a blue-only to a green-blue water approach to land-water management. *Journal of Water Resources Planning and Management, 136*(6), 606–610.
Fazey, I., Wise, R. M., Lyon, C., Câmpeanu, C., Moug, P., & Davies, T. E. (2016). Past and future adaptation pathways. *Climate and Development, 8*(1), 26–44.
Feola, G. (2015). Societal transformation in response to global environmental change: A review of emerging concepts. *Ambio, 44*(5), 376–390.
Fiksel J. (2006). Sustainability and resilience: Toward a systems approach. *Sustainability: Science, Practice, & Policy, 2*(2): 14–21.
Folke, C. (2006). Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change, 16*(3), 253–267.
Folke, C., Colding, J., & Berkes, F. (2003). Synthesis: Building resilience and adaptive capacity in social-ecological systems. In F. Berkes, J. Colding, & C. Folke (Eds.), *Navigating social-ecological systems building resilience for complexity and change*. Cambridge, UK: Cambridge University Press.
Folke, C., Carpenter, S., Walker, B., Scheffer, M., Elmqvist, T., Gunderson, L., & Holling, C. S. (2004). Regime shifts, resilience, and biodiversity in ecosystem management. *Annual Review of Ecology, Evolution, and Systematics, 35,* 557–581.
Folke, C., Carpenter, S., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society, 15,* 20.
Folke, C., Biggs, R., Norström, A. V., Reyers, B., & Rockström, J. (2016). Social-ecological resilience and biosphere-based sustainability science. *Ecology and Society, 21*(3), 41.
Galaz, V., Biermann, F., Folke, C., Nilsson, M., & Olsson, P. (2012). Global environmental governance and planetary boundaries: An introduction. *Ecological Economics, 81,* 1–3.
Gallopín, G. C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. *Global Environmental Change, 16*(3), 293–303.
Gillard, R. (2016). Questioning the diffusion of resilience discourses in pursuit of transformational change. *Global Environmental Politics, 16*(1), 13–20.
Gillard, R., Gouldson, A., Paavola, J., & Van Alstine, J. (2016). Transformational responses to climate change: Beyond a systems perspective of social change in mitigation and adaptation. *Wiley Interdisciplinary Reviews: Climate Change, 7*(2), 251–265.
Goldman, M. (2006). *Imperial nature: The World Bank and struggles for social justice in the age of globalization*. New Haven, CT: Yale University Press.
Gonzalès, R., & Parrott, L. (2012). Network theory in the assessment of the sustainability of social-ecological systems. *Geography Compass, 6*(2), 76–88.
Gordon, L. J., Finlayson, C. M., & Falkenmark, M. (2010). Managing water in agriculture for food production and other ecosystem services. *Agricultural Water Management, 97*(4), 512–519.
Gotts, N. M. (2007). Resilience, panarchy, and world-systems analysis. *Ecology and Society, 12*(1), 24.
Gunderson, L. H., & Holling, C. S. (2002). *Panarchy: Understanding transformations in systems of humans and nature*. Washington, DC: Island Press.
Hahn, T., & Nykvist, B. (2017). Are adaptations self-organized, autonomous, and harmonious? Assessing the social–ecological resilience literature. *Ecology and Society, 22*(1), 12.
Haigh, R., & Amaratunga, D. (2010). An integrative review of the built environment discipline's role in the development of society's resilience to disasters. *International Journal of Disaster Resilience in the Built Environment, 1*(1), 11–24.
Hassler, U., & Kohler, N. (2014a). The ideal of resilient systems and questions of continuity. *Building Research & Information, 42*(2), 158–167.

Hassler, U., & Kohler, N. (2014b). Resilience in the built environment. *Building Research & Information, 42*(2), 119–129.

Hernández-Delgado, E. A. (2015). The emerging threats of climate change on tropical coastal ecosystem services, public health, local economies and livelihood sustainability of small islands: Cumulative impacts and synergies. *Marine Pollution Bulletin, 101*(1), 5–28.

Hicks, C. C., Levine, A., Agrawal, A., Basurto, X., Breslow, S. J., Carothers, C., et al. (2016). Engage key social concepts for sustainability. *Science, 352*(6281), 38–40.

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual review of ecology and systematics, 4,* 1–23.

Holling, C. S. (1996). Engineering resilience versus ecological resilience. In P. Schulze (Ed.), *Engineering within ecological constraints* (pp. 31–43). Washington D.C.: National Academy of Engineering.

Hollnagel, E., Woods, D. D., & Leveson, N. (2006). *Resilience engineering: Concepts and precepts*. Boca Raton, FL: CRC Press.

Hughes, T. P., Graham, N. A. J., Jackson, J. B. C., Mumby, P. J., & Steneck, R. S. (2010). Rising to the challenge of sustaining coral reef resilience. *Trends in Ecology & Evolution, 25*(11), 633–642.

Ingalls, M. L., & Stedman, R. C. (2016). The power problematic: Exploring the uncertain terrains of political ecology and the resilience framework. *Ecology and Society, 21*(1), 6.

Johnson, J. L. (2009). Climate change and fishery sustainability in Lake Victoria. *African Journal of Tropical Hydrobiology and Fisheries, 12,* 31–36.

Johnson, J. L., & Bakaaki, R. (2016). Working with fish in the shadows of sustainability. In J. E. Murton, D. Bavington, & C. A. Dokis (Eds.), *Subsistence under capitalism: Historical and contemporary perspectives* (pp. 195–233). Montreal, Quebec: McGill-Queen's University Press.

Karpouzoglou, T., Dewulf, A., & Clark, J. (2016). Advancing adaptive governance of social-ecological systems through theoretical multiplicity. *Environmental Science & Policy, 57,* 1–9.

Kates, R. W., Travis, W. R., & Wilbanks, T. J. (2012). Transformational adaptation when incremental adaptations to climate change are insufficient. *Proceedings of the National Academy of Sciences of the United States of America, 109*(19), 7156–7161.

Keenan, R. J. (2012). Adaptation of forests and forest management to climate change: An editorial. *Forests, 3*(1), 75–82.

Kelly, P. M., & Adger, W. N. (2000). Theory and practice in assessing vulnerability to climate change and facilitating adaptation. *Climatic Change, 47*(4), 325–352.

Kottak, C. P. (1999). The new ecological anthropology. *American Anthropologist, 101*(1), 23–35.

Leach, M., Scoones, I., & Stirling, A. (2010). Governing epidemics in an age of complexity: Narratives, politics and pathways to sustainability. *Global Environmental Change, 20*(3), 369–377.

Leach, M., Rockström, J., Raskin, P., Scoones, I., Stirling, A. C., Smith, A., et al. (2012). Transforming innovation for sustainability. *Ecology and Society, 17*(2), 11.

Lebel, L., Anderies, J. M., Campbell, B., Folke, C., Hatfield-Dodds, S., Hughes, T. P., & Wilson, J. (2006). Governance and the capacity to manage resilience in regional social-ecological systems. *Ecology and Society, 11*(1), 19.

Leenhardt, P., Teneva, L., Kininmonth, S., Darling, E., Cooley, S., & Claudet, J. (2015). Challenges, insights and perspectives associated with using social-ecological science for marine conservation. *Ocean and Coastal Management, 115,* 49–60.

Liu, J., Dietz, T., Carpenter, S. R., Folke, C., Alberti, M., Redman, C. L., et al. (2007). Coupled human and natural systems. *Ambio, 36*(8), 639–649.

Meadows, D. H., Meadows, D. L., Randers, J., & Behrens, W. W. (1972). *The limits to growth. A report for the club of Rome's project on the predicament of mankind*. New York, NY: Universal Books.

Miller, K., Charles, A., Barange, M., Brander, K., Gallucci, V. F., Gasalla, M. A., et al. (2010a). Climate change, uncertainty, and resilient fisheries: Institutional responses through integrative science. *Progress in Oceanography, 87*(1), 338–346.

Miller, F., Osbahr, H., Boyd, E., Thomalla, F., Bharwani, S., Ziervogel, G., et al. (2010b). Resilience and vulnerability: Complementary or conflicting concepts? *Ecology and Society, 15*(3), 11.

Moffatt, S. (2014). Resilience and competing temporalities in cities. *Building Research & Information, 42*(2), 202–220.

Moser, S. C., & Ekstrom, J. A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Sciences of the United States of America, 107*(51), 22026–22031.

Muller, M. (2007). Adapting to climate change. *Environment and Urbanization, 19*(1), 99–113.

Nelson, D. R. (2011). Adaptation and resilience: Responding to a changing climate. *Wiley Interdisciplinary Reviews: Climate Change, 2*(1), 113–120.

Nelson, D. R., Adger, W. N., & Brown, K. (2007). Adaptation to environmental change: Contributions of a resilience framework. *Annual Review of Environment and Resources, 32,* 395–419.

Newton, A. C. (2016). Biodiversity risks of adopting resilience as a policy goal. *Conservation Letters, 9*(5), 369–376.

O'Brien, K., Eriksen, S., Inderberg, T. H., & Sygna, L. (2015). Climate change and development: adaptation through transformation. In T. H. Inderberg, S. Eriksen, K. O'Brien, & L. Sygna (Eds.), *Climate change adaptation and development: Transforming paradigms and practices*. New York, NY: Routledge.

Olsson, P., Gunderson, L. H., Carpenter, S. R., Ryan, P., Lebel, L., Folke, C., et al. (2006). Shooting the rapids: Navigating transitions to adaptive governance of social-ecological systems. *Ecology and society, 11*(1), 18.

Olsson, L., Jerneck, A., Thoren, H., Persson, J., & O'Byrne, D. (2015). Why resilience is unappealing to social science: Theoretical and empirical investigations of the scientific use of resilience. *Science Advances, 1*(4), e1400217.

Osbahr, H., Twyman, C., Neiladger, W., & Thomas, D. (2008). Effective livelihood adaptation to climate change disturbance: Scale dimensions of practice in Mozambique. *Geoforum, 39*(6), 1951–1964.

Ostrom, E., & Janssen, M. A. (2005). Multi-level governance and resilience of social-ecological systems. In M. Spoor (Ed.), *Globalisation, poverty and conflict: A critical 'Development' reader* (pp. 239–259). Dordrecht, The Netherlands: Springer.

Park, J., Seager, T. P., Rao, P. S. C., Convertino, M., & Linkov, I. (2013). Integrating risk and resilience approaches to catastrophe management in engineering systems. *Risk Analysis, 33,* 356–367.

Partelow, S. (2016). Coevolving Ostrom's social-ecological systems (SES) framework and sustainability science: Four key co-benefits. *Sustainability Science, 11*(3), 399–410.

Pelling, M. (2011). *Adaptation to climate change: From resilience to transformation*. New York, NY: Routledge.

Pelling, M., O'Brien, K., & Matyas, D. (2015). Adaptation and transformation. *Climatic Change, 133*(1), 113–127.

Perrings, C., & Brock, W. (2009). Irreversibility in economics. *Annual Review of Resource Economics, 1,* 219–238.

Pimm, S. L. (1984). The complexity and stability of ecosystems. *Nature, 307*(5949), 321–326.

Redman, C. L. (2014). Should sustainability and resilience be combined or remain distinct pursuits? *Ecology and Society, 19*(2), 37.

Rickards, L. (2013). Transformation is adaptation. *Nature Climate Change, 3*(8), 690.

Saunders, F. P. (2015). Planetary boundaries: At the threshold… again: Sustainable development ideas and politics. *Environment, Development and Sustainability, 17*(4), 823–835.

Silliman, B. R., van de Koppel, J., McCoy, M. W., Diller, J., Kasozi, G. N., Earl, K., et al. (2012). Degradation and resilience in Louisiana salt marshes after the BP–Deepwater Horizon oil spill. *Proceedings of the National Academy of Sciences, 109*(28), 11234–11239.

Sinclair, S. J. (2016). Getting the best out of “resilience” as a conservation policy goal: A response to Newton. *Conservation Letters, 9*(5), 390–391.

Smit, B., Burton, I., Klein, R., & Street, R. (1999). The science of adaptation: A framework for assessment. *Mitigation and Adaptation Strategies for Global Change, 4,* 199–213.

Speranza, C. I., Wiesmann, U., & Rist, S. (2014). An indicator framework for assessing livelihood resilience in the context of social–ecological dynamics. *Global Environmental Change, 28,* 109–119.

Stafford Smith, M., Horrocks, L., Harvey, A., & Hamilton, C. (2011). Rethinking adaptation for a 4°C world. *Philosophical transactions of the royal society A: Mathematical, physical and engineering sciences, 369*(1934), 196–216.

Strunz, S. (2012). Is conceptual vagueness an asset? Arguments from philosophy of science applied to the concept of resilience. *Ecological Economics, 76,* 112–118.

Thapa, S., Marshall, F., & Stagl, S. (2010). *Understanding Peri-urban Sustainability: The role of the resilience approach. STEPS Working Paper 38*. Brighton, UK: STEPS Centre.

Thomas, D., Mitchell, T., & Arseneau, C. (2016). Re-evaluating resilience: From individual vulnerabilities to the strength of cultures and collectivities among indigenous communities. *Resilience, 4*(2), 116–129.

Thornton, T. F., & Comberti, C. (2017). Synergies and trade-offs between adaptation, mitigation and development. *Climatic Change, 140*(1), 5–18.

Turner, B. L., II. (2010). Vulnerability and resilience: Coalescing or paralleling approaches for sustainability science? *Global Environmental Change, 20*(4), 570–576.

Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and transformability in social-ecological systems. *Ecology and society, 9*(2), 5.

Walker, B., Salt, D., & Reid, W. (2006). *Resilience thinking: Sustaining people and ecosystems in a changing world*. Washington DC: Island Press.

Wardekker, J. A., de Jong, A., Knoop, J. M., & van der Sluijs, J. P. (2010). Operationalising a resilience approach to adapting an urban delta to uncertain climate changes. *Technological Forecasting and Social Change, 77*(6), 987–998.

WCED. (1987). *Report of the world commission on environment and development: Our common future (Brundtland Report). United Nations World Commission on Environment and Development (WCED).* Oxford, UK: Oxford University Press.

Westley, F., Olsson, P., Folke, C., Homer-Dixon, T., Vredenburg, H., Loorbach, D., et al. (2011). Tipping toward sustainability: Emerging pathways of transformation. *AMBIO: A Journal of the Human Environment, 40*(7), 762–780.

Wilson, S., Pearson, L. J., Kashima, Y., Lusher, D., & Pearson, C. (2013). Separating adaptive maintenance (resilience) and transformative capacity of social-ecological systems. *Ecology and Society, 18*(1), 22.

Wise, R. M., Fazey, I., Stafford Smith, M., Park, S. E., Eakin, H. C., Van Garderen, E. A., et al. (2014). Reconceptualising adaptation to climate change as part of pathways of change and response. *Global Environmental Change, 28,* 325–336.

Xu, L., Marinova, D., & Guo, X. (2015). Resilience thinking: A renewed system approach for sustainability science. *Sustainability Science, 10*(1), 123–138.

Yu, D. J., Anderies, J. M., Lee, D., & Perez, I. (2014). Transformation of resource management institutions under globalization: The case of Songgye community forests in South Korea. *Ecology and Society, 19*(2), 2.

Zhou, H., Wang, J., Wan, J., & Jia, H. (2010). Resilience to natural hazards: A geographic perspective. *Natural Hazards, 53*(1), 21–41.

Using Meta-Analysis in the Social Sciences to Improve Environmental Policy

Alexander Maki, Mark A. Cohen and Michael P. Vandenbergh

Abstract

Policymakers have recently looked to the social sciences for effective strategies to address environmental issues, including how to change people's environmental behaviors. During that time, social scientists have been challenged to improve how they assess, summarize, and convey the state of environmental social science. Meta-analysis, the quantitative review of existing research using data from multiple studies, is one method researchers use to assess the state of knowledge and share best practices. Development of new data reporting standards and systems would improve not only environmental social science, but also the interface between environmental social sciences and policymakers. In particular, dynamic meta-analyses, or frequently updated meta-analyses, would ensure that policymakers have access to up-to-date findings and would allow policymakers to examine subsets of studies that best approximate relevant contexts for new policies. These new standards for conducting and reporting meta-analyses would allow environmental social scientists to more effectively

A. Maki (✉)
Vanderbilt Institute of Energy and Environment and the Climate Change Research Network, Vanderbilt University, 159 Buttrick Hall, PMB 407702, 2301 Vanderbilt Place, 37240 Nashville, TN, USA
e-mail: alexander.maki@vanderbilt.edu

M.A. Cohen
Owen Graduate School of Management, Vanderbilt University, 401 21st Avenue South, 37203 Nashville, TN, USA
e-mail: mark.cohen@owen.vanderbilt.edu

M.P. Vandenbergh
Vanderbilt University Law School, Vanderbilt University, 131 21st Avenue South, 37203 Nashville, TN, USA
e-mail: michael.vandenbergh@vanderbilt.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*, World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_2

inform policy, and would help policymakers understand and assess the latest developments in the field.

Keywords
Meta-analysis · Environmental policy · Social sciences · Behavior change

1 Using Meta-Analysis in the Social Sciences to Improve Environmental Policy

Survey results suggest that people are increasingly concerned about environmental issues, including climate change, drought, and flooding (Aschwanden 2016). Given these well-documented threats to the environment, there is a continuing need to find cost effective approaches to changing individuals' environmental behaviors (e.g., efficient technology purchases, energy and water conservation; Gifford 2014). For example, individual and household behaviors are estimated to have a substantial impact on greenhouse gas emissions, and in turn, on climate change (Carrico et al. 2011; Dietz et al. 2009; Vandenbergh and Gilligan 2015). To more effectively influence these environmental behaviors, we need policies informed by sound social science that help people engage in behaviors that benefit the environment, and at the same time are not too costly or onerous to the individuals being asked to change their behavior. As policymakers look to harness the social sciences to help address environmental problems, they confront challenges in accessing and interpreting the results of myriad social science studies. The use of meta-analytic approaches can enable social scientists to assist in the rapid dissemination of best practices.

By focusing on use of meta-analytic approaches across the social sciences, we argue that improvements to the conducting and reporting of meta-analyses will aid policymakers in their ability to promptly and effectively craft policy that targets pressing environmental issues. Specifically, we largely focus here on individual level environmental behavior change. First, we outline why social science meta-analyses can improve the translation of social science research into environmental policy by both guiding policymakers on how to craft environmental policy and increasing the credibility of social science research. Second, we discuss how improving environmental social science meta-analyses would better ensure that policymakers are equipped with needed information when crafting effective environmental policy. Third, we explore a relatively new approach to meta-analysis, dynamic meta-analysis, which would provide policymakers with the most up-to-date data relevant to environmental policy, and provide those data in a way that policymakers can more easily adapt to their needs. Finally, we briefly cover additional ways in which meta-analyses could code primary articles to provide policymakers with additional information they may desire when crafting policy. By improving how social scientists approach meta-analyses, environmental social scientists will be better positioned to inform policy that reflects the latest empirical trends and best practices.

2 Relevance of Environmental Social Science to Policymakers

As a whole social scientists have struggled to inform and guide environmental policy (Carrico et al. 2015; Clayton et al. 2015; Steel et al. 2004). With research relevant to policymakers being conducted by environmental social scientists of all stripes, including economists, communication scientists, psychologists, and sociologists, there is an opportunity to improve how effectively social scientists inform policymakers. But, these efforts require more attention.

We use the term policymaker in a general sense to refer to any individual concerned with developing and implementing policies or actions regarding environmental protection. This includes elected officials, but also program managers in an advocacy group or corporate firm who are looking to affect some kind of environmental outcome (e.g., the carbon footprint of a company) or behavior (e.g., home energy use; Vandenbergh 2013). Because policymakers often attempt to influence environmental outcomes at a larger scale than environmental social scientists typically study, environmental policymakers are usually unable to simply extract a finding or use an intervention from the environmental social science literature and immediately put it into practice. Additionally, in the literature on environmental behavior change interventions targeting individuals' behaviors, it is not always clear to social scientists themselves which behavior change efforts are the most effective at influencing these behaviors (Schultz 2015). This fact makes it hard for policymakers to use best practice intervention options. And, even when there are clear findings in the literature, environmental social scientists do not always effectively share their findings with the wider community (Hallegatte and Mach 2016).

An additional barrier that makes it difficult to translate social science findings into environmental policy is policymakers' perceptions of the environmental social sciences. Recent reviews in a number of social science and health disciplines have suggested that social science research may not be as reproducible as once hoped, including in psychology (Open Science Collaboration 2012, 2015), economics (Chang and Li 2015), and the health sciences (Arrowsmith 2011). Given this recent attention, policymakers may deem social science literature as untrustworthy or unreliable. Thus, there are a number of factors that currently make it difficult for environmental social scientists to assist policymakers with evidence-based policy development. Use of meta-analysis, and in particular improvements to how social scientists use and report meta-analyses, could help ensure that policymakers draw appropriate insights from environmental social science, and use these insights in the design of laws, policies, and programs.

3 Using Meta-Analysis to Bring Primary Environmental Social Science Research to Policymakers

Given these concerns, environmental social scientists need tools to not only allay concerns policymakers have about the state of the social sciences, but also to provide clear road markers for how environmental policy development should proceed. Meta-analysis is one such tool that can inform evidence-based policy-making. Meta-analysis is the quantitative summary and comparison of studies examining a similar phenomenon (Cumming 2014). For example, meta-analyses have considered the effect of behavior change interventions on environmental behaviors and outcomes, including use of informational messages (Delmas et al. 2013), feedback on one's behavior (Karlin et al. 2015), use of financial incentives (Maki et al. 2016), and social influence approaches such as behavioral modeling or use of community block leaders (Abrahamse and Steg 2013). These meta-analyses provide a quantitative summary of how large a change in environmental behavior or environmental outcome we can expect when using a behavior change technique. For example, Delmas et al. (2013) considered the effect of providing homeowners with home energy audits on home energy use, finding across 156 studies that audits on average led to a 14% decrease in household energy use. In other areas of the environmental social sciences, meta-analysis has been used to explore the factors most strongly linked to belief in anthropogenic climate change (Hornsey et al. 2016) and the effect of environmental regulation on firm and country competiveness (Cohen and Tubb 2016).

Meta-analysis is an approach distinct from literature reviews and qualitative assessments of prior research. Sometimes referred to as narrative reviews, literature reviews are a selective survey of the research on a specific topic, generally attempting to provide a broad overview (Ressing et al. 2009). Systematic reviews differ from traditional literature reviews in that they follow a specified search process to locate primary research articles (or unpublished data sets) related to a topic, including explicit definitions of inclusion and exclusion criteria and the search strategy and search terms. Systematic reviews survey article databases and leading scholars to locate all of the potential articles or unpublished studies on a specific topic, and then an initial review of articles is conducted to determine study inclusion eligibility (Uman 2011). Rigorous systematic reviews tend to use a flow diagram to document the identification, inclusion, and exclusion of studies through the systematic review process (see Fig. 1). A meta-analysis builds upon a systematic review by extracting relevant quantitative data from articles included in the systematic review, often in combination with qualitative coding of primary articles for study characteristics (e.g., quality of the study, aspects of the sample, or intervention characteristics). Rigorous meta-analyses also tend to test for publication bias in the included articles, to better estimate whether the meta-analytic effects are representative of the potential population of all relevant studies (Macaskill et al. 2001; Rothstein et al. 2005).

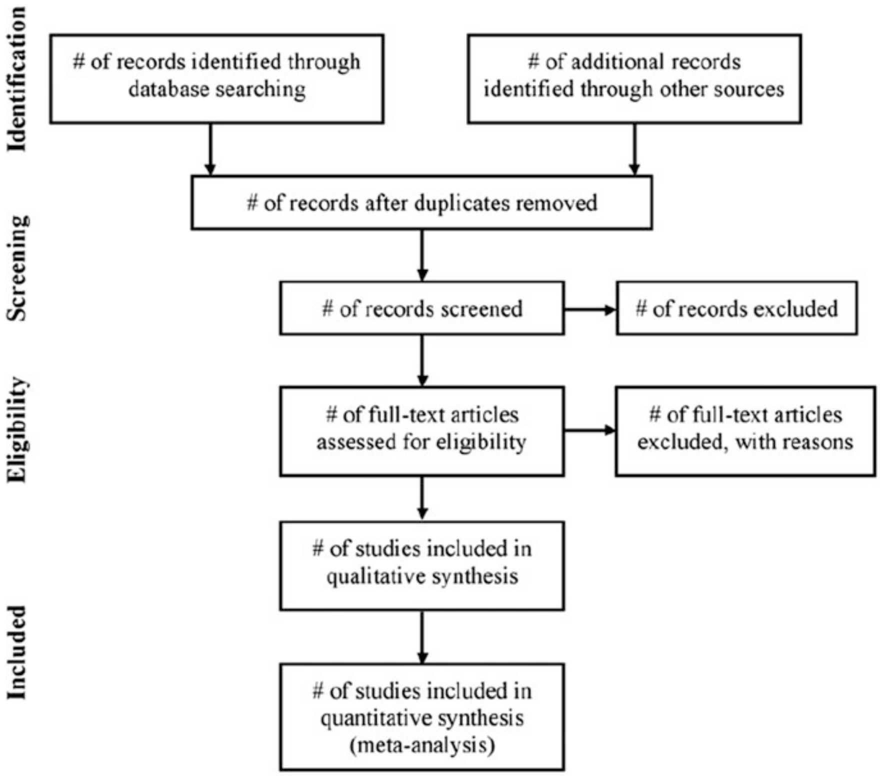


Fig. 1 Flow of information through the phases of a systematic review. Borrowed with permission from Moher et al. (2009)

A strength of meta-analysis is its ability to provide an overall quantitative picture of a phenomenon or relationship. This provides increased confidence in the findings in a literature, and gives policymakers some sense of the size of the expected effect for that phenomenon or relationship. For example, even though primary research is conflicted on whether use of social norm messaging leads to towel reuse in hotels, meta-analytic evidence suggests there is strong support for the effect of social norm-based messages on towel reuse (Scheibehenne et al. 2016). Meta-analyses can also help policymakers appreciate how effects may vary across contexts. For example, meta-analysis has revealed that although providing individuals with feedback on their energy use can lead to 8 to 12% savings in energy use on average (Karlin et al. 2015). However, context and nuance also matters as providing more frequent feedback—more often than once a month—tends to lead to stronger effects as compared to providing less frequent feedback.

It is important to acknowledge that meta-analysis cannot erase weaknesses that already exist in some literatures (Bangdiwala et al. 2016), as a meta-analysis is only as good as the articles it relies on. If a literature contains too few studies, or too many poorly designed studies, a meta-analysis may produce unreliable estimates of effects. If a literature has too many studies all exploring the identical research question, a meta-analysis will be unable to consider differences between studies (e.g., how studying households versus office employees may affect the direction and size of the effect). If a meta-analysis combines primary studies that are too distinct from each other, this can lead to meta-analytic results that are difficult to interpret. Meta-analyses should discuss these issues explicitly, and when appropriate provide additional analyses that attempt to resolve these issues (e.g., conduct separate analyses with and without studies deemed to be poorly designed).

Meta-analysis can not only provide an overall picture of a given relationship in environmental social science research, but it can also help social scientists build credibility with policymakers and the public regarding concerns over study replication. By averaging effects over a number of studies, and thus increasing the sample sizes used to pinpoint an effect, both scientists' and policymakers' confidence in the direction and size of effects should increase as use of meta-analysis becomes more common. Thus, meta-analyses have a number of clear strengths that can aid policymakers over and above single primary studies on social-scientific topics of relevance to environmental policies.

4 Improving the Ability of Meta-Analyses to Inform Environmental Policymakers

More effective detailing, standardizing, and reporting of meta-analysis would also help address current shortcomings in the literature and improve the ability of social scientists to inform environmental policy. Current meta-analyses often lack vital details that are present in the primary sources that would be useful to policymakers. These include specific details about how interventions were designed or implemented in primary studies, and how interventions affect specific groups of people. These problems in part arise because we lack a norm that encourages researchers across the social sciences to provide standard information when conducting and reporting meta-analyses.

For example, social-psychological meta-analyses on environmental topics often fail to report specifics about the types of interventions that were used in primary sources. Osbaldiston and Schott (2012) detail interventions at a general level (e.g., rewards or feedback), but are unable to discuss specifics of these interventions beyond this basic level because of coding decisions. Alternatively, Karlin et al. (2015) discuss differences between types of feedback approaches (e.g., informational, normative) and frequency of feedback (e.g., monthly, daily). More consistent understandings of, and coding for, types of interventions by meta-analyzers would give clearer guidelines to policymakers on how to craft their own interventions. For example, in the health sciences researchers have categorized the interventions linked to healthy eating and exercise behavior change into distinct categories, allowing for more reliable comparisons of the effectiveness of different categories of interventions (e.g., Abraham and Michie 2008; Michie et al. 2013). One eventual goal, with a commonly accepted coding scheme for environmental interventions, would be to produce materials guiding policymakers on how to design interventions or policies in sufficient detail that would replicate approaches from the literature. With their focus on coding numerous articles across a literature, meta-analyses are poised to offer these kinds of insights to environmental policymakers.

Another important consideration is how different interventions influence different types of individuals or segments of society. For example, if a primary article examines how financial incentives influence home energy efficiency, the article may report how these interventions influence men versus women, single versus family households, or low versus high income households. Policymakers often target their policies towards specific individuals or groups, and thus the direction and size of the effect of incentives on these different groups is of value to policymakers. However, meta-analyses inconsistently examine how interventions affect different groups across a literature.

As a whole, improved and consistent reporting standards in the environmental social sciences would aid our ability to inform environmental policymakers. The health sciences literature can point us toward a more effective synthesizing and reporting of environmental research. Use of meta-analysis is a quickly growing area of focus in the social sciences, and health sciences more specifically (Ioannidis 2016; Sutton and Higgins 2008). The health sciences are often concerned with influencing behaviors, including individual behavior change. Health science researchers arguably also have a longer history of exploring, through use of both primary and meta-analytic research, the most effective interventions and policies targeting behavior change. There has been a drastic increase in meta-analytic research in the health sciences (Ioannidis 2016), something the environmental social sciences may mirror moving forward. Finally, there are simply more researchers, research centers, collaborations, and funding opportunities for health researchers; hence they have been examining how to improve meta-analyses for a longer time period.

Given disappointment over past efforts to adequately report necessary components of reviews and meta-analyses, the PRISMA group (Moher et al. 2009) proposed improvements to meta-analytic reporting in the health sciences (Table 1). This approach could be further adapted to ensure that the conducting and reporting of environmental social science meta-analyses are better prepared to inform and guide environmental policymakers. Coding for additional key study elements of primary articles, in addition to the standard PRISMA reporting items, would be useful in the environmental social sciences. These elements include consistent reporting of demographic information across studies when available, such as the sample gender ratio, age, race, socio-economic status, political ideology, and family household size. Coding for study quality, including blinding of participants and experimenters, when relevant, type of randomization, and attrition for longitudinal studies (e.g., Wells and Littell 2009) would help consumers of meta-analyses better determine study quality. Finally, aspects of the social context of each study can help guide policymakers efforts to tailor policies to specific situations, including the

Table 1 PRISMA checklist of items to include when reporting a systematic review or meta-analysis

Section/Topic	#	Checklist Item	Reported onPage #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both	
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS)	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale	
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched	
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis)	
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators	
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made	
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level) and how this information is to be used in any data synthesis	
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means)	

(continued)

Table 1 (continued)

Section/Topic	#	Checklist Item	Reported onPage #
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis	
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies)	
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified	
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram	
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations	
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see Item 12)	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency	
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15)	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16])	
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., health care providers, users, and policy makers)	
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias)	
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research	
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review	

Borrowed with permission from Moher et al. (2009)

setting in which the study took place (e.g., households, workplace offices, public settings), and the populations targeted (e.g., general public, students, construction workers). Increased standardization of reporting in meta-analyses would also help shine light on when primary studies are not doing an effective job of reporting these dimensions.

5 Developing Dynamic Environmental Meta-Analyses

Given the recent push in the social and health sciences to share data and more fully report methods and results, the environmental social sciences have the opportunity to explore ways to more dynamically and systematically update meta-analyses with new, relevant primary studies, including unpublished research. This would help the environmental social sciences move toward a truly dynamic, constantly informed field ready to propose and update best policies. Development of cutting-edge environmental policy necessitates cutting-edge meta-analyses. Instead, environmental social sciences are currently underprepared to provide such up-to-date guidance. For example, classic meta-analytic research on the psychological factors linked to environmental behavior was conducted in 1986 (Hines et al. 1986/1987). Only in 2007 did researchers update this meta-analysis to provide a more complete picture of the then-current knowledge of the psychological factors linked to environmental behavior (Bamberg and Möser 2007). Some organizations, such as Cochrane Collaboration (Moher et al. 2008), have proposed standards for how best to update meta-analyses over time, particularly in the health sciences. The occasional updating of meta-analyses on environmental topics is certainly preferable to never updating them, but the time that lapses between updates can sometimes lead to available meta-analyses being far outpaced by the literature.

Instead, a dynamic meta-analytic approach in the environmental social sciences —similar to an idea briefly considered in the past (Whitehead 1997) and more recently explored by Page and Moher (2016), which they called “living cumulative network meta-analysis”—could be prepared to constantly provide the most up-to-date findings to policymakers, and provide the results in a way that policymakers could tailor to their needs. By partnering with such open science websites as Open Science Framework and Psychfiledrawer.org, environmental meta-analyzers could maintain an open database of studies that have examined a given environmental social science phenomenon or relationship, creating both an overall database across studies and one that would allow researchers to explore specific subsets of studies to better appreciate distinct contexts (e.g., types of environmental outcomes or demographics). Similar efforts are being discussed in other fields, including efforts led by Vivli, which aim to share clinical data across studies and labs to provide an overall database of research findings (Panko 2016). Other efforts are also underway to create neutral, data sharing platforms in the medical sciences (Bierer et al. 2016).

Ideally, researchers would enter information from each study into a public database, guided by an updated PRISMA reporting standard, including the phenomenon or relationship studied, the direction and magnitude of the effect, and other core characteristics of the intervention and sample. This information could be entered by the primary researcher or social scientists interested in maintaining a meta-analytic database on a topic related to their own research. These databases would be hosted by one of the aforementioned online repositories, and whenever policymakers needed the latest up-to-date synthesized findings on a given intervention or for a specific relationship, the data could be downloaded and used by the policymaker. Alternatively, and ideally, these databases would come with the ability to request information about a specific relationship online through an easy user interface, and the relevant results would be produced for the policymaker. To the extent that it is possible, databases could also be linked or nested within one another, so a policymaker could consider all possible interventions that may be effective at reducing employee energy use in the workplace, or they could specifically look at energy feedback software for decreasing energy office use.

An additional benefit of creating an open-source, dynamic system for meta-analyses is that it will send a clear signal to researchers about the types of variables and details they need to measure and report in their primary research articles. This could include standards emphasized in an updated set of PRISMA-like guidelines tailored to the environmental social sciences, such as reporting on intervention or sample characteristics, but also additional interdisciplinary concerns such as the unexpected effects of environmental intervention and policy efforts (e.g., "rebound effects"; Gillingham et al. 2013). Thus, dynamic meta-analyses could guide research and reporting norms to improve the entire environmental social science research enterprise.

An approach resembling a dynamic reporting of meta-analyses would ensure that environmental social scientists are proposing cutting-edge findings when policymakers are designing policy. We strongly encourage other researchers, including social scientists outside the environmental field, to bring their own ideas and tools to such an enterprise, but the approach is appealing enough to deserve further attention. There are potential shortcomings, of course, such as uncertainty about who would publish new meta-analyses with the statistics gathered and how frequently. These repositories also need to contain complete, easy to discern data with relevant codebooks, in order to not become "data dumpsters" (Merson et al. 2016). This may mean that an official body, which would probably require consistent funding, would maintain and update these databases. The logistics would need to be determined and adapted over time, but if we want to create a dynamic social science truly ready to inform cutting-edge policy, and policy that is ideally tailored to specific groups or contexts, a more dynamic approach to environmental social science meta-analyses is something we need to consider.

6 Additional Considerations for Improving Environmental Policy Efforts

Finally, social scientists conducting primary or meta-analytic research must also improve their ability to discuss other important types of information and evidence relevant to policymakers. First, we need to consider how our interventions influence change in environmental outcomes or behaviors over time (e.g., Rothman 2000). Meta-analyses in the environmental behavior change area have tended to find a significant drop in the number of studies that report follow-up effects over time compared to studies reporting initial change in outcomes or behavior (e.g., Lokhorst et al. 2013; Maki et al. 2016). Policymakers want to understand not only the expected magnitude of change, but also the persistence of the behavior change—how *long* change can be expected to be maintained.

Second, we need an improved grasp of the supplemental effects of our interventions, including how interventions influence a wide range of environmental and social outcomes, not just the behaviors or outcomes specifically targeted by the intervention (sometimes called "behavior spillover" or "rebound effects"; Gillingham et al. 2013; Thøgersen 1999; Truelove et al. 2014), including whether they influence the spread of environmental outcomes across social networks (e.g., Smith and Christakis 2008; Noonan et al. 2011; Darley and Beniger 1981). Similarly, working across traditional disciplinary boundaries would help environmental social scientists incorporate variables and outcomes from each other's studies. For example, how interventions affect outcomes such as overall personal well-being (e.g., Zhang et al. 2014) is vital to appreciating the effects of environmental policies, as are the economic effects on individuals, private firms, and public entities. And, relatedly, we need to better determine estimates of the economic costs of our interventions, to ensure we are designing interventions that can be taken to scale with limited financial barriers (Barker et al. 2016; Carnall et al. 2016; Castelnuovo et al. 2016; Ho et al. 2016; Whelan et al. 2016). This would help ensure that environmental social scientists have a complete picture of all of the positive and negative effects of environmental policies.

Third, we need to consider behaviors that both have the largest influence on important environmental outcomes ("technical potential"; Dietz et al. 2009) and the behaviors and outcomes that we have a reasonable chance of influencing ("behavioral plasticity"; Dietz et al. 2009). Policymakers want to target behaviors that have the greatest influence on pressing environmental issues, and thus primary and meta-analytic research must focus on these behaviors of interest. As a whole, if primary studies report these types of considerations, meta-analyzers should code for (or at least comment on) behavior maintenance, behavior spillover, technical potential, and behavioral plasticity. When unable to code for them, meta-analyzers can spur on additional work in these areas by advocating for improved measurement and reporting of these dimensions by primary environmental social science researchers.

Even after environmental social science meta-analyses have informed new environmental policies, it is worth acknowledging that the research process does not end there. Research on intervention fidelity suggests that we need to be cognizant of whether policymakers are truly sticking to the best environmental practices outlined by meta-analyses (Damschroder et al. 2016). One could view the meta-analytic enterprise, to the extent that it interfaces with policy, to be an iterative process that leads to new insights, new policies, and new questions deserving of further empirical exploration.

7 Barriers to Improving Environmental Social Science Meta-Analyses

We must acknowledge that a number of barriers exist that make implementation of the aforementioned recommendations difficult. For example, even though social scientists have recently pushed for greater transparency in research (Open Science Collaboration 2012), they have also been slow to adopt these new practices. Meta-analyses can only be of quality when primary research is of quality and reported on in a manner that allows for others to use in a meta-analysis, and thus primary researchers should be nudged to consider how their work influences future meta-analyses. However, asking researchers to adjust how they report their primary research to improve meta-analytic efforts will not be sufficient. In a "publish or perish" world, researchers need incentives to improve their practices. Thus, journal editors and research funders should also push for new standards with the end goal of increasing the quality of both primary research and meta-analyses, and thus the promise of exporting our work to policymakers. This could include new requirements for publishing primary empirical results (such as requiring standard measures of the size of effects) and new expectations from funders that primary researchers should enter their results in online dynamic meta-analyses.

Another barrier stems from how to fund and manage the creation and maintenance of dynamic meta-analyses. Ideally, either leadings scholars on a given topic or paid staff associated with a research center would manage dynamic meta-analyses. Regardless of who maintains these publicly available meta-analyses, stable funding would be required at some level.

Finally, scholars or staff who maintain a specific dynamic meta-analysis would potentially need to be available on occasion to assist policymakers, or liaisons between policymakers and scholars, with how to examine and understand certain sets of relevant results. Online tutorials and handbooks would need to be developed that would help policymakers, but inevitably there would also have to be someone available who could occasionally respond to inquiries. This type of guidance would be important in order to make using these meta-analyses as easy as possible to use, and to improve their ability to inform environmental decision-making. Ideally, the results would also be consistently reported in such a way that would make them easy for policymakers to understand. Building off of work by David Kenny and his

Data to Text programs (Kenny 2014) would be an ideal step, as these programs take output from statistical programs and translate it into a narrative that describes the results and how to properly interpret them. Such an approach would make it far easier for non-statisticians to understand the results of dynamic meta-analyses. Also, given concerns about the quality of primary studies included in meta-analyses, policymakers should also have access to easy to understand summaries of the quality of the studies included in the meta-analysis, and the ability to exclude poorly designed studies from reports of meta-analytic results. This may be difficult to implement, as it is unlikely any scholar entering their study information would deem their own research of poor quality. Yet, policymakers require that information to understand the confidence that the scientific community currently places in the results.

8 Conclusion

Meta-analysis is a tool that can help the environmental social sciences drastically improve their ability to inform environmental policy. To improve its exportability, environmental social scientists must improve the conducting and reporting of their meta-analytic research to better inform policymakers. They must also explore ways to create data reporting structures that are prepared to dynamically convey up-to-date best practices to policymakers. Taking these steps will improve the exportability of the environmental social sciences toward more effective designing and implementing of environmental policies that are better able to address the pressing environmental problems of our day.

References

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. *Health Psychology, 27,* 379–387.

Abrahamse, W., & Steg, L. (2013). Social influence approaches to encourage resource conservation: A meta-analysis. *Global Environmental Change, 23,* 1773–1785.

Arrowsmith, J. (2011). Phase II failures: 2008−2010. *Nature Reviews Drug Discovery, 10,* 1.

Aschwanden, C. (2016). Democrats—and republicans—are growing more worried over climate change. http://fivethirtyeight.com/features/democrats-and-republicans-are-growing-more-worried-over-climate-change/.

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology, 27,* 14–25.

Bangdiwala, S. I., Bhargava, A., O'Connor, D. P., Robinson, T. N., Michie, S., Murray, D. M., et al. (2016). Statistical methodologies to pool across multiple intervention studies. *TBM, 6,* 228–235.

Barker, P. M., Reid, A., & Schall, M. W. (2016). A framework for scaling up health interventions: Lessons from large-scale improvement initiatives in Africa. *Implementation Science, 11,* 1–11.

Bierer, B. E., Li, R., Barnes, M., & Sim, I. (2016). A global, neutral platform for sharing trial data. *The New England Journal of Medicine, 374,* 2411–2413.

Carnall, M., Dale, L., & Lekov, A. (2016). The economic effect of efficiency programs on energy consumers and producers. *Energy Efficiency, 9,* 647–662.
Carrico, A. R., Vandenbergh, M. P., Stern, P. C., & Dietz, T. (2015). US climate policy needs behavioural science. *Nature Climate Change, 5,* 177–179.
Carrico, A. R., Vandenbergh, M. P., Stern, P. C., Gardner, G. T., Dietz, T., & Gilligan, J. M. (2011). Energy and climate change: Key lessons for implementing the behavioral wedge. *Journal of Energy & Environmental Law, 18452,* 61–67.
Castelnuovo, G., Pietrabissa, G., Cattivelli, R., Manzoni, G. M., & Molinari, E. (2016). *Not only clinical efficacy in psychological treatments: Clinical psychology must promote cost-benefit, cost-effectiveness, and cost-utility analysis. Frontiers in Psychology 7*. doi:10.3389/fpsyg.2016.00563.
Chang, AC., & Li, P. (2015). *Is economics research replicable? Sixty published papers from thirteen journals say "usually not*." Finance and Economics Discussion Series 2015-083, Washington: Board of Governors of the Federal Reserve System. http://dx.doi.org/10.17016/FEDS.2015.083.
Clayton, S., Devine-Wright, P., Stern, P. C., Whitmarsh, L., Carrico, A., Steg, L., et al. (2015). Psychological research and global climate change. *Natura Climate Change, 5,* 640–646.
Cohen, M. A., & Tubb, A. (2016). The impact of environmental regulation on firm and country competitiveness: A meta-analysis of the porter hypothesis. http://ssrn.com/abstract=2692919.
Cumming, G. (2014). The new statistics: Why and how. *Psychological Science, 25,* 7–29.
Damschroder, L. J., Goodrich, D. E., Kim, H. M., Holleman, R., Gillon, L., Kirsh, S., et al. (2016). Development and validation of the ASPIRE-VA coaching fidelity checklist (ACFC): A tool to help ensure delivery of high-quality management interventions. *Translational Behavioral Medicine, 6,* 369–395.
Darley, J. M., & Beniger, J. R. (1981). Diffusion of energy-conserving innovation. *Journal of Social Issues, 37,* 150–171.
Delmas, M. A., Fischlein, M., & Asenio, O. I. (2013). Information strategies and energy conservation behavior: A meta-analysis of experimental studies from 1975 to 2012. *Energy Policy, 61,* 729–739.
Dietz, T., Gardner, G. T., Gilligan, J., Stern, P. C., & Vandenbergh, M. P. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Sciences of the United States of America, 106,* 18452–18456.
Gifford, R. (2014). Environment psychology matters. *Annual Review of Psychology, 65,* 541–579.
Gillingham, K., Kotchen, M. J., Rapson, D. S., & Wagner, G. (2013). The rebound effect is overplayed. *Nature, 493,* 475–476.
Halletatte, S., & Mach, K. J. (2016). Make climate-change assessments more relevant. *Nature, 534,* 613–615.
Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1986/1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *Journal of Environmental Education, 18,* 1–8.
Ho, F. Y., Yeung, W., Ng, T. H, & Chan C. S. (2016). The efficacy and cost-effectiveness of stepped care prevention and treatment for depressive and/or anxiety disorders: A systematic review and meta-analysis. Scientific Reports 6. doi:10.1038/srep29281.
Hornsey, M. J., Harris, E. A., Bain, P. G., & Fielding, K. S. (2016). Meta-analyses of the determinants and outcomes of belief in climate change. *Nature Climate Change*. doi:10.1038/NCLIMATE2943.
Ioannidis, J. P. A. (2016). The mass production of redundant, misleading, and conflicted systematic reviews and meta-analyses. *The Milbank Quarterly, 94,* 485–514.
Karlin, B., Zinger, J. F., & Ford, R. (2015). The effects of feedback on energy conservation: A meta-analysis. *Psychological Bulletin, 141,* 1205–1227.
Kenny, D. A. (2014). Data to text. Retrieved from. http://davidakenny.net/dtt/datatotext.htm#MA.

Lokhorst, A. M., Werner, C., Staats, H., van Dijk, E., & Gale, J. L. (2013). Commitment and behavior change: A meta-analysis and critical review of commitment-making strategies in environmental research. *Environment and Behavior, 45,* 3–34.

Macaskill, P., Walter, S. D., & Irwig, L. (2001). A comparison of methods to detect publication bias in meta-analysis. *Statistics in Medicine, 20,* 641–654.

Maki, A., Burns, R. J., Ha, L., & Rothman, A. J. (2016). Paying people to protect the environment: A meta-analysis of financial incentive interventions to promote proenvironmental behavior. *Environmental Psychology, 47,* 242–255.

Merson, L., Gaye, O., & Guerin, P. J. (2016). Avoiding data dumpsters—toward equitable and useful data sharing. *The New England Journal of Medicine, 374,* 2414–2415.

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., et al. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine, 46,* 81–95.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & The PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLOS Medicine, 6,* e1000097.

Moher, D., Tsertsvadze, A., Tricco, A., Eccles, M., Grimshaw, J., Sampson, M., & Barrowman, N. (2008). When and how to update systematics reviews. Cochrane database of systematic reviews 1. doi:10.1002/14651858.MR000023.pub3.

Noonan, D. S., Hsieh, L. C., & Matisoff, D. (2011). Spatial effects in energy-efficient residential HVAC technology adoption. *Environment and Behavior, 45,* 476–503.

Open Science Collaboration. (2012). An open, large-scale, collaborative effort to estimate the reproducibility of psychological science. *Perspective on Psychological Science, 7,* 657–660.

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science, 349,* 943–951.

Osbaldiston, R., & Schott, J. P. (2012). Environmental sustainability and behavioral science: Meta-analysis of proenvironmental behavior experiments. *Environment and Behavior, 44,* 257–299.

Page, M. J., & Moher, D. (2016). Mass production of systematic reviews and meta-analyses: An exercise in meta-silliness? *The Milbank Quarterly, 94,* 515–519.

Panko, B. (2016). Industry-backed project aims to become one-stop shop for clinical research data. *Science*. doi:10.1126/science.aag0554.

Ressing, M., Blettner, M., & Klug, S. J. (2009). Systematic literature reviews and meta-analyses. *Deutsches Ärzteblatt International, 106,* 456–463.

Rothman, A. J. (2000). Toward a theory-based analysis of behavioral maintenance. *Health Psychology, 19,* 64–69.

Rothstein, H. R., Sutton, A. J., & Borenstein, M. (2005). Publication bias in meta-analysis. In H. R. Rothstein, A. J. Sutton, & M. Borenstein (Eds.), *Publication bias in meta-analysis—prevention, assessment, and adjustments hoboken* (pp. 1–7). NJ: Wiley.

Scheibehenne, B., Jamil, T., & Wagenmakers, E. (2016). Bayesian evidence synthesis can reconcile seemingly inconsistent results: The case of hotel towel reuse. *Psychological Science, 27,* 1043–1046.

Schultz, P. W. (2015). Strategies for promoting proenvironmental behavior: Lots of tools but few instructions. *European Psychologist, 19,* 107–117.

Smith, K. P., & Christakis, N. A. (2008). Social networks and health. *Annual Review of Sociology, 34,* 405–429.

Steel, B., List, P., Lach, D., & Shindler, B. (2004). The role of scientists in the environmental policy process: A case study from the American west. *Environmental Science & Policy, 7,* 1–13.

Sutton, A. J., & Higgins, J. P. T. (2008). Recent developments in meta-analysis. *Statistics in Medicine, 27,* 625–650.

Thøgersen, J. (1999). Spillover processes in the development of a sustainable consumption pattern. *Journal of Economic Psychology, 20,* 53–81.

Truelove, H. B., Carrico, A. R., Weber, E. U., Raimi, K. T., & Vandenbergh, M. P. (2014). Positive and negative spillover of pro-environmental behavior: An integrative review and theoretical framework. *Global Environmental Change, 29,* 127–138.

Uman, L. S. (2011). Systematic reviews and meta-analyses. *Journal of the Canadian Academy of Child and Adolescent Psychiatry, 20,* 57–59.

Vandenbergh, M. P. (2013). Private environmental governance. *Cornell Law Review, 99,* 134–137.

Vandenbergh, M. P., & Gilligan, J. M. (2015). Beyond gridlock. *Columbia Journal of Environmental Law, 40,* 217–303.

Wells, K., & Littell, J. H. (2009). Study quality assessment in systematic reviews of research on intervention effects. *Research on Social Work Practice, 19,* 52–62.

Whelan, M. E., Goode, A. D., Eakin, E. G., Veerman, J. L., Winkler, E. A. H., Hickman, I. J., et al. (2016). Feasibility, effectiveness and cost-effectiveness of a telephone-based weight loss program delivered via a hospital outpatient setting. *Translational Behavioral Medicine, 6,* 386–395.

Whitehead, A. (1997). A prospectively planned cumulative meta-analysis applied to a series of concurrent clinical trials. *Statistics in Medicine, 16,* 2901–2913.

Zhang, J. W., Piff, P. K., Iyer, R., Koleva, S., & Keltner, D. (2014). An occasion for unselfing: Beautiful nature leads to prosociality. *Journal of Environmental Psychology, 37,* 61–72.

Integrating Social Science Research to Advance Sustainability Education

Christine Jie Li, Martha C. Monroe and Tracey Ritchie

Abstract

The development and evaluation of the instructional module, *Southeastern Forests and Climate Change*, provided a platform to conduct social science research that has the capacity to improve sustainability education and our ability to achieve target outcomes. In addition to conveying information about climate change and forest management to secondary science students, the module was designed to empower learners to take action and build skills in systems thinking. We applied Hope Theory in the design of the 14 activities and measured hope among high school students who participated in the evaluation of the activities. Activities helped learners understand how others are working on climate issues, how forest owners adapt management protocols, and how individuals can contribute to solutions—all of which help nurture hopefulness and efficacy. We also focused on developing systems thinking skills by providing opportunities for students to learn and practice common systems tools, such as causal loop diagrams. High school students (n = 924) from 24 schools in the southeastern United States completed pre-and post-activity surveys that assessed knowledge, hope, and systems thinking skills. Data suggest that there was a significant increase in hope concerning climate change, and a significant increase in systems thinking skills after some activities. Knowledge of forest management, carbon cycle, the role of forests in mitigating climate change, life cycle assessment, and

C.J. Li (✉)
School of Natural Resources, University of Missouri, Columbia, MO 65203, USA
e-mail: lij1@missouri.edu

M.C. Monroe · T. Ritchie
School of Forest Resources and Conservation, University of Florida, 110410, Gainesville
FL 32611, USA
e-mail: mcmonroe@ufl.edu

T. Ritchie
e-mail: tracey.ritchie@ufl.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_3

product externalities also significantly increased. In this article, we describe the principles used to design the activities, the results, and the implications of this social science research.

Keywords
Climate change · Hope · Systems thinking skills · Curriculum development

1 Introduction

Schools are society's opportunity to allow younger generations to gain knowledge and skills to become active and responsible citizens. Many of the goals of environmental and sustainability education, such as building skills for action competence (Uzzell 1999) and facilitating the thinking for future scenarios for sustainability (Kagawa and Selby 2015), are lacking in today's classrooms. This may be because the teaching strategies that lead to these outcomes are not well known.

Much is written and debated about the most effective ways to create meaningful experiences that engage youth in building both appropriate mental models and sufficient efficacy to take actions (Bandura 1977; Corno and Mandinach 1983; Johnson-Laird 1983; Kaplan and Kaplan 2009; Norman 1983; Peterson et al. 1982; Schunk 1985). Some researchers have alerted educators to the importance of enhancing students' disposition to use their knowledge and skills, as having ability is not the same as being willing to use it (Facione et al. 1997). Closely aligned with disposition are self-efficacy, outcome expectancy, and hope. Without hope, would students bother to learn about the complex issues facing society? When these issues are global and distant, can students believe they can do anything to make a difference?

Climate change is a challenging topic for educators who intend to nurture hope among their students. Knowledge alone can foster a depressing outlook on the future, with climate models suggesting the following potential outcomes:

- Sea level rise of 0.5 meters (20 inches) will cause coastal flooding and affect 5 million to 200 million people worldwide (NRC 2012).
- Habitat change due to climate could threaten nearly half the bird species in the continental United States and Canada by the end of century (NAS 2015).
- Challenges to agriculture as the human population approaches 8 billion could bring significant loss to the world economy (IPCC 2007, 2013; NRC 2011a, b; U.S. Global Climate Research Program 2009).

Unlike place-based and small-scale problems that students can tackle with success in their curriculum, climate change does not lend itself as easily to student projects that build self-efficacy, hopefulness, and a sense that they have the skills to address this challenge. Yet, research has demonstrated that hope is an essential element of engaging people in solving problems caused by climate change (Ojala 2007, 2012).

Hope is characterized by an expectation that the future will be better than the present and that one has the power to make it so (e.g., Averill et al. 1990; Bruininks and Malle 2005; Farran et al. 1995; McGreer 2004; Pettit 2004; Stotland 1969). According to Hope Theory (Snyder 2000), hope is a thinking process in which people exhibit agency thinking (willpower) and pathways thinking (waypower). Agency thinking refers to the appraisal that one is capable of executing the means to attain certain goals, and pathways thinking refers to the appraisal that one is capable of generating those means. Lopez and his colleagues (2000) transformed the notion of hope by defining three important characteristics of high-hope individuals. These individuals can (1) clearly conceptualize the goals, (2) envision a major strategy to a desired goal and generate alternative pathways, and (3) perceive that he/she has the ability and is willing to employ these strategies in pursuit of the goals. A 3-year longitudinal study with college students in the United Kingdom suggests that hope uniquely predicts personal achievement above intelligence, personality, and previous academic achievement (Day et al. 2010). Therefore, education programs that seek to help students consider how to effectively address climate change should nurture hope as well as increase understanding about the issue.

However, understanding climate change and its causes and impacts is not a simple task. Students can better understand how climate, ecosystems, and human activities are related when they use a systems perspective to approach the issue. Systems thinking is a method to help students think through complex problems (Skaza et al. 2013). It can force students to think beyond the familiar linear, cause and effect relationships they have come to rely on and to start considering the multitude of relationships that contribute to society's wicked problems. To do this, teachers need instructional materials that enable them to cover more than system structure and function and that challenge their students to understand the variables within a particular system and how they are directly and indirectly related. The strong presence of systems within the Crosscutting Concepts of the Next Generation Science Standards suggests that science educators should teach students how to understand and interpret system behavior and models (NGSS 2013).

Previous studies have demonstrated that students often lack the ability to comprehend the complexity of the climate system and identify and visualize the impacts of invisible components of a system (Shepardson et al. 2014). However, systems thinking skills are essential if students are to successfully engage in and thoroughly understand sustainability issues (Sandri 2013). Students need to understand that some environmentally friendly behaviors (e.g., littering, recycling, saving water) will not have an impact on mitigating climate change (Bofferding and Kloser 2015). Students need a deeper understanding of the interrelationships to know which actions will improve the system. Purposeful education that not only teaches about a system, but also to think at a systems level is needed to create a citizenry that can understand and appreciate complexity.

This study explored the levels of knowledge, hope, and systems thinking among high school students with the following questions: (1) Can climate change education programs nurture hope and enhance systems thinking skills? (2) Does an increase in knowledge decrease hopefulness?

1.1 Building Hope Through Instructional Activities

Over the past 30 years, researchers and educational professionals have worked to cultivate self-efficacy (Bandura 1977) to make a difference in students' lives and academic performance (Snyder et al. 2002). Self-efficacy is "the belief in one's capabilities to organize and execute the courses of action required to manage prospective situation" (Bandura 1995, p. 2) which is a very similar if not overlapping construct with hope. Educators can contribute to the development of self-efficacy beliefs by utilizing the following strategies (Bandura 1977), all of which should also increase hopefulness:

1. Performance accomplishments: The experience of mastery enhances students' perspectives on their abilities.
2. Vicarious experience: The observation of someone else perform a task or handle a situation can help students perform the same task by imitation.
3. Verbal persuasion: When students are encouraged by others to perform a task, they tend to believe that they are more capable of performing the task.
4. Physiological states: The ability to diminish or control anxiety may have positive impact on self-efficacy beliefs.

We applied these four strategies and Hope Theory in designing an instructional module, *Southeastern Forests and Climate Change*. This secondary environmental education module focuses on climate change impacts on southern forest ecosystems, forest impacts on climate, and the ways people can affect these relationships. The 14 activities introduce concepts, provide data, engage students in discussions, and provide examples of how people are researching or addressing the issue. The impetus and framework for this activity was grant funding from USDA/NIFA focusing on climate impacts to southern pine management (see Monroe et al. this volume). All activities and resources can be downloaded from the module website (http://sfrc.ufl.edu/extension/ee/climate/). The four strategies for hope and the emphasis on systems thinking were used throughout the module to provide students with the inspiration and skills to address complex environmental issues. To measure our successes in conveying hopefulness and systems thinking skills, we conducted a thorough evaluation process to improve the value of the module while also answering our research questions.

Recognizing the limitations of practical links between climate change and hope, we developed the following four principles to design the lessons for this module:

1. **Others Care**. One aspect of hopefulness is believing that others are concerned about the same problem, which can reduce anxiety and create opportunities for vicarious experiences. We used a simple strategy of asking students to read and discuss articles from researchers associated with the Southern Research Station of the US Forest Service who have explored various aspects of climate variability and change in forests. These articles describe the questions and observations that motivated the scientists, their initial findings, and the tools they are developing to learn more about the effects of change on the forest systems. Students discuss these findings and recognize that work is being done that will help define problems and suggest solutions. In addition, climate and forest scientists and their graduate students are featured in the online slide presentations and videos, introducing students to careers in science that can help solve important problems.
2. **Others Are Doing Things**. Not only are others concerned, but many are currently engaged in actions that help mitigate climate change and support adaptations to likely promote change. We conveyed this key element of hope through lessons in several ways. After an introduction to the carbon cycle, students realize the power of carbon sequestration and the role forest landowners can play in using forests to mitigate change. An exercise on heredity reveals that scientists are breeding trees from across the natural range of loblolly pine to create seedlings that might exhibit tolerance to future climates. An explanation of climate science is followed by an exercise to help students understand some of the reasons that people disagree about climate change. Students then participate in a role play as a committee of individuals with different opinions who are asked to generate and evaluate recommendations for actions the community could take to address climate change. The ensuing discussion results in an increased understanding of why people hold different perspectives and their underlying interests. And finally, we introduce the concept of life cycle assessment (LCA) to help students realize that people are measuring carbon dioxide emissions of various products to suggest alternatives that might be better for climate.
3. **Things I Can Do**. Teachers specifically requested that we include examples of things students can do to affect climate change (Monroe et al. 2013). Since the focus of the module is on forest ecosystems, we avoided examples of energy conservation. While some youth might inherit forest lands, that could not be an assumed opportunity for all. To make forests relevant for all students, we focused on the LCA link to show that consumers can consider the impact of their purchasing decisions on climate. One activity helps students understand that durable wood products continue to sequester carbon, and using these instead of carbon-emitting alternatives can contribute to a significant reduction in atmospheric carbon dioxide. A concluding activity suggests ways students can work together on a service project in their community to raise awareness of the roles that forests play in carbon sequestration or strategies to enhance local forests. These activities combine persuasion and mastery in opportunities that students select; the materials do not advocate specific behaviors.

4. **Seeing Connections**. Climate change information can be depressing due to the variety of ways, suspected and unknown, that the climate system might respond to an increase in atmospheric carbon dioxide. While the negative consequences garner headlines in the environmental community, we sought to build skills in seeing connections that suggest a resilient system might be able to cope with some degree of climate change. An ecosystem's ability to adapt suggests that things may be different but will not collapse; we will still have plants and animals in some combination. While carbon sequestration will not "solve" the problem of climate change, students learn how forest ecosystems are resilient and how they may adapt under different climate conditions, but will not disappear completely. Our activities stress systems thinking skills so that students can recognize connections within a complex system and understand how that complexity enables the system to respond to change. This strategy is an attempt to diminish anxiety about climate change impacts.

1.2 Enhancing Systems Thinking Skills

To expand on the idea of "Seeing Connections" to bolster hope, we emphasized the development of systems thinking skills to take learners beyond simply seeing connections to being able to understand these connections, predict impacts of different relationships in a system, and apply solutions (Senge and Sterman 1992). Systems thinking helps students recognize patterns and interrelationships and imagine the impacts of changes to one variable in a system at different temporal and spatial scales. For many years, ecologists and business managers have used systems thinking to understand complex systems and to make predictions of how changes in one variable might alter critical outputs. The Next Generation Science Standards explicitly list systems as a crosscutting theme and expect that students will gain systems thinking skills in order to create models, and articulate or predict change. The prevalence of linear thinking, better suited for simple or artificial systems, speaks to the importance of teaching systems thinking in a manner that will empower students to use these skills to understand complex and nuanced systems. It is an interesting paradox that systems are everywhere and may be considered commonplace (e.g., digestive system, solar system) but this familiarity cannot help learners understand important systems concepts that help explain how systems behave, such as feedback loops or delays.

We utilized the forest and climate systems as the context for which students could begin to practice using systems thinking skills and tools. Students created causal loop diagrams to explore the relationships (both direct and indirect) that exist in a forest system and used computer models to see how climate change could impact tree and bird species. Behavior-over-time graphs were also used to depict how systems or their variables changed over time. These tools help students visualize systems, and better understand the variables that make up the system and the relationships between those variables.

2 Methods

2.1 Research Plan

To answer the research questions and assess the effectiveness of the educational resources, we utilized the evaluation as an opportunity to collect data for both research and evaluation questions (for evaluation information, see Monroe et al. this volume). To test learning outcomes, we grouped the activities into four packages and asked teachers to select the package that best fit their course objectives. Three of the module activities were not used in the evaluation and research process, as one had not yet been developed and two were culminating activities that were not feasible for teachers to complete. We used pre-experimental design, also called one-group pretest-posttest design, to collect data. A benefit of this design is the inclusion of a pretest to determine baseline scores, which allows us to ascertain whether a change in learning has taken place. Elements of hope and systems thinking were represented in each package (Table 1). The study was not about testing each strategy separately because some of the strategies, such as seeing connections, were used in activities that span all packages. Using a control group was not feasible because comparable lessons were not available that could cover the same content without also conveying hope or teaching about systems.

2.2 Procedure

We sent an invitation through several email lists to recruit secondary teachers from the southeastern United States after approval from the Institutional Review Board at University of Florida. From the 123 applicants, 36 high school teachers were selected to represent regional and grade level diversity. We purposefully selected the teachers from the counties with and without working forests based on the data from the USDA Forest Service Timber Products Output Reports Website (2013) and US Census Bureau (2013). They agreed to conduct the four assigned activities for their selected package during their regular instruction, collect the parental consent forms, and involve their students in pre- and post-activity surveys. Instructions were provided by mail and were reinforced in teacher emails. We asked teachers to administer the student pre-survey and post-survey within a week of finishing the activities.

2.3 Instruments

Student pre- and post-activity surveys were developed, reviewed by 9 experts to ensure content accuracy, revised, and pilot tested with 89 high school students. The student pre- and post- activity surveys included (1) a 14-item climate change hope scale (Cronbach alpha is 0.84) (Li and Monroe 2017), (2) 4 items on systems

Table 1 Packages with Activities, Knowledge-based Concepts, Learning Outcome and Hope Strategies

Package	Activity Titles	Knowledge-based Concepts	Hope Strategies				Systems Thinking Tools		
			Seeing Connections	Others Care	Others Are Doing Things	Things I Can Do	Causal Loop Diagram	Computer Model	Behavior Over Time Graph
1	The Real Cost	– Life cycle assessment – Externalities – Role of forests in mitigating climate change	X	–	–	X	–	–	–
	Adventures in Life Cycle Assessment		X	–	–	X	–	–	–
	Life Cycle Assessment Debate		X	–	–	X	–	–	–
	The Carbon Puzzle		X	X	X		–	–	X
2	Clearing the Air	– Forest management – Climate change science – Role of forests in mitigating climate change	X	X	X	X	–	X	X
	The Changing Forests		–	X	X	–	–	–	–
	Atlas of Change		X	–	–	–	–	X	–
	Managing Forests for Change		X	X	X	–	X	–	–
3	Managing Forests for Change	– Forest management – Carbon cycle – Carbon sequestration Genetic diversity	X	X	X	–	X	–	–
	Mapping Seed Sources		–	X	X	–	–	–	–
	Carbon on the Move		X	–	–	–	–	–	–

(continued)

Table 1 (continued)

Package	Activity Titles	Knowledge-based Concepts	Hope Strategies				Systems Thinking Tools		
			Seeing Connections	Others Care	Others Are Doing Things	Things I Can Do	Causal Loop Diagram	Computer Model	Behavior Over Time Graph
	Counting Carbon		X	–	–	–	–	–	
4	Clearing the Air	– Forest management – Life cycle assessment – Externalities Role of forests in mitigating climate change	X	X	X	X	–	X	X
	Managing Forests for Change		X	X	X	–	X	–	–
	The Real Cost		X	–	–	X	–	–	–
	The Carbon Puzzle		X	X	X		–	–	X

thinking skills, (3) 7 items covering demographic information, and (4) a 48-item test of knowledge. Systems thinking was only measured in packages 3 and 4 because we were interested in keeping the surveys short for packages 1 and 2 that had more younger students to reduce tests mortality. To reduce the pre-test impact on the post-test, the knowledge tests contained parallel questions with similar, but not the same, wording and answer choices. The climate change hope scale was developed from Snyder's (2000) Will & Ways hope scale and Ojala's (2012) Hope Concerning Climate Change scale for Swedish youth. The questions on systems thinking skills were guided by Stave and Hopper's (2007) taxonomy of systems thinking skills. Multiple choice questions were used to measure students' ability to identify the variables of a given system, the relationship between variables in the system, and the ability to interpret a system diagram and apply it to a new situation.

3 Results

3.1 Participants

Twenty-four pilot testers completed the activities and returned student pre- and post-surveys. About half (44%) of the teachers used the activities in environmental science or advanced placement (AP) environmental science classes. About 26% used the activities in biology and AP biology classes. Approximately 15% used the activities in earth science classes. The remaining teachers (15%) used the activities in courses such as land resources, economics, ecology, and environmental issues and investigation. Students (n = 924) from 24 high schools completed the pre-and post-surveys and had signed parent consent forms. Students were equally divided by gender; about 57% were 11th and 12th graders and 43% were 9th and 10th graders. However, the packages differed by age because they were designed to supplement different high school courses. As a result, 40% of students participating in packages 1 and 2 were 11th and 12th graders, while packages 3 and 4 reached 66% of this age group. About 14% self-identified as Hispanic. The majority of students were white (70%), with the remainder representing five racial communities (American Native = 1%, Asian or Pacific Islander = 2%, African American = 12%, two or more races = 8%, other = 6%). Student respondents were from Florida (42%), Kentucky (17%), Virginia (17%), North Carolina (12%), Georgia (4%), Arkansas (4%), and Oklahoma (4%).

3.2 Student Learning Outcome

We used dependent t-tests to compare student pre- and post-tests in terms of knowledge gain, hope change, and skills building. Data suggest that there was a significant increase in knowledge of LCA, externalities, climate science, forest management, carbon cycle, and the role of forests in mitigating climate change in

Table 2 Dependent T-tests Results from Students' Pre- and Post-tests

Learning Outcome	Pre-test Mean (n)	Post-test Mean (n)	T (one-tailed) (df)
Knowledge			
Package 1: LCA and externalities	2.83 (114)	4.25 (114)	2.98 (113)***
Package 2: Climate science, modeling, and forests management	3.64 (84)	4.15 (84)	0.9 (83)
Package 3: Carbon cycle and the role of forests in mitigating climate change	4.97 (171)	6.98 (171)	4.48 (170)***
Package 4: Climate science, LCA, and the role of forests in mitigating climate change	5.41 (178)	6.14 (178)	2.04 (177)***
Hope			
Package 1	58.28 (188)	60.37 (188)	1.56 (187)**
Package 2	56.87 (239)	58.46 (239)	1.29 (238)*
Package 3	56.65 (227)	58.40 (227)	1.43 (226)*
Package 4	62.03 (231)	64.06 (231)	1.86 (230)**
Systems thinking skills			
Package 1	–	–	–
Package 2	–	–	–
Package 3	1.96 (182)	1.97 (182)	0.54 (181)
Package 4	2.21 (194)	2.40 (194)	1.07 (193)*

Note *$p < .05$; **$p < .01$; ***$p < .001$

Package 1, Package 3, and Package 4. Hope concerning climate change significantly improved among all four packages. Systems thinking skills stayed relatively the same in package 3, and significantly increased among students who received the package 4 (Table 2).

3.3 Knowledge and Hope

Multiple linear regression analysis was used to determine whether or not learning about forests and climate change significantly affected change in hopefulness while controlling for gender and grade level. Adding background information as controlling variables helps the model make predictions that are more accurate. We ran multiple regression analysis for each package and used the different value between hope post-score and pre-score (Posthope-Prehope) as the dependent variable.

Independent variables were the different value between knowledge post-score and pre-score (PostK-PreK), gender (0 = female; 1 = male), and grade level (0 = 9th and 10th grade; 1 = 11th and 12th grade). The results of the regression indicated the change in knowledge was a significant predictor in affecting change in hopefulness in package 1 (B = 1.03, $p < 0.01$) and 4 (B = 0.98, $p < 0.001$) when controlling for gender and grade level. The model explained 11.9% of the variance in package 1 ($R^2 = 0.12$, $F(4, 105) = 3.42$, $p < 0.05$) and 10.2% of the variance in package 4 ($R^2 = 0.10$, $F(4, 169) = 4.70$, $p < 0.01$). This indicates that as the knowledge score increases by one unit in package 1, hope increases by 1.03 units. Knowledge in package 1 highlights the carbon dioxide emissions associated with different products and examines the relationship between consumer choices and environmental impacts. As the score in knowledge increases by one unit in package 4, hope increases by 0.98 units (Table 3). Knowledge in package 4 connects climate science with life cycle assessment and the role of forests in mitigating climate change. It also highlights connections between today's decision and tomorrow's impacts through systems thinking.

Table 3 Regression Coefficients from Multiple Linear Regression Analysis

Package		B	SE B	β	T
1	Constant	3.49	2.31	–	1.51
	PostK-PreK	1.03	0.34	0.29	3.06**
	Gender	−0.71	1.72	−0.04	−0.41
	Grade level	−2.64	2.10	−0.14	−1.23
2	Constant	0.76	5.80	–	0.13
	PostK-PreK	0.39	0.51	0.08	0.77
	Gender	−0.50	2.37	−0.02	−0.21
	Grade level	1.81	5.80	0.05	0.20
3	Constant	2.25	1.33	–	1.69
	PostK-PreK	0.24	0.25	0.07	0.94
	Gender	−1.06	1.47	−0.05	−0.72
	Grade level	1.90	1.72	0.09	1.10
4	Constant	4.93	2.21	–	2.23*
	PostK-PreK	0.98	0.26	0.28	3.82***
	Gender	0.78	1.22	0.05	0.64
	Grade level	−2.88	2.14	−0.10	−1.3

Note *p < .05; **p < .01; ***p < .001

4 Implications for Sustainability Education

One result from this study suggests that hope can be nurtured through sustainability education materials. We learned that the activities were effective in enabling teachers to engage students in learning the concepts and nurturing hope about climate change. Seeing connections, learning that others care and are doing things, and understanding what students can do effectively built students' hope through agency and pathways thinking in the context of mitigating and adapting to climate change. A high school student from Florida recognized that he was gaining ideas about others when he commented: "I loved it! This activity taught me a lot about different perspectives and viewpoints from other people and opened my eyes to new horizons!"

Students in package 4 increased their systems thinking abilities after practicing with casual loop diagrams, computer models, and behavior-over-time graphs. In the post-surveys, students demonstrated they were able to read and interpret new diagrams and answer questions about system dynamics. Often students have an innate ability to think in terms of systems, but these abilities are not usually encouraged or practiced throughout K-12 education. When teachers made a conscious effort to emphasize systems thinking tools and vocabulary, they were able to foster systems thinking skills in students. Ideally these skills should become routine thinking habits that students are able to apply to any system. The difference between students who participated in package 4 and students who participated in package 3 demonstrates that the development of systems thinking skills takes practice with different content and a variety of tools.

Another key finding that emerged from this research was that an increase in knowledge about climate change can be accompanied by an increase in hopefulness, and it is not on the function of gender and grade level. However, the association between knowledge and hope depends on the type of information that is provided. If the knowledge highlights connections between today's decision and tomorrow's impacts, especially through systems thinking as in package 4, it is more likely that the increase in knowledge will lead to the increase in hopefulness. In addition, if the lessons focus on what students can do to address the issue, as in packages 1 and 4, hope is more likely to be fostered. Another factor, perhaps, could influence the result is that more students in package 4 are from Advance Placement Environmental Science class in which their teachers might have experience in teaching systems thinking or were introduced system thinking before.

These results and our experiences working with educators significantly altered how we designed the systems thinking component of the module. We realized the importance of helping teachers draw attention to systems components and demonstrate systems thinking. Now, each activity includes a Systems Thinking Connection section to highlight the skills and tools in the activity and tips for how the teacher can reinforce them. We learned from the teacher surveys that systems thinking was new for educators who do not teach Advanced Placement Environmental Science classes, and they were seeking more assistance in strategies to present content at a systems level. We also included discussion questions in the activity descriptions designed to help students think about a topic from a systems perspective. A new activity introduced the behavior-over-time graph that examine amount of carbon in the atmosphere over time. In addition to the systems thinking components of the activities, we believed that teachers needed an opportunity to practice systems thinking skills with their students in other contexts. We developed nine supplemental exercises that allow students the opportunity to apply their newly developed skills to novel systems. One of these activities introduces students to another systems thinking tool, stock-and-flow diagrams. The nine exercises can be found on the module website and include activity sheets to practice diagrams and online tools for practice with models.

Limitations of this study provide insights for future research. Students were not randomly selected and teachers who pilot tested the program were volunteers who were interested in teaching about climate change and received a stipend, which constrains the ability to generalize these results to other populations. We did not test the design principles separately, since they were utilized repeatedly in many activities. An experimental study could be developed to test the effectiveness of a single principle. Longitudinal studies are needed to answer additional research questions such as, how long lasting are program effects on hope and systems thinking and would the effects influence students' willingness to participate in environmental problem-solving as an adult? Future research could look at whether or not the assumptions hold true for adult learners and other factors that we did not include in this study, such as environmental identity, perceptions about anthropogenic climate change, and perceived risks. The relationship between hope and systems thinking needs to be further tested. Future study could also look at how to teach teachers about systems thinking and evaluating whether the changes we made in the module help them teach and influence their efficacy in teaching systems thinking skills.

5 Conclusion

Effective climate change education should not only increase learners' understanding about the issue but also nurture a sense of hopefulness. Without hope, information might create a depressing and pessimistic outlook for the future. Sustainability educators can develop and nurture a sense of hopefulness by showing examples of people who are currently working to understand, mitigate and adapt to climate change, as well as the potential for others to join them. This can help learners broaden their hope pathways thinking. Opportunities at an appropriate scale can help learners explore, investigate issues, and resolve to build responsibility and hope agency thinking. Using systems thinking to make choices and understand consequences could help individuals identify a need, create a vision, and design an action plan, even if other people are responsible for implementing it.

The scale of climate change makes it difficult to empower learners to be skilled and hopeful, since it can be challenging to see the impact that small-scale actions have on a global problem. Yet that is exactly what all of us are capable of doing. Carefully using systems thinking to help teachers and students understand the connections and apply solutions to problems of similar scale should help students develop systems thinking skills and may help nurture hope.

Acknowledgements This project was funded by the Pine Integrated Network: Education, Mitigation, and Adaptation project (PINEMAP), a Coordinated Agricultural Project funded by the USDA National Institute of Food and Agriculture, Award #2011-68002-30185, and the School of Forest Resources and Conservation at the University of Florida

References

Averill, J. R., Catlin, G., & Chon, K. K. (1990). *Rules of hope*. New York: Springs-Verlan.

Bandura, A. (eds.). (1995) Self-efficacy in changing societies. Cambridge: Cambridge University Press.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215.

Bofferding, L., & Kloser, M. (2015). Middle and high school students' conceptions of climate change mitigation and adaptation strategies. *Environmental Education Research, 21*(2), 275–294.

Bruininks, P., & Malle, B. F. (2005). Distinguishing hope from optimism and related affective states. *Motivation and Emotion, 29,* 327–355.

Corno, L., & Mandinach, E. B. (1983). The role of cognitive engagement in classroom learning and motivation. *Educational Psychologist, 18,* 88–108.

Day, L., Hanson, K., Maltby, J., Proctor, C., & Wood, A. (2010). Hope uniquely predicts objective academic achievement above intelligence, personality, and previous academic achievement. *Journal of Research in Personality, 44,* 550–553.

Facione, P. A., Facione, N. C., & Giancarlo, C. A. (1997). The motivation to think in working and learning. In E. Jones (Ed.), *Preparing competent college graduates: Setting new and higher expectations for student learning* (pp. 67–79). San Francisco: Jossey-Bass.

Farran, C. J., Herth, K. A., & Popovich, J. M. (1995). *Hope and hopelessness: Critical, clinical, constructs*. Thousand Oaks: Sage.

Intergovernmental Panel on Climate Change (IPCC). (2007). *Climate change 2007: Synthesis report*. Contribution of working groups I, II, and III to the fourth assessment report of the Intergovernmental panel on climate change [Core Writing Team, Pachauri, R.K. and Reisinger, A. (Eds)]. Geneva: IPCC.

Intergovernmental Panel on Climate Change (IPCC). (2013). *Climate change 2013: The physical science basis*. Contribution of working group I to the fifth assessment report of the Intergovernmental Panel on Climate Change. [Stocker, T. F., D. Qin, G. K. Plattner, M. Tignor SK, Allen J, Boschung A, Nausels Y, Xia V, Bex PM, Midgley (Eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Johnson-laird, P. (1983). *Mental models*. Cambridge: Harvard University Press.

Kaplan, S., & Kaplan, R. (2009). Creating a larger role for environmental psychology: The Reasonable person model as an integrative network. *Journal of Environmental Psychology, 2009,* 1–11.

Lopez, S. J, Bouwkamp, J., Edwards, L. M., & Terramoto, Pedrotti J. (2000). *Making hope happen via brief interventions*. Paper presented at the second Positive Psychology Summit. Washington, DC.

Li C. J., & Monroe, M. C. (2017). Development and validation of the climate change hope scale for high school students. *Environ Behav*.

McGeer, V. (2004). The art of good hope. *Annals of the American Academy of Political & Social Sciences, 592,* 152–165.

Monroe, M. C., Oxarart, A., & Plate, R. R. (2013). A role for environmental education in climate change for secondary science educators. *Appl Envion Educ Comm, 12*(1), 4–18.

National Audubon Society (NAS). (2015). Audubon's birds and climate change report. Retrieved from http://climate.audubon.org/.

National Research Council (NRC). (2012). Climate change: Evidence, impacts, and choices: Answers to common questions about the science of climate change. Washington: The National Academies Press USA. Retrieved from http://nas-sites.org/americasclimatechoices/more-resources-on-climate-change/climate-change-lines-of-evidence-booklet/.

National Research Council (NRC). (2011a). *Climate stabilization targets: Emissions, concentrations, and impacts for decades to millennia*. Washington: The National Academies Press USA.

National Research Council (NRC). (2011b). *Informing an effective response to climate change*. Washington: The National Academies Press USA.

NGSS Lead States. (2013). *Next generation science standards: For states, By states*. Washington: The National Academies Press.

Norman, D. (1983). Some observations on mental models. In D. Gentner and A. Stevens (eds.), Mental models (Lawrence Erlbaum Associates, Hillsdale, N. J., pp 6−14).

Ojala, M. (2007). *Hope and worry: Exploring young people's values, emotions, and behavior regarding global environmental problems, Örebro Studies in Psychology 11*. PHD dissertation, Örebro University

Ojala, M. (2012). Hope and climate change: The importance of hope for environmental engagement among young people. *Environmental Education Research, 18*(5), 625–664.

Peterson, P. L., Swing, S. R., Braverman, M. T., & Buss, R. (1982). Students' aptitudes and their reports of cognitive processes during direct instruction. *Journal of Educational Psychology, 74,* 535–547.

Pettit, P. (2004). Hope and its place in mind. *Annals of the American Academy of Political & Social Sciences, 592,* 152–165.

Sandri, O. J. (2013). Threshold concepts, systems and learning for sustainability. *Environmental Education Research, 19*(6), 810–822.

Schunk, D. H. (1985). Self-efficacy and classroom learning. *Psychology in the Schools, 22*(2), 208–223.

Selby, D., & Kagawa, F. (Eds.). (2015). *Sustainability Frontiers: Critical and transformative voices from the borderlands of sustainability education*. Germany: Budrich.

Senge, P., & Sterman, J. (1992). Systems thinking and organizational learning: Acting locally and thinking globally in the organization of the future. *European Journal of Operational Research, 59*(1), 137–150.

Shepardson, D. P., Roychoudhury, A., Hirsch, A., Niyogi, D., & Top, S. M. (2014). When the atmosphere warms it rains and ice melts: Seventh grade students' conceptions of a climate system. *Environmental Education Research, 20*(3), 333–353.

Skaza, H., Crippen, K. J., & Carroll, K. R. (2013). Teachers' barriers to introducing system dynamics in K-12 STEM curriculum. *System Dynamics Review, 29*(3), 157–169.

Snyder, C. R. (Ed.). (2000). *Handbook of hope: Theory, measures, and applications*. San Diego: Academic Press.

Snyder, C. R., Shorey, H. S., Cheavens, J., Pulvers, K. M., Adams, V. H., III, & Wiklund, C. (2002). Hope and academic success in college. *Journal of Educational Psychology, 94*(4), 820–826.

Stave, K., & Hopper, M. (2007). What constitutes systems thinking? A proposed taxonomy. In Proceedings of the 26th international conference of the system dynamics society. Athens.

Stotland, E. (1969). *The psychology of hope*. San Francisco: Jossey-Bass.

U.S. Census Bureau. (2013). 2013 Population estimates. Retrieved from. http://www.census.gov/popest/data/index.html.
U.S. Department of Agriculture Forest Service. (2013). Timber Product Output (TPO) Reports. Knoxville, TN: U.S. Department of Agriculture Forest Service, Southern Research Station. http://srsfia2.fs.fed.us/php/tpo_2009/tpo_rpa_int1.php. [May, 2013].
U.S. Global Climate Research Program. (2009). Global climate change impacts in the U.S. Washington: Cambridge University Press.
Uzzell, D. (1999). Education for environmental action in the community: New roles and relationships. *Cambridge journal of education, 29*(3), 397–413.

Author Biographies

Christine Jie Li completed a Ph.D at the University of Florida and is currently an Assistant Professor at the University of Missouri. Her work on measuring and enhancing hopefulness was a key dimension of the instructional material described here. She earned her master's degree from the University of Minnesota-Duluth in 2012

Professor Martha C. Monroe completed a Ph.D at the University of Michigan (1991) and is currently a Professor and Extension Specialist at the University of Florida in the School of Forest Resources and Conservation. Her work explores strategies to enhance knowledge and skills to engage the public in sustainable practices

Tracey Ritchie received her Ph.D at the University of Florida in 2017. Her research focused on enhancing systems thinking skills in both teachers and students in the context of science education. Tracey also holds a master's degree in Environmental Education from Florida Atlantic University.

Inclusive Sustainability: Environmental Justice in Higher Education

Flora Lu, Rebecca Hernandez Rosser, Adriana Renteria, Nancy Kim, Elida Erickson, Anna Sher and Lisa O'Connor

Abstract

The aim of this paper is to demonstrate why and how efforts at UC Santa Cruz have begun to shift from sustainability as a technical, expert-oriented activity focused on aspects such as built environment, climate, energy, food and water, to

F. Lu (✉)
Department of Environmental Studies, University of California, 1156 High Street, Santa Cruz, CA 95064, USA
e-mail: floralu@ucsc.edu

R.H. Rosser
American Indian Resource Center, University of California, 1156 High Street, Santa Cruz, CA 95064, USA
e-mail: rrosser@ucsc.edu

A. Renteria
Ethnic Resource Centers, University of California, 1156 High Street, Santa Cruz, CA 95064, USA
e-mail: arenter1@ucsc.edu

N. Kim
Asian American/Pacific Islander Resource Center, University of California, 1156 High Street, Santa Cruz, CA 95064, USA
e-mail: nikim@ucsc.edu

E. Erickson
Sustainability Office, University of California, 1156 High Street, Santa Cruz, CA 95064, USA
e-mail: ekericks@ucsc.edu

A. Sher · L. O'Connor
Institutional Research, Assessment & Policy Studies, University of California, 1156 High Street, Santa Cruz, CA 95064, USA
e-mail: asher@ucsc.edu

L. O'Connor
e-mail: ljoconno@ucsc.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*, World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_4

more of a concern with *inclusive sustainability*, which centers on issues of power dynamics, difference, and ethical considerations. As the campus undergoes significant demographic change (e.g., UCSC's undergraduate population is 66% non-white and 43% are first generation college students), framings of sustainability must resonate with these increasingly diverse populations. The People of Color Sustainability Collective (PoCSC) is a groundbreaking partnership between UCSC's Ethnic Resource Centers, Colleges Nine and Ten, and Sustainability Office. PoCSC's efforts to recognize, celebrate, and validate diverse understandings and expressions of sustainability is a response to evidence of exclusion among certain sectors of our student population. Based on a recent campus-wide survey, this paper compares and contrasts responses between white, non-Hispanic students and students of color in terms of their participation in and perceptions about the environmental sustainability movement, finding that the former participate at a higher rate and rate mainstream environmental concerns such as conservation of biodiversity as more important, while environmental justice issues such as food access were rated more important to students of color. However, many areas of convergence between the two groups was found, notably a broad agreement about the importance of environmental issues.

Keywords

Inclusive sustainability · Diversity · Higher education · People of color sustainability collective · Race · Ethnicity · Environmentalism

1 Introduction

If the sustainability movement had an epicenter, it would arguably be California, a state that has "played an out-sized role over the last century" in promoting sustainability discourse and "embodying sustainability in the eyes of the world" (Greenberg 2013, p. 55). Perhaps no university campus exemplifies the concept of sustainability as the University of California at Santa Cruz (UCSC), recognized by the Environmental Protection Agency, *Forbes* Magazine, the Princeton Review, Sierra Club, and US News and World Report as being a "green" campus both literally (with its verdant 2,000-acre campus) and figuratively, from efforts on waste reduction (with a goal of zero waste by 2020), water conservation, on-campus cogeneration energy production, sustainable food production and sourcing, to having the first organic farm and garden program established on a university campus in the country. UCSC demonstrates ecological leadership on most of the typical areas associated with sustainability—built environment, climate, energy, food and water—joining a surge of green campus initiatives across the U.S. that seek to reduce carbon footprints, offer sustainability-themed degrees and programs, go local and organic, and build capital campaigns.

While such efforts are badly needed, the aim of this paper is to argue that such traditional framings of sustainability must be complemented by simultaneous efforts at *inclusive sustainability*, a concept elaborated below. Breen (2010) argues that campus sustainability movements and initiatives have narrowly defined sustainability in scientific terms and positivistic definitions. Such a definition sidesteps political analysis and is largely devoid of the deeper social contexts in which sustainability is embedded, locating efforts in marketing, operations, and individualist measures (e.g., ride a bike, eat local, use compact fluorescents) rather than "interdisciplinary green democratic education" or challenging structural inequities that promote environmental degradation. Sustainability is, as Scoones (2007, p. 589) puts it, a 'boundary term' in which "science meets politics, and politics meets science"; it is a complex term with divergent meanings that reflect "tensions and contradictions…in terms of inclusion and exclusion, of diversity and contestation, and the role of history and geography in shaping its divergent meanings" (Greenberg 2013, p. 57). When sustainability discourse centers predominantly as a technical, expert-oriented activity based on neutral empiricism, the resulting exchange of ideas can be stifled, lacking a robust grappling with issues of power dynamics, difference, and ethical considerations.

In her senior thesis advised by the first author, Pack (2014) undertook 20 semi-structured interviews in Spring 2013 and approximately 450 undergraduate surveys in Fall 2013; her study, despite its limitations, was the first investigating the intersection of race and sustainability at UCSC, and has catalyzed much conversation and subsequent efforts. Pack found that among students who were active environmentally, people of color tended to participate through initiatives with an environmental justice focus (although few such opportunities existed). The overwhelming majority participated in initiatives with a sustainability focus. Students Pack interviewed expressed that the campus environmental movement was "somewhat limited to issues and perspectives of privileged White people."

These provocative findings dovetailed with anecdotal evidence provided by students to staff (including some of the co-authors of this paper) that point to a potential incommensurability between the campus' stated dedication to ideals of environmentalism and diversity, and the way that students experience these ideals as actual practices. This paper presents some results from the first campus-wide survey at UCSC on environmental sustainability, which was conducted by the People of Color Sustainability Collective (PoCSC), a groundbreaking partnership between the UCSC Ethnic Resource Centers, Colleges Nine and Ten, and the Sustainability Office. It examines the degree to which students of diverse ethnic backgrounds participate in environmental efforts and the factors that influence such participation in sustainability programs. The paper compares and contrasts responses by students of color and White, non-Hispanic (WNH) students as to the importance of environmental issues to them, how important they perceive these issues to be to the institution, and the racial/ethnic composition of those who participate in sustainability. Finally, it describes a concept coined by PoCSC —"inclusive sustainability"— which entails the recognition, celebration, and validation of diverse understandings and expressions of sustainability. The paper asserts that environmental sustainability is as much processual, symbolic/cultural, and affective as material, challenging discourses which equate it solely with biophysical measurements, flows and outputs.

2 Background

In 2014, Directors of the Ethnic Resource Centers[1] (ERCs) organized a student panel with graduating seniors to hear about their experiences at UCSC and ascertain ways that the Resource Centers can better address their needs. One student shared an experience where she was throwing something away at the library and a white male student abruptly and harshly chastised her for not throwing the waste in the correct receptacle. This interaction, akin to a public shaming, caused the student to feel upset, embarrassed, angry, and even caused her to consider transferring to another school. Events such as these inspired the Resource Center Directors to create a social media campaign, #POCsustainability, to create a platform to recognize the contributions people of diverse cultures make to sustainability efforts and for students to share about their experiences and to connect with others with similar experiences.

In March 2015, the ERCs and student leaders behind #POC sustainability held a discussion for 30 participants, most them students of color, who shared their thoughts about the intersection of race, class and environmentalism. The discussion highlighted not just the widespread perception that WNH students and the relatively wealthy dominate the environmental movement on campus, but also how the environmental efforts of people of color and low-income folks (e.g., reusing, reducing consumption, repurposing, limiting waste, etc.) are discounted, considered strategies of just coping with poverty, and even considered “unhygienic.” Many efforts to be sustainable on campus are consumer-based and are financially out of reach for low-income students—some who reported being shamed by other students for what they eat and where they buy their food and other items. Students commented that in courses, definitions of the ‘environment’ were taken as given and sustainability was portrayed as apolitical, resulting in a lack of critical discussion.

Co-authors Lu and Erickson attended the discussion organized by ERC Directors Kim and Rosser, and ensuing conversations resulted in an unprecedented alliance between these units, bridging the Ethnic Resource Centers, the Sustainability Office, and Colleges Nine and Ten to form the People of Color Sustainability Collective in 2015. PoCSC is an interdisciplinary initiative dedicated to bridging the sustainability, diversity and social justice efforts on campus through a multifaceted approach that utilizes education and outreach, (curricular, co-curricular, and extracurricular) programming, cross-campus collaboration, and research. PoCSC seeks to showcase the sustainability accomplishments of communities of color and

[1]Asian-American/Pacific Islander Resource Center, Chicano Latino Resource Center (El Centro), American Indian Resource Center, and African American Resource and Cultural Center.

aims to redefine sustainability to include diverse cultural approaches. By creating spaces where students, staff, and faculty can have critical dialogues regarding race, class, ethnicity, gender, and sustainability, the Collective is working towards re-envisioning UCSC as a leader in both mainstream environmentalism and environmental justice. PoCSC thus seeks to forge a more *inclusive sustainability*, one based on nuanced and diverse socio-cultural and ecological understandings, and one that creates a space for a multiplicity of approaches to steward our planet.

Not only does PoCSC host events and programs on campus that raise awareness and create spaces for underrepresented voices in the environmental movement, the initiative also undertakes research to foster a critical dialogue between faculty, administrators and students; better inform programmatic design; and fill a gap in the scholarship about diversity and sustainability at college campuses. In Spring 2016, PoCSC worked with the Institutional Research, Assessment & Policy Studies (IRAPS) office to develop and implement a campus-wide survey to measure student participation in and perceptions of the campus sustainability movement. Given its focus on empowering undergraduates, PoCSC involved students in the development and outreach for the survey.

3 Methodology

In spring 2016, a census survey of the undergraduate campus community (n = 15,746) was conducted. Over the course of five weeks, all enrolled students were invited to take an online survey where they were asked to share their perceptions of and participation in the environmental sustainability movement on campus. The survey response rate was 21% (n = 3,266). UCSC's IRAPS office oversaw survey design, administration, and data analysis.

At the time of the survey, the undergraduate student population consisted of three fairly large groups: 30% Asian American, 31% Hispanic/Latino, and 34% White, non-Hispanic (WNH) students. African-American students constituted close to four percent, American Indian/Alaska Native students were one percent of the population, and Native Hawaiians/Other Pacific Islanders were under one percent (Fig. 1). Students of color made up two-thirds of the campus undergraduate population.

Survey respondents were representative of the student population in terms of race and ethnicity, first generation status, transfer status, and class level. As typical for student surveys, men participated at somewhat lower rates compared to women, and ethnic groups slightly varied in their gender composition. Weighted data was used for our analysis to ensure proper representation of the student population in terms of gender and ethnicity. In addition to the survey data, the analyses incorporated institutional data on students' demographic background (gender, race/ethnicity, first generation status) and academic path (major, college, class level, and transfer status).

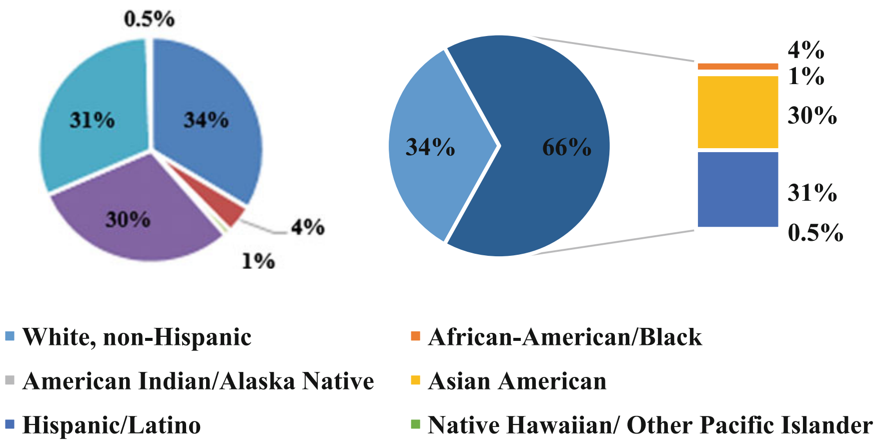


Fig. 1 Undergraduate population by race/ethnicity in Spring 2016

Student participation in the sustainability movement was measured based on self-reported participation in various specific organizations. Students could select more than one organization where they were a member and/or an event participant. If a student indicated being a member in at least one of the student organizations, programs or campus units, it was coded as an indicator of "membership" and a dichotomous variable was created differentiating members from non-members. If a student indicated being a member in some organizations and/or a participant in at least one of the organizations, this was coded as an indicator of "broad participation." This variable also had two categories to distinguish a participant and non-participant.

In the analyses of ethnic group differences, a dichotomous categorical variable: PoC vs WNH, or a trichotomous variable representing three large ethnic groups was used, shown on Fig. 1. Multivariate logistic regression, ANOVA and chi-square analyses were conducted. The survey results presented here are part of larger, ongoing research efforts using interviews and focus groups at UCSC to better understand these processes.

4 Results

Student participation in campus organizations and programs is shaped by institutional history and policies, compositional ethnic diversity, interpersonal relations, and personal beliefs and values. The paper presents results in five subsections, each addressing a research question:

1. Is there evidence of inclusive participation by students of diverse ethnic backgrounds in a multitude of organizations and programs on campus?

2. What are the factors that influence student participation in the environmental sustainability movement? The following background factors were considered: gender, race, first generation status; academic path: class level, transfer status, major, college affiliation; personal experiences: prior participation in high school, experience with environmental health issues and environmental threats; and importance of environmental issues.
3. How important is environmental sustainability to students as individuals? Do specific issues vary in importance between students of color and WNH students? What environmental issues do students perceive as university priorities, and how do these overlap with their own?
4. What is the impact of student participation in programs on their learning about sustainability?
5. Are there differences in students' perception of ethnic diversity in student organizations?

4.1 *Student Participation in Organizations and Programs*

Student participation in the environmental sustainability movement on campus was measured based on student responses about either having been an active member in organizations and programs, or having participated in campus events and programs. Overall student participation was very high; about 50% of students participated in at least one program, event or organization. It was found that 54% of WNH students participated overall in environmental sustainability efforts compared to 49% of students of color, a statistically significant difference. Table 1 shows the breakdown by different racial/ethnic groups. Relatively fewer students (11%) were members of campus programs and organizations. Students of color were not any more or less likely than WNH students to serve as members of these programs. The similarity of ethnic composition of members and participants to the student population is shown in Chart 2 (Fig. 2).

Specific organizations in six main categories were clustered based on their focus and type: (1) student-led organizations, (2) staff-run campus units, (3) education programs, (4) media projects, (5) food-centered programs, (6) garden projects, and (7) recreation trips by OPERS. As shown in Table 2, student participation varied by focus and type, and some variation in participation (3–6%) based on ethnicity.

About the same proportion of students reported having been active in environmental sustainability before and during their college experience. While in high school, 46% of students of color and 49% of WNH students participated in environmental sustainability related organizations and programs. When asked why they participate in environmental sustainability programs at UCSC and what is most valuable about that participation, students cited learning about sustainability; giving back and making a difference; and meeting new people and networking.

Table 1 Rates of participation by ethnic group and for international students (N of respondents in parentheses)

	All domestic (%)	Domestic students						
		African American/Black (n = 111) (%)	American Indian/Alaskan Native (n = 29) (%)	Asian American (n = 896) (%)	Hispanic/Latino (n = 961) (%)	Pacific Islander (n = 18) (%)	WNH (n = 1,071) (%)	International students (n = 123) (%)
Broad Participation	51	57	64	47	51	63	54	43
Membership	11	8	6	11	12	15	13	12

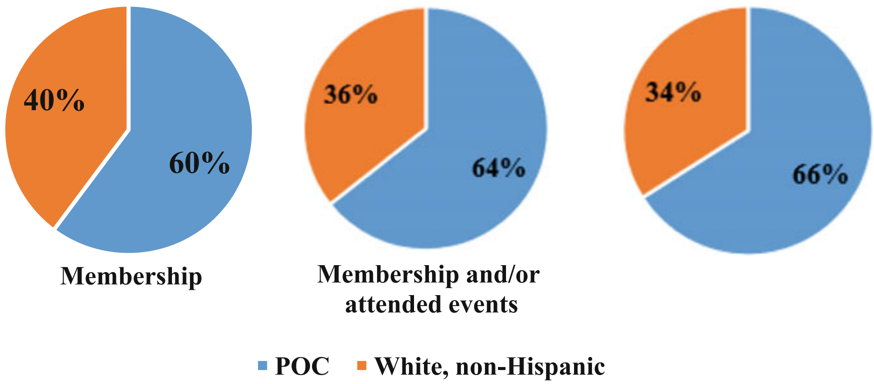


Fig. 2 Membership, Broad Participation, and Student Population by Race/Ethnicity

4.2 *Factors Associated with Student Participation*

In order to identify key factors associated with student participation in the environmental sustainability movement on campus, logistic regression modeling was used to examine the following: (1) factors associated with current participation in student organizations (as measured by membership or attendance of an event), and (2) current membership in environmental sustainability-related programs (Table 3).

The first model examined factors associated with broad participation (member and/or participant in a sustainability organization), and found that ethnicity and first generation status were not significant predictors (Table 4).

Within the three large racial/ethnic subpopulations (Asian American, Hispanic/Latino, and WNH students) and taking into account students' first generation status, the following significant predictors were found:

Table 2 Rates of Broad Participation (attended or members), by Program Type and Ethnicity

	Campus (%)	Students of Color (%)	WNH (%)
Overall participation*	51	49	54
Participation by Program Type			
Gardens*	36	34	40
Student organizations	25	26	24
Staff-run campus units (Sustainability office, PoCSC, Common ground)	17	19	15
Food programs	20	19	22
OPERS recreation trips	16	15	18
Education programs	10	10	10
Media*	9	10	7
CA Student Sustainability Coalition	6	6	4

* statistically significant differences at $p < 0.05$

Table 3 Variables in Logistic Regression Modeling

Variable	Description	Variable Levels
PREDICTORS		
Prior_Engmnt	Engagement in environment sustainability-related activities in High School	1 = Membership or attendance in HS 0 = No prior membership or attendance in HS
Community_Health	Environmental health threats impacted home community	1 = Impacted home community 0 = Did not impact
Personal_Health	Environmentally-caused health problems in self or family	1 = Student or someone in immediate family suffers from environmentally-caused health problems 0 = Neither student nor family members suffer from environmentally-caused health problems
Concerns	Average concern across 5 topics: Environmental Health, Agroecology, Conservation and Protection of Biodiversity, Access to Healthy Food, and Environmental Justice	4 = Very concerned 3 = Concerned 2 = Somewhat concerned 1 = Not concerned
Env_College	Affiliated with an environmentally-focused college (Rachel Carson College)	1 = Environmentally-focused college 0 = Other college
Major_ENVS	Environmental Studies major or other	1 = Environmental Studies major 0 = Other major
Senior	Time at UCSC	1 = Senior 0 = Frosh, Sophomore, or Junior
CONTROL VARIABLES		
AsianAmerican	Race/Ethnicity (Asian American)	1 = Not Asian American 0 = Asian American
HispanicLatino	Race/Ethnicity (Hispanic/Latino)	1 = Not Hispanic/Latino 0 = Hispanic/Latino
Gender	Gender	1 = Women 0 = Men
First_Gen	1st generation status	1 = Not 1st generation 0 = 1st generation
Transfer	Transfer status	1 = Started as freshman 0 = Transfer student
OUTCOMES		
ORG_Part	**Broad participation (attendance or membership)**	1 = Attended or was a member of environmental sustainability-related programs or organizations 0 = Did not participate
ORG_Member	**Membership**	1 = Was a member of environmental sustainability-related programs or organizations 0 = Was not a member

Table 4 Predictors of broad participation

	β	S.E.	Sig.	Exp(β)
Prior_Engmnt**	0.739	0.098	0.000	2.095
Community_Health*	0.282	0.132	0.033	1.326
Personal_Health*	0.235	0.097	0.015	1.264
Concerns**	0.558	0.077	0.000	1.747
Env_College**	0.559	0.152	0.000	1.750
Major_ENVS**	1.656	0.324	0.000	5.236
Senior**	0.627	0.112	0.000	1.871
AsianAmerican	0.195	0.120	0.103	1.216
HispanicLatino	0.133	0.127	0.295	1.143
Gender**	0.470	0.097	0.000	1.599
First_Gen	0.171	0.106	0.106	1.187
Transfer**	0.736	0.140	0.000	2.088
Constant	−3.704	0.330	0.000	0.025

- Environmental Studies majors were 5.2 times more likely to participate compared to all other students.
- Students who attended Rachel Carson College, a residential college focused on environmental sustainability, also were 1.8 times more likely to participate than students affiliated with other colleges.
- Seniors were about 2 times more likely to participate than other students.
- Transfer students were about 2 times more likely to participate than students who started as freshmen at UCSC.
- Students from communities impacted by environmental health issues were 1.3 times more likely to participate than their peers who were not impacted. Additionally, students who experienced personal and/or had immediate family who had experienced environmental health issues, were 1.3 times more likely to participate.
- Students who participated in programs or organizations in high school were twice as likely to continue participating once attending UCSC.
- Women were 1.6 times more likely to participate in organizations/events, which is congruent with previous studies (e.g., Zelezny 2000).
- Students who are very concerned with environmental sustainability issues are also 1.7 times more likely to participate.

Similarly, ethnicity and first generation status were not significant predictors of membership (Table 5). Taking into account multiple factors, the same significant factors were found to be important as in the broad participation model.

4.3 *Importance of Environmental Sustainability to Students and to Campus*

Students evaluated the overall importance and specific topics related to environmental sustainability and sustainable infrastructure issues and distinguished

Table 5 Predictors of Membership

	β	S.E.	Sig.	Exp(β)
Prior_Engmnt**	0.584	0.124	0.000	1.792
Concerns**	0.614	0.108	0.000	1.848
Env_College**	0.464	0.161	0.004	1.590
Major_ENVS**	1.849	0.192	0.000	6.352
Senior**	0.602	0.129	0.000	1.826
AsianAmerican	0.268	0.158	0.089	1.308
HispanicLatino	0.120	0.155	0.440	1.127
Gender*	0.267	0.124	0.031	1.306
First_Gen	0.049	0.135	0.715	1.051
Transfer*	0.346	0.174	0.047	1.413
Constant	−5.265	0.429	0.000	0.005

Table 6 Importance of five environmental sustainability topics (% of "important" or "very important")

	All UCSC students		
	To Me (%)	To UCSC (%)	Difference (%)
Environmental sustainability	**94**	**94%**	**0**
Access to healthy, affordable, and culturally appropriate **food**	84	81	-3
Conservation of natural resources and **protection** of biodiversity and habitats	81	88	+7
Environmental health (including asthma, cancer, toxic exposures, chemical exposures in the workplace, access to clean water)	79	83	+4
Environmental justice (including rights of American Indians/Indigenous People, equitable distribution of land and resources, equitable environmental policy making)	73	75	+2
Agroecology	59	79	+20

between their own priorities and those of the campus. Overall, the vast majority (94–96%) of all students considered environmental sustainability to be important, both to themselves and to the campus (Table 6). In other words, there was no gap in students placing high importance on environmental sustainability and their perception of high importance of this issue to the campus as a whole. Students of color and WNH students found environmental sustainability similarly important to themselves and to the campus.

The overlap between students' concerns and their perceptions of campus priorities was further explored. Of the students who rated each of the environmental sustainability topics as "important" or "very important," the vast majority (82 to 97%) reported that the campus *also* found these issues "important" or "very

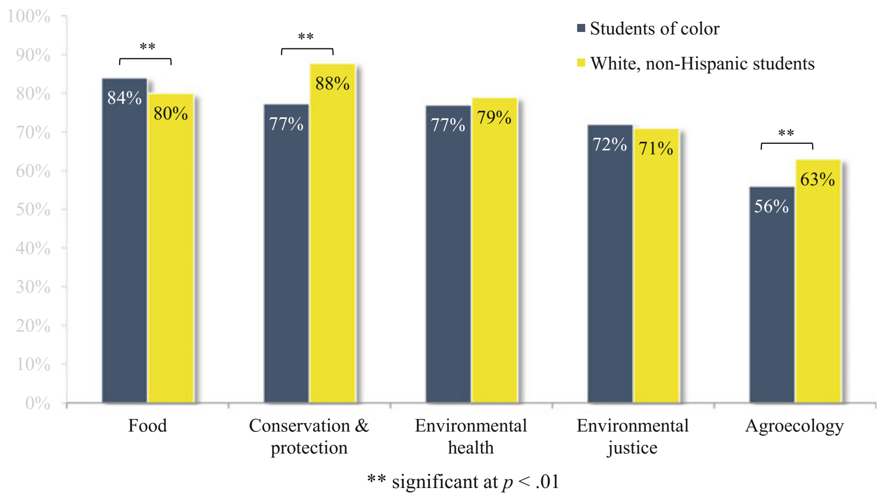


Fig. 3 Percentage of Students who Rated Environmental Sustainability Issues as "Important"/ "Very Important" to them, by Ethnicity

important," suggesting that nearly all students who are concerned about environmental sustainability reported that campus priorities align with their own.

Students valued some topics more than others. Of the five environmental sustainability topics, the top three topics were "access to healthy food," "conservation and protection of biodiversity," and "environmental health" for both personal and campus-wide importance. Agroecology, was relatively less important to students, but the majority of them reported it to be important to the campus.

Perceptions of three of the five environmental sustainability issues differed between students of color and WNH students (Fig. 3). Specifically, "conservation and protection of biodiversity," and "agroecology" were rated as important/very important by more WNH students, while more students of color rated "access to healthy food" as important/very important. Environmental health and environmental justice were similarly important to students in both groups.

Perceptions of campus importance of "environmental health" and "environmental justice" differed between students of color and WNH students (see Fig. 4). These topics were rated 4–7% higher in importance to the campus by students of color than WNH students.

Students considered sustainable infrastructure to be a key concern: at least 70% of all students rated renewable energy, green building design, sustainable transportation, waste reduction and prevention, and sustainable water use as "important/very important" to themselves or to UCSC (Table 7). Of the five issues presented on the survey, students rated sustainable water use, waste reduction and prevention, and renewable energy as the most important to both themselves and to the campus.

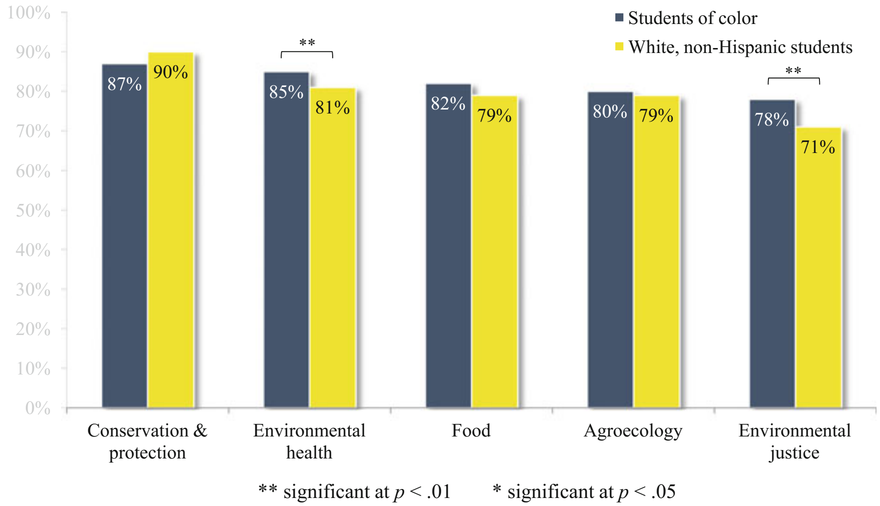


Fig. 4 Percentage of Students who Rated Environmental Sustainability Issues as "Important"/"Very Important" to Campus, by Ethnicity

Table 7 Students'ratings of the importance of sustainable infrastructure issues to themselves and to UCSC

	All UCSC students		Students of color		WNH students	
	To Me (%)	To UCSC (%)	To Me (%)	To UCSC (%)	To Me (%)	To UCSC (%)
Sustainable water use	90	92	89	93	91	91
Waste reduction and prevention	85	91	85	92	86	90
Renewable energy	85	84	83	85	90	83
Sustainable transportation	83	79	81	82	87	73
Green building design	71	77	67	78	77	75

4.4 *Impact of Student Participation in Programs and Events on Learning About Sustainability*

Given that students seek opportunities to learn about environmental sustainability, they were asked to what extent they learned about various issues through participation in campus organizations, clubs and programs. Table 8 shows percentage of respondents who heard about these issues "often" or "sometimes" as opposed to "seldom" or "never" (not shown).

Table 8 Impact of Participation in Organizations on Student Learning by Ethnicity

Through your participation in campus organizations, clubs, and programs on the environment and sustainability, to what extent have you learned about the following issues:	Total campus (%)	Students of color (%)	WNH (%)
	Percent "often" or "sometimes"		
Race and class-based inequalities in the USA	71	71	71
Race and class-based inequalities globally	66	66	65
American Indian/Indigenous peoples'views on environment and sustainability	41	40	40
Non-industrialized countries'views on environment and sustainability	38	38	38
Biodiversity (ecology, restoration, protected areas, conservation, etc.)	64	6	68*
Impact on human life (health, food, housing, etc.)	73	73	72

* Statistically significant at p <0 .01 level

Students of color and WNH students were almost identical in terms of responses for all categories except "Biodiversity," where WNH students were statistically more likely than students of color to report learning about issues of conservation and ecology "often" or "sometimes" through their participation in campus organizations.

Two topics, about American Indian/Indigenous people's views and about non-industrialized countries' views around issues of environmental sustainability were reported as relatively less frequently discusses compared to other topics.

4.5 *Students'Perceptions of Ethnic Diversity in Student Participation*

Students reported their perceptions of who participated in environmental sustainability-related activities at UCSC. Specifically, students agreed or disagreed with two statements: "Students of my (racial) ethnic background participate in environmental sustainability-related activities at UCSC" and "Students of all (racial) ethnic backgrounds participate in environmental sustainability-related activities at UCSC."

The majority of students agreed that students of their own (80%) and all (76%) racial/ethnic backgrounds participate in these environmental sustainability-related activities, consistent with our findings based on the aggregate analysis of self-reported participation. Students of color and WNH students differed in their level of agreement (Table 9).

Table 9 Percentage who Agree/Strongly Agree with Statements about Student Participation in Environmental Sustainability-Related Activities, by Ethnicity

	Students of Color (%)		WNH Students (%)	
	"My"	"All"	"My"	"All"
Students of _____ ethnic backgrounds participate in environmental sustainability-related activities at UCSC	74	74	92	81
Students of _____ social (class) backgrounds participate in environmental sustainability-related activities at UCSC	78	69	90	77

5 Analysis

UCSC is a hub of environmental activity: half of UCSC students participated in environmental sustainability programs and/or were members of environmental organizations. WNH participated at a slightly higher rate compared to Asian American and Hispanic/Latino students by 3–7%, and no significant ethnic group difference was found in the rates of membership. While one's ethnicity was not a predictor of participation in the environmental movement on campus, one of the strongest predictors was majoring in Environmental Studies (5.2 times more likely to participate in sustainability programs or organizations, and 6.3 times more likely to be a member of a sustainability organization). It is noteworthy that WNH students constituted 33% of undergraduates and 51% of Environmental Studies majors (the largest of such disparities among Social Sciences majors). Prior engagement with sustainability efforts before college, being concerned about environmental issues, attending a residential college with an environmental theme, being a transfer student or senior, being female, and also having experienced community health concerns were also significant predictors of student involvement in sustainability efforts.

When asked for their perceptions of which racial/ethnic and socioeconomic groups participate in environmental sustainability related activities on campus, 92% and 90% of WNH students stated that peers of their ethnic background and class background, respectively, do. This is much higher than the response of PoC (about 74–78%). It was found that 19% of WNH students and 26% of students of color disagreed that "students of all ethnic backgrounds participate in environmental sustainability related activities at UCSC," a statistically significant difference. Given that only half of students participate across ethnic groups, these results may be indicative of students' shared agreement that student participation campus-wide, across ethnic groups could further increase.

The vast majority of students, participants and non-participants, strongly expressed the importance of environmental and environmental justice issues. There were differences between the groups in terms of specific issues: mainstream environmental concerns such as conservation of biodiversity were rated more important to WNH students (and these students report learning more about such issues), while environmental justice issues such as food access were rated more important to PoC. Overall, the results resoundingly attest to how PoC and WNH students at UCSC feel that environmental sustainability issues are important, both to them personally and to the institution.

Our survey results point to the need for more curricular/co-curricular programming to further learning about Indigenous peoples' and non-industrialized countries' views about environmental sustainability, expanding the range of perspectives conveyed. This is a central mission of PoCSC: to expand exposure to environmental epistemologies beyond those which are traditionally privileged.

6 Conclusion

As one of our students remarked, "There needs to be greater inclusion in the overall environmental movement and that starts with groups in universities." An institution like UCSC, renowned for its commitment to being "green," clearly can model what an *inclusive* sustainability could look like. The campus' commitment to and support of sustainability efforts to reduce energy use, conserve water, generate less waste and reduce its carbon footprint are vital, but also need to be expanded beyond these biophysical considerations and include processual, symbolic, and affective elements of sustainability in equal measure.

Sustainability is not reducible to an outcome, a measurable end point like a LEED certified building or the achievement of zero waste. It is a social and political process and a set of relationships that recognize that understandings of sustainability are embedded in historically and culturally specific contexts that reflect privilege and marginalization, cooptation and dispossession. From the erasure of local peoples from protected areas to the appropriation and distortion of native peoples' beliefs and practices, environmental sustainability has had a legacy entangled with social injustice (Holt 2005; Dowie 2009; Finney 2014). Judgements of whether others, namely low-income PoC, are knowledgeable and supportive of sustainability thus need to recognize that such normative litmus tests can be exercises of power and domination for political ends. Inclusivity occurs when diverse socio-cultural approaches and lived experiences of impacted communities are not just included, but are also given the same level of respect as scholars and scientists, thus challenging epistemological hierarchies and notions of expertise.

The current, predominant approach that is based on making these diverse members of our student body aware about sustainability (as an institutionalized concept) must be complemented by efforts that ascertain, validate, and incorporate the manifold ways that students experience and engage with the concept of sustainability. Paying attention to their socio-cultural and economic positionality, including race, ethnicity, class, and gender, helps us to better understand what sustainability activities students undertake, what patterns emerge, and why. Our experiences highlight that these issues are closely linked to student success and retention, matters of great concern to universities.

Acknowledgements The authors gratefully acknowledge the support of Executive Vice Chancellor Alison Galloway, Dean of Students Alma Sifuentes, the Dreaming Fund of the Community Foundation of Greater Birmingham, the Student Fee Advisory Committee, Carbon Fund Grant, Campus Sustainability Plan Grant, Office of Diversity, Equity and Inclusion, CARE, and Measure 43. A special thank you to Vice Chancellor of Business and Administrative Services Sarah Latham for her leadership, collaboration, and dedication to this initiative. Deep appreciation goes to El Centro Director Judith ("Dr. J") Estrada, AARCC Director Shonté Thomas, and ERC staff and student interns, especially Catherine Alfaro, Ashley Carrillo, Jenn Figueroa, Cristal Gonzalez, Raymond LeBeau, Julisa Lopez, and Aniela Quintanilla. The authors thank graduate student researcher in IRAPS Priscilla Sung for analytical support.

References

Breen, S. D. (2010). The mixed political blessing of campus sustainability. *Political Science and Politics, 43*(4), 685–690.

Dowie, M. (2009). *Conservation refugees: The hundred-year conflict between global conservation and Native Peoples*. Cambridge: The MIT Press.

Greenberg, M. (2013). What on earth is sustainable? Toward critical sustainability studies. *Boom: A Journal of California, 3*(4), 54–66.

Finney, C. (2014). *Black faces, white spaces: reimagining the relationship of African Americans to the great outdoors*. Chapel Hill: University of North Carolina Press.

Holt, F. L. (2005). The Catch-22 of Conservation: Indigenous Peoples. *Biologists and Culture Change. Human Ecology, 33*(2), 199–215.

Pack C. M. (2014) Privileged perspectives or diverse discourse? Disparities in student perceptions of and participation in the environmental movement at UCSC. Senior thesis, Department of Environmental Studies, UC Santa Cruz, Santa Cruz.

Scoones, I. (2007). Sustainability. *Development in Practice, 17*(4/5), 589–596.

Zelenzy, L. C., Chua, P., & Aldrich, C. (2000). Elaborating on Gender Differences in Environmentalism. *Journal of Social Issues, 56*(3), 443–457.

Author Biographies

Professor Flora Lu holds a A.B. in Human Biology from Stanford University and a Ph.D. in Ecology from the University of North Carolina at Chapel Hill. She is a Professor of Environmental Studies at UCSC and Provost of Colleges Nine and Ten. An ecological anthropologist, she is interested in human/environment dynamics in tropical rainforests, the political economy of oil extraction, resource governance, and environmental justice. She has published four books and three dozen publications in journals such as *Human Ecology*, *Conservation Biology*, *Current Anthropology*, *Human Organization*, and the *Journal of Ecological Anthropology.*

Dr. Rebecca H. Rosser (Mexican American and Mescalero/Warm Springs Apache) is Director of the UCSC American Indian Resource Center. She earned an MFA in Exhibition Design and Museum Studies at CSU Fullerton, an M.A. in American Indian Studies from UCLA and her Ph. D. in American Studies from the University of New Mexico. Her current work focuses on raising awareness about the experiences of Native American students in the university setting, with particular attention to the stereotypical expectations surrounding Native identity. She has worked in a variety of institutions including the Southwest Museum in Los Angeles, the Pueblo Cultural Center, UCLA American Indian Studies Center and the Center for Southwest Research.

Adriana Renteria received her B.A. in Environmental Studies and Economics from UC Santa Cruz in 2015. Adriana is a first generation queer Chicana who grew up in Merced, California. As a UCSC student, she was involved with several student organizations and clubs including Hermanas Unidas, IDEASS, Education for a Sustainable Living Program, Student Environmental Center, and the American Indian Resource Center. As the Program Coordinator for the People of Color Sustainability Collective, Adriana dedicated herself to creating an inclusive campus sustainability community for all students at her alma mater. She is passionate about environmental justice and the honoring of cultural knowledge, experiences, and traditions.

Nancy I. Kim is Managing Director of UCSC Resource Centers and Director of the Asian American/Pacific Islander Resource Center. She received her M.A. in Asian American Studies from UCLA and taught courses at UCLA, CSU Northridge, and Scripps College. Her research interests include Asian American feminist pedagogy and coalition building between communities of color.

Elida Erickson is Director of the Sustainability Office at UCSC and received her M.S. in Higher Education and Student Affairs Administration from Indiana University (2004). She joined the University of California, Santa Cruz campus in 2005, and the Sustainability Office in 2011. She has collaborated with the local community, students, faculty and staff to support the goal of Zero Waste by 2020, as well as reduce campus water usage by 25% in response to the California statewide drought in 2014–2015. As a strong advocate for student engagement and empowerment in campus sustainability, Elida is also passionate about examining Whiteness within the environmental movement and challenging the movement to explore diverse cultural interpretations of sustainability.

Dr. Anna Sher received her Ph.D. in Sociology from Stony Brook University. She is the Director for Assessment & Survey Research at the UCSC Institutional Research, Assessment, and Policy Studies office. Since 2009, she has led campus-wide survey projects to assess campus climate for diversity and inclusion for the Chancellor’s Diversity Advisory Council. She has been working with faculty and staff in student support units to develop and measure student learning outcomes and experiences, and to use this evidence to ensure equity and inclusion through program improvement.

Lisa O’Connor received her M.P.H. from San Diego State University. She joined the UCSC Institutional Research, Assessment, and Policy Studies office in 2015 as Survey Analyst. She brings over a decade’s worth of experience in social science research, specifically in public health and education initiatives. She enjoys using data to help inform and improve policy change and practice. Prior to working at UCSC, she managed research initiatives that worked directly with culturally and economically diverse students and their parents, teachers and administrators. Her previous work experience includes program planning, management, and evaluation in the areas of adolescent health, substance use prevention and treatment, and access to education.

Connective Methodologies: Visual Communication Design and Sustainability in Higher Education

Denielle Emans and Kelly M. Murdoch-Kitt

Abstract

By employing an expanded view of 21st-century communication design as a starting point for research, this paper aims to share with a multidisciplinary audience a brief overview of design research methodologies and intersections with sustainability. The researchers trace this evolution from the 1960 s to present, wherein higher education classrooms frequently integrate ecological and social dimensions into teaching and learning. The literature reveals how design research has developed distinct approaches to working *for* and *with* communities to fuel creative action. The researchers utilize grounded theory to review results from a series of initial interviews and survey data collected from a purposive sample of design professionals in the United States, along with an analysis of a range of texts in the intersecting realms of design, education, and sustainability. Professional respondents cite evolving trends in global business interactions, communications, and problem-solving as indicators that higher education should

This study has evolved from ongoing research by two graphic design faculty: Denielle Emans and Kelly M. Murdoch-Kitt (respectively teaching at VCUQatar in Doha, Qatar and Rochester Institute of Technology, in Rochester, New York, when this chapter was written; Kelly now teaches in the Penny W. Stamps School of Art & Design at University of Michigan). Building off their prior research in Intercultural Design Collaborations (IDC), these two educators examine university-level design partnerships involving team-based projects and virtual communication in order to advance sustainable design.

D. Emans (✉)
Graphic Design Department, Virginia Commonwealth University in Qatar, Ar-Rayyan, Qatar
e-mail: djemans@vcu.edu

D. Emans
Centre for Communication and Social Change, University of Queensland, Brisbane, Australia

K.M. Murdoch-Kitt
Penny W. Stamps School of Art & Design, University of Michigan, Ann Arbor, MI, USA

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_5

prepare design students to tackle complex sustainability challenges. This paper concludes with a discussion of the importance of integrating intercultural collaboration into higher education curricula to help students realize the intricacies involved in environmental health and cultural vitality.

Keywords
Visual communication design · Sustainability · Intercultural collaboration Design research

1 Introduction: Communication Design and Sustainability

A unique and fundamentally interdisciplinary field of inquiry, communication design represents a network of disciplines focused upon the analysis and production of the visually constructed world. Though design certainly involves aspects of the sciences and humanities, it is distinctly a "third culture" (Cross 2001). Communication design involves the organization of visual elements to convey a message, idea, or information to a given audience (Landa 2011). Beyond the communication of a client's message or commercial endeavor, however, designers of visual communication employ a range of strategies to increase public awareness, motivate behavior change, and persuade audiences to take action (Medley and Kueh 2015; Frascara 1998).

Contemporary environmental and social challenges have expanded the discipline of design to include the need to modify, reinforce, and facilitate sustainability—the relative resiliency of humans, our constructed sociocultural systems, and our habitat. Some designers have gone so far as to focus their efforts solely on design for a sustainable future (McDonough and Braungart 2002, 2013; Papanek 1995, 1971). McDonough and Braungart, for instance, make an urgent call for an optimistic and positive outlook toward harnessing the creativity and ingenuity of designers to address sustainability challenges in "The Upcycle: Beyond Sustainability — Designing for Abundance" (2013). The diversification of the communication design discipline is further evidenced in the growing body of literature devoted to designers' new roles in social and behavioral contexts (Resnick 2016; Shea 2012; Simmons 2011; Faude-Luke 2009; Fry 2009).

Academics in communication design routinely draw on intellectual cultures outside of design to advance research in social change and climate resilience (Gibson and Owens 2015; Davis 2012; Frascara 1998). Ball and Gilligan (2010) highlight opportunities for social scientists to use visual technologies and visual culture to inform their research, while also citing the work of visual artists who use social sciences to inform their socially engaged practice. The user-centered and visualization methods employed by designers to explore sustainability, on the other hand, remain largely at the periphery of the social sciences. Different disciplinary origins or default academic "silos" in the humanities may explain the missing link.

Findings presented at interdisciplinary conferences on sustainability education typically focus on the outcomes of empirical scientific research that resolves evidence-based environmental problems with technical, biological or theoretical solutions (Just Sustainability Conference 2014; AASHE 2016). Reviewing sources such as AASHE also reveals an abundance of education resources available across a variety of social and physical science curricula, but few examples incorporate the processes or outcomes of design with sustainability. Rarely is the potential for behavior change and information dissemination raised through the lens of communication design to reshape our global trends toward over-consumption and ecological destruction.

In an effort to introduce design research methodologies to a multidisciplinary audience, this paper examines the opportunities between communication design and sustainability in higher education. This is important because, while many disciplines focus on scientific, technological and social impacts on issues of sustainability, the design discipline examines the role of human behavior, but also proposes and creates opportunities to change behaviors through creative action. The findings of this study are transferable to many disciplines beyond communication design and emphasize the importance of ongoing exchange between designers and social scientists.

2 Design and Social Science Methodologies

2.1 The Evolution of Design Research

In the past half-century, design, sustainability, and social science methodologies have become deeply intertwined. As early as the 1960s, designers began to integrate interdisciplinary endeavors and research methods to prescribe systematic procedures for arriving at design solutions (Frankel and Racine 2010; Cross 2001). A few of the leading figures in this early period of design research were John Chris Jones, Bruce Archer, and Horst Rittel. Victor Margolin outlines the importance of these individuals to the origin of the design methods movement by summarizing their contributions in his paper "Design Research: Towards a History" (2010).

In 1970, John Chris Jones published the first edition of "Design Methods: Seeds of Human Futures" where he adapted a number of methods from the social sciences, but also proposed designers account for community and transparency as critical components of the discipline. A few years later, Bruce Archer helped found the Design Research Society (DRS), an organization focused on the distinguishing features of design methodologies and knowledge (Margolin 2010). An important aspect of Archer's contribution was his paper "Design: Science: Method" (1981) in which he noted cultural studies as a valuable component of design research in the appendix to the article.

Rittel and Webber introduced the notion of "wicked" problems to designers in 1973; these problems cannot be completely described or solved in traditional linear methods. Buchanan expanded upon this work in his 1992 paper, “Wicked Problems in Design Thinking.” These authors all assert that the inherent complexity and “fundamental indeterminacy” of social problems makes “definitive and objective” solutions impossible. In the complex environments of a pluralistic society, there is a perception that “there is no objective definition of equity or public good; policies that respond to social problems cannot be meaningfully correct or false…” (Rittel and Webber 1973).

By the early 1980s, social scientists began to serve the processes of communication design firms by working with consumers to evaluate their needs and desires, often through observation and interviews (Sanders and Stappers 2014; Sanders 1999). The methodologies of social scientists provided frameworks to help designers understand people’s ideas and later synthesize these findings into design opportunities (Sanders 2002). During the same timeframe, market research experts helped demonstrate the profitability of a designed product from the perspective of demographic analyses (Sanders and Stappers 2014). Designers also began experimenting with ethnographic methods to systematically study individuals and groups to create design solutions for specific groups of people.

A few years later, Donald A. Schön (1991) called for ‘professionals’ to make conscious attempts to become more reflective about their working processes. The notion of reflective practice was meaningful for designers who were gaining a sense of increased involvement in their research and practice. Around the same period, Victor Papanek advocated for reality-based aesthetics and environmentally conscious design processes as part of ‘natural design’ (1995). A longtime advocate of ecologically and socially responsible design, Papanek’s philosophies gained widespread popularity with the release of his seminal book, “Design for the Real World: Human Ecology and Social Change” (1971).

Following the work of Schön, Nigel Cross (2001) espoused how designers cultivate novel ways of thinking, and should not sacrifice these ways of knowing for imported methodologies from the sciences or the arts. Cross wanted to elevate the rigor of design to the level of other disciplines and create a unique “intellectual culture, acceptable and defensible in the world on its own terms” (2001). In the article “The Designer as Producer,” Ellen Lupton also encouraged graphic designers to take control of the “content and social function of their work” by sharing control of production with the public but also, empowering people to “become producers as well as consumers of meaning” (2012). This notion of production, rather than authorship alone, signals an important distinction for design researchers to *construct* content and meaning.

In the 21st century, designers have embraced discrete approaches to research, rather than exclusively borrowing methodologies from disciplines outside of design. For design researchers like Sanders and Stappers, design research is more integrated than ever before “especially in the newer domains of practice such as systems, service, and social design” (2014). One distinguishing factor regarding the research methodologies of designers, however, is the need for research to eventually fuel or inform a productive, tangible (as opposed to theoretical) output. This *creative action* may result in a system, a set of experiences, or even a new round of procedures and protocols. Saikaly describes this practice-based approach to design research and inquiry as a “designerly mode of inquiry” (2005), while Peter Lloyd describes it as “active engagement in shaping future forms by suggestion, prototype, speculation, practice, and intervention” (2017).

2.2 Human-Centered, User-Centered, and Co-Design Methods

Design research is an inclusive field of inquiry that critically and productively links together many disciplines, technologies, and audiences to generate design knowledge and processes. A critical mass of theoretical concepts and debate indicate a growing maturity in the discipline of design, from discursive and analytical aspects, to anthropological and speculative (Lloyd 2017). As part of design research, the active construction of future forms is often described by terms that incorporate social science methodologies, but also distinct creative approaches (IDEO 2016; Tassi 2009; Jordan 2002). The following section provides a brief introduction to some of the methods that inform human-centered design, user-experience design, and participatory design (Fig. 1). While certainly not all-encompassing, the aim is to provide a multidisciplinary audience with a brief introduction to the strategies designers might employ to create higher orders of design—such as service design—which encompass consideration of nested systems and the ability to approach intractable problems.

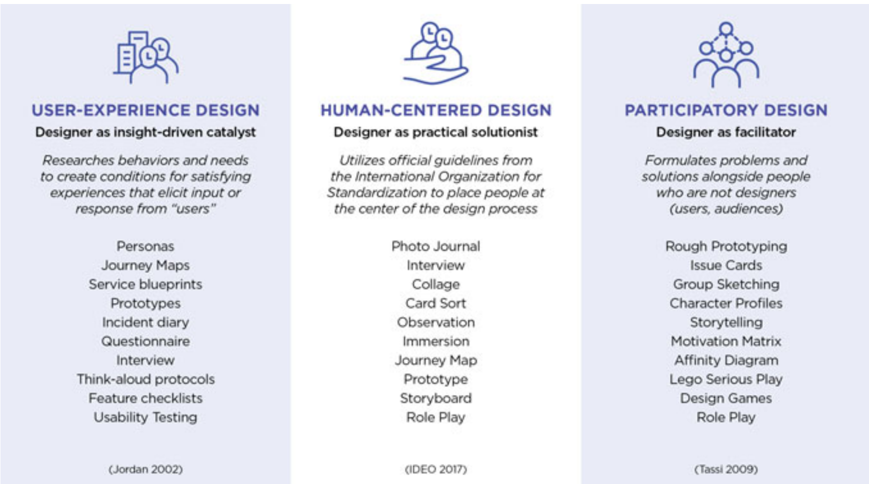


Fig. 1 A brief comparison of some of the methodologies involved in user experience, human-centered and participatory design. Note that many of the activities listed are context-dependent and interchangeable across these domains

2.2.1 User Experience Design

Visual, interactive and product designers use social sciences to evaluate human needs and behaviors with the goals of communicating, educating, and improving quality of life. Those involved in User Experience and Human Factors may even describe their practice as a social science. The relationship between users (people) and products (designed objects, interfaces, etc.) inherently relies upon the integration of social sciences. For instance, Klemmer, Hartmann, and Takayama discuss the role of "bodily activity"—in this case, people's interaction with user-centered designs—"as being essential to understanding human cognition" (2006). They emphasize that this understanding of cognition is critical to creating interactive experiences. Synthesized qualitative data, gathered from people who might end up using the final design ("users"), informs the creation of prototypes (rapidly created interim representations of a design concept). Referred to as "user-centered" design, this kind of technique is explained by Jordan (2002) as the following:

> …a usability-based approach to user-centered design is one which sees the product as a tool with which users try to accomplish particular tasks without wanting to have to expend unnecessary effort or endure any physical or mental discomfort. This definition has received wide acceptance as a basis for much of the human factors work carried out in industry.

User-centered strategies also rely upon a number of methods that have roots in the social sciences, but a critical aspect of this type of process is the use of evaluation. According to Jordan (2002), "… a battery of methodologies for evaluating usability has been established. The majority of these were originally developed in psychology and have been adapted specially for the evaluation of product usability." Designers conduct usability testing as a means to inform the development of viable prototypes, deliver formal presentations relevant to the iterative development of their design work, and evaluate the design work of their peers (designers tend to collect feedback through dialogic 'critique'). Some typical examples of these methods include "focus groups, incident diaries, questionnaires, interviews, think-aloud protocols, feature checklists and experiments" (Jordan 2002).

2.2.2 Human-Centered Design

Human-centered design supports numerous research methods and synthesis/analysis techniques to understand, empathize, and have conversations with people who will ultimately use designed services, systems, and products (Martin and Hanington 2012). Designer and educator Alexander R. Wilcox Cheek (2016) teaches human-centered research methods in his courses at Carnegie Mellon University's campus in Doha, Qatar. In his lecture on how these methodologies tie into the practice of service design, he states:

> Design methods are different from pure social sciences because designers don't feel the need to stay "true" to one single method or approach. If a method isn't working to provide us with insights, we can switch to something else that might be more effective. We can also hack together different social science methods to make our own (2016).

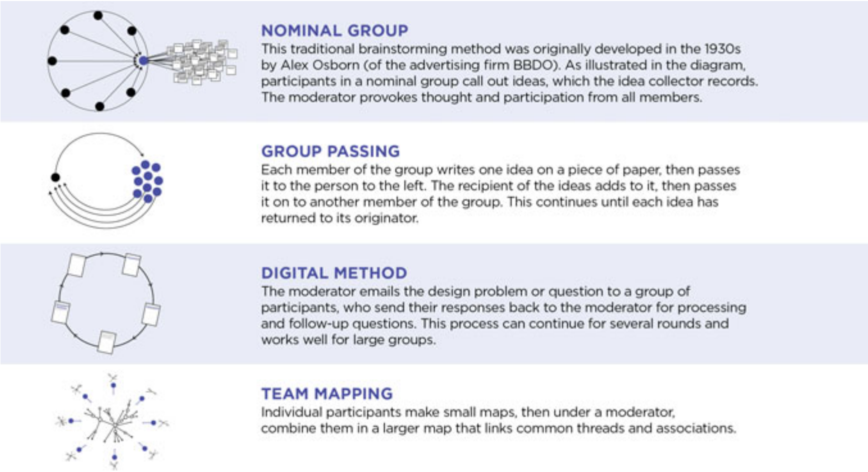


Fig. 2 Four different approaches designers frequently use to collaborate through brainstorming include: Nominal Group, Group Passing, Digital Method, and Team Mapping

As part of human-centered strategies, cooperative activities often take the form of visual and semantic tools that enable participants to identify a need or concern and subsequently create services, systems, interfaces, or products that address the need (Kolko 2012). Tim Brown describes the act of prototyping as a productive, broadly informed conversation about specific problematic situations that can yield design work that would not otherwise emerge, much less become realized (2008). As part of a larger design thinking process–one involving the cycles of prototyping, testing, and refinement–this entails identifying an aspect of human behavior and converting that finding into a benefit to the individual or audience (Brown 2008).

Klemmer et al. (2006) discuss the importance of prototypes as a way designers can share their knowledge of a topic or problem with potential users or audience members. Designers plan and facilitate interviews with potential audience members or "users," to generate collaborative methods with these individuals and groups (Martin and Hanington 2012). Often, collaborative methodologies involve designers sitting alongside potential users to prototype, sketch, brainstorm, or other forms of physical ideation together. Another way designers frequently collaborate is through a range of brainstorming approaches that include nominal group, digital passing, group passing, and team mapping (Fig. 2).

2.2.3 Co-Creativity: Co-Design and Participatory Strategies

In addition to the user-centered design methods widely popular in the United States, there is significant design research in the area of co-design and participatory strategies pioneered by European scholars in the 1970s (Malmö University 2017; Ehn and Badham 2002). Recent scholarship from Pelle Ehn, Erling Björgvinsson, and Per-Anders Hillgren (2010, 2012) points to the continued importance of participatory strategies in the formulation of design problems and solutions *with* people. Guided by active listening, knowledge exchange, and co-creation, these participatory processes involve stakeholders in all aspects of the design process (Robertson and Simonsen 2012). As a form of mutual learning, the process has wider implications for design research when both parties (designers and participants) are involved in the transmission of ideas for a purpose—such as sustainability—rather than a product (Robertson and Simonsen 2012; Sanders and Stappers 2008).

Similar to participatory action research (Loewenson et al. 2011), participatory design offers an opportunity to respond to existing power structures through the collaborative and iterative phases of planning, action, reflection and evaluation. The basic principles of this approach are to empower participants through collaboration in a manner that might lead to positive social or environmental change. During all phases, community involvement is paramount to research objectives, including knowledge construction, informal discussions, in-depth interviews, and feedback sessions. In order to increase an individual's—or a group's—self-determination about a topic, the process spirals in methodological stages that include: question, reflect, dialogue, and make decisions (McIntyre 2008). As part of this reflective activity, the approach necessitates the integration of culture, local context, and social relationships into its framework.

2.3 Design for Sustainability

Designers increasingly aim to contribute to social, economic, or environmental wellbeing through productive, results-oriented processes and interventions using their training in visual language and strategies (Resnick 2016; Brown and Wyatt 2010). The results of these efforts range dramatically, from socio-technical systems (Holm et al. 2010), exhibitions of low-cost innovations (Bloemink 2007), to interactive online spaces for sharing insights about sustainable and unsustainable living (Chick and Micklethwaite 2011). Although not all of these approaches can claim the desired effect and may result in unpredicted behaviors, there remains a sincere desire for designers to play an integral role in exploring novel approaches to design for sustainable behavior (Lilley 2009; Lockton et al. 2008).

The design of mobile applications, for example, can bridge the gap between access and information by helping individuals retrieve data about the environmental impacts of their choices, helping them to make informed decisions about their consumption habits. Designed communications for utility companies can also offer an opportunity to influence the behavior of individual consumers by giving them a broader frame of reference about their energy consumption and normalize conservation. An example of this is when energy customers' monthly bills were redesigned to include a visual depiction illustrating how their neighbors (with similar sized homes) used less energy; it encouraged them to curb their energy usage (Wendel 2014).

Informational websites, political posters, and short documentary videos are also important examples of visual communication strategies used to raise public awareness about environmental impacts and the need to support protection efforts. Educating the general public about impending water shortages or hazardous pollutants through multimedia campaigns can place pressure on governmental agencies to implement sustainable practices. Indigenous communities in the USA fighting the Dakota Access Pipeline (DAPL), for example, used a mix of visual strategies to garner public support against the construction of a pipeline to transport crude oil from domestic wells to American consumers (Indigenous Rising 2015). A better-informed and connected public is, in turn, positioned to urge elected officials to make policy changes for long-term resiliency.

3 Methodology

3.1 Grounded Theory

This paper analyzes a series of initial interviews and survey data to investigate the intersecting realms of design, education, and sustainability. The study also includes the review of existing curricula, educational precedents, and project structures. Methods employed as part of a grounded theory framework for the study include inductive logic, comparative analysis of data, theoretical analysis of findings, and informed practice (Charmaz 2014; Sarker, Lau, and Sahay 2000). According to Charmaz (2014), the use of grounded theory can help support a process where substantive findings emerge through analysis and related insights, leading to a "conceptual handle on the studied experience." The research framework involves a flexible process where clarity emerges from the comparison of data (Glaser 2010, 1978).

A purposive sampling strategy of initial interviews and survey data was collected from approximately 20 communication design industry professionals and educators in the United States. Participants were chosen according to their (a) capacity, personal interest, and willingness to participate in the research, (b) specialized knowledge of the research issues, and (c) maximum variation of the small sample of approximately 20 respondents (Patton 1990; Kuzel 1999). Figure 3 presents the questions used to guide the semi-structured, targeted-audience interviews.

Interview findings indicate that sustainability is emerging as a theme that designers are confronting in professional practice. Some respondents cited the need for awareness in sourcing renewable or ethical materials and labor (for example, papers, inks, and bindery work when printing a book). Others referred to a need for design to intervene at a strategic level, helping organizations ideate and frame new directions, goals, and positioning for more responsible and responsive products and services within an evolving business and communications landscape.

In addition, analysis of undergraduate and graduate programs revealed a link to sustainability and communication design emerging in many American universities. However, many of the projects in these courses seem to focus solely on environmental issues, without broader consideration of the Triple Bottom Line model.

RESEARCH QUESTIONS

Q. In what ways can educators best prepare design students to meet the demands of contemporary practice?

Q. Are ethical, political, and/or social conditions integrated into your professional design practice?

Q. Do you think that understanding and addressing sustainability is a necessary component of today's professional design practice?

Q. How do you think considerations of ethics and sustainability could change the practice of design for the 21st century?

Q. Based on your experiences, to what extent, if any, do you believe designers should have an understanding of different cultures or ability to work with international clients/partners/collaborators?

Q. Do you think design education should prepare students for the above ideas and goals? Why or why not?

Q. Were topics related to sustainability, ethics, and culture/internationalism part of your own design education experience?

Fig. 3 Research questions

Reflecting on the study of literature, curricular materials, and discussions with practicing designers, several themes emerged relevant to the intersection of design and sustainability, including the need to: (1) understand—and help others understand—complex topics and problems; (2) work in collaborative contexts (involving skills such as listening, conversing, providing constructive and critical feedback about ideas/work, asking questions, empathizing); and (3) incorporate international perspectives related to global resiliency. *Please see Sects.* 4.3 *for a detailed discussion of these findings.*

3.2 Limitations

A limitation of the study was a focus on a small sample of design professionals and academics working in the United States. Future research will involve professional designers located in other countries to incorporate more diverse perspectives and experiences. Furthermore, following the authors' original survey, AIGA and Google have since partnered together to create an international design census, expanding upon their earlier efforts to conduct annual, US-oriented design salary surveys. As a next step, it may be possible for the authors to integrate data from this new resource to create a better basis for professional perspectives to later expand upon the topics discussed in this paper.

4 Results and Analysis

4.1 Communication Design and Sustainability in Higher Education: Evolving U.S. Curricula

In the early part of the 21st century, Jorge Frascara called for design educators to see the world as a living system and find their place within it (2002). He claimed that physical and cultural sustainability "must become part of every design process, and schools will have an important role to play in the formation of the new generations of designers" (Frascara 2002). More than ten years later, Cumulus (the International Association of Universities and Colleges of Art, Design and Media) echoed Jorge Frascara's concern. The organization invited its members to consider how design knowledge could have an effect on the challenges confronting the world, from the macro level of politics to the micro level of the domestic sphere (Cumulus 2016). This drive for civic engagement is reverberated in the professional association for design in the United States who asked how designers might generate the optimism and energy to make a difference "nationally or in our own backyards" (AIGA 2017).

Several university-level design programs worldwide have answered the call to incorporate UNESCO's Sustainable Development Goals (SDGs) (UNESCO 2005, 2016) into their design curricula. The DMBA at California College of the Arts, for example, focuses on bringing ethics and meaning to business, looking at how design adds "lasting value" beyond profits. The program combines experience in areas encompassing economics, finance, operations, marketing, and design, all framed by social, cultural and ecological impacts. Students engage in customer-centered research, prototyping and iterative making across a variety of media, metric analysis, and business strategy development (CCA 2016). Several programs in the United States have also integrated sustainable development goals into their curricula (Fig. 4).

Beyond higher education programs positioned within traditional university settings, design educators are forging new models for teaching social and environmental innovation at the graduate level. The founder of the University of the Underground, Nelly Ben Hayoun, explains that designers should apply a new kind of education at the graduate level "to radically shake up design thinking and practice." The educational and learning objectives emphasized in this model are built on the power of creativity and a shared purpose. The University of the Underground aims to teach students how "to engineer situations, to design experiences and events to best support social dreaming, social actions and power shifts within institutions, companies and governments…" (Hayoun 2017).

There are quite a few university-level design programs outside the U.S. which have incorporated UNESCO's SDGs to inform their curricula and their cross-disciplinary efforts in and around sustainability. One such example is Ravensbourne University's Master of Design (MDes) in Social Innovation, which focuses on applying design thinking to global challenges in the environmental, social, and economic domains. In other parts of the world, such as the Gulf Region, the Masdar Institute in Abu Dhabi

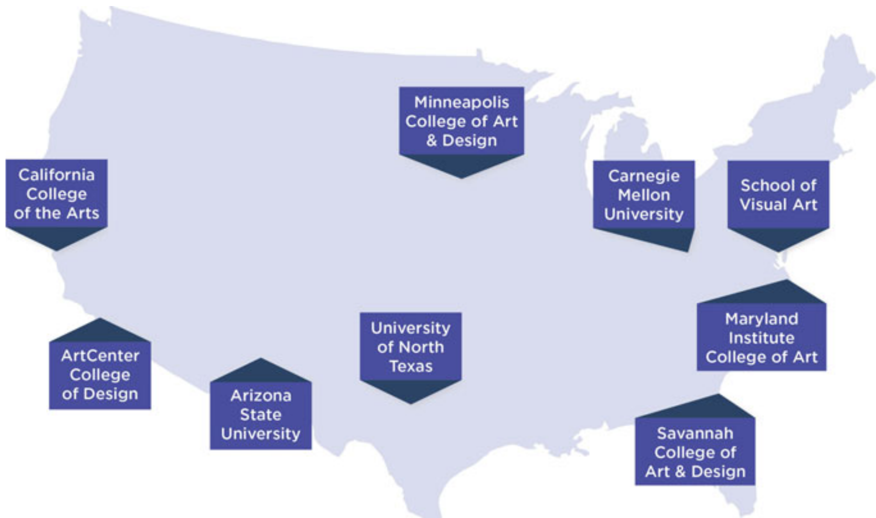


Fig. 4 A selection of U.S. institutions that formally combine design and sustainability education at the graduate level (ArtCentre College 2016; ASU 2017; CMU 2016; DRC 2017; MCAD 2016; MICA 2016; SCAD 2016; SVA 2016)

(in cooperation with Massachusetts Institute of Technology) addresses sustainability challenges such as climate change and clean energy through innovation, research, education, and entrepreneurship activities (Masdar 2017).

As part of a disciplinary shift towards sustainability in communication design, some academic programs have begun integrating environmental and social dimensions into their curricula to bridge the gap between theory and application (Martin and Ahdab 2015). Though this disciplinary shift has the potential for deepening the relationship between design and resilience in theory as well as practice, much of the scholarly work dedicated to this relationship focuses on pedagogic development. These studies seek to encourage consumers to change behaviors or prepare graduates with the necessary attributes and values to succeed in this endeavor (Trimmel 2015). Alternatively, they may aim to broaden students' understanding of the design process through the evaluation of social and environmental systems in which their product would exist and encourage students to understand sustainability as a holistic process (Johnson 2014).

4.2 The Everyday Classroom: The Importance of Integrating Sustainability into the Communication Design Curriculum

A key finding gathered from the 20 professional respondents in the United States of America revealed positive attitudes toward the integration of sustainability into the

Fig. 5 This research advocates for students (across communication design curricula) to learn to question, reflect, make decisions, dialogue, and collaborate as part of sustainability-driven projects and activities

curriculum of communication design. This conclusion emerged both within the responses of the professional respondents and in recent scholarly articles on design pedagogy (Trimmel 2015; Martin and Ahdab 2015; Johnson 2014; Vernon 2013). But while there are entire programs dedicated to sustainability and communication design in higher education in the United States, professional respondents indicate that environmental and social dimensions should *not* remain confined to topic-specific majors or programs. Instead, economic, social, and climate resilience should integrate into everyday classrooms and students should learn to question, reflect, and dialogue in order to make decisions about sustainability (Fig. 5).

4.2.1 Sustainable Sourcing: Renewable and Ethical Outputs

According to one professional survey respondent: "[e]veryone who designs something that will be consumed on a mass level needs to examine the impact of their actions and understand what is at stake." Respondents observed that contemporary design students need connective learning experiences to teach them to examine cause-and-effect relationships. While one respondent pinpointed the need for students to understand how their choices can directly affect resources, another expressed the need to understand sustainability beyond a resource standpoint. In other words, the concept of sustainability must move beyond "designing with the environment in mind" or "designing smarter packaging" to consider many different aspects of the world (Fig. 6).

One professional designer (who also identified as a design educator) expressed that many students request the inclusion of environmental topics as part of everyday coursework, such as sourcing renewable or ethical materials and labor. The respondent noted "many of the students are demanding that sustainability be addressed in projects and access to supplies, and even presentation styles (digital vs. printed) in our curriculum. It's a bit of the cart leading the horse which is wonderful to experience!"

However, many communication design students fail to understand that sometimes it takes more energy to recycle something than to make a new product.

Fig. 6 Respondent Feedback

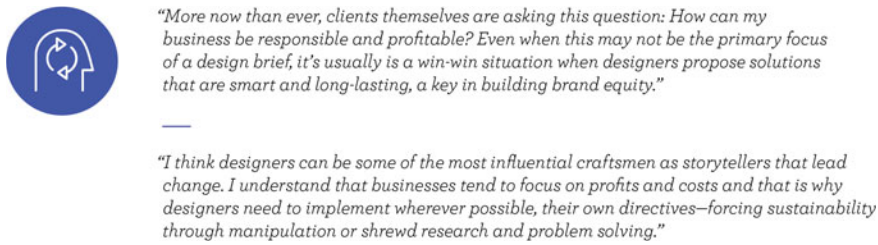


Fig. 7 Respondent Feedback

Meanwhile, students from fields such as materials science, mechanical engineering, packaging and industrial design often learn this lesson early in their collegiate experience. Similarly, maintaining one aspect of a natural resource at the expense of a local economy may not be "sustainable." In other cases, some things should not be "sustained"—for example, containment feedlots. Designed to fatten livestock for slaughter, these densely packed buildings or muddy paddocks over-consume resources, wreak environmental havoc, and provide an inhumane environment for the animals.

4.2.2 Real-World Environmental and Social Applications

Much of higher education is preparing students—and those who teach them—to confront wicked problems (Kolko 2012; Buchanan 1992; Rittel and Webber 1973). These challenges are not necessarily solvable, black or white, true or false; perhaps they can only be rendered better or worse. Moreover, the time it takes for a given design problem to be *solved* and the time for a so-called *solution* to become the next *problem* is rapidly decreasing. Rather than being dismayed by this outlook, one respondent offered a new directive for young designers to champion their personal ideals of sustainability—such as water scarcity, social injustice, and climate change—through social entrepreneurship (Fig. 7).

Respondents cite evolving trends in global business interactions, communications, and problem-solving as indicators that higher education should weave real-world sustainability applications into the curriculum as much as possible.

In this regard, educators can "ensure that the students have a proper mix of idealism and boots-to-the-ground everyday expectations of the kinds of quality of work, scheduling and financial realities they can expect as they enter the field." The following statement echoes this perspective: "What designers can do to promote sustainability is not to insist on it for its very own sake but to see sustainability also as a business strategy for the client."

4.2.3 Working Collaboratively Across Disciplines and Cultures

One of the final points gleaned from the professional respondents within this study was an emphasis on learning to work collaboratively, both across cultures and in interdisciplinary teams. One professional's response points to the impact of designers understanding different cultures, noting that "[f]requently, my clients want to reach across many cultures in the [San Francisco, California] Bay Area alone, and so design is the perfect instrument to do that. Good design makes complex ideas universal and understandable." Adding to this point, another respondent draws attention to designers' "multiple ways of knowing" as important contributors to successful global communication, stating "[n]ew design graduates *cannot* afford to be introverted or inexperienced when it comes with interfacing with others with diverse backgrounds (Fig. 8)."

While professional respondents noted the importance of students' understanding the broader impact and relevance of their work, most of the U.S. design and liberal arts programs reviewed for this paper did not engage with local or global communities to address sustainability challenges as part of their standard curricula. This point was reinforced by a survey of a variety of communication design projects over the past five years, gleaned from international academic conference proceedings in design pedagogy (DRS 2013, 2015; Cumulus 2014). Analysis indicates that surprisingly few communication design projects interweave notions of intercultural communication or dialogue into sustainability education.

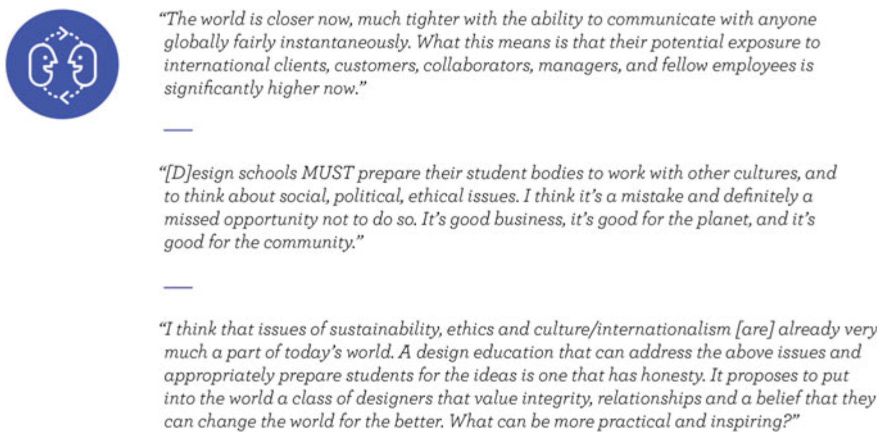


Fig. 8 Respondent Feedback

Furthermore, outside of the context of academic programs that purposefully combine design and sustainability education in parallel, when students in traditional design programs engage in sustainability-oriented projects (in non-collaborative environments), they often refer to the topic on a surface level. This limited approach can devalue the rich systemic and systematic thinking that students can discover by engaging in an intercultural experience devoted to a particular subject matter. Students might assume that sustainability relates to environmental issues, but, without the benefit of dialogue with various communities, they may not realize the intricacies involved in economic health and cultural vitality. This disconnected view of the nested relationship of social, cultural, ecological, and economic conditions runs the risk of students developing a myopic understanding of sustainability.

4.3 New Opportunities for Sustainability Education: A Call for Intercultural Collaboration

Critics might argue that intercultural collaboration is not a necessary component of education for designers learning about climate, social, and economic resilience. Yet, the benefits of this experience are plentiful, particularly for learning that extends beyond the classroom to include mutual understanding and respect for other cultures. Intercultural design collaborations in sustainability can bolster students' systemic thinking and encourage them to "connect the dots" to see bigger pictures as well as focus on important details from new points of view. Working across cultures can provide students with a more expansive view of how environmental and social issues play out on the international stage, and how different countries and cultures respond to similar problems. Respondents illustrated how global perspectives—and the ability to work with other cultures—are fundamental to education.

In a communication design context, collaborations involve generating context-specific visual, spatial, product or digital interfaces with people in a different country or cultural environment. This process involves learning to communicate across disciplinary boundaries, to reach common understandings, work through misunderstandings, and create a common language. It also demands trust, built over time. There are activities and processes to encourage this type of cross-cultural engagement, but success hinges upon commitment from both sides (Gibson and Owens 2015).

Working directly with undergraduate students, in different cultural contexts, to identify logistical and lifestyle challenges offers potential avenues for creative innovation with respect to sustainability. If a student in one country initially considers a project about recycling, for example, communication with students in other cultures might broaden her view to consider other methods or impacts of recycling, or entirely reframe the ideas of "waste" and "consumption" from a new perspective. Integrating collaboration with sustainability topics could be a viable method to broaden and elevate students' views by creating new opportunities for cooperative problem-solving, and, according to the work of Hill, Brandeau, Truelove and Lineback, combining diverse perspectives and problem-solving approaches is the requisite underpinning of successful innovation (2014).

A necessary component of successful intercultural teamwork involves confronting perceptions, stereotypes, and unconscious blinders before the initiation of a project. Anthropologist Edward T. Hall's cultural continuum is a useful approach to help unravel unconscious culturally determined attitudes and linguistic patterns. For instance, the social dynamics of many Middle Eastern cultures prioritize the collective (in Hall's terms, "high-context"), while North American cultures prioritize the individual ("low-context") (Hall 1976). This differentiation is important because it promotes an understanding of how an individual's position along the high-to-low context continuum relates to a collaborator's location along that same continuum (Fig. 9).

Using Hall's cultural continuum can empower students to acknowledge a broad conceptualization of culture, defined by discrete communication strategies, personality dynamics, and educational goals. Through ongoing intercultural communication and cooperative approaches, student teams can learn to work together to collect data, make decisions, create interventions, critique projects, and evaluate findings. The ability to build empathy and understanding for 'users' is central to the success of this human-centered design (Martin and Hanington 2012). Murdoch-Kitt and Emans go on to detail a study that successfully integrates this mechanism as part of multicultural sensitivity training during the formation of student partnerships (2015).

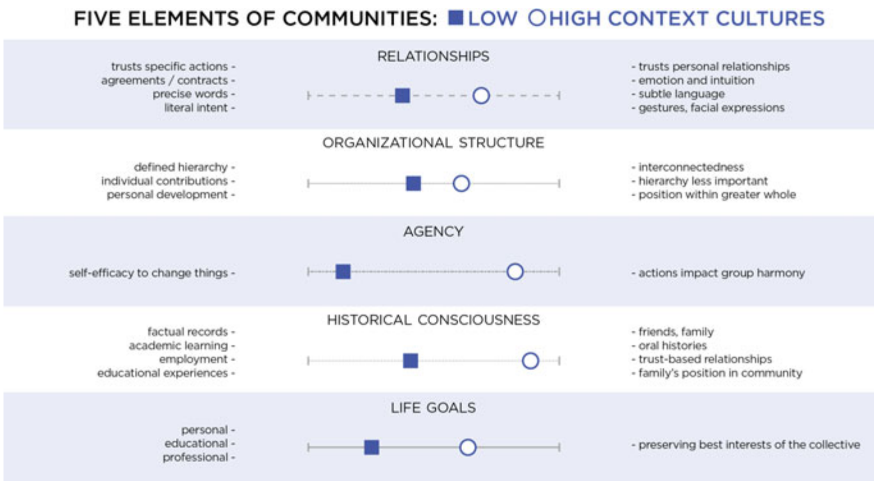


Fig. 9 Tunstall's Five Experiential Elements of Communities interpreted in terms of Hall's Low- and High-Context Cultures, adapted by Murdoch-Kitt and Emans (2015). The shapes indicate how the diagram could be used to illustrate similarities and differences across cultures; different individuals and groups will map differently along each value spectrum

Combining Hall's continuum with design anthropologist Elizabeth Tunstall's model of "experiential elements of community" enables students to understand how interactions, expectations and communications might differ as they compare specific values (Tunstall 2000). For example, along the element of relationships, someone identifying as high-context establishes trust and understanding through personal relationships, emotion and intuition. Communication is less direct and more subtle, emphasizing gestures, facial expressions, etc. For someone with low-context leanings, on the other hand, relationships and trust are demonstrated through specific actions as well as through formal agreements or contracts. Communication relies on precise words with literal intent (Murdoch-Kitt and Emans 2015; Tunstall 2000, 2008; Hall 1976).

Based on the findings from this grounded theory analysis, the authors of this paper encourage faculty across disciplines to engage with in-depth and sophisticated sustainability projects through intercultural collaboration. By immersing diverse teams in cooperative activities, participants can learn to critically assess sustainability problems through discussions with peers, colleagues, and their communities. Implementing sustainability education into educational models and design classroom requires support networks, resources, and curriculum development, broadly informed by contributions from multiple disciplines. The introduction of various social science methodologies and human-centered strategies could encourage students to account for a user-focused method as part of productive, enlightening investigations of sustainability topics.

5 Conclusions

With a growing number of programs at the undergraduate and graduate level, research indicates an increasing trend within higher education in the United States to connect communication design (in its various forms) with environmental and social stability. Professional respondents suggest that students within communication design should learn to 1) examine the impact of their actions; 2) source renewable or ethical materials/labor; 3) understand how design can be sustainable beyond a resource standpoint; 4) address real-world environmental and social applications; 5) champion their personal ideals of sustainability in practice or social entrepreneurship; and 6) work collaboratively across cultures and in interdisciplinary teams.

Opportunities to expand sustainability education could involve working across cultures and disciplines to generate meaningful, human-centered solutions to sustainability challenges. Therefore, future research will encompass a comparative analysis of academic programs to better demonstrate the educational themes and design research methodologies in the United States and globally. The researchers plan to build upon these finding to examine how greater awareness of global environmental issues directly tie to cross-cultural learning experiences through a series of pedagogical studies. Involving faculty, professional designers, and students located in different cultural contexts will help incorporate more diverse perspectives and experiences in an effort to solve the international puzzle of economic, social and planetary resilience.

Acknowledgements The researchers would like to thank their respective institutions for support of this research: Virginia Commonwealth University in Qatar and Rochester Institute of Technology. The researchers also acknowledge the generosity of the professional respondents who shared their time and energy as part of this study. Your feedback and insights made this paper possible.

References

AASHE. (2016). Sustainability tracking, assessment and rating system (STARS). Association for the advancement of sustainability in higher education. https://stars.aashe.org/. Accessed: 27. Sept. 2016.

AIGA. (2017). The Professional Association for Design. Retrieved from http://www.aiga.org

Archer, B. (1981). A view of the nature of design research. In R. Jacques & J. A. Powell (Eds.), *Design: Science: method* (pp. 36–39). Guilford, England: Westbury House.

ArtCenter College. (2016). Designmatters at ArtCenter college of design leads conversation about vital role of design in addressing most pressing societal challenges. http://www.artcenter.edu/connect/college-news/designmatters-at-artcenter-college-of-design-leads-conversation-about-designs-vital-role-in-addressing-societys-most-pressing-challenges.html. Accessed: 12. Feb. 2017.

ASU. (2017). The nation's first school of sustainability. https://design.asu.edu/degree-programs/environmental-design. Accessed: 12. Feb. 2017.

Ball, S., & Gilligan, C. (2010). Visualising migration and social division: Insights from social sciences and the visual arts. Forum: Qualitative social research, 11(2). http://www.qualitative-research.net/index.php/fqs/article/view/1486/3002#footnoteanchor_6. Accessed: 27. Sept. 2016.

Bjögvinsson, E., Ehn, P., & Hillgren, P. A. (2010). Participatory design and democratizing innovation. In Proceedings of the 11th Biennial Participatory Design Conference, pp 41–50.

Bjögvinsson, E., Ehn, P., & Hillgren, P. A. (2012). Design things and design thinking: Contemporary participatory design challenges. *Design Issues, 28*(3), 101–116.

Bloemink, B. (2007). *Design for the other 90% catalogue*. New York: Cooper-Hewitt, National Design Museum.

Brown, T., & Wyatt, J. (2010). Design thinking for social innovation. Stanford Social Innovation Review, pp 30–35. (Winter).

Brown, T. (2008). 'Design Thinking', Harvard Business Review, June, pp 84–92.

Buchanan, R. (1992). Wicked problems in design thinking. *Design Issues, 8*(2), 5–21.

CCA. (2016). MBA in design strategy from California college of the arts. https://www.cca.edu/academics/graduate/strategy-mba. Accessed: 27. Sept. 2016.

Charmaz, K. (2014). *Constructing grounded theory*. London: Sage.

Cheek, A. (2016). *Designing for service with human-centered design research methods*. Doha, Qatar: Carnegie Mellon University.

Chick, A., & Micklethwaite, P. (2011). *Design for sustainable change: How design and designers can drive the sustainability agenda*. Worthing: AVA Publishing.

CMU. (2016). MDes at Carnegie Mellon University, Graduate Program. http://design.cmu.edu/programs/grad. Accessed: 27. Sept. 2016.

Cross, N. (2001). Designerly ways of knowing: Design discipline versus design science. *Design Issues, 17*(3), 49–55.

Cross, N. (2007). *Designerly ways of knowing*. Basel, Boston, Berlin: Birkhäuser Architecture.

Cumulus. (2014). In D. Laubscher, F. Freschi, C. Luisa, A. Breytenbach & K. Pope (Eds.), Proceedings of Cumulus Johannesburg Conference: Design with the other 90%, 22–24September 2014, University of Johannesburg and Greenside Design Center, Johannesburg, South Africa. Retrievedfrom http://www.cumulusjohannesburg.co.za/files/9014/1810/9492/CumulusJoburgProceedings_Sep14.pdf

Cumulus. (2016). In A. L Bang, M. Mikkelsen, & A. Flinck (Eds.), REDO cumulus Conference Proceedings, Design School Kolding, Denmark, 30 May–2 June2017. Retrieved fromhttps://issuu.com/designskolen_kolding/docs/a4_redo_samlet

Davis, M. (2012). *Graphic design theory: Graphic design in Context*. London: Thames & Hudson.

DRC. (2017). The design research center at The University of North Texas. http://designresearchcenter.unt.edu. Accessed: 12. Feb. 2017).

DRS. (2013). In J. B. Reitan, P. Lloyd, L. M. Nielsen, I. Digranes & E. Lutnæs (Eds.), Proceedings of the 2nd International Conference for Design Education Researchers, 14–17 May2013, Oslo and Akershus University College of Applied Sciences, Oslo, Norway, Vol. 1. Retrieved fromhttps://journals.hioa.no/index.php/formakademisk/article/view/506

DRS. (2015). In R. V. Zande, E. Bohemia & I. Digranes (Eds.), Proceedings of the LearnxDesign 3rd International Conference for Design Education Researchers,28–30 June 2015, The School of the Art Institute of Chicago, Chicago, IL, Vol. 2. Retrieved fromhttps://www.researchgate.net/publication/279182507_Proceedings_of_the_3rd_International_Conference_for_Design_Education_Researchers_volume_3

Ehn & Badham. (2002). Participatory design and the collective designer. In T. Binder, J. Gregory, I. Wagner (Eds.), PDC 02 Proceedings of the Participatory Design Conference, Malmo, Sweden, pp. 23–25.

Faude-Luke, A. (2009). *Design activism: Beautiful strangeness for a sustainable world*. Abingdon: Routledge.

Frankel, L., & Racine, M. (2010). The complex field of research: For design, through design & about design. Paper presented at the International Conference of the Design Research Society, Montréal, July 2010. http://www.drs2010.umontreal.ca/data/PDF/043.pdf. Accessed: 12. Feb. 2017.

Frascara, J. (1998). Graphic design: Fine art or social science? *Design Issues, Fall, 5*(1), 18–29.

Frascara, J. (2002). From user-centered to participatory design approaches. In J. Frascara (Ed), *Design and the social Sciences*. London: Taylor & Francis.

Fry, T. (2009). *Design futuring: Sustainability and ethics and new practice*. London: Bloomsbury.

Glaser, B. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory*. Mill Valley, CA: The Sociology Press.

Glaser, B. (2010). The future of grounded theory. *Qualitative Health Research, 9*(6), 836–845.

Gibson, M., & Owens, K. (2015). Making meaning happen between 'Us' and 'Them': Strategies for bridging gaps in understanding between researchers who posses design knowledge and those working in disciplines outside design. In P. Rodgers & J. Yee (Eds), *The Routledge Companion to Design Research* pp. 386–399.

Hall, E. T. (1976). *Beyond culture*. New York: Random House.

Hayoun, N. (02 February 2017). Nelly Ben Studios launches University of the Underground – a radical rethink of design education." It's Nice That. http://www.itsnicethat.com/articles/university-of-the-underground-launch-020217. Accessed: 12. Feb. 2017.

Hill, L., Brandeau, G., Truelove, E., & Lineback, K. (2014). *Collective genius*. Brighton: Harvard Business Review Press.

Holm, J., Søndergård, B., & Hansen, O. (2010). *Design and sustainable transition*. New York: Routledge.

IDEO. (2016). Design Kit Methods http://www.designkit.org/methods. Accessed: 28. Dec. 2016.

Indigenous Rising. (2015). http://indigenousrising.org/. Accessed: 11. Feb. 2017.

Johnson, K. (2014). Beyond the artifact; developing student awareness of contextual social and environmental sustainability. Design with the other 90%: Cumulus Johannesburg Conference Proceedings, Edited by D. Laubscher, F. Freschi, C. Luisa, A. Breytenbach, and K. Pope, pp. 169–180. http://www.cumulusjohannesburg.co.za/files/9014/1810/9492/CumulusJoburgProceedings_Sep14.pdf. Accessed: 27. Sept. 2016.

Jordan, P. (2002). Human factors for pleasure seekers. In J. Frascara (Ed), Design and the social sciences (pp 9–23). Abingdon: Taylor & Francis.

Klemmer, S., Hartmann, B., & Takayama, L. (2006). How bodies matter: Five themes for interaction design. DIS 2006, June 26–28 (pp. 140–149).

Kolko, J. (2012). *Wicked problems: Problems worth solving: a handbook & a call to action*. USA: Ac4d.

Kuzel, A.J. (1999). Sampling in qualitative inquiry. In B. F. Crabtree & W. L. Miller (Eds.), *Doing qualitativeresearch* (pp. 33–45). California: Sage Publications.

Landa, R. (2011). *Graphic Design Solutions* (4. Ed.). Belmont: Wadsworth Publishing.

Lilley, D. (2009). Design for sustainable behaviour: Strategies and perceptions. *Design Studies, 30,* 704–720.

Lockton, D., Harrison, D., & Stanton, N. (2008). Making the user more efficient: Design for sustainable behavior. *International Journal of Sustainable Engineering, 1,* 3–8.

Loewenson, R., Flores, W., Shukla, A., Kagis, M., Baba, A., Ryklief, A., et al. (2011). Raising the profile of participatory action research at the 2010 global symposium on Health Systems Research. *MEDICC Review, 13*(3), 35–38.

Lloyd, P. (2017). From design methods to future-focused thinking: 50 years of design research. *Design Studies, 48,* A1–A8.

Lupton, E. (2012). Graphic Design: Now in Production, ed. Andrew Blauvelt and Ellen Lupton. Minneapolis: Walker Art Center, pp 12–13. http://elupton.com/2010/10/the-designer-as-producer/. Accessed: 15. Feb. 2017.

Malmö University. (2017). Research at Malmö University. http://mah.se/english/research/. Accessed: 15. Feb. 2017.

Margolin, V. (2010). Design research: Towards a history. In Proceedings of the Design Research SocietyInternational Conference “Design & Complexity”. Université de Montréal, Montreal, Canada, 7–9 July 2010.

Martin, P., & Hanington, B. (2012). Universal methods of design: 100 ways to research complex problems, develop innovative ideas, and design effective solutions. USA: Rockport.

Martin, P., & Ahdab, D. (2015). A pedagogical prototype focused on designing value. In Proceedings of Learn X Design: 3rd International Conference. LearnxDesign: Proceedings of the 3rd International Conference for Design Education Researchers, Edited by R. V. Zande, E. Bohemia, and I. Digranes, vol 2: 715–734. https://www.academia.edu/13300519/Proceedings_of_the_3rd_International_Conference_for_Design_Education_Researchers_volume_2_. Accessed: 27. Sept. 2016.

Masdar. (2017). About Masdar Institute of Science and Technology. http://www.masdar.ae/en/research/detail/about-the-masdar-institute-of-science-and-technology.Accessed: 4. Feb. 2017.

MCAD. (2016). Sustainable design master of arts. http://mcad.edu/academic-programs/sustainable-design. Accessed: 27. Sept. 2016.

McDonough, W., & Braungart, M. (2013). *The upcycle: Beyond sustainability — designing for abundance*. New York, NY: Melcher Media.

McDonough, W., & Braungart, M. (2002). *Cradle to cradle: Remaking the way we make things*. New York: North Point Press.

McIntyre, A. (2008). Participatory action research: Qualitative research methods series 52. California: Sage.

Medley, S. & Kueh, C. (2015). “Beyond problem solving: A framework to teach design as an experiment in the university environment.” In L. A. Noel and M. L. Poy. Ministry of Design – From cottage industry to state enterprise (pp 170–80). St. Augustine, Trinidad: Department of Creative and Festival Arts, The University of the West Indies.

MICA. (2016). MA in Social Design. https://www.mica.edu/Programs_of_Study/Graduate_Programs/Social_Design_(MA).html. Accessed: 27. Sept. 2016.

Murdoch-Kitt, K., & Emans, D. (2015). Experiential elements of high-to-low-context cultures. LearnxDesign: Proceedings of the 3rd International Conference for Design Education Researchers, Edited by R. V. Zande, E. Bohemia, and I. Digranes, vol 3: 1301–1318.

https://www.academia.edu/13300472/International_Conference_for_Design_Education_Researchers_volume_3_. Accessed: 27. Sept. 2016.

Murdoch-Kitt, K., Emans, D., & Martin, K. (2015). "Sustainability at the forefront: educating students through complex challenges in visual communication and design." In P. Thompson (Ed), *Interdisciplinary Environmental Review* (vol. 16, 2–4).

Papanek, V. (1995). *The green imperative: Natural design for the real world*. New York: Thames and Hudson.

Papanek, V. (1971). *Design for the real world: Human ecology and social change*. New York: Pantheon Books.

Patton, M. (1990). *Qualitative evaluation and research methods*. Beverly Hills, CA: Sage Publications.

Resnick, E. (2016). *Developing citizen designers*. New York and London: Bloomsbury.

Rittel, H., & Webber, W. (1973). "*Dilemmas in a general theory of planning." policy sciences* (4 (2), pp. 155–69). Netherland: Kluwer Academic Publishers.

Robertson, T., & Simonsen, J. (2012). Participatory design. In Routledge International (Ed.), *Handbook of participatory design*. Abindgon: Routledge.

Saikaly, F. (2005). *approaches to design research: Towards the designerly way, paper presented at the sixth international conference of the European Academy of Design (EAD06)*. Bremen, Germany: University of the Arts.

Sanders, E. (1999). Postdesign and participatory culture. Useful and critical: The position of research in design. 9–11 September 1999; Tuusula, Finland. University of Art and Design Helsinki (UIAH).

Sanders, E. (2002). From user-centered to participatory design approaches. In J. Frascara (Ed), Design and the social sciences (pp 1–8). Abingdon: Taylor & Francis.

Sanders, E., & Stappers, P. (2008). Co-creation and the new landscapes of design. CoDesign (vol 4(1)).

Sanders, E., & Stappers, P. (2014). *From designing to co-designing to collective dreaming: Three slices in time interactions, 21*(6), 24–33.

Sarker, S., Lau, F., & Sahay, S. (2000). Building an inductive theory of collaboration in virtual teams: An adapted grounded theory approach. 33rd Annual Hawaii International Conference in Systems Science, Hawaii.

SCAD. (2016). Design for sustainability. https://www.scad.edu/academics/programs/design-sustainability. Accessed: 27. Sept. 2016.

Schön, D. A. (1991). *The reflective practitioner: How professionals think in action*. Aldershot: Avebury, Ashgate.

Shea, A. (2012). *Designing for social change: Strategies for community-based graphic design*. New York: Princeton Architectural Press.

Simmons, C. (2011). Just design: Socially conscious design for critical causes. How Books Sociology Icons by Yu Luck from the Noun Project.

SVA. (2016). MFA in design for social innovation. http://www.sva.edu/graduate/mfa-design-for-social-innovation. Accessed: 27. Sept. 2016.

Tassi, R. (2009). Service design tools. http://www.servicedesigntools.org/taxonomy/term/1. Accessed: 12. Feb. 2017.

Trimmel, S. (2015). Directions towards sustainability through higher education. LearnxDesign: Proceedings of the 3rd International Conference for Design Education Researchers, Edited by R. V. Zande, E. Bohemia, and I. Digranes, vol 2: 907–920. https://www.academia.edu/13300519/Proceedings_of_the_3rd_International_Conference_for_Design_Education_Researchers_volume_2_. Accessed: 27. Sept. 2016.

Tunstall, E. (2000). Sapient Communities Project Phase I and II Reports.

Tunstall, E. (2008). My communitas Workshops. School of design, NC State University, Raleigh. Retrieved 11 Feb, 2015. http://dori3.typepad.com/my_weblog/2008/01/my-communitas-w.html.

UNESCO. (2005–2014). United nations decade of education for sustainable development (2004–2015): Draft international implementation scheme. 2005. Paris: UNESCO.
UNESCO. (2016). Sustainable development knowledge platform. https://sustainabledevelopment.un.org/?menu=1300. Accessed: 27. Sept. 2016.
Vernon, S, (2013). Design education for social sustainability. Design education from kindergarten to PhD – Design learning for tomorrow: Proceedings of the 2nd International Conference for Design Education Researchers, Edited by J. B. Reitan, P. L. E. Bohemia, L. M. Nielsen, I. Digranes, and E. Lutnæs, pp 204–216.
Wendel, S. (2014). *Designing for behavior change*. CA: O'Reilly Sebastopol.

Author Biographies

Denielle Emans is an Assistant Professor in the Graphic Design Department at Virginia Commonwealth University in Qatar and a Ph.D. Candidate within the Centre for Communication and Social Change at the University of Queensland in Brisbane, Australia. She holds a Master's degree in Graphic Design from North Carolina State University's College of Design and a Bachelor of Arts in Communications from the University of North Carolina, Chapel Hill. Denielle specializes in the area of visual communication with an emphasis on bringing social innovation and intercultural communication together to fuel creative action.

Kelly M. Murdoch-Kitt is an Assistant Professor in the Penny W. Stamps School of Art & Design at the University of Michigan, Ann Arbor. She has a background in interaction and user experience design. Her recent pedagogic research collaborations explore methods, tools, and benefits of effective intercultural design collaboration. She is also exploring the impacts of integrating sustainability challenges into project-based design courses. She holds a Master's degree in Graphic Design from North Carolina State University's College of Design and a Bachelor of Arts from Wake Forest University.

The Teaching Green Building: Five Theoretical Perspectives

Laura B. Cole

Abstract

Teaching Green Buildings (TGBs) are designed to educate building users about green building design and often broader themes about the connection between buildings and their surrounding ecosystems. The outcomes of a well-designed TGB range from increasing knowledge to fostering a sense of place to promoting environmental behavior change. To date, however, these buildings have been weakly theorized in scholarship and haphazardly designed in practice. This chapter draws on an interdisciplinary research base to discuss five potential roles for TGBs as: symbol, science museum, 3D textbook, call to action, and place.

1 Introduction

Teaching Green Buildings (TGBs) aspire to educate occupants about sustainability through building design (Cole 2013b). These buildings expand the conceptualization of green building performance — often measured in gallons, kilowatts, and dollars — to social metrics that include inspiring and educating the people who use green buildings. The strategies used in such buildings draw from scholarship across disciplines and are variously passive and active, individual or collective, and formal to informal (Cole 2014). In practice, for example, design features in TGBs range from energy feedback kiosks to indoor plants to greenhouses used in K-12 science curriculum. The design features vary widely depending on the building program

L.B. Cole (✉)
University of Missouri at Columbia, Architectural Studies Attn: Laura Cole 137
Stanley Hall University of Missouri, Columbia, MO 65211, USA
e-mail: colelb@missouri.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_6

and users, but the essential goal of the TGB is to create design that supports sustainability education and engagement.

While any green building could be used to teach sustainability, the TGB is designed for hands-on and minds-on learning experiences. A residential building can be a TGB, but the strategy is more common in commercial, institutional, and educational buildings. Green school buildings, from K-12 to Higher Education, are the most common venues for "teaching green" features. Universities in particular have adopted the strategy of green buildings as "living laboratories" to experiment with green campus buildings as an educational resource (König 2013).

While the term "Teaching Green Building" is employed here, others have used the terminology of green buildings as "3-Dimensional Textbooks" (Kong et al. 2014; Nair and Fielding 2005; Taylor 1993) or "Teaching Tools" (United States Green Building Council 2008) or "Third Teachers" (O'Donnell Wicklund Pigozzi Peterson Architects Inc et al. 2010). The multitude of terms, while converging on a similar idea, reveal different philosophical approaches. The 3-D textbook concept, for example, evokes the idea of knowledge collected by experts and conveyed to an audience who is willing to do the "reading," so to speak. Language that treats TGBs as "teaching tools" for sustainability represents a more reductionist approach, conjuring images of a building as a toolbox, or an assemblage of parts that can be used to construct various types of learning experiences. The third teacher concept, which is rooted in the Reggio Emilia approach to education (Edwards et al. 1997), is a systems approach that applies more specifically to school settings. The third teacher framework encourages a conceptualization of green buildings as working in concert with educators and peers to create a total educational experience. The term "Teaching Green Building" attempts to, with an economy of words, back away from specific settings or pedagogical approaches to offer a broad term that is inclusive of a greater number of building types and educational strategies.

The study of TGBs is an interdisciplinary pursuit that sits at the intersections of architectural studies, environmental education, museum studies, environmental psychology, and beyond. Theory across these domains can be used to craft an evidence-based approach to designing and using TGBs in practice (Cole 2014). Evidence base from empirical research in TGBs is in the early stages of development; we still have much to learn about how and if these buildings work. There are, however, some notable research developments across several disciplines. Researchers of social dimensions in green buildings have shown that green school buildings increase academic performance for students (e.g., Mendell and Heath 2005; National Academies Press 2006) and green office buildings offer a range of benefits to employees (e.g., Brown et al. 2010; Heerwagen 2000). Meanwhile, scholars in landscape architecture connect landscape design to environmental education outcomes (Malone and Tranter 2003; Ozguner et al. 2011; Tranter and Malone 2004). Other research has examined institutional and organizational factors within TGBs from the differing disciplines of environmental design (Barr 2011; Day 2009) and education (Henderson 2014). Work by Kong et al. (2014) used a qualitative case study of a TGB in Bali to create a framework for school design patterns. Other work in green schools shows that the building itself is only one predictor of green building knowledge and environmentally friendly behaviors, where personal context (such as eco-friendly behaviors at home) and socio-cultural factors (such as teachers and administrators) also appear to influence outcomes (Cole 2015).

Despite a growing body of empirical scholarship, we have yet to establish a strong theoretical foundation for the Teaching Green Building. This chapter is among the first efforts to untangle the variety of terms and philosophical approaches across disciplines to illustrate how TGBs can work to achieve a multitude of outcomes. The sections to come introduce five unique ways to conceptualize TGBs as: a symbol of sustainability, a science museum for informal education, a textbook for formal education, a place with which users form an emotional bond, and a call to action for greener practices (Table 1). These theoretical perspectives draw from a range of disciplines or sub-disciplines. Given the interest in *buildings* that *teach sustainability*, the disciplines of Architecture and Environmental Education (EE) are the foundation of this framework.

The five perspectives in Table 1 largely trace environmental literacy scholarship that outlines four key outcomes for EE: knowledge, affective dispositions, skills, and action (e.g., Marcinkowski 2010; UNESCO 1976). For knowledge, environ-

Table 1 Five theoretical perspectives for the teaching green building

The Teaching Green Building as…	Description	Outcome	Sample discipline(s)
Symbol	Green building designed as a symbol of sustainability and culture change	Architectural meaning	Architecture
Science museum	Presence of engagement opportunities to learn about the green building (e.g., signage, displays, or kiosks)	Informal or free-choice learning	Museum studies
3-D Textbook	Green building integrated into educational programming	Formal learning	Environmental education
Place	Green building designed for human-place bonding with intent to connect occupants to the building and/or surrounding ecosystem (e.g., biophilic design)	Place-making	Architecture; environmental psychology; environmental education; sociology
Call to action	Green Building offers opportunities to engage in pro-environmental behaviors and offers behavioral feedback	Behavior change	Conservation psychology; environmental psychology; environmental education; design studies

Source Author

mental educators distinguish between informal learning (Science Museum) and formal learning (3-D Textbook) (e.g., Eshach 2007). Affective dispositions include desirable outcomes such as environmental sensitivity, attitudes about nature, and a having sense of personal responsibility to care for nature, which are summarized here under human-place bonding (Place). Finally, environmental educators generally see environmental skills and action as the ultimate goal of EE (e.g., Hines et al. 1987) (Call to Action). Architectural scholarship further enhances TGB theory by expanding our understanding of the symbolic potential of TGBs. Together, these five viewpoints provide a palette of metaphors for the Teaching Green Building that can be employed in the design process singularly or in complement to each other. Given the vast nature of each body of literature below, the themes are condensed here and bounded by their application to the theorization of TGBs.

2 Symbol

One basic role of a green building is to stand as a symbol of culture change. Sustainability is an abstract, aspirational concept. In this way, it shares a slippery quality common to terms such as art, beauty, and justice. Despite the airy intangibility of sustainability as a societal goal, it is nonetheless made concrete in the world we create for ourselves. Each tangible artifact in the built environment is part of the ongoing narrative of our society's relationship to its surrounding ecology. Unfortunately, in the modern city, the vast majority of buildings today are telling the wrong story about the situation of humans on the planet. Put another way, "the advent of cheap and readily available oil let the modern building work in spite of nature rather than with it" (Sawin et al. 2007). The result is the non-distinct modern building that communicates that locality is unimportant, disconnection is normal, and precious resources need not be conserved (Orr 2002).

Can building design help us to discover our "ecological address," as Vickers and Matthews (2002) so aptly put it? While the first task of a green building, arguably, is to lighten the building's ecological footprint within the surrounding environs, there is also a potentially important role for buildings in culture change. Another major task of a green building could be to shock and delight, decrease apathy, and re-sensitize people to the possibilities of a new relationship to nature through built form. Seibold-Bultman (2007) writes about the need for tangible manifestations of sustainability, or images and objects that bring abstract ideas into focus. These visualizations of sustainability are not simply created to educate, but must be designed to engage and inspire. Not all green buildings are designed to "look" green; however, TGBs, with the intent to educate users, may benefit from architectural design that outwardly communicates green intent. Designers of TGBs are thus involved in the construction of architectural meaning and increasingly helping to visualize what sustainability looks like in a given time and place. Their design choices affect the nuanced ways in which buildings are understood and interpreted by users or the public.

Architectural semiotics is an area of architectural research that began in the mid-20th Century and is a discourse that provides potential insight into architectural meaning in the TGB. This area of research built on earlier foundational work by structural linguist Ferdinand de Saussure, and offered a framework for analyzing architectural meaning by identifying signs present in architectural environments (e.g., Eco 1997; Hattenhauer 1984; Jencks 1980). Fully explicating this theory is more complicated than what can be accomplished in this short chapter. However, there are a few notable contributions the semiotics discourse can make to the theorization of TGBs. One such contribution is the distinction between denotation (what is taken at face value) and connotation (what is implied) (Eco 1997).

It is the functioning of a green building (e.g., energy efficiency, water conservation, environmentally friendly materials, etc.) that at once denotes environmental performance and connotes social change. Understood in this way, green buildings have a dual role of physically conserving resources while also becoming beacons for an ethic of environmental care. Umberto Eco (1997) suggested that architecture can be a challenge for semiotic analysis, and notes that "most architectural objects do not communicate (and are not designed to communicate), but function" (p. 174). He goes on to note that the *function* is part of the *communication*, and this is a particularly relevant point for green buildings where environmental performance is the defining function. Green buildings in general denote and connote environmental stewardship; Teaching Green Buildings, with goals to both function and communicate, amplify the possibilities that symbolic meaning will be crafted by designers and understood by users.

If we understand green buildings as having an interpretable message, then we can further acknowledge that architectural "language" varies enormously across different green buildings. As Guy and Farmer (2001) suggest, there is no one logic to green building design. In fact, they propose six competing logics of green building design as: eco-technic, eco-centric, eco-aesthetic, eco-cultural, eco-medical, and eco-social (p. 141). These logics suggest that green buildings are designed and built with differing motivations that range from high technology to low technology where emphasis is variously placed on individual health, the community, and/or ecosystems. The more clarity a design team has about the emphasis of a green building project — the building's overarching narrative – the better that emphasis can be celebrated and communicated to building users. The next challenge, of course, is effective communication. Research by Cranz et al. (2013) cautions that, even with the best intentions, green designers may fail to communicate sustainability. We might begin by recognizing that "architects and nonarchitects do not necessarily share aesthetic sensibilities—and architects often misjudge the opinions of the public" (Cranz et al. 2013, p. 829). Architects can attempt to bridge the gap by working harder to design in a way that is meaningful to the public and, when necessary, translate architectural meaningful to the building user.

3 Science Museum

Where the symbolic reading of a green building is a passive type of engagement, a green building can also be designed for users to actively engage with its features. A metaphor for this approach is the science museum, where users engage in learning experiences at a series of vignettes. The progression through learning experiences in a science museum is often orchestrated to variously engage the mind and senses. This approach aligns well with the "toolbox" or "teaching tool" philosophy of TGB design where we imagine the TGB as a collection of displays each designed to reveal different aspects of the building's design.

The type of learning that happens in science museums is commonly termed informal or free-choice learning, and is characterized by initiative on the part of the learner (J. H. Falk et al. 2009). Falk and colleagues offer a sizable body of work built on decades of empirical evidence that is summarized in the "Contextual Model for Learning in Museums" (J. Falk et al. 2007; J. Falk and Storksdieck 2005; J. H. Falk and Dierking 2000). This framework outlines three major contexts that affect informal learning: physical, personal, and sociocultural. The relationship of these contexts to the Teaching Green Building is examined elsewhere (Cole 2014) and summarized in Table 2. The Contextual Model for Learning, developed through research in informal learning environments like museums, informs the pursuit of TGBs by expanding the horizon beyond the physical environment. This model highlights the importance of the unique individuals and social settings that affect free-choice learning experiences.

Taking a science museum approach to designing a TGB, if undertaken intentionally at the beginning of the design process, would encourage the design team to curate learning experiences across the building to consider the total educational experience. In contrast, some TGBs are designed in an ad hoc way with a sign added here or a kiosk installed there, with the hope that people notice and engage with these features. If TGB design increasingly reflects decades of research on informal learning venues, then designers will additionally consider (1) the total orchestration of learning

Table 2 Teaching Green Buildings and the Contextual Model of Learning

Contextual model for learning	Application to teaching green buildings
Physical context	The given features (signs, kiosks, displays, etc.) within at TGB that are designed to engage visitors/users in free-choice learning experiences
Personal context	The prior knowledge, experiences, and interests of individuals that affect the ways in which they engage with a green building
Socio-cultural context	The culture of sustainability communicated at the organizational or institutional level, social norms among building users, the presence of knowledgeable others who share insights about the green building's features

Source Adapted from Falk et al. (2007)

across the space, (2) the intellectual and emotional starting point of the individual building users, and (3) the culture of sustainability among the user groups within the building. A deeper understanding of the physical, personal, and socio-cultural contexts can increase the chances that a TGB is a successful venue for free-choice learning.

4 3-Dimensional Textbook

Inspired by the term "textbook" as a curricular artifact, the 3-Dimensional (3D) textbook approach to TGBs integrates formal learning experiences. The emphasis on formal education makes the 3D textbook approach most readily pertinent to the design of green school buildings and environmental education centers, where formal education already takes place (Kong et al. 2014; Nair and Fielding 2005; Taylor 1993). This is the approach taken by universities employing the "living laboratory" idea in campus buildings, where the building becomes woven into curricular opportunities. The Environmental Studies building at Oberlin College, for example presents an excellent model of a green building deeply tied to undergraduate coursework (Orr 2006) (See Fig. 3).

Like the science museum approach, 3D textbook implies the involvement of a content expert who is crafting an educational experience. Just as a textbook may be assigned to the course, a building can be assigned and aligned with formal education. This viewpoint will encourage strategies that go beyond kiosks and signage on the walls (a museum approach) to strategies that are more deeply intertwined with the social dynamics of the people in a space (an educational programming approach).

Green Building Literacy is the term used to describe the multi-faceted outcomes of successful green building education (Cole 2015). Green Building Literacy involves a mixture of knowledge, affect, and behaviors that relate to green building design (Cole, in review). In terms of green building knowledge, the focus of a 3D textbook approach, the formal lessons that could be taught using a green building are vast in number. One starting point for defining "green building knowledge" domains is to consult the metrics used in architectural practice that define green building. Dominant green building rating systems in North America include Leadership in Energy and Environmental Design (LEED) (United States Green Building Council 2008) and the Living Building Challenge (International Living Future Institute 2016) Knowledge domains drawn from these frameworks include:

- Green infrastructure
- Sustainable Landscapes
- Energy and Atmosphere
- Water
- Materials and Resources

- Indoor Environmental Quality
- Economic Impacts
- Beauty and Inspiration
- Local and Healthy Food Systems

Many green buildings address all or most of these categories in their own unique ways. These categories can help to organize the “chapter headings” of the Teaching Green Building as 3D textbook. A TGB that supports formal green building curriculum will increasingly connect environmental lesson plans to the categories above to strengthen the connection between the built environment and educational programming.

5 Place

Place theory — with its emphases on symbolic meaning, actions, and social and physical contexts — is one theoretical domain that has the potential to weave together the diverse approaches to TGBs. Key outcomes of the previous theoretical approaches included awareness and education; the focus here is on the outcome of sense of place, or connectedness to place, which can be engendered through TGB design.

“Sense of place” can be conceptualized as a combination of meanings, attachment, and satisfaction a person has toward a place (Stedman 2003). Within this framework, Stedman (2003) emphasizes “place attachment” as the factor that has the most depth and complexity. Place attachment is a term used widely to describe human-place bonding (Hernandez et al. 2013; Lewicka 2011) and, pertinent to the design of TGBs, is a phenomena of interest to environmental educators, environmental psychologists, and environmental designers alike.

Theorizing place has a long tradition in the areas of architecture and environmental psychology. Interestingly, place theory in other disciplines, such as sociology, has deemphasized the role of the built environment and focused more on social processes (Stedman 2003). However, scholars generally agree that place attachment is alternatively socially-based and physically-based (Scannell and Gifford 2010), meaning that the built environment can play a critical role. Of the many potential theoretical frameworks of place, Canter’s (1977) Model of Place integrates the built environment and provides a tri-partite framework for understanding ‘place’ at the intersection of the physical environment, the meanings that environment has for users, and the activities accomplished in that place (Fig. 1). TGBs are designed to communicate and engage. A thoughtfully designed TGB could have symbolic importance to users while affording a variety of opportunities to learn about sustainability and make a difference through participating in pro-environmental activities. In this way, the Fig. 1 framework integrates the many roles of the TGB as a symbol and venue for learning and action.

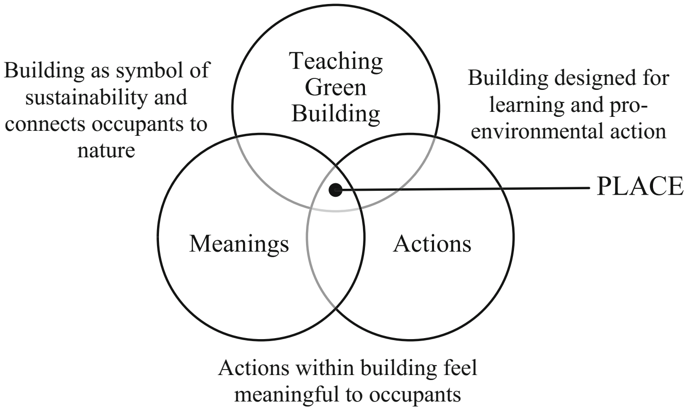


Fig. 1 The teaching green building and Canter's model of place. (*Source* Adapted from Canter (1977))

Human-place bonding in natural environments is also a long-standing research agenda for environmental educators. Educators are particularly interested in how connection or disconnection to nature affects environmental education (EE) outcomes like knowledge, attitudes, and sensitivity toward the environment (e.g., Chawla 1998; Louv 2008; Sobel 2008). Environmental educators also study connections between 'sense of place' and pro-environmental behaviors (Kudryavtsev et al. 2011). Environmental educators have additionally explored the importance of place-based learning, or the ability to deepen learning through hands-on experience in one's own ecosystem (e.g., Gruenewald 2003; Somerville and Green 2011). TGBs are well positioned to provide complex place-based learning experiences that explore the relationship between built and natural worlds. Further, while EE research has largely focused on place theory in outdoor environments, a rich potential exists to connect what we know about the importance of human-nature connections to building design. Green buildings, more than conventional buildings, are often celebrated for the integration of nature into the built environment.

A recent movement toward biophilic design centers on integrating nature into the built environment. Biohphilic design is an extension of the "biophilia hypothesis" proposed by E.O. Wilson (1984) that defines biophilia as the innate human connection to nature. Since the time Wilson's work arose out of conservation biology, scholars of the built environment have begun a major sub-area of scholarship on biophilic design. In efforts to inform practice, scholars have created robust frameworks that outline the precise architectural features and geometries that trigger a biophilic response (e.g., Kellert 2011; Ryan et al. 2014). Biophilic design considerations are vast and range from lighting and materials to organic shapes, interior plants, window views, and well beyond. Other researchers have focused on evaluating the benefits of biophilic design, examining a great variety of psychological and physiological outcomes such as stress reduction, increased wellbeing, faster healing in hospitals, and more [for a review of the literature see Söderlund and

Newman (2015)]. Pertinent to the “teaching” aspect of Teaching Green Buildings, human-nature connection has also been related to school design and enhanced learning outcomes (e.g., Malinin and Parnell 2012).

In summary, human-place bonding is an important aspiration for TGB design. TGBs already have rich potential to foster sense of place for occupants given the overlay of environmental meanings and actions associated with the building (Fig. 1). A well designed TGB will additionally connect the occupants to nature through approaches such as biophilic design. A biophilic TGB will offer myriad psychological and physiological benefits to occupants while also providing an inspired venue for environmental education.

6 Call to Action

A green building can further be a “call to action” for environmental stewardship. The former approaches address broad educational goals where the building occupant, or learner, is ideally constructing a foundation for *content knowledge* on green building design (e.g., what is a solar panel?) The “call to action” approach to Teaching Green Buildings, rooted in theories of environmental behavior change, involves *procedural knowledge*, or a type of learning that is rooted in taking action (e.g., how do I compost this apple core?) Research in conservation psychology and environmental psychology, along with design studies and environmental education, can all inform this approach.

If promoting behavior change is the goal within a TGB, then a rich and interdisciplinary knowledge base can illuminate pathways to pro-environmental behavior change. To begin, various sub-disciplines within psychology have long-running research agendas to unpack the psychological dimensions of behavior change. Over the decades, research in both conservation psychology and environmental education examines the array of variables shown over time as predictors of environmentally responsible behaviors (e.g., Azjen 1991; Bamberg and Möser 2007; Hines et al. 1987; Hungerford and Volk 1990; Stern 2000). Literature in the field of environmental psychology is similarly dense with empirical studies on the environment-behavior connection, with a sub-area of focus on environmental stewardship (e.g., De Young 1993, 2000; Kaplan and Kaplan 2009).

Across the substantial literature base on theories of behavior change, a key takeaway is that behaviors are multiply determined. There are many variables and many different pathways to a given behavioral outcome. Models of behavior change across disciplines essentially converge on knowledge, attitudes, skills, social settings, and behavioral willingness as key factors predicting behavioral decisions (e.g., Azjen 1991; Hines et al. 1987; Hungerford and Volk, 1990; Stern 2000). Fewer theories incorporate the physical environment. The models that address the physical environment frame it as a behavior setting (Kaplan 1991), a component of “perceived behavioral control” (Azjen 1991), or vaguely as a “situational factor” (Hines et al. 1987).

Given that the physical environment does not figure prominently in models of behavior change, designers who wish to promote behavior change through architectural design do not have a single, widely-accepted framework. There is, however, a growing body of literature in the area of "Design for Sustainable Behavior" and an ever-increasing number of empirical studies that point to evidence-based strategies.

Design for Sustainable Behavior (DfSB) is a growing area of scholarship in product design that could lend insights to architectural design. Lilley and Wilson (2013) present an overview of the research to date that elucidates approaches to DfSB that variously put the power of decision-making in the hands of the user, on one hand, and behaviors determined by the product on the other. An important question arises for designers of Teaching Green Buildings: what are best practices for promoting environmental actions within a green building? Basic strategies include informing occupants of behavioral options, persuading occupants to participate, and, on another extreme, actually determining their behavior through building design (Fig. 2). Table 3 uses the axis of influence framework to illustrate various strategies to promote recycling in a TGB.

While installing static signage to inform building users of behavioral options is a basic strategy, using dynamic behavioral feedback systems could increase the levels of occupant behavior change. Real-time feedback, for example, has been a long-standing research agenda in the area of energy conservation behaviors since the 1970s [for reviews of the literature see Darby (2001) and (2006)]. Darby (2001) outlines multiple types of energy feedback for homeowners, where the most applicable to architectural design is "direct feedback," which includes smart meters and feedback digital displays that could be visibly placed in the architectural environment. Across 21 studies, direct feedback yielded 5–20% energy savings and was the most promising form of feedback across all types examined (Darby 2001). A study in Oberlin College dormitories has similarly demonstrated the promise of energy feedback to significantly reduce energy consumption, where high resolution feedback reduced energy consumption by 55% compared to 31% in dormitories with low-resolution feedback (Petersen et al. 2007). Most research in this area points to the importance of feedback for behavior change, but authors commonly stress that feedback shouldn't be used alone but in conjunction with other behavior change interventions (such as information campaigns, incentives, and evoking social norms).

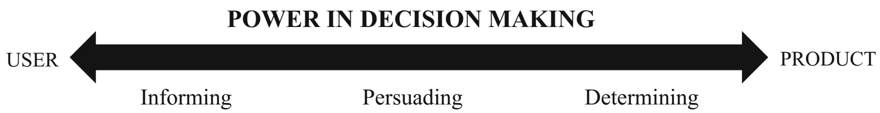


Fig. 2 The design for sustainable behavior axis of influence. (*Source* Adapted from (Lilley & Wilson (2013) and Zachrisson & Boks (2012))

Table 3 Various strategies to promote recycling behavior in TGBs using the axis of influence framework

DfSB axis of influence	Teaching green building sample strategies to encourage recycling
Informing	Signage next to recycling bins informing occupants about where and how to recycle
Persuading	Recycling bins playfully designed with signage that informs and persuades occupants to recycle. Trash cans labeled as "landfill"
Determining	Large recycling bins strategically located throughout space and with fewer and smaller trash cans available

Source Adapted from Lilley & Wilson (2013) and Zachrisson & Boks (2012))

The Bullitt Center in Seattle, which is arguably the most sustainable modern commercial building in the world, offers a potent example of DfSB. This building meets the stringent guidelines of the Living Building Challenge and was designed to engage visitors with its green features. The website and building signage *inform* building users about the various features. Even more compelling is the "irresistible stair" that was designed to *persuade* visitors to save energy and make a healthy choice by taking the stairs (Bullitt Foundation 2016). There some evidence for this strategy. For example, Zacharias and Ling (2014) showed that architecturally separating the stair and the escalator in shopping malls increased stair usage by 95%.

The examples thus far demonstrate single architectural features that promote environmental behavior change and are variously overt and covert. TGBs may be designed to have isolated features, but they can also be designed to impart a holistic sense of greenness. Researchers Wu et al. (2016), for example, were interested to learn if an overall atmosphere of sustainability, what they termed "building atmospherics," related to recycling behavior. In comparing a green campus building to a conventional one, they found that research participants did indeed recycle more often. Interestingly, they also found that as recycling behavior went up in the green building, so did recycling errors (Wu et al. 2016).

In examining this spectrum from informing to determining, a key question emerges for the designer of a TGB. If increasing pro-environmental behaviors within the building is a design goal, will this goal be accomplished deterministically (through coercion or persuasion) or more gently by "nudging" the building occupant, to use a term popularized by Thaler and Sunstein (2008)? Ethical questions emerge with deterministic approaches (Lilley and Wilson 2013), but psychological questions also arise. A deterministic space (e.g., a building where it is difficult to find a trash can) could evoke psychological reactance for building users who become irritated by the design. Further, a space that provides extrinsic motivation to conduct a behavior, or behavior motivated by external forces, will likely fail to help building users develop their own internal reasons (or intrinsic motivations) to perform eco-friendly behaviors. It is the difference, for example, between conducting a behavior because it is convenient or expected versus doing it because one believes it is the right thing to do. Research shows us that when external motivators are removed, the behavior typically returns to baseline (e.g., Abrahamse et al. 2005; Clary and Snyder, 1999; Lepper et al. 1973). The presence of intrinsic motivation, on the other hand, would be more likely translate across time and settings. Research in conservation psychology presents a strong case for considering both extrinsic and intrinsic motivations (De Young 2000; Kaplan 2000), where scholarship indicates that extrinsic motivations alone may be challenged to promote long-lasting behavior change.

In summary, occupant behavior change is most likely to occur at the intersection of factors such as green building design, organizational policy, educational efforts and culture change. This complexity may explain in part why some scholars believe that green building design should be less sensitive to occupant behavior, meaning that buildings should perform efficiently with or without conscientious occupants (e.g., Karjalainen 2016). But no building can be designed to completely override user behavior, and such a building would fail to engage its users in the environmental story of the building, which is one of the main goals of a TGB. Designers of TGBs will ideally achieve a delicate balance between delivering an efficient building and one that additionally serves as a meaningful "call to action" for occupants.

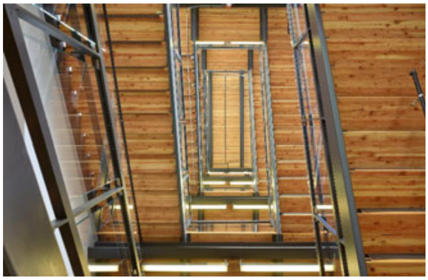
7 Implications for Practice

A key goal of this chapter is to elucidate multiple strategies for the design of TGBs to support increasingly intentional approaches. While any one of the five strategies could be the dominant approach to designing a TGB, these strategies can also be used together to provide rich and layered sustainability education. Figure 3 shows images that are representative of each perspective from five different TGBs in the United States. The five perspectives build upon one another in a sequence that moves from creating sustainability awareness through design (Symbol), to helping people learn about sustainability (Science Museum and 3D Textbook) to fostering connections between people and place (Place) to inspiring action (Call to Action) (Fig. 4). While these outcomes could certainly shuffle in order or be diagrammed in a less linear way, they are shown in sequence here to emphasize that the ultimate goal of environmental education is action. Our climate will not stabilize itself, our water, soil, and air will not magically resist pollution, and species will not be saved from extinction unless we — individually and collectively — act. Green buildings can begin by shocking and delighting but must ultimately do a better job of protecting our environment. Teaching Green Buildings go beyond typical green buildings to invite users to take part in the meaningful work of environmental protection.

Symbol: Amidst traditional campus buildings at Oberlin College, the Environmental Studies building stands out as a visible symbol of sustainability on campus. *Source* Author

Science Museum: This display offers real-time feedback on the building's energy performance in the lobby of Redding School of the Arts. *Source* Author

3D Textbook: The greenhouse at Greenhills School is integrated into the high school biology curriculum. *Source* Author



Call to Action: The "irresistible stairs at the Bullitt Center encourages occupants to take the stairs instead of the elevator. *Source* Ben Benschneider

Place: The campus of the Willow School has a LEED gold building, a LEED platinum building, a renovated historic building, and a relocated barn, all connected by native landscaping. The whole campus, indoors and out, is used as a living laboratory for K-8 education. The use of natural materials and indoor/out connections is designed intentionally to foster human-place bonding. *Source* Author

Fig. 3 Five perspectives from awareness to action

8 Implications for Research

While few studies have been conducted specifically within Teaching Green Buildings, research across disciplines — such as the research summarized above — points to the promise of buildings designed to engage, teach, and support environmental action for building occupants. This outline of five theoretical

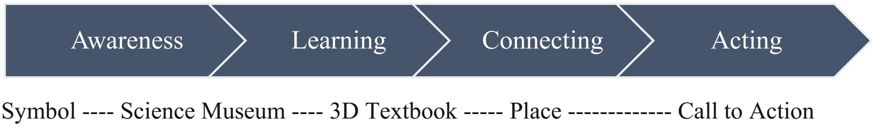


Fig. 4 The five perspectives in exemplar teaching green buildings

perspectives shows that these special settings could be studied from a variety of disciplinary lenses and for an array of occupant outcomes.

Methods for exploring outcomes in TGBs are similarly diverse. For example, TGB studies to date have employed ethnography to study institutional factors (Henderson 2014), survey research with school administrators to illuminate school culture (Barr 2011), qualitative case analysis of a green school in Bali (Kong et al. 2014), survey research with students in a range of TGBs (Cole 2015), and Photovoice interviews with middle school students to discover environmental education outcomes (Cole 2013a). The overwhelming majority of this research is conducted in schools, and also in unique private and charter schools that have access to excellent green facilities. We know much less about TGBs in places like public schools, civic spaces, and office buildings.

The evidence base for what works in TGBs is yet in the early stages. However, there is a wealth of empirical knowledge from across disciplines that can inform design approaches. That is to say, specific strategies within TGBs can be evidence-based. For example, based on literature reviewed previously, we know that interactive energy feedback enhances energy conservation behaviors, building atmospherics can inspire greater recycling participation, and biophilic design features are linked to a wide range of beneficial psychological outcomes. What is yet missing is an integrative framework to inform the theory and practice of TGB design. The work here intends to make a provisional step in this direction.

9 Conclusion

As implied by the name, the fundamental goal of a "Teaching Green Building" is education. Reviewing theory across disciplines, however, reveals expansive possibilities for these buildings that extends well beyond imparting knowledge. TGBs are an interdisciplinary pursuit, and there is no one way to frame a successful TGB. The purpose of this review of theoretical perspectives is to uncover the multiplicity of lenses that can be used to frame the diverse possibilities for what a TGB is and does. What unites these various approaches is the emphasis on social impacts. The possibilities for social impact range from symbolic meaning to formal/informal environmental education to place-making and environmental behavior change. These impacts are not monolithic but have multiple, potentially overlapping dimensions. For example, design that supports sustainable behaviors has possible overlaps with informal learning outcomes and also sense of place if a building user feels that their actions within a building matter. The perspectives outlined thus present complementary ways of viewing a single setting. The frameworks presented here further offer tools for scholars interested in studying — and practitioners wishing to build — Teaching Green Buildings. At the intersection of these various approaches lie exciting possibilities for making positive change through built form.

References

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology, 25*(3), 273–291. doi:10.1016/j.jenvp.2005.08.002.

Azjen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology, 27*(1), 14–25. doi:10.1016/j.jenvp.2006.12.002.

Barr, S. K. (2011). *Green Schools that Teach: Identifying Attributes of Whole-School Sustainability.* (Degree of Master of Science), Colorado State University, Fort Collins, Colorado.

Brown, Z., Cole, R. J., Robinson, J., & Dowlatabadi, H. (2010). Evaluating user experience in green buildings in relation to workplace culture and context. *Facilities, 28*(3/4), 225–238.

Bullitt Foundation. (2016). Bullitt Center. Retrieved November 1, 2016, from http://www.bullittcenter.org/.

Canter, D. V. (1977). *The psychology of place*. New York: Architectural Press.

Chawla, L. (1998). Significant life experiences revisited: A review of research on sources of environmental sensitivity. *The Journal of environmental education, 29*(3), 11–21. doi:10.1080/00958969809599114.

Clary, E. G., & Snyder, M. (1999). The motivations to volunteer: Theoretical and practical considerations. *Current Directions in Psychological Science, 8*(5), 156–159. doi:10.1111/1467-8721.00037.

Cole, L. B. (2013a). The green building as a medium for environmental education. *Michigan Journal of Sustainability, 1*(1), 161–169. doi:10.3998/mjs.12333712.0001.012.

Cole, L. B. (2013b). *The Teaching Green School Building: Exploring the Contributions of School Design to Informal Environmental Education.* (Ph.D.), University of Michigan.

Cole, L. B. (2014). The Teaching Green School Building: A framework for linking architecture and environmental education. *Environmental Education Research, 20*(6), 836–857. doi:10.1080/13504622.2013.833586.

Cole, L. B. (2015). Green Building Literacy in the school building: A study of five middle schools in the united states. *Children, Youth and Environments, 25*(3), 145–174. doi:10.7721/chilyoutenvi.25.3.0145.

Cranz, G., Lindsay, G., Morhayim, L., & Lin, A. (2013). Communicating sustainability. *Environment and Behavior, 46*(7), 826–847. doi:10.1177/0013916513475449.

Darby, S. (2001). Making it obvious: Designing feedback into energy consumption. In P. Bertoldi, A. Ricci, & A. de Almeida (Eds.), *Energy efficiency in household appliances and lighting* (pp. 685–696). Berlin, Heidelberg: Springer.

Darby, S. (2006). The effectiveness of feedback on energy consumption: A Review for Defra of the Literature on Metering, Billing and Direct Displays. *Environmental Change Institute*, University of Oxford.

Day, E. (2009). *Fostering Whole-Systems Thinking Through Architecture: Eco-School Case Studies in Europe and Japan.* (Undergraduate Honors Thesis), Cornell University, Ithaca. http://ecommons.cornell.edu/handle/1813/13216.

De Young, R. (1993). Changing behavior and making it stick: The conceptualization and management of conservation behavior. *Environment and Behavior, 25*(3), 485.

De Young, R. (2000). New ways to promote proenvironmental behavior: Expanding and evaluating motives for environmentally responsible behavior. *Journal of Social Issues, 56*(3), 509–526.

Eco, U. (1997). Function and sign: The semiotics of architecture. In N. Leach (Ed.), *Rethinking architecture: A reader in cultural theory*. London: Routledge.

Edwards, C. P., Gandini, L., & Forman, G. E. (1997). *The hundred languages of children: the Reggio Emilia approach–advanced reflections*. Greenwich, Conn.: Ablex Pub. Corp.

Eshach, H. (2007). Bridging in-school and out-of-school learning: Formal, non-Formal, and informal Education. *Journal of Science Education and Technology, 16*(2), 171–190. doi:10.1007/s10956-006-9027-1.

Falk, J. H., & Dierking, L. D. (2000). *Learning from museums: Visitor experiences and the making of meaning*. Walnut Creek, CA: AltaMira Press.

Falk, J., & Storksdieck, M. (2005). Using the contextual model of learning to understand visitor learning from a science center exhibition. *Science Education, 89*(5), 744–778.

Falk, J., Dierking, L., & Foutz, S. (2007). *In principle, in practice: Museums as learning institutions*. Lanham: AltaMira Press.

Falk, J. H., Heimlich, J. E., & Foutz, S. (2009). *Free-choice learning and the environment*. Lanham: AltaMira Press.

Gruenewald, D. A. (2003). Foundations of place: A multidisciplinary framework for place-conscious education. *American Educational Research Journal, 40*(3), 619–654.

Guy, S., & Farmer, G. (2001). Reinterpreting sustainable architecture: The place of technology. *Journal of Architectural Education, 54*(3), 140–148.

Hattenhauer, D. (1984). The rhetoric of architecture: A semiotic approach. *Communication quarterly, 32*(1), 71–77.

Heerwagen, J. (2000). Green buildings, organizational success, and occupant productivity. *Building Research and Information, 28*(5), 353–367.

Henderson, J. A. (2014). *"Not for Everyone, but Kind of Amazing": Institutional Friction and the Nature of Sustainability Education.* (Ph.D.), University of Rochester.

Hernandez, M., Hidalgo, C., & Ruiz, C. (2013). Theoretical and methodological aspects of research on place attachment. In L. C. Manzo & P. Devine-Wright (Eds.), *Place attachment: Advances in theory, methods and applications*. New York: Routledge.

Hines, J., Hungerford, H., & Tomera, A. (1987). Analysis and Synthesis of Research on Responsible Environmental Behavior: A Meta-Analysis. *Journal of Environmental Education, 18*(2), 1–8.

Hungerford, H. R., & Volk, T. L. (1990). Changing learner behavior through environmental education. *Journal of Environmental Education, 21*(3), 8–22.

International Living Future Institute. (2016). The Living Building Challenge. Retrieved July 1, 2016. http://living-future.org/lbc.

Jencks, C. (1980). The architectural sign. *Signs, symbols and Architecture*, 71–119.

Kaplan, S. (1991). Beyond Rationality: Clarity-based decision making. In T. Gärling & G. W. Evans (Eds.), *Environment, cognition, and action* (pp. 171–190). NY: Oxford University Press.

Kaplan, S. (2000). Human nature and environmentally responsible behavior. *Journal of Social Issues, 56*(3), 491–508.

Kaplan, S., & Kaplan, R. (2009). Creating a larger role for environmental psychology: The Reasonable Person Model as an integrative framework. *Journal of Environmental Psychology, 29*(3), 329–339.

Karjalainen, S. (2016). Should we design buildings that are less sensitive to occupant behaviour? A simulation study of effects of behaviour and design on office energy consumption. *Energy Efficiency, 9*(6), 1257–1270. doi:10.1007/s12053-015-9422-7.

Kellert, S. R. (2011). Dimensions, Elements, and Attributes of Biophilic Design. In S. R. Kellert, J. Heerwagen, & M. Mador (Eds.), *Biophilic design: The theory, science and practice of bringing buildings to life*. New Jersey: John Wiley & Sons.

Kong, S. Y., Rao, S. P., Abdul-Rahman, H., & Wang, C. (2014). School as 3-D textbook for environmental education: Design model transforming physical environment to knowledge transmission instrument. *Asia-Pacific Education Researcher, 23*(1), 1–15.

König, A. (2013). *Regenerative sustainable development of universities and cities: the role of living laboratories*. Northampton, MA: Edward Elgar Publishing.

Kudryavtsev, A., Stedman, R. C., & Krasny, M. E. (2011). Sense of place in environmental education. *Environmental Education Research, 18*(2), 229–250. doi:10.1080/13504622.2011.609615.

Laura Healey, M., & Rosie, P. (2012). Reconceptualizing school design: Learning environments for children and youth. *Children, Youth and Environments, 22*(1), 11–22. doi:10.7721/chilyoutenvi.22.1.0011.

Lepper, M., Greene, D., & Nisbett, R. (1973). Underminding children's intrinsic interest with extrinsic reward: A test of the "overjustification" hypothesis. *Journal of Personality and Social Psychology, 28*(1), 129–137.

Lewicka, M. (2011). Place attachment: How far have we come in the last 40 years? *Journal of Environmental Psychology, 31*(3), 207–230.

Lilley, D., & Wilson, G. T. (2013). Integrating ethics into design for sustainable behaviour. *Journal of Design Research, 11*(3), 278–299.

Louv, R. (2008). *Last Child in the Woods*. New York: Algonquin Books.

Malinin, L. H. & Parnell, R. (2012). Reconceptualizing school design: Learning environments for children and youth. *Children, Youth and Environments, 22*(1), 11–22. doi:10.7721/chilyoutenvi.22.1.0011.

Malone, K., & Tranter, P. J. (2003). School Grounds as Sites for Learning: Making the most of environmental opportunities. *Environmental Education Research, 9*(3), 283–303. doi:10.1080/13504620303459.

Marcinkowski, T. (2010). *Major features of environmental literacy*. Department of Science and Mathematics Education, Florida Institute of Technology. Melbourne, Florida.

Mendell, M. J., & Heath, G. A. (2005). Do indoor pollutants and thermal conditions in schools influence student performance? A critical review of the literature. *Indoor Air, 15*(1), 27–52. doi:10.1111/j.1600-0668.2004.00320.x.

Nair, P., & Fielding, R. (2005). *The Language of School Design: Design Patterns for 21st Century Schools*. Designshare, Inc.

National Academies Press. (2006). Green schools: Attributes for health and learning. http://www.nap.edu/catalog/11756.html.

O'Donnell Wicklund Pigozzi Peterson Architects Inc, Furniture, V. S., & Design, Bruce Mau. (2010). *The third teacher: 79 ways you can use design to transform teaching & learning*. New York: Abrams.

Orr, D. W. (2002). Architecture as Pedagogy II. *Conservation Biology, 11*(3), 597–600.

Orr, D. W. (2006). *Design on the edge: The making of a high-performance building*. Cambridge, MA: MIT Press.

Ozguner, H., Cukur, D., & Akten, M. (2011). The role of landscape and urban planning disciplines to encourage environmental education among primary school children. *Energy Education Science and Technology Part B: Social and Educational Studies, 3*(3), 369–386.

Petersen, J. E., Shunturov, V., Janda, K., Platt, G., & Weinberger, K. (2007). Dormitory residents reduce electricity consumption when exposed to real-time visual feedback and incentives. *International Journal of Sustainability in Higher Education, 8*(1), 16–33.

Ryan, C. O., Browning, W. D., Clancy, J. O., Andrews, S. L., & Kallianpurkar, N. B. (2014). Biophilic design patterns: emerging nature-based parameters for health and well-being in the built environment. *International Journal of Architectural Research, 8*(2), 62–76.

Sawin, J. L., & Hughes, K. (2007). Energizing cities. In L. Starke (Ed.), *State of the World 2007: Our Urban Future*. New York, NY: W.W. Norton.

Scannell, L., & Gifford, R. (2010). Defining place attachment: A tripartite organizing framework. *Journal of Environmental Psychology, 30*(1), 1–10. doi:10.1016/j.jenvp.2009.09.006.

Seibold-Bultmann, U. (2007). What does sustainability look like? Green architecture as an aesthetic proposition. *Interdisciplinary Science Reviews, 32*(1), 3–6.

Sobel, D. (2008). *Childhood and nature: Design principles for educators*. Portland, ME: Stenhouse Publishers.

Söderlund, J., & Newman, P. (2015). Biophilic architecture: A review of the rationale and outcomes. *AIMS Environmental Science, 2*(4), 950–969. doi:10.3934/environsci.2015.4.950.

Somerville, M., & Green, M. (2011). A pedagogy of "organized chaos": Ecological learning in primary schools. *Children, Youth and Environments, 21*(1), 14–34. doi:10.7721/chilyoutenvi.21.1.0014.

Stedman, R. C. (2003). Is it really just a social construction?: The contribution of the physical environment to sense of place. *Society & Natural Resources, 16*(8), 671–685.

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues, 56*(3), 407–424.

Taylor, A. P. (1993). The learning environment as a three-dimensional textbook. *Children's Environments, 10*(2), 170–179.

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. New York, NY: Penguin Group.

Tranter, P. J., & Malone, K. (2004). Geographies of environmental learning: an exploration of children's use of school grounds. *Children's Geographies, 2*(1), 131–155. doi:10.1080/1473328032000168813.

UNESCO. (1976). The Belgrade Charter: A global framework for environmental education. In Unesco (Ed.). Paris, France.

United States Green Building Council. (2008). LEED 2009 for Schools New construction and major renovations. https://www.usgbc.org/resources/leed-schoolsnew-construction-v2009-current-version.

United States Green Building Council. (2009). LEED for New Construction. https://www.usgbc.org/resources/leed-new-construction-v2009-current-version.

Vickers, V. G., & Matthews, C. E. (2002). Children and place: A natural connection. *Science Activities: Classroom Projects and Curriculum Ideas, 39*(1), 16–24.

Wilson, E. O. (1984). *Biophilia*. Cambridge, Mass: Harvard University Press.

Wu, D. W.-L., DiGiacomo, A., Lenkic, P. J., Wong, V. K., & Kingstone, A. (2016). Being in a "Green" building elicits "Greener" recycling, but not necessarily "Better" recycling. *PloS one, 11*(1).

Zacharias, J., & Ling, R. (2014). Choosing between stairs and escalator in shopping centers. *Environment and Behavior, 47*(6), 694–709. doi:10.1177/0013916513520418.

Zachrisson, J., & Boks, C. (2012). Exploring behavioural psychology to support design for sustainable behaviour research. *Journal of Design Research 14, 10*(1–2), 50–66.

Author Biography

Laura Cole is an Assistant Professor of Architectural Studies at the University of Missouri at Columbia where she teaches undergraduate studios, design business practices, and sustainable design. Her current research focuses on the social dimensions of green buildings, with a particular focus on how sustainable design can be environmentally educational for the public.

Blockchain for Good? Digital Ledger Technology and Sustainable Development Goals

Richard Adams, Beth Kewell and Glenn Parry

Abstract

Blockchain technology (aka Distributed Ledger Technology or DLT) is a novel configuration of Peer-to-Peer, cryptographic and distributed computing technologies that have the potential to shift the internet from an internet of information to an internet of value network, with significant disruptive potential. To date, the cryptocurrency 'bitcoin' is the application of DLT that has attracted most attention, not all of it favourable. However, DLTs are about much more than cryptocurrencies and, as Kranzberg's (1986) first law of technology, that 'Technology is neither good nor bad; nor is it neutral' reminds us, we can ethically frame applications of new technologies. To date, research has tended to focus on the technical characteristics of DLTs, and there has been little reflection on potential socially and environmentally beneficial use cases: Blockchain for Good (B4G). The aim of this this exploratory and descriptive paper is to reflect on innovative B4G applications that could help deliver socially and environmentally beneficial outcomes, framed in terms of the UN's Sustainable Development Goals, through challenging existing business models and providing new opportunities for value creation.

R. Adams (✉) · B. Kewell
Surrey Centre for the Digital Economy, University of Surrey,
Surrey GU2 7XH, Guildford, UK
e-mail: r.jadams@btinternet.com

B. Kewell
e-mail: e.kewell@surrey.ac.uk

G. Parry
Strategy and Operations Management, Faculty of Business & Law,
UWE Frenchay Campus, Coldharbour Lane, Bristol BS16 1QY, UK
e-mail: Glenn.Parry@uwe.ac.uk

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_7

1 Introduction

For nearly thirty years, fuelled by an increasing evidence base of anthropogenic environmental degradation as well as growing awareness of global scale injustice and inequality, from lack of food to labour exploitation, the notion of Sustainable Development (WCED 1987) has galvanised action across the most signficant domains of human activity. Sustainable Development was defined in the Brundtland report as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’. The re-casting of the UN’s eight Millennium Development Goals (UN Millennium Project 2005) as 17 Sustainable Development Goals (SDGs), comprising of 169 targets to be achieved by 2030, suggests that considerable effort is required if we are to achieve this objective (UN 2015).

Technological innovations have been mobilised in the cause of Sustainable Development, ranging from those that incrementally enable better use of resources (De Marchi 2012) to those that exploit the affordances of the digital infrastructure to develop new platform-based business models such as the sharing economy and collaborative consumption (Botsman and Rogers 2010).

The Blockchain (aka Distributed Ledger Technology or DLT) is a novel configuration of Peer-to-Peer (P2P), cryptographic and distributed computing technologies that promise an innovation at least as disruptive and transformative as the internet has been (Welch 2015; Davidson et al. 2016; McWaters, et al. 2016; Adams et al. 2017). This promise lies in its capacity to move value (money and other digital assets) across the internet in as seamless and unencumbered a fashion as is the case currently for information.

To date, attention has focused principally on DLT use cases as cryptocurrencies (e.g. Bitcoin) and in financial services[1] such as for improving the efficiency and reliability of clearing and remittance services (Ali, et al. 2014; McWaters, et al. 2016). However, DLTs clearly have applicability for widespread use in other areas (Walport 2016).

In this paper, we focus on what the technology might achieve, not on how it works. Our exploration is framed in the current debate about the potential impact of DLTs, for good or ill (Kranzberg 1986; Krugman 2013). Specifically, the purpose is to extend this debate into an exploration of DLT use cases where it is being used for socially and environmentally beneficial ends: Blockchain for Good (B4G).

We proceed as follows: First, we describe our approach to this exploratory research. Second, we offer a brief overview of the technological characteristics of the Blockchain. Third, we examine the notion that DLTs have unique affordances rendering them appropriate solutions to the SDGs. Consequently, in this article we begin to explore the impact of DLTs on the UN’s Sustainable Development Goals which is the contribution of the paper.

[1] See, for example http://www.r3cev.com/ R3 is a financial innovation firm managing a consortium of some of the world's leading financial institutions to design and deliver DLTs to the global financial markets.

2 Approach

The UN's SDGs provide a vision for governmental, corporate and civic action, throwing down the gauntlet of widespread and systemic change. Social systems move from one technological regime to another, but technologies do not fulfil societal functions on their own. Artefacts by themselves have no power; they do nothing (Geels 2005). Affordance theory suggests that an artefact is perceived in terms of its action possibilities. To promote the uptake of B4G, it is therefore necessary to understand the affordances of DLTs and how these might be mobilised in support of the SDG agenda.

Drawing on Gibson's (1978) work on the ecology of perception, Pea (1993, p. 51) describes as 'Affordance' the "perceived and actual properties of a thing, primarily those functional properties that determine just how the thing could possibly be used". An affordance, then, is what an object or technology offers, provides or furnishes in the context of use: a chair 'affords' sitting or an improvised ladder, a bicycle 'affords' travel or exercise.

A technology affordance is "an action potential…what an individual or organization with a particular purpose can do with a technology" (Majchrzak and Markus 2012). As 'action potential', DLTs can be regarded as a generative mechanism (Volkoff and Strong 2013) through which the SDGs might be achieved. Following Seidel et al. (2013), identifying the affordances of novel technologies that relate to realising SDGs can assist organizations and scientists create the future in which the challenges of sustainability, such as hunger, climate change and social justice, can more determinedly be addressed. That is, what are the affordances of DLTs and how might these affordances contribute to the realisation of the SDGs?

The following thematic analysis (Thomas and Harden 2007) is based on a preliminary search, consisting of keyword searches on the internet, snowballing and expert recommendations, to accumulate a database of instances of B4G practice. Currently, the database consists of approximately 70 discrete B4Gs and the number is expected to grow. At this stage of our exploratory work, inclusion criteria remain quite relaxed and the database consists of B4Gs ranging from the speculative, such as AidCoin (Curion 2015) to fully operational (e.g. Banqu[2]).

3 Blockchain for Good

The Blockchain first appeared, largely unheralded, in 2008. Attention, instead, was directed toward the application whose existence Blockchain Technology made possible. The focal application, and the first to run on a blockchain, was the crypto-currency Bitcoin (Nakamoto 2008; Lemieux 2013).

[2]http://www.banquapp.com/.

The significance of the underlying DLT, is that it enables the digital transfer of value without the need for a trusted third party. Simply put, DLT allows anyone to transact with anyone anywhere on a P2P basis. DLTs enhance the transparency of information exchanges (including payments and deposits), making trust obligations much easier to discharge between transacting parties. This service is normally provided by intermediaries such as banks. DLT reallocates these responsibilities to computers and algorithms (Ali, et al. 2014; Welch 2015; McWaters, et al. 2016). Because of the way in which the technology is configured to allow P2P digital exchange of value, the blockchain, to many observers, represents a revolutionary and disruptive innovation (Swan 2015; Zuberi and Levin 2016).

Fundamentally, a blockchain is a ledger of transactions of digital assets: of who owns what, who transacts what, of what is transacted and when. Transactions are not recorded on a single database, but distributed on the computers of the network of users (nodes) of the system. No single entity owns or controls the ledger and so network members can view the recorded transactions. Transactions are recorded and stored in 'blocks' and each block linked chronologically (hence chain) and cryptographically to those which precede it to create an immutable, tamper-resistant record. All transactions are time-stamped to provide a record of when transactions occurred and in what order: this assures against 'double spending' and tampering with previous transaction records (Reber and Feuerstein 2014). The ledger is 'kept honest' by network consensus, a transaction validation process undertaken by network users, which includes checking that digital signatures are correct through a process known as 'mining': mining is incentivised by reward systems. Once a block is accepted by the network and added to the chain, it cannot be changed: it is a permanent, transparent and immutable record.

Consequently, DLTs may be characterised as globally distributed, P2P, open ledgers of exchange providing an immutable and verifiable record and encrypting the identities of users that is hard to tamper with. Davidson et al. (2016) describe DLTs as a new general purpose technology which are, by definition, highly pervasive and can impact entire economies giving rise to *creative destruction* (Schumpeter 1934; Jovanovic and Rousseau 2005) with the potential to disrupt any centralized system that coordinates valuable information (Wright and De Filippi 2015).

This represents a fundamental change in the way in which humans can exchange value, and two important implications follow. First, because the technology provides the required trust to give peers the confidence to exchange value directly, the requirement for socially-constructed institutional third-party providers of trust is significantly reduced: they become disintermediated. The second implication is that the blockchain presages a new functionality for the internet: *it moves from an internet of information to an internet of value* (Swan 2015). It means, that for objects that can be expressed in code, multiple novel application possibilities are opened up, and raises the question, how can blockchain technology that creates immutable, tamper-resistant distributed records of transactions of digital assets be applied in the service of SDGs?

3.1 Blockchain Properties

Mattila (2016) points out that the technology stack components of DLTs is diverse and can be configured in a variety of ways, resulting in different DLT architectures, implying the need for design decisions. Blockchains can be categorized as Permissioned/Permissionless (aka Unpermissioned) and Specific Purpose Blockchains optimized for the management of assets and General Purpose Blockchains designed to allow users to write their own programs to be stored on the blockchain and automatically executed in a distributed manner. Notwithstanding these divergences, DLTs share certain characteristics which may be more or less attenuated depending on context of application, in particular: the distributed (decentralized) consensus mechanism, immutability, algorithmic trust, resilience against manipulation, and secure information sharing.

Nakamoto's (2008) white paper describes what might be considered to be a pure form of DLT, that is to say a permissionless blockchain encompassing a network of participants that are not known to one another and each of them can access the blockchain with complete freedom to read or write to it, no actor can prevent any other actor from contributing content nor can any actor remove any previously validated contribution; and consensus is incentivised through economic mechanisms. Permissionless Blockchains are therefore highly censorship resistant and can provide an immutable,[3] network-validated global record of transaction histories—right up to the present moment.

On the other hand, anyone[4] may have a copy of the ledger in a permissioned blockchain, but only certain authorised parties may write to it and the consensus process is determined by the owner(s) of that blockchain, usually carried out by trusted actors in the network (CPTM 2016). Assuming that chosen actors honestly and disinterestedly validate transactions, then permissioned blockchains can offer certain advantages, in at least two respects: first, they can be designed with specific functionality in mind and second alternatives to economically-incentivized validation mechanisms (proof-of-work) can be incorporated. As a result, permissioned blockchains can be more efficient and faster than unpermissioned versions (CPTM 2016) but at the cost of reduced security, immutability and censorship-resistance (Mattila 2016).

A sub-category of the permissioned blockchain is the private blockchain in which only certain authorised users have access to the database, whether for reading or writing, which tend to exist behind some organizational firewall, but offer within-group transparency, privacy and control, for a defined set of users.

Whether or not they truly are DLTs continues to be debated, but the permissioned blockchain does have a role in helping deliver the SDG agenda. In the following, we explore some of these further and consider their affordance in terms of the SDGs.

[3]Immutable to the extent that that particular blockchain continues to be maintained. It is not clear what happens in the circumstance that the blockchain ceases to continue.

[4]Anyone, subject to, of course, the nature of the permissions.

3.2 Blockchain Mining

In the Bitcoin blockchain, transactions are validated by network members (nodes) in a process known as mining. This distributed, network-member-driven process, performs the function of the centralized trusted third party intermediary model. Network participants compete with each other using computer power (known as proof-of-work) to validate blocks of transactions every 10 min or so. The proof-of-work is difficult to produce but easy for other nodes to verify and so transaction validity is established by majority consensus of network members. The miner that first successfully validates a block is rewarded with newly minted bitcoins.[5]

That network members commit resources to validating transactions contributes to the cryptographic security and fraud resilience of the bitcoin blockchain. It is configured in such a way that it makes more sense for would be attackers to participate as miners (greater opportunity for reward at lesser cost), thus increasing the resilience of the blockchain (Doguet 2013; Fox-Brewster 2015; Welch 2015).

However, the computationally intensive method of proof-of-work has been described as costly and wasteful (McWaters et al. 2016). As miners around the world competitively dedicate resources to validate transactions, Aste (2016) estimates about a billion Watts are consumed globally every second to produce a valid proof of work for Bitcoin.

In light of this, alternative validation mechanisms are being investigated, some of which resonate with the SDG agenda but also relax some of the communitarian properties of the proof-of-work approach (such as openness to the whole community). Dierksmeier and Seele (2016) argue that it should be possible to promote ethical goals in society, e.g., by hitching the 'mining' to the creation of ecological or social benefits. Certainly, reducing energy consumption in the process would generate ecological benefits and, a small number of initiatives have emerged in this area. SolarCoin,[6] for example, rewards generators of solar energy with new coin; another, GridCoin (Halford 2014) introduces a novel algorithm based on work done in Berkely Open Infrastructure for Network Computing projects: miners are incentivized to participate in scientific projects (e.g. healthcare and space exploration) aiming to provide benefit to humanity. In the CureCoin blockchain, the bitcoin validation calculations are replaced by (useful) protein folding tasks: mining CureCoin helps science through simulating protein behaviour and providing these data to research scientists.

[5]For more details on mining, see Antonopoulos, A.M. (2014). Mastering Bitcoin: unlocking digital cryptocurrencies, O'Reilly Media, Inc.; Swan, M. (2015). Blockchain: Blueprint for a New Economy, O'Reilly Media, Inc., and: http://www.coindesk.com/information/how-bitcoin-mining-works/.

[6]https://solarcoin.org/.

3.3 The Internet of Value(S)

The previous section describes how social or ecological benefit can be linked to the production of alt-currencies. This section focuses on how these benefits can be linked to currency use. The notion of *coloured coins* (Bradbury 2013) is used to denote a small part of a coin with specific attributes which may represent anything from physical assets to a community's values. By moving coloured coins through network, asset ownership can be securely transferred. Similarly, coins coloured with values, in which morals, principles or ethics are embedded in the code, can allow individuals to align their spending closely with their values.

Taghiyeva et al. (2016) describe a proof-of-concept pilot for a blockchain-based Islamic crypto-currency in which transactions and Muslim values, including a blended anti-radicalisation agenda, are aligned: a currency with a community's desirable social principles engineered-in. This resonates with Helbing's (2013, 2014) concept of *Qualified Money* where values can be embedded in DLTs. CarbonCoin[7] claims to be the first digital currency with a conscience, designed to engage the environmentally conscious community. Such possibilities raise important questions about whose values are embedded into a currency and who does the engineering.

In terms of assets, DLTs provide a mechanism both for their registration and transfer. A number of commentators have argued that this may prove a boon in developing or politically unstable economies for the registration of individual's property rights. Where there is a lack of trust in central authorities to maintain uncorrupted registers of assets, such as property title, these may be recorded immutably, transparently, and verifiably on a blockchain. Already, a number of pilots and trial projects are underway: Bitland[8] use DLT to map land title in Ghana providing a registry of ownership which subsequently facilitates the mobilization of capital as well as a transparent property market. Similar initiatives can be found in Honduras (Alejandro 2016), Sweden (Rizzo 2016) and Georgia (Shin 2016). Progress has been slow and success mixed (ODI 2016), attesting to the still emergent nature of the technology. Indeed, it is too easy to get carried away by the theoretical potential of DLTs. While a blockchain based registry of assets may be transparent and immutable, for it to be meaningful in terms of economic participation and activity it must exist within a stable infrastructure: armed aggressors, for example, may still unlawfully seize property regardless of whether or not it is recorded on the blockchain. However, the existence and immutability of the record may act as a deterrent against such behaviour.

[7]http://carboncoin.cc/.
[8]http://bitlandglobal.com.

3.4 Supply Chain

Assets can be registered to the blockchain using unique keys. This provides a register of ownership as well as tracking and pattern of ownership over time. Initiatives that have leveraged this affordance, include Everledger,[9] a permanent ledger for diamond certification and related transaction history transparently recording ownership history and reducing crime, and Provenance[10] who provide a system for tracking materials and products in a manner that is public, secure and inclusive. For the SDGs, this means that claims (e.g., not blood-diamonds or sustainably fished tuna) can be demonstrated to be authentic right through the supply chain, shifting the value system towards origin and provenance (Greenspan 2015).

DLT applications are also being explored in the energy market both as a system enabling individuals to sell excess solar-generated electricity to each other without going through third parties (e.g. PowerLedger[11] and TransActive[12]) as well as developing a market infrastructure for carbon trading, an independent ledger of the permits to emit Earth's allowance of greenhouse gases (Casalotti 2016). One scenario is that, within a short time, every individual on the planet, for example, be issued with an annual carbon allocation trackable on a DLT.

3.5 Innovations in Governance

Blockchains are distributed ledgers transparently recording transactions of assets which, as the notion of *Qualified Money* (above) attests, can include computationally embedded features such as programmable money (cryptocurrencies), programmable contracts (i.e. smart contracts), and organizations made of software (Potts et al. 2016). Here, *code* substitutes for *trust*, and allows for new types of commerce. Appropriately designed, these can be the building blocks of new forms of economic and social governance that meet the objectives of the SDGs.

Smart contracts are computer protocols that facilitate, verify and enforce the performance of a contract: self-executing code. They are the automation of the performance of contracts which only execute when pre-specified conditions are met, thus removing the need for third party resolution. This is an assured and low-cost mechanism that can offer for Bottom of the Pyramid economic actors increased speed, efficiency, and trust that the contract will be executed as agreed, thus enabling arm's length transactions and payments triggered on receipt of goods. A further application is in the realm of providing more secure and inclusive voting and elections. The danger, of course, is that the contract performs no matter what: this raises questions about who writes them (*Quis custodiet ipsos custodies?*), how

[9] http://www.everledger.io/.
[10] https://www.provenance.org/.
[11] http://powerledger.io/.
[12] http://transactivegrid.net/.

to write-in flexibility to respond to and incorporate external events, and individual's free will in connecting with them.

It is a small step from smart contracts to Decentralized Autonomous Organizations (DAOs) which are similarly executed by code but, unlike smart contracts, may include a potentially unlimited number of participants (Buterin 2014). DAOs remain largely untested and use cases relating to SDGs are hard to find: nevertheless, indicative of the infancy of the technology, one major DAO initiative fell victim to misappropriation of approximately $80 m (Price 2016), indicating the need for further developmental work. One area where the concept has been developed is in the creation of DLT mediated organisations made of people but where the governance structure is encoded directly into the technical infrastructure stipulating and enabling the rules and procedures of the organisation that every member of the organisation will have to abide by: such design propositions may help to eliminate fraud and corruption.

3.6 Sharing Economy

The sharing economy has been heralded as one solution to the challenges of sustainability by promoting environmentally sensitive forms of consumption, encouraging different models of ownership and addressing issues such as the under-utilisation of assets. However, some scholars recognise a *Dark Side* (Malhotra and Van Alstyne 2014), partly for its tendency to reinforce the contemporary unsustainable economic paradigm (Martin 2016), partly because some providers' business models are argued to be as much about evading regulations as about sharing, partly for spreading precarity throughout the workforce, for middlemen sucking profits out of previously un-monetized interactions (Scholz 2016) and for being unavailable to disadvantaged groups, those of low socioeconomic status and users from emerging regions (Thebault-Spieker et al. 2015).

DLTs address some of these criticisms by decentralising and disintermediating. Embedding sensors into existing assets, our 'things' can collect and share data. By integrating these data into the blockchain, we can keep an immutable ledger of shared transactions without the need for middlemen (Huckle et al. 2016). La'Zooz[13] is a decentralized transportation platform owned by the community and utilising vehicles' unused space enabling people with private cars to share their drive with others traveling the same route: a decentralized Uber.

La'Zooz generates new tokens from 'Proof of Movement' not 'Proof of Work'. As they drive, drivers earn Zooz, passengers pay using Zooz and can also earn Zooz by providing route advice to drivers. Thus La'Zooz offers to provide a ride sharing service that is based on truer sharing economy principles, rather than monetary incentives (Bheemaiah 2015). The business model moves from rent extraction to value creation in networks: value is distributed amongst those who created it, offering greater reward and opportunity for inclusion.

[13] http://lazooz.net/.

3.7 Financial Inclusion

The opportunity for wider financial inclusion is held up as one of the great promises for SDGs of DLTs. Through automation, disintermediation, low cost and security of transfer comes the opportunity for transactions involving low value units and for remote, disenfranchised, peripheral and marginal communities to connect in new ways either amongst themselves or with activities in the wider world. DLTs allow the almost instantaneous transfer of digital tokens, if not at zero cost then at a significantly cheaper rate than established services. This makes the transfer of small amounts of currency economically viable, enabling new actors to enter the field and new opportunities for e-commerce (Athey 2015). It might be anticipated, then, that reductions in the cost of financial transactions through DLTs will result in widening financial inclusion.

One critical factor in enabling greater financial inclusion is identity which, it is argued (Birch 2014) will underpin future digital transactions and lies at the heart of realising the potential of DLT. The question of what defines identity is challenging, not least because it "does not lend itself easily to definition nor does it remain unchangeable" (Ajana 2010, p. 5).

Identities are made up of multiple attributes: date and place of birth, parents' names, school, criminal record, employment record, biometrics, papers published etc. These attributes reflect who we are and are configurable depending on who we need to identify ourselves to and for what purpose.

Identity is not a single entity but rather it is a structure composed of configurable identity holons (Fish and Priest 2011) which, after Koestler (1968), can be understood as autonomous (id)entities in their own right fulfilling particular purposes, functions and objectives yet contained within a higher level structure of identity. That is, configurations of identity attributes are 'whole' or fit-for-purpose in one form or at one level and simultaneously are part of another. In each case each needs to be sufficient to authenticate the claim we are making.

For most, it is relatively straightforward to assemble authenticated attributes of identity (passport, utility bill, etc.), but approximately 1.8bn of the world's population have no legally recognised identity (Dahan and Gelb 2015). The reasons are various, but the consequence is that the 'identityless' exist on the margins of society unable formally to participate in democratic, educative, healthcare and economic activity.

Part of the problem of identitylessness is the extent to which identity has been a centralised phenomenon, something that, to a large extent, is given to people by some authority. The affordances of DLTs offer an alternative approach to building identities from the bottom up, as the gradual accretion of different attributes of identity. This way, an individual's identity is not under the control or the gift of any central authority, nor is it vulnerable to tampering or theft from malicious third parties. Further, individuals are able to control which attributes may/may not be made public depending on the authentication need. This is currently an area of intense DLT development including initiatives from ID2020,[14] BitNation,[15] BlockchainBorderBank,[16] BanQu,[17] and NevTrace.[18]

4 Conclusion

Global interest in DLTs is gathering pace, yet the world's vision of what we might be able to achieve with it is as limited as it was with regard to the internet and world wide web in the late 1980s. Far-sightedness is required to imagine the possible contribution of DLTs in addressing sustainability-related challenges. This paper has explored, through affordance theory, how DLTs might contribute to that process.

Our exploratory desk research has inherent methodological limitations. Intended as a scoping study to begin to explore the notion of B4G, the work is characterized by a high level of subjectivity in both its sample selection and analysis. As such, the results cannot be said to be representative or generalizable at any level. However, in terms of B4G, as an emergent phenomenon or shared interpretative schema that is being co-constructed by a wide ecosystem of actors as a means of giving direction and catalyzing actions, choices and behaviours (Ranson et al. 1980), our findings are interesting inthemselves and provide a promising basis for further research. Obvious extensions of this work include tighter specification of an analytic framework 'for good' and validating initial findings with a panel of experts through Delphi study. The essential premise of technology affordance is that, to understand the uses and consequences of technologies, they must be considered in the context of their dynamic interactions between people and organizations (Majchrzak and Markus 2012), DLTs are a case-in-point. Further applied research and development are required which, given the sensitivities of the domain, require a multi-stakeholder, living-lab ethnographic approach, to understand which configurations of DLT and their affordances work best in which circumstances and why, as well as the extent to which they can deliver on the sustainability agenda.

Within this limited space, we have presented a rather one-sided, limited perspective and are aware that DLTs are not a universal panacea. The notion of Blockchain for Good inevitably raises questions about its counter, 'Blockchain for Bad', and there exists, beyond the scope of this paper, a body of cautionary literature. Analysing crypto-currencies through the lens of ethical impact, Dierksmeier and Seele (2016) also find detrimental outcomes, such as the facilitation of nefarious consumption. Physicist Stephen Hawking, Elon Musk and, as of 12 November 2016, 8749 others have signed an open letter counselling against the incautious application of artificial intelligence and DAOs (Russell et al. 2015). DLTs feel no guilt, regret or remorse. This raises questions about who will do the coding. As yet,

[14] http://id2020.org/.
[15] https://bitnation.co/.
[16] http://law.mit.edu/blockchainborderbank.
[17] http://www.banquapp.com/.
[18] http://nevtrace.com/.

there is little regulation specific to DLT. Still, might DLTs yet be subsumed by incumbent organizations and authorities as another tool of control and surveillance, or can they really deliver a more democratic, egalitarian, collaborative and sustainable society?

Acknowledgements The authors gratefully acknowledge the support of a BA/Leverhulme Small Research Grant (SG160335) in the preparation of this work.

References

Adams, R., Parry, G., Godsiff, P., & Ward, P. (2017). Editorial: The future of money and further applications of the blockchain. *Strategic change: Briefings in Entrepreneurial Finance*.
Ajana, B. (2010). Recombinant identities: Biometrics and narrative bioethics. *Journal of Bioethical Inquiry, 7,* 237–258.
Alejandro, J. (2016). Blockchain for good—A beginner's guide. http://tech.newstatesman.com/guest-opinion/blockchain-for-good-beginners-guide. Accessed 30 Sept 2016.
Ali, R., Barrdear, J., Clews, R., & Southgate, J. (2014). Innovations in payment technologies and the emergence of digital currencies. *Bank of England Quarterly Bulletin, 54*(3), 262–275.
Aste, T. (2016). The fair cost of bitcoin proof of work. https://ssrn.com/abstract=2801048 or http://dx.doi.org/10.2139/ssrn.2801048. Accessed 26 Feb 2017.
Athey, S. (2015). 5 Ways digital currencies will change the world. https://www.weforum.org/agenda/2015/01/5-ways-digital-currencies-will-change-the-world/. Accessed 15 Nov 2016.
Bheemaiah, K. (2015). Why business schools need to teach about the blockchain. Available at SSRN. http://ssrn.com/abstract=2596465.
Birch, D. (2014). *Identity is the new money.* London Publishing Partnership.
Botsman, R., & Rogers, R. (2010). *What's mine is yours: How collaborative consumption is changing the way we live.* HarperBusiness.
Bradbury, D. (2013). Colored coins paint sophisticated future for Bitcoin. http://www.coindesk.com/colored-coins-paint-sophisticated-future-for-bitcoin/.
Buterin, V. (2014). DAOs, DACs, DAS and more: An incomplete terminology guide.
Casalotti, A. (2016). Global carbon trading on the blockchain. Bitcoin and blockchain leadership forum.
CPTM. (2016). *Commonwealth partnership for technology management (CPTM) brief on "Adaptive flexibility approaches to financial inclusion in a digital age: Recommendations and proposals".* London: CPTM Smart Partners' Hub.
Currion, P. (2015). AidCoin: A revolution in humanitarian financing. https://medium.com/@paulcurrion/introduction-513f86ed92df#.ebhmrftlz. Medium.com. Accessed 15 Dec 2016.
Dahan, M., & Gelb, A. (2015). *The role of identification in the post-2015 development agenda.* World Bank Working Paper 2015.
Davidson, S., De Filippi, P., & Potts, J. (2016). Economics of blockchain. http://ssrn.com/abstract=2744751.
De Marchi, V. (2012). Environmental innovation and R&D cooperation: Empirical evidence from Spanish manufacturing firms. *Research Policy, 41,* 614–623.
Dierksmeier, C., & Seele, P. (2016). Cryptocurrencies and business ethics. *Journal of Business Ethics,* 1–14.
Doguet, J. (2013). The nature of the form: Legal and regulatory issues surrounding Bitcoin digital currency system. *Louisiana Law Review, 73*(4), 1118–1153.
Fish, J. N., & Priest, J. B. (2011). Identity structures: Holons, boundaries, hierarchies, and the formation of the collaborative identity. *The Family Journal, 19,* 182–190.
Fox-Brewster, T. (2015). How hackers abused tor to rob blockchain, steal bitcoin, target private email and get away with it. *Forbes, 24*(2), 7.

Geels, F. W. (2005). *Technological transitions and system innovations: a co-evolutionary and socio-technical analysis.* Edward Elgar Publishing.
Gibson, J. J. (1978). The ecological approach to the visual perception of pictures. *Leonardo, 11,* 227–235.
Greenspan, G. (2015). MultiChain private blockchain—White paper. http://www.multichain.com/white-paper/. Multichain.
Halford, R. (2014). Gridcoin—Crypto-currency using Berkeley open infrastructure network computing grid as a proof of work. http://www.gridcoin.us/images/gridcoin-white-paper.pdf.
Helbing, D. (2013). Economics 2.0: The natural step towards a self-regulating, participatory market society. *Evolutionary and Institutional Economics Review, 10,* 3–41.
Helbing, D. (2014). Qualified money-a better financial system for the future. Available at SSRN 2526022.
Huckle, S., Bhattacharya, R., White, M., & Beloff, N. (2016). Internet of things, blockchain and shared economy applications. *Procedia Computer Science, 98,* 461–466.
Jovanovic, B., & Rousseau, P. L. (2005). General purpose technologies. *Handbook of economic growth, 1,* 1181–1224.
Koestler, A. (1968). *The ghost in the machine*. Oxford, England: Macmillan.
Kranzberg, M. (1986). Technology and history:" Kranzberg's laws". *Technology and Culture, 27,* 544–560.
Krugman, P. R. (2013). Bitcoin is evil. http://krugman.blogs.nytimes.com/2013/12/28/bitcoin-is-evil/?_r=1. New York Times. Accessed 26 Apr 2016.
Lemieux, P. (2013) Who is Satoshi Nakamoto? *Regulation, Fall 36,* 14–15.
Majchrzak, A., & Markus, L. (2012). *Technology affordances and constraint theory of MIS*. Thousand Oaks, CA: Sage.
Malhotra, A., & Van Alstyne, M. (2014). The dark side of the sharing economy… and how to lighten it. *Communications of the ACM, 57,* 24–27.
Martin, C. J. (2016). The sharing economy: A pathway to sustainability or a nightmarish form of neoliberal capitalism? *Ecological Economics, 121,* 149–159.
Mattila, J. (2016). The blockchain phenomenon: The disruptive potential of distributed consensus architectures. http://brie.berkeley.edu/BRIE/. Berkeley roundtable on the international economy (BRIE). Berkeley: University of California.
McWaters, R., Galaski, R., & Chaterjee, S. (2016). The future of financial infrastructure: An ambitious look at how blockchain can reshape financial services: World economic forum.
Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. *Consulted, 1,* 28.
ODI. (2016). Applying blockchain technology in global data infrastructure. http://theodi.org/technical-report-blockchain-technology-in-global-data-infrastructure. Open Data Institute.
Pea, R. D. (1993). Practices for distributed intelligence and designs for education. In G. Salomon (ed.), *Distributed cognitions: Psychological and educational considerations*. Cambridge, UK: Cambridge University Press.
Potts, J., Davidson, S., & De Filippi, P. (2016). Disrupting governance: The new institutional economics of distributed ledger technology. Available at SSRN.
Price, R. (2016). Digital currency ethereum is cratering amid claims of a $ 50 million hack. *Business Insider,* 17 June, 2016.
Ranson, S., Hinings, B., & Greenwood, R. (1980). The structuring of organizational structures. *Administrative Science Quarterly, 25,* 1–17.
Reber, D., & Feuerstein, S. (2014). Bitcoins-hype or real alternative? *Internet Economics VIII*, 81.
Rizzo, P. (2016). Sweden tests blockchain smart contracts for land registry. *CoinDesk*, June 16, 2016.
Russell, S. V., Dewey, D., & Tegmark, M. (2015). Research priorities for robust and beneficial artificial intelligence: An open letter. A association for the advancement of artificial intelligence.
Scholz, T. (2016). Platform cooperativism: Challenging the corporate sharing economy, New York. www.rosalux-nyc.org. Rosa Luxemburg Stiftung.

Schumpeter, J. A. (1934). *The theory of economic development: An inquiry into profits, capital, credit, interest and the business cycle*. London, UK: Oxford University Press.

Seidel, S., Recker, J., & Vom Brocke, J. (2013). Sensemaking and sustainable practicing: Functional affordances of information systems in green transformations. *MIS Quarterly, 37,* 1275–1299.

Shin, L. (2016). Republic of georgia to develop blockchain land registry system. *Forbes,* 21 April.

Swan, M. (2015). *Blockchain: Blueprint for a new economy*. O'Reilly Media, Inc.

Taghiyeva, M., Mellish B, & Ta'eed, O. (2016). Currency of intangible non-financial value. https://github.com/seratio/whitepaper. IoV blockchain alliance for good (www.bisgit.org).

Thebault-Spieker, J., Terveen, L. G., & Hecht, B. (2015). *Avoiding the south side and the suburbs: The geography of mobile crowdsourcing markets*. Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing, 2015. 265–275.

Thomas, J., & Harden, A. (2007). *Methods for the thematic synthesis of qualitative research in systematic reviews. Evidence for policy and practice information and co-ordinating (EPPI-) centre, social science research unit*. London: ESRC National Centre for Research Methods.

UN. (2015). Transforming our world: The 2030 agenda for sustainable development. https://sustainabledevelopment.un.org/post2015/transformingourworld.

UN Millennium Project. (2005). *Investing in development: A practical plan to achieve the millennium development goals*. New York: United Nations and Earthscan.

Volkoff, O., & Strong, D. M. (2013). Critical realism and affordances: Theorizing IT-associated organizational change processes. *MIS Quarterly, 37,* 819–834.

Walport, M. (2016). Distributed ledger technology: Beyond block chain. A report by the UK government chief scientific adviser. Government office for science.

WCED. (1987). *Our common future. World commission on environment and development*. Oxford, United Kingdom: Oxford University Press.

Welch, A. (2015). The bitcoin blockchain as financial market infrastructure: A consideration of operational risk. *Legislation and Public Policy, 18,* 837–893.

Wright, A., & De Filippi. P. (2015). Decentralized blockchain technology and the rise of lex cryptographia. Available at SSRN 2580664.

Zuberi M, & Levin, R. (2016). Schumpeter's revenge: The gale of creative destruction. *Banking and Financial Services Policy Report,* 35(5).

Part II
Research and Behavioral Interventions

Psychological Distance and Response to Human Versus Non-Human Victims of Climate Change

Christie Manning, Hannah Mangas, Elise Amel, Hongyi Tang, Laura Humes, Rowena Foo, Vera Sidlova and Kelly Cargos

Abstract

Despite the serious threat of climate change to sustainability, people in the United States feel little urgency to address the issue. The goal of this research project was to use psychological methods to better understand why Americans respond to climate change the way they do, and to assess strategies to spur a

C. Manning (✉) · H. Mangas · H. Tang · L. Humes · R. Foo · V. Sidlova · K. Cargos
Macalester College, 1600 Grand Avenue, Saint Paul, MN 55105, USA
e-mail: cmanning@macalester.edu

H. Mangas
e-mail: hmangas@macalester.edu

H. Tang
e-mail: jlzx20070606@126.com

L. Humes
e-mail: humes.laura@gmail.com

R. Foo
e-mail: rwnfoo@gmail.com

V. Sidlova
e-mail: vera.sidlova@gmail.com

K. Cargos
e-mail: jasc65.kcargos@gmail.com

E. Amel
University of Saint Thomas, JRC LL56, 2115 Summit Avenue, St. Paul,
St. Paul, MN 55105, USA
e-mail: Elamel@stthomas.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_8

stronger action-oriented response. Using Construal Level Theory as a foundation, three psychological studies explored the perceived psychological distance of climate change, empathy toward victims of climate change, and people's willingness to take action. Past research suggests that perceptions of low psychological distance toward climate change are associated with higher concern and willingness to take action. In the current research, participants read short scenarios about climate change and how it impacts specific victims, such as geographically and socially similar people (low psychological distance) or a geographically and socially dissimilar social agent such as an animal (high psychological distance). Using both self-report surveys and implicit methods, our studies examined the relationship between psychological distance and response to climate change. Consistent with other research, we found that psychologically closer framings of climate change do not always effectively ameliorate psychological distance, nor result in greater intention to act. Our results further suggest that people may engage in psychological distancing when faced with climate change suffering. These findings provide important insights for effective communication about challenging sustainability issues.

Keywords
Psychological distance · Climate change · Empathy · Sustainability communication · Framing

1 Introduction

Despite scientific consensus that climate change is a serious concern, the American public has been slow to respond. If we are to achieve the social equity, economic viability, and environmental stability inherent in long-term, global sustainability we must make earnest progress to solve climate change. One of the challenges, perhaps especially in the United States, of eliciting significant ameliorative action is that climate change is perceived as far away and not relevant to most Americans' personal experience. Indeed, research from the social science discipline of psychology suggests that one potential barrier to action on climate change may stem from this perception that climate change is a faraway, future problem. From the perspective of Construal Level Theory (Trope and Liberman 2010), this subjective sense, called psychological distance, likely decreases our emotional and behavioral response (Marx et al. 2007; Weber 2006). The present research builds upon the theoretical framework of Construal Level Theory to explore whether the psychological distance of climate change could be mitigated, and how. By exploring individual response to climate change using the methods of psychology, we hope to offer a new perspective on ways to communicate climate change to promote action, and progress toward sustainability.

Construal Level Theory (CLT) offers a compelling theoretical framework to investigate the psychological distance of climate change. According to CLT, psychological distance occurs along four dimensions: spatial distance (how geographically far away the event is), temporal distance (how far in the past or the future), hypotheticality (how uncertain the event is), and social distance (whether the entities affected by the event are important or related to the referent individual) (Trope and Liberman 2010; Spence et al. 2012). Climate change is arguably high on all dimensions of distance (Milfont 2010). Its risks are characterized by "high levels of uncertainty, by strongly delayed consequences, and by consequences that occur at distant places and are – therefore – borne by others" (Gattig and Hendrickx 2007, p. 22).

A key premise of CLT is that psychologically distant objects and events are represented, or construed, differently than those that are psychologically near. Essentially, the more distant something is in psychological space, the more abstractly we think about it and represent it in the brain. Objects and events perceived as psychologically distant are encoded in high construal representations that retain only the high-level, superordinate features of the entity. Scholars suggest that because climate change is widely perceived as psychologically distant, and not an immediate or personal threat (e.g., Spence et al. 2012), it is likely mentally encoded in a high-level construal as predicted by CLT (Milfont 2010). This high level construal thus strips the issue of its low level details, such as sensory information, specific contexts, visceral emotions, or other tangible qualities that tend to evoke a sense of urgency, engagement, and motivation to act (e.g., Marx et al. 2007; Weber 2006).

Researchers have speculated that it should be possible to spur people to greater concern and action through lowering psychological distance. Studies supporting this facilitative relationship include, for example, an interview study by Spence et al. (2012), which found a correlation between lower psychological distance and increased concern. In a framing study by Jones et al. (2016), participants exposed to a more proximal framing of climate change showed higher concern and intention to act. Similarly, Scannell and Gifford (2011) found that a geographically local (and thus spatially close) depiction of climate change increased participant self-reported engagement with the issue (e.g., "How likely are you to seek out information about climate change?").

Not all studies have shown support for a relationship between psychological distance and individual response to climate change; recent results are mixed (Brügger et al. 2016; McDonald et al. 2015). One reason for these mixed findings likely stems from the wide variation in operational definitions and manipulation of psychological distance, as well as the wide range of dependent variables used to measure its effects, such as 'concern', 'engagement', 'motivation', and 'intention' or 'willingness' to act. In addition, McDonald et al. (2015) suggest that an attempt to lower psychological distance by making climate change more proximal may in fact cause people to emotionally distance themselves from it (McDonald et al. 2015).

The current set of studies adds to this growing literature on psychological distance and climate change, exploring how lower distance along different dimensions of climate change may promote individual concern and action. Across our three studies, we use scenarios describing those suffering impacts of climate change. We focus in particular on the social distance dimension by varying, in all three studies, whether the sufferer is human or non-human. Past research suggests that lowering social distance increases engagement with otherwise psychologically distant issues. For example, Pahl and Bauer (2013) found that perspective taking with future humans facing severe environmental degradation increased people's intention to take action as well as their time spent looking at information about environmental degradation. Schultz (2000) also showed that perspective taking with images of animals being harmed by human actions correlated with higher environmental concern. Other studies suggest that forming an empathy or compassion bond with otherwise psychologically distant social agents, human and non-human, results in greater willingness to take action (e.g., Berenguer 2007) or increased support for climate mitigation policy (e.g., Lu and Schuldt 2016), for emotions such as empathy and compassion lower social distance by increasing sense of similarity with the 'other' through shared emotions (Decety and Lamm 2009).

The following three studies examine these predictions of Construal Level Theory by examining how both empathy and psychological distance may vary in response to different victims of climate change impacts. The studies use social science methods, namely implicit and explicit measures of psychological responses, to understand why challenging and urgent sustainability issues such as climate change seem to lack behavioral traction, at least in the United States.

2 Study 1

In Study 1 we examined the effect of two dimensions of psychological distance, spatial and social, on people's perceptions of climate change distance and their stated willingness to take action. We hypothesized that the presence of a human social agent would decrease psychological distance and increase willingness to donate, and that spatial proximity would have the same effect.

2.1 Participants

One hundred sixty-one adult Minnesota residents (ages 18–73) participated in the study. Fifty-eight percent identified as male, 39% female, and 3% did not identify a gender.

2.2 Design and Materials

We used a 2 × 2 experimental design. Participants read a scenario describing impacts of climate change on a particular group. Within the scenario we varied two dimensions of psychological distance: spatial distance (climate change was described as impacting Minnesota or Kenya) and social distance (the group who was impacted was either people or an iconic bird species). We measured the effects of the different scenario versions on participants' perceptions of climate change using a set of 14 questions we created to assess the dimensions of distance as well as the issue's general salience. Participants indicated their agreement with each of 14 statements using a 7-point Likert scale (ex. "The idea of climate change makes me want to take action."). Responses ranged from "Strongly Disagree" to "Strongly Agree." We also measured participants' willingness to make a donation to address climate change with a single question answered on a 7-point Likert scale.

2.3 Procedure

Participants were recruited through local Minnesota online networks such as Facebook and email listservs. They completed the study online. Participants were randomly assigned to one of four conditions and they read a short text-based scenario describing the effects of climate change on their assigned group (Minnesota loons, Minnesotans, Kenyan flamingos, Kenyans). After reading the scenario, participants answered the set of survey questions including the psychological distance scale, willingness to donate, and demographic questions.

2.4 Results

We found no significant main effect for spatial distance or social distance, however, we observed a significant interaction between spatial distance and social distance (F (1, 94) = 5.912, p = 0.017) on participants' level of psychological distance (see Fig. 1), with lowered psychological distance for Loons in Minnesota and People in Kenya, and conversely higher psychological distance for People in Minnesota and Flamingoes in Kenya. We also found a marginally significant interaction for willingness to donate (F (1, 94) = 3.581, p = 0.062); see Fig. 2), showing the same pattern.

2.5 Discussion

Our findings suggest that framing climate change as solely impacting humans versus non-humans does not affect psychological distance. Similarly, presenting the effects of climate change in a local context alone also does not change the psychological distance of climate change. However, the interaction between social

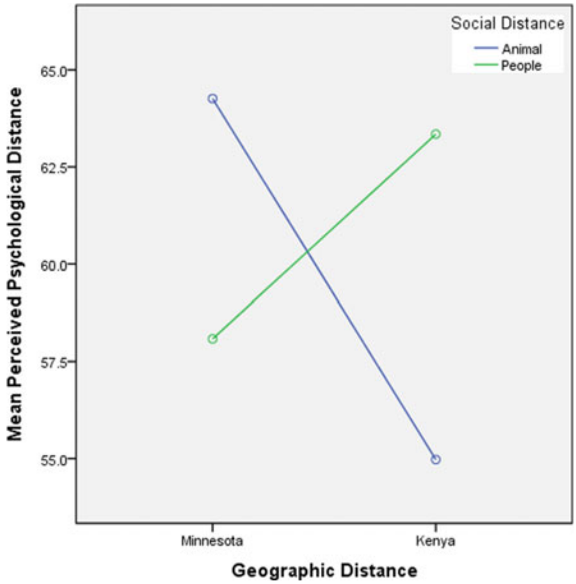


Fig. 1 Participants' Psychological Distance in the four conditions of Study 1

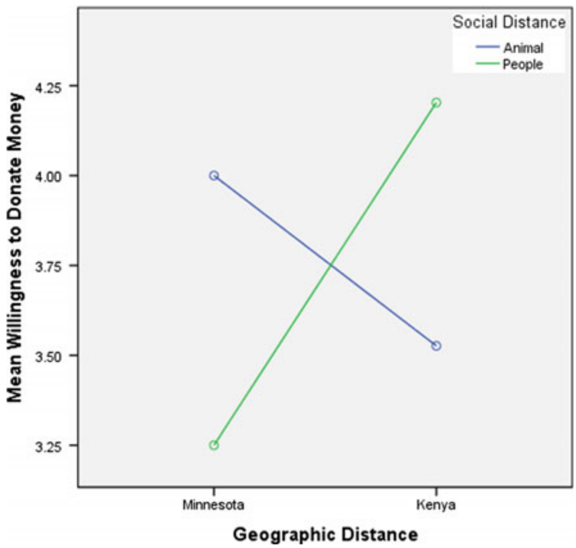


Fig. 2 Participants' willingness to donate in the four conditions of Study 1

distance and spatial distance indicates that we respond differently to humans and animals affected in local as opposed to distant contexts. Participants expressed less sense of distance to climate change, and greater willingness to donate, when presented with loons in Minnesota, but when reading of climate change in Kenya, the mention of people being affected elicited significantly lower psychological distance than the mention of flamingos. This suggests that whether we understand climate change as a local or a faraway issue changes our responsiveness to human and non-human social agents.

Our findings may in part be explained by an unintended confound in our materials. That is, Americans tend to believe that climate change is more likely to impact people in distant countries (Leiserowitz 2005), and news reports often emphasize climate vulnerability in developing lands. Thus, the suffering of people in Kenya may be more believable to participants than the suffering of Minnesotans. Spence et al. (2012) similarly found among their participants a higher willingness to act in response to impacts in developing countries compared to local impacts. Their study, however, explored impacts only on people, and not non-human species.

It is also possible that our participants engaged in psychological distancing to resist the idea that climate change could affect people like them, a response suggested by McDonald et al. (2015). When our scenarios described climate change as impacting geographically close people (i.e., Minnesotans), participants expressed greater psychological distance than when our scenarios depicted geographically distant people (i.e., people in Kenya) or socially different sufferers (i.e., loons in Minnesota), suggesting that participants may have psychologically distanced themselves from information that may have made climate change too personally close.

Study 2 was designed to address two questions that arose from Study 1. First, we wanted to remove the potential confounding factor of the use of a developing land (Kenya) in our scenarios, and (2) use a new, implicit measure of people's response to climate change, to test whether psychological distancing might be taking place.

3 Study 2

Research suggests that psychological distance effects manifest implicitly as well as explicitly. Bar-Anan et al. (2006) found that participants associated words that implied more distance with words implying higher level of construal on an Implicit Associations Test (IAT). Implicit attitudes are defined as "introspectively unidentified (or inaccurately identified) traces of past experience that mediate favorable or unfavorable feeling, thought, or action toward social objects" (Greenwald and Banaji 1995). They often differ from self-reported attitudes because they are not identified on the conscious level and therefore cannot be reported explicitly.

Study 2 had three conditions: a distant climate change scenario (describing *future* climate change impacts on *cactus wrens* in *Arizona*), a near climate change scenario (describing *present* climate change impacts on *loons* in Minnesota), and a control condition with no scenario. In this study, we again measured participants' perceived level of psychological distance after reading a scenario. In addition, we added an implicit measure to gauge participants' implicit, below-conscious-awareness perception of psychological distance. We administered a Go/No-go Association Test (GNAT), which assesses implicit associations between two concepts, and in the current study, we constructed the GNAT to measure implicit connections participants held between climate change and the concept of distance. We predicted that if participants read a spatially, socially, and temporally distant climate change scenario, they would implicitly associate "climate change" with "far", whereas participants who read a proximal climate change scenario would implicitly associate "climate change" with "near".

In addition to evaluating participants' implicit perception of psychological distance toward climate change, we also added an additional explicit measure of pre-existing ideology in Study 2 by asking participants to place themselves in one of the categories of the "Climate change 6 Americas" analysis (Leiserowitz et al. 2011).

3.1 Participants

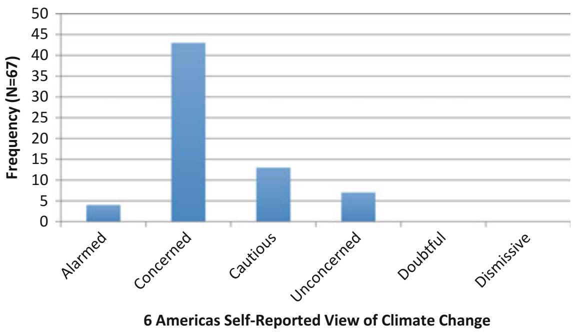
Ninety-five residents of Minnesota between the ages of 18–80 participated in the study. Forty-three identified as male, 51 female, and one did not specify a gender. Twenty-eight participants were dropped from the data analysis due to either missing more than half of the survey questions or not properly completing the GNAT portion of the study, for a total remaining participant set of 67. Figure 3 shows the remaining participants' 6 Americas categorization breakdown.

3.2 Design and Materials

Participants in Study 2 were randomly assigned to one of three conditions: high distance, low distance, and no scenario. We measured the effects of the different conditions on participants' perceptions of climate change using the same set of 14 Psychological Distance questions used in Study 1.

Additionally, we measured participants' implicit perception of the psychological distance of climate change using the GNAT which assesses "the strength of association between a target category and two poles of an attribute dimension" (Nosek and Banaji 2001, p. 627). Specifically, the GNAT is comprised of a number

Fig. 3 Six Americas breakdown for participants in Study 2



of trials that pair a category word (e.g., "climate change") with one of two attribute words (e.g., "far in time" or "near in time") at the top of the computer screen. In the center of the screen (beneath the target and attribute words) different stimuli words flash one after another in quick succession on a set time interval (ex. 750 ms). Participants must quickly hit the spacebar if the word in the center of the screen is associated with *either* of the two words at the top of the screen (the category or the attribute word irrespectively), indicating that the word is a "go". If the word in the center of the screen is *not* associated with either of the two words above, then participants are instructed to do nothing, thus indicating that the word is a "no-go".

Participants' responses favor one target-attitude pairing over the other based on their implicit attitudes. If a participant implicitly feels that Attribute A is more congruent with the target category, they respond more accurately during trials in which Attribute A is paired with the target category. Conversely, they respond less accurately during trials in which Attribute B is paired with the target category. The stronger the implicit association between the given target and attribute, the more accurate the participant's responses will be during those trials. Thus, the GNAT interprets more accurate responses as indicative of a strong implicit association between the given category and attribute, which in turn suggests an implicit attitude that reflects this preference.

Our target category was "climate change" and our two attributes were "near in time" and "far in time". We selected these two attributes because they represent the two poles of temporal psychological distance. We also chose to test a second category, "presidential election", which at the time of data collection in August 2012 was three months in the future, as a distractor task that was not evaluated, pairing it with the same two attributes. Stimuli words belonged to one of the four groups mentioned above ("climate change", "presidential election", "near in time", or "far in time").

Our GNAT was composed of 8 trials. The first two trials were practice trials—the first trial presented only one category word ("fruit") and required participants to press the spacebar when a word associated with "fruit" appeared on the screen. The second trial presented the category "fruit" and the attribute "good" and operated like a regular GNAT trial. The last six trials presented randomized pairings of "climate change" and "near in time" or "far in time", and "presidential election" and "near in time" or "far in time". We expected that participants who had been primed to think about climate change distantly (high-distance scenario) would have greater sensitivity in the *climate change + far* condition. We expected that participants who had been primed to think about climate change as near (low-distance scenario) would have greater sensitivity in the *climate change + near* condition. Finally, we expected that participants who received no scenario (control) would demonstrate greater sensitivity in the *climate change + far* condition. The two climate change pairings were repeated once in each trial, as were the distractor pairings. In total, the test took about 12 min to complete.

To identify pre-existing ideological stance on Climate change, participants were presented with the name and a short description of each of the six groups described in the Climate Change 6 Americas segmentation analysis of Americans, created by

Leiserowitz and colleagues (Leiserowitz et al. 2011). Participants select the category they feel most describes their response to climate change. The categories are: Alarmed, Concerned, Cautious, Unconcerned, Doubtful, and Dismissive.

3.3 Procedure

Participants were recruited in person at the Minnesota State Fair. After agreeing to take part in the study, participants were randomly assigned to one of three conditions. Depending on the condition they were assigned, participants read no scenario at all, or they read either the high distance or low distance version of a short text. All participants answered a few preliminary questions, including a question asking them to categorize themselves according to the “Climate Change 6 Americas” analysis. After reading the scenario and answering the preliminary survey questions, participants completed the GNAT test on a laptop computer. Each received a US$5 prize for completing the 15-minute study.

3.4 Results

We analyzed our GNAT data using a 3-way mixed design ANOVA. Between-subjects independent variables were scenario condition (manipulated independent variable: high distance, low-distance, or none) and the 6 Americas category (quasi-independent variable). The Attribute distance within the GNAT (*near* vs. *far*) was a within-subject independent variable. Our survey dependent variable was psychological distance as measured by the 14-item Psychological Distance scale. Our GNAT repeated-measures dependent variable was sensitivity (d′) for Attribute *near* and Attribute *far*.

D-prime (d′) represents the discriminability of signal from noise in the GNAT. In other words, d′ is a measure of the extent to which participants were able to identify the GNAT targets from the GNAT distractors. In the GNAT, stimuli are *signals,* or targets, when they are rightly associated with the target category or attribute. Stimuli are *noise,* or distractors, when they are unrelated to the given category or attribute. The GNAT operates by recording hits (correct identification of a target) and false alarms (incorrect identification of a distractor). Sensitivity (d′) is calculated, following Nosek and Banaji (2001), using Signal Detection Theory and converting hit rates and false alarm rates into z-scores and then calculating a difference score. In the GNAT, higher sensitivity in a pairing condition (e.g., *climate change* + *near* shows higher sensitivity than *climate change* + *far*) reflects a stronger association and implicit attitude (Nosek and Banaji 2001). In analyzing our results, we calculated means of sensitivity (d′) to both the Attribute *near* and the Attribute *far*.

We found no main effect on the GNAT for sensitivity between Attribute *near* or Attribute *far*. We furthermore found no significant main effect for the 6 Americas self-categorization on either the survey or on the GNAT. Additionally, there was no

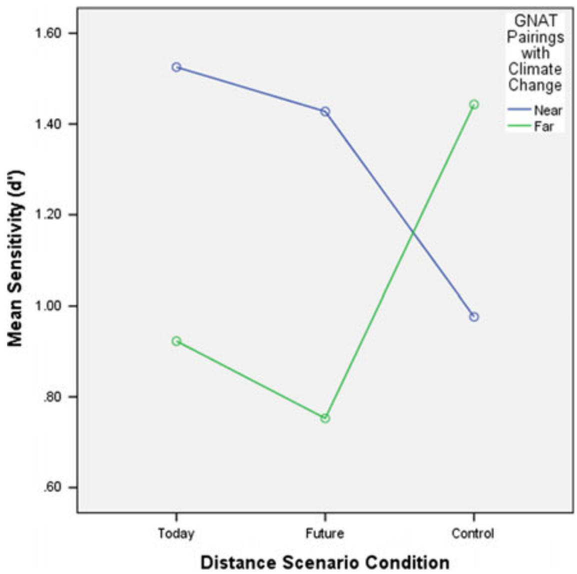


Fig. 4 Average sensitivity across the three scenario conditions

significant interaction between GNAT Attribute and 6 Americas category, nor was there a significant interaction between the three independent variables (GNAT Attribute, scenario condition, and 6 Americas self-categorization). However, there was a significant interaction between GNAT Attribute and scenario condition, F (2, 56) = 6.43, p = 0.003. The average sensitivity (d′) for both Attribute conditions (*near* and *far*), across the three scenario conditions are shown in Fig. 4. These results suggest that Attribute and scenario condition together, controlling for the 6 Americas category, significantly impacted participants' sensitivity to signal stimuli, such that those participants who had received either of the scenarios, high-distance or low-distance, were more sensitive to the *climate change* + *near* pairing than the control group who did not read a scenario. In contrast to the GNAT data, we found no significant effect of scenario condition on participants' psychological distance scores, recorded on their surveys and analyzed in a separate 3-way ANOVA.

3.5 Discussion

Our results indicate that participants who received any concrete scenario about climate change, regardless of whether the scenario described climate change as near or distant, had a stronger implicit associate between climate change and the idea of nearness. Conversely, participants who did not receive a scenario responded with more sensitivity to the pairing *climate change* + *far*, implying a stronger implicit associate between climate change and the idea of distance. These implicit findings were not replicated on the survey responses. Instead, participants who received concrete scenarios did not differ from the control group (no scenario) in their psychological distance scores. Study 2 findings indicate, at an implicit level, unconscious psychological distance does appear to be decreased by reading anything concrete about climate change—even something that describes it as distant temporally and geographically, and affecting non-human social agents. During an explicit evaluation of climate change, such as the process participants engaged in when answering our survey questions, however, may indeed prompt psychological distancing from the issue, as suggested by McDonald et al. (2015).

4 Study 3

Our results from Study 2 suggest that the high psychological distance response to Minnesotans in Study 1 could be a result of participants' inability to explicitly express their internal responses to climate change, or even intentional psychological distancing. Study 3 was thus designed to reexamine the question raised by Study 1: do people respond differently to human vs. non-human victims of climate change, and why? In Study 3, we added several new elements. First of all, we created a brief description of a forest fire, and we varied within our survey the social agent who was impacted by the forest fire: a person, a moose, or a tree. Secondly, we added two perspective-taking conditions: participants were instructed to either imagine how the sufferer feels in the situation (empathy condition) or to remain objective and focus only on the facts (objectivity condition). Third, we chose to examine a new set of dependent variables drawn from the literature: behavioral intention (Gifford and Comeau 2011) and moral obligation to help the sufferer (Lu and Schuldt 2016). Following Lu and Schuldt (2016) and others, we hypothesized that the differences in our dependent variable would be mediated by emotion such as empathy, and we thus added measures of empathy and personal distress. Finally, in Study 3 we chose to control for participants' 6 Americas identification in several of our analyses, as other studies suggest that individuals who hold extreme viewpoints are unlikely to be swayed by new information, such as our stimulus materials, when that information does not align with their beliefs. This is likely to be true for people who identify themselves at either extreme of the 6 Americas (Leiserowitz et al. 2011; Kahan et al. 2010).

4.1 Participants

Participants (N = 253) residing throughout the United States were recruited through Amazon Mechanical Turk and compensated US$1.00 for their participation in the study. Forty-seven of these were excluded from analyses due to inordinately short survey completion times (under seven minutes) that led the researchers to believe that not all questions were fully read or answered to the best of subjects' abilities; this yielded a final sample size of N = 207. Figure 5 shows the remaining participants' 6 Americas categorization breakdown.

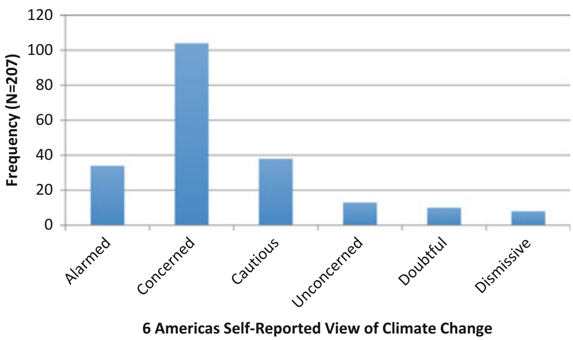


Fig. 5 Breakdown of Study 3 participants' 6 Americas placements

4.2 Design

A 3 × 2 factorial design was used, and both variables, social agent and perspective-taking condition were between-subjects variables. The social agent variable had three levels (human, moose, and tree), and perspective-taking had two levels (empathy and objectivity).

4.3 Materials

A total of six survey versions were created to represent each combination of social agent and empathy level conditions. All surveys included a preliminary set of questions about participants' feelings toward climate change, as well as the Climate Change 6 Americas categorization. This was followed by a short passage about one of three social agents living in and depending on a forest, which was accompanied by an image of that social agent or, in the case of the human condition, a house, in a forest. The survey included several multiple choice questions about specific climate change impacts (e.g., drought, extreme storms, rising temperatures) and their effects on forests like the one previously described. Participants were instructed to answer the questions either objectively or by actively thinking about how the social agent would feel in the situation. Each question was followed by an explanation of the correct answer. After the questionnaire, participants responded to questions measuring empathy and personal distress (Berenguer 2007), moral obligation toward the social agent and climate change in general, intentions to engage in pro-environmental behaviors (adopted from Gifford and Comeau 2011), moral obligation to help the social agent, and brief demographic questions.

4.4 Procedure

After clicking on the Mechanical Turk survey link, and agreeing to participate, participants were randomly assigned to one of the six experimental conditions. The survey began with the 6 Americas measure. Participants then read their assigned scenario and viewed a picture of the relevant social agent (person, moose, tree), and were given instructions to either answer the subsequent multiple choices questions with either a focus on the objective facts (objectivity condition) or a focus on how the social agent would feel in the situation (empathy condition). Questions were presented one at a time, and after giving a response, participants were told whether they had answered correctly, and given an explanation of the correct answer. After answering the multiple choice questions, participants completed the rest of the survey, including measures of empathy, personal distress, moral obligation toward the social agent, intentions to engage in pro-environmental behaviors, and demographics. The survey took about 10 minutes to complete.

4.5 Results

We examined differences in three dependent variables: reported moral obligation to help the relevant social agent, moral obligation to do something about climate change, and behavioral intentions, across the six combinations of social agent (human, moose, or tree) and perspective conditions (empathy, objectivity) using a factorial MANOVA. Results showed a significant between-subject main effect for empathy level on participants' moral obligation to help the social agent ($F(1147) = 3.994$, $p < 0.048$) Contrary to our hypothesis, a pairwise comparison found participants in the perspective taking condition reported lower moral obligation to help the social agent ($M = 2.960$) than those receiving objectivity instructions ($M = 3.394$), $p = 0.010$ (See Fig. 6). Unlike Study 1, in Study 3 we observed no differences across our three different social agents (person, moose, tree).

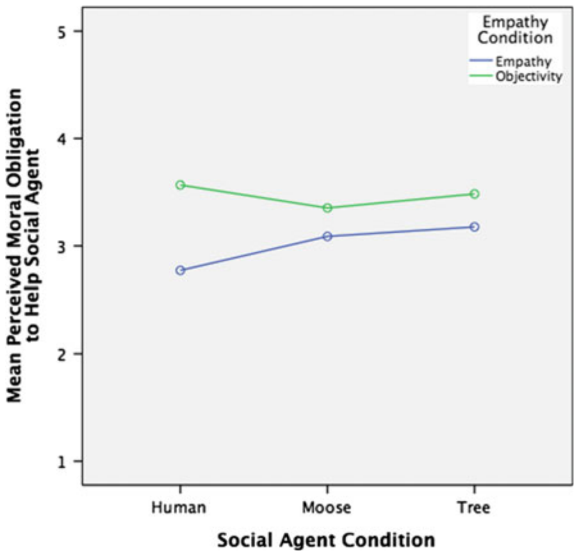


Fig. 6 Mean perceived moral obligation to help the social agent focused on in each condition

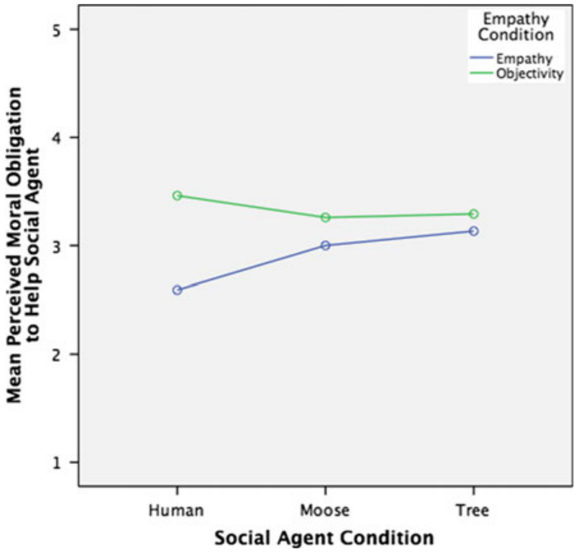


Fig. 7 Mean perceived moral obligation to help the social agent focused on in each condition, excluding data from participants at each extreme end of the 6 Americas

We conducted the remaining analyses excluding participants who marked themselves as one of these extreme positions (excluded: N = 41). An ANOVA for the remaining data set again revealed a similar main effect for perspective taking on moral obligation to help the social agent, $F(1159) = 5.796$, $p = 0.017$. Again, there were no significant differences among the groups' reported moral obligation to help against climate change (See Fig. 7).

A final ANOVA was conducted with participants' 6 Americas ratings as a fixed factor. No significant differences were found among the groups in this analysis.

To examine the relationship between empathy and our dependent variables, we performed a correlation analysis and found a positive correlation between participants' empathy score and moral obligation to help the social agent ($r = 0.542$, $p = 0.000$), motivation to address climate change ($r = 0.545$, $p = 0.000$), and behavioral intentions ($r = 0.436$, $p = 0.000$). When the 6 Americas categorization was included, partial correlations were no longer significant between empathy and the three dependent variables.

4.6 Discussion

The overarching conclusion of Study 3 is that beliefs about climate change are deeply rooted and difficult to change through short-term manipulations or interventions such as reading a brief scenario describing climate change impacts. Participant moral obligation to help was most strongly predicted by pre-set attitude toward climate change as recorded in the self-reported 6 Americas categorization.

Individuals are likely to view new information regarding climate change through the lens of their previously established opinions, knowledge, and values.

Longer-term, more personally compelling experiences may be more effective at changing opinions or eliciting motivating emotional reactions than merely spreading information. This finding also underscores the importance of accurately evaluating any given audience's pre-existing feelings about climate change before designing a strategy to maximize the obligation they feel to help those suffering from the effects of climate change.

However, this will not always be possible; few situations outside of controlled research settings grant those leading pro-environmental efforts the opportunity to assess the exact views of each individual whom they are trying to motivate. The other results of this study provide insight into ways to frame climate change when information about pre-existing views is not readily available. The finding that specific instructions to empathize with a victim of climate change actually decrease moral obligation to help that victim—particularly when that victim is human—aligns with previous findings about defensive psychological distancing of distressing topics. McDonald et al. (2015) discuss a behavior pattern of defensive and avoidant reactions to climate change when people are faced with the dangers that it poses to humanity. The instructions given to participants in the empathy condition in the present study may have made the climate change impacts covered by the stimulus materials too personally relevant, and participants thus engaged in a process of distancing to avoid emotional discomfort. This is further supported by the non-significant trend participants in the human social agent condition showed the greatest difference between the two perspective taking conditions.

Furthermore, the consistent discrepancy between reported moral obligation to help the specific social agent and moral obligation to do something to combat climate change in general suggests that while concern for specific victims of climate change can be elicited, it does not necessarily translate into general concern about climate change. This partially explains why famous images related to specific victims of climate change do not necessarily make climate change a concrete or low-construal enough issue for people to be more willing to act to combat it. This aligns with the findings of Leviston et al. (2014) that the famous image of a polar bear standing on a melting iceberg elicits strong emotional arousal from viewers, but it does not translate to more general concern and willingness to help against climate change.

5 Conclusions

Our research began with the premise that the psychological distance of climate change is a significant barrier to an effective response. We examined whether framing climate change in proximal terms could lower psychological distance, increase empathy for those suffering from climate change impacts, and increase people's willingness to act. Our results suggest two main conclusions.

First, across three studies, we found support for the idea that people engage in a process of psychological distancing when faced with information that could potentially make climate change more personally relevant. When our scenarios described climate change as impacting geographically close people (i.e., Minnesotans), participants expressed greater psychological distance than when our scenarios depicted geographically distant people (i.e., people in Kenya) or socially different sufferers (i.e., loons in Minnesota). The findings of our second study, using an implicit measure, suggest that the results from our first study were, indeed, due to participants attempting to psychologically distance themselves. In Study 2 we found a discrepancy between our results from implicit and explicit measures. Implicit measures suggested that participants implicitly perceived lower psychological distance after reading concrete information about climate change compared to a control group who did not read about climate change. When asked explicitly through a survey, however, the same participants showed no effect from having read about climate change. Finally, participants in our third study also appeared to engage in psychological distancing: those participants who were instructed to intentionally empathize with a sufferer of climate change actually showed lower empathy than those participants instructed to remain objective. Though the results of each study are not conclusive by themselves, the pattern across our three studies is consistent and suggests that people engage in motivated cognitive processes to keep climate change psychologically distant. These findings align with those of other researchers, such as McDonald et al. (2015), who suggest that people may psychologically distance themselves when confronted with troubling information about climate change.

Second, the findings of Study 3 indicate that people's response to climate change is probably relatively stable and unlikely to change in response to information such as the climate change scenarios we presented. Participants' self-reported 6 Americas category was a far stronger predictor of moral obligation to help a victim of a climate-change-fueled forest fire than our experimental manipulations. However, the interaction we saw in Study 1 between social and geographic distance, leading to both lower psychological distance and higher willingness to donate for people in Kenya compared to people in Minnesota, suggests there may be an exception to this inflexibility in people's response to climate change. It is unclear why this is the case, but other studies also suggest that people in industrialized countries such as the UK and US feel a sense of responsibility toward climate change victims in less developed lands (e.g., McDonald et al. 2015; Spence et al. 2012).

Our findings, however, also suggest it may be possible to tap into empathy to lessen psychological distancing and increase individuals' willingness to help others. Further research can provide greater insight into this. Future studies should furthermore examine whether real-world, personal encounters with climate change, rather than hypothetical ones like the scenarios created for our studies, may impact psychological distance differently, and in doing so, prevent intentional defensive distancing.

Our studies were limited by several factors, for example, our participants tended to already be somewhat concerned about climate change. Our findings are thus not generalizable to a more general American, much less the international, population. In addition, because the studies took place on Mechanical Turk or at a state fair, participants may have not given their full attention to the questions; a laboratory study or measures which require less time and cognitive effort could address this.

This research examined a critical aspect of sustainability, response to climate change. through the social science perspective of psychology. Our findings add to the growing literature advising caution regarding how the urgency of climate change is communicated. The implications of our findings are relevant to all efforts to increase people's awareness of the challenging and often intimidating issues of sustainability. Though it is intuitively appealing to make climate change and other threats to sustainability personally relevant to people, this approach seems to backfire. Much more research is needed to understand how to inform people about the real and growing dangers we face in ways that motivate an effective response.

References

Bar-Anan, Y., Liberman, N., & Trope, Y. (2006). The association between psychological distance and construal level: Evidence from an Implicit Association Test. *Journal of Experimental Psychology: General, 135,* 609–622. doi:10.1037/0096-3445.135.4.609.

Berenguer, J. (2007). The effect of empathy in proenvironmental attitudes and behaviors. *Environment and Behavior, 39,* 269–283. doi:10.1177/0013916506292937.

Brügger, A., Morton, T. A., & Dessai, S. (2016). "Proximizing" climate change reconsidered: A construal level theory perspective. *Journal of Environmental Psychology, 46,* 125–142. doi:10.1016/j.jenvp.2016.04.004.

Decety, J., & Lamm, C. (2009). The biological basis of empathy. In J. T. Cacioppo & G. G. Bernston (Eds.), *Handbook of neuroscience for the behavioral sciences*. New York: Wiley.

Gattig, A., & Hendrickx, L. (2007). Judgmental discounting and environmental risk perception: Dimensional similarities, domain differences, and implications for sustainability. *Journal of Social Issues, 63*(1), 1, 21–39. 10.1111/j.1540-4560.2007.00494.x.

Gifford, R., & Comeau, L. A. (2011). Message framing influences perceived climate change competence, engagement, and behavioral intentions. *Global Environmental Change, 21,* 1301–1307. doi:10.1016/j.gloenvcha.2011.06.004.

Greenwald, A., & Banaji, M. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review, 102,* 4–27. doi:10.1037/0033-295X.102.1.4.

Jones, C., Hine, D. W., & Marks, A. D. G. (2016). The future is now: Reducing psychological distance to increase public engagement with climate change. *Risk Analysis*. doi:10.1111/risa.12601.

Kahan, D. M., Jenkins-Smith, H., & Braman, D. (2010). Cultural cognition of scientific consensus. *Journal of Risk Research, 14*(2), 147–174. doi:10.1080/13669877.2010.511246.

Leiserowitz, A. (2005). American risk perceptions: Is climate change dangerous? *Risk Analysis, 25* (6), 1433–1442. doi:10.1111/j.1540-6261.2005.00690.x.

Leiserowitz, A., Maibach, E., Roser-Renouf, C., & Smith, N. (2011). *Global Warming's Six Americas, May 2011*. Yale University and George Mason University. New Haven, CT: Yale Project on Climate Change Communication.

Leviston, Z., Price, J., & Bishop, B. (2014). Imagining climate change: The role of implicit associations and affective psychological distancing in climate change responses. *European Journal of Social Psychology, 44,* 441–454. doi:10.1002/ejsp.2050.

Lu, H., & Schuldt, J. (2016). Compassion for climate change victims and support for mitigation policy. *Journal of Environmental Psychology, 45,* 192–200. doi:10.1016/j.jenvp.2016.01.007.

Marx, S. M., Weber, E. U., Orlove, B. S., Leiserowitz, A., Krantz, D. H., Roncoli, C., et al. (2007). Communication and mental processes: Experiential and analytic processing of uncertain climate information. *Uncertainty and Climate Change Adaptation and Mitigation, 17*(1), 47–58. doi:10.1016/j.gloenvcha.2006.10.004.

McDonald, R. I., Chai, H. Y., & Newell, B. R. (2015). Personal experience and the 'psychological distance' of climate change: An integrative review. *Journal of Environmental Psychology, 44,* 109–118. doi:10.1016/j.jenvp.2015.10.003.

Milfont, T. L. (2010). Global warming, climate change and human psychology. In V. Corral-Verdugo, C. H. García-Cadena, & M. Frías-Arment (Eds.), *Psychological approaches to sustainability: Current trends in theory, research and practice*. New York: Nova Science.

Nosek, B. A., & Banaji, M. R. (2001). The Go/No-Go Association Task. *Social Cognition, 19*(6), 625–664.

Pahl, S., & Bauer, J. (2013). Overcoming the distance: Perspective taking with future humans improves environmental engagement. *Environment and Behavior, 45,* 155–169. doi:10.1177/0013916511417618.

Scannell, L., & Gifford, R. (2011). Personally relevant climate change. *Environment and Behavior, 45*(1), 60–85. doi:10.1177/0013916511421196.

Schultz, P. W. (2000). Empathizing with nature: The effects of perspective taking on concern for environmental issues. *Journal of Social Issues, 56,* 391–406. doi:10.1111/0022-4537.00174.

Spence, A., Poortinga, W., & Pidgeon, N. (2012). The psychological distance of climate change. *Risk Analysis, 32*(6), 957–972. doi:10.1111/j.1539-6924.2011.01695.x.

Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological Review, 117*(2), 440–463. doi:10.1037/a0018963.

Weber, E. U. (2006). Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). *Climatic Change, 77,* 103–120. doi:10.1007/s10584-006-9060-3.

Bridging the Gap Between Policy and Action in Residential Graywater Recycling

L. Bell

Abstract

This study explores the social dimensions of local climate adaptive policies through an Arizona policy, the 2010 Residential Gray Water Ordinance (RGWO). An ecological model of behavior is used as a framework for analyzing the complex relationship between sustainably focused policy initiatives and their success or failure at the individual level. Water cycle fluctuation will be significantly impacted by global climate change in upcoming decades and additional demand for potable water will increase due to growing urban populations. The reuse of residential graywater is an underutilized option for reducing potable water use, municipal energy use, and greenhouse gas emissions, with seemingly little negative impact on public health. The RGWO is a policy passed in Tucson, Arizona, requiring new single family and duplex housing be built with separate graywater plumbing to enable graywater recycling for irrigation. Local adaptations of such policies often depend on a variety of unforeseen factors and few studies have considered the role architects, activists, builders, and citizens play in the success of local climate adaptive initiatives. Data from in-depth guided interviews was used to develop insight into how different stakeholders can impact policy implementation. Eight participants were interviewed through a snowball sampling of local graywater installation professionals, educators, activists and researchers. Data from interviews was transcribed, coded, analyzed for themes presented within an ecological framework. The aim of this paper is to offer new perspectives on integrating sustainably focused policies by evaluating social and political barriers encountered at multiple levels through an ecological model: individual, interpersonal, organizational, community and policy levels.

L. Bell (✉)
Human-Environment Relations, Department of Design and Environmental Analysis, Cornell University, Ithaca, NY, USA
e-mail: lmb377@cornell.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*, World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_9

Keywords
Graywater · Building ordinance · Implementation · Barriers
Water conservation · Qualitative methods

1 Climate Adaptive Policy Integration

This case study of an Arizona policy, the 2010 Residential Gray Water Ordinance (RGWO), explores the social dimensions that may support or undermine sustainably oriented regional policy initiatives. Water cycle fluctuation will significantly impacted by global climate change in upcoming decades and additional demand for potable water will increase due to growing urban populations (Sokolow et al. 2016). For cities to adapt to climate change and become more sustainable, we must imagine how water policy can enable widespread conservation (Makropoulos and Butler 2010). Increasingly, policy makers recognize the need to integrate climate change adaptation into policy design (Urwin and Jordan 2008). To date, most discussions over adaptive policy integration have been focused at national and international levels. However, local adaptations of such policies often depend on a variety of unforeseen factors. Academics and policy makers have not deeply explored the role stakeholder actors play in individual policies geared towards climate adaptation. As municipalities are increasingly interested in designing policies for water recycling, it is critical to understand the socio-technical barriers to successful policy implementation so policies can better address them. Evaluating policy integration from a bottom-up approach acknowledges the importance of various stakeholders involved in implementing the RGWO. While neither approach offers a complete picture of the potentially enabling or constraining effects of different stakeholders on future adaptive planning, the aim of this paper is to offer new perspectives on integrating sustainably focused policies by evaluating social and political barriers encountered at the multiple levels through an ecological model: individual, interpersonal, organizational, community and policy levels (Moskell and Broussard 2013).

2 Graywater Systems

Areas particularly impacted by water scarcity have the most to gain from climate adaptive water policies. The Southwestern portion of the U.S. is especially sensitive to rising temperatures and increased drought (U.S. Environmental Protection Agency 2016). With no unallocated renewable water supplies in the American Southwest, emerging water demands need to be met by reallocating existing supplies, overdrafting groundwater, reusing water, or desalting seawater (Sokolow

2016). The reuse of residential graywater is an underutilized option for reducing potable water use, municipal energy use (Mehta 2009), and greenhouse gas emissions, with seemingly little negative impact on public health (National Academies of Sciences, Engineering, and Medicine 2016; EPA 2008; Yu et al. 2013). Therefore graywater reuse provides one sustainable strategy for reducing urban water demand.

Graywater in the U.S. is defined as wastewater from residential clothes washers, bathtubs, showers, and sinks not including wastewater from kitchen sinks, dishwashers or toilets (Roesner et al. 2006), and accounts for approximately 45% of household water (DeOreo et al. 2016). In the arid Southwest, 60–70% of municipal water use occurs at a residential scale, with most water being used outdoors for landscaping and pools (Holway 2009). By reusing residential graywater, municipalities could significantly reduce water demand and energy costs associated with landscaping.

However, research is still needed on potential impacts on human health and long-term impacts of graywater on plants, soil chemistry and microbiology. After examining the potential long term impacts of graywater constituents on soil and groundwater quality, plant and human health, Sharvelle and colleagues (2012) found that most landscape plants were healthy under long-term graywater irrigation. Although graywater irrigation did result in accumulation of sodium, surfactants, and antimicrobials in the soil, the sodium increase after five years was not significant enough to raise concern about soil quality or plant health but salts could leach through soil when graywater is used for irrigation. While residential reuse of graywater seems possible at a broad scale, using graywater successfully for irrigation requires the consideration of various factors, including soil drainage, rainfall, climate and vegetation. Although designing homes for graywater reuse has the potential to promote sustainable living, residential graywater reuse requires both policy support and the behavioral input of multiple agents for widespread success. If municipalities hope to engage individuals in a decentralized water management system, it is critical to consider stakeholder needs at various stages of policy implementation.

3 Residential Gray Water Ordinance

Recognizing the potential of graywater for more effective water use, the city of Tucson put the Residential Gray Water Ordinance into effect in 2010 requiring new single-family and duplex housing to be built with separate graywater plumbing to enable residential graywater recycling for irrigation (City of Tucson 2010). Stating that, "Gray water is a valuable resource as it makes 'double use' of potable water that would otherwise go down the drain. …Gray water can save a typical household 13,000 gallons of potable water per year…[and] a desert community should do everything possible to conserve water and promote efficient use of water resources."

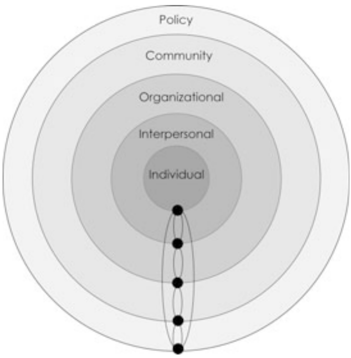
the RGWO represents an example of local climate adaptive policy (City of Tucson 2010).

On September 23, 2008, the City of Tucson adopted a Residential Gray Water Ordinance (No. 10579) put into effect July 1, 2010 mandating the following:

1. All new single family and duplex residential dwelling units shall include either a separate multiple pipe outlet or a diverter valve, and outside “stub-out” installation on clothes washing machine hook-ups, to allow separate discharge of gray water for direct irrigation.
2. All new single family residential dwelling units shall include a building drain or drains for lavatories, showers, and bathtubs segregated from drains for all other plumbing fixtures, and connected a minimum of three (3) feet from the limits of the foundation, to allow for future installation of a distributed gray water system.
3. All gray water systems shall be designed and operated according to the provisions of the applicable permit authorized by ADEQ under the Arizona Administrative Code, Title 18, Chapter 9 (City of Tucson 2010).

Updates to the RGWO were made on July 9, 2013 to include minimum graywater fixture requirements, to encourage the use of gravity fed systems, and to mandate appropriate repercussions for the negligence of the ordinance. As most urban buildings are plumbed to route all wastewater to the sewer, retrofitting a home for graywater reuse can be costly (Lancaster 2006), RGWO makes it easier and less costly for residents to reuse graywater and conserve potable water. Although over 2000 homes have been built after the ordinance, there is no information available on whether or not the ordinance has facilitated graywater reuse.

4 The Ecological Model



Author’s interpretation of McLeroy et al. (1988)

Ecological models of behaviors provide frameworks for alterations and changes in social or physical environments through multi-level analysis ranging from high-level policy to tangible design (Moskell and Broussard 2013). Stemming from Urie Bronfenbrenner's original Ecological Framework for Human Development (Bronfenbrenner 1979) ecological systems theory espouses that in order to understand human development and behavior, the contextual ecological system must be considered (Bronfenbrenner and Morris 2007; Bronfenbrenner and Evans 2000). Policy implementation literature has utilized similar models, for example, Young (2002) used the terms macro, meso, and micro to describe varying (vertical and horizontal) scales at which policy development activities can take place and intersect.

A variety of ecological models have been used in environmental and community psychology to evaluate how individual behavior both affects and is affected by the social environment, and how behavior both shapes and is shaped by multiple levels of influence. The ecological model (McLeroy et al. 1988) employed in this study categorizes behaviors and their influencers into five categories: individual, interpersonal, organizational, community, and policy. This model provides a helpful framework for analyzing behavior and beliefs within a nested system, enabling researchers and policy makers to target barriers at multiple levels (described in Table 1).

The ecological model is an appropriate framework to examine climate adaptive policy as it illuminates the daily complexities and challenges inherent in public policy due to multiple players and spheres of influence on decision making (Schensul and Trickett 2009). In their article on adaptive water management and social learning, Stokols et al. (2003) discuss the importance of understanding the complexities of human-environment-technology systems for more integrated water management. Due to this complexity, there is uncertainty in the understanding of water use system elements and interactions, including interruptions, feedback loops, and delays that generate those trends. Multiple stakeholders have different ideas about the causes of problems, producing a variety of appropriate and legitimate solutions. Understanding the potential for multi-level interventions could prove critical for policy adoption (Stokols et al. 2003).

Table 1 An ecological perspective: levels of influence

Levels of influence	Description
Individual	Individuals and characteristics that influence behavior on a direct level: beliefs, values, education
Interpersonal	Interacting individuals, interpersonal processes, with primary groups including family, friends, peers
Organizational	Rules, regulation, policies, and informal structures impacting the individual
Community	Formal and informal cultural and social networks, associations, and neighborhoods
Policy	Policies and regulations affecting individuals

Source Author's interpretation of McLeroy et al. (1988)

5 Objectives

Through in-depth guided interviews, the study aims to address the following research questions:

Q1. How might we conceptualize stakeholder roles in implementing the climate adaptive Residential Gray Water Ordinance?
Q2. What barriers do stakeholders (builders, architects, educators and policy makers) face when designing residential housing for dual plumbing?
Q3. What considerations might other municipalities have in enacting similar policies?

Based on results from the guided interviews, the proposed recommendations will consider interactions and interdependence of levels of the ecological model. Coded results will be presented to reflect multi-level intervention points to encourage residential graywater recycling.

6 Methods

6.1 Exploratory Interviews

In-depth semi-structured interviews were conducted with eight participants, five of whom were current graywater users. The purpose of the interviews was to explore the participants' perceptions of how and why the Residential Gray Water Ordinance was developed, how well it has served its purpose and the perceived barriers to residential graywater recycling among both policymakers and residential builders. The interviews examined how Pima County, Arizona architects, builders, homeowners and graywater stakeholders understand the current and potential impact of a graywater building ordinance meant to enable water recycling on private properties in Tucson, Arizona.

6.2 Participant Recruitment and Procedure

A snowball sample was used to gather participants whose professional fields are related to or have been impacted by, the Residential Gray Water Ordinance. The sampling began with fourteen individuals publically recorded as part of Tucson's Graywater and Rainwater Stakeholder Group and the Watershed Management Group. Semi-structured interviews evaluated participants involvement with the RGWO and the nature of their professional and their personal experiences with graywater systems. A digital audio recorder was used to record the interviews when participants consented, and in all cases notes were taken during the interviews.

6.3 Analysis

Interviews were transcribed and analyzed using a constant comparative method (Glaser and Strauss 1967) to combine explicit coding procedure with an analytic procedure for theory development. Data analysis followed Glaser and Strauss' (1967) description of the four stages of the constant comparative method, namely:

1. Coding transcribed data into categories of analysis
2. Integrating defined categories and their properties
3. Delimiting theory
4. Writing the theory

The data is presented and discussed below by according to categories emerging from the data and presenting these categories within an ecological model framework. This data will be used to provide background and structure for a large-scale survey carried out in an extension of this study.

7 Analysis

7.1 Macrosystem (Policy) Level Barriers

Author's interpretation of McLeroy et al. (1988)

In the United States, there are no national guidelines mandating the regulation of graywater use; states, counties, and cities are responsible for the governance of graywater use (Tufvesson 2009). Inconsistent plumbing codes and legislation have hindered the development of standardized technological approaches for promoting the reuse of graywater (Little 2000). As of 2013, twenty states some form of graywater reuse, but Arizona and California are considered leaders in promoting graywater reuse because they use a tiered system of regulation created to reflect the extent of potential health risks encountered at different scales (i.e. residential as compared to industrial), making it easier for individuals to recycle small amounts of water from their home (Sharvelle et al. 2012).

Arizona has one of the most permissive graywater laws in the U.S. because it operates on a three-tiered system that provides oversight in proportion to possible impact. This allows low-risk and low volume residential users to use graywater without a permit as long as a series of guidelines are followed (Ludwig 2006). Arizona's Type 1 Reclaimed Water General Permit for Gray Water allows private residents to reuse graywater directly if the flow of water is less than 400 gallons per day. Although a permit is not required, users must legally meet thirteen defined safety conditions (Cupp and Nichols 2011). For this reason, Tucson's Residential Gray Water Ordinance was supported at the state level. This, in turn, made it easier for municipalities and smaller organizations to support policies like the RGWO because state legislation alleviated some liability concern. Climate adaptive policies can be enabled by liability reducing state policies. Local and regional municipalities need to be able to adaptively respond to climate sensitive issues through political action. Enabling local adaptive policies at the state level can encourage more context specific innovative climatic responses.

7.1.1 Non-Integrated Policy Creation

At the time the RGWO was passed, the social and political climate were receptive to graywater usage, and residential graywater was presented as a platform for extending Tucson's water conservation efforts. Before implementing the policy, a group of stakeholders (called Tucson's Graywater and Rainwater Stakeholder Group) was assembled to provide critical feedback on the project. While the policy represented a monumental step forward in acknowledging the potential benefit of residential graywater use, stakeholders voiced concern that lack of specificity in the wording of the ordinance allowed for a flexible interpretation that often benefited the builder rather than the homeowner. Because design specifications were flexible and vague to accommodate a variety of building types, some of the stakeholders believed the ordinance was not implemented in a way that benefited the homeowner.

Interviewed activists noted that graywater stub-outs were placed in locations that were often inaccessible or unnoticed by homeowners (for example, on the side of the house opposite from the yard), thereby deflating the potential of the ordinance. In 2012, revisions were made to the ordinance to both encourage the specific use of gravity fed systems, but to also stipulate enforcement of the ordinance. One water conservation educator noted that design barriers were not simply due to negligence on the part of builders, but to the lack of specificity in the ordinance wording, misplaced incentive mechanisms (discussed later), or a lack of educational outreach to the organizations responsible for implementing the ordinance:

> Some of the issues that emerged were from plumbers and engineers. Many had/have no direct experience with graywater systems and they are relying on outdated information to determine how to install these systems. Many of them turn towards expensive pumps and containers, in part because these are the companies spending the most money on

> advertising, so that's what they see and that is what they think graywater needs to look like (Water Conservation Educator).

By considering how policies may be put into action by various stakeholders, policy makers can preempt potential conflicts of interest or misinterpretations. Designing charrettes or stakeholder scenario planning sessions may improve policy clarity. Additionally, creating a documented standard of design practice for multiple stakeholders could help create consistent standards and resolve ambiguity.

7.1.2 Planning

Planning for the implications of the policy at the regional scale emerged as a controversial element that appeared to hinder the integration of the ordinance. Tucson Water has been producing and delivering reclaimed water since 1984, and one of the first water utilities in the nation to begin recycling water, treating it for irrigation and other non-drinking water use (City of Tucson 2011). One stakeholder explained:

> There has been controversy over whether or not residential graywater reuse at a large scale is a good idea or not. The city reclaims wastewater already, and that may be a more effective effort at water reclamation instead of having individuals reusing their graywater (Water Conservation Researcher).

Currently there are more than 1000 sites using Tucson's reclaimed water for irrigation and landscaping, including: 50 parks, 65 schools, more than 700 single-family homes and 18 golf courses (City of Tucson 2011). Large Scale residential graywater use could deflate the potential for a city run water reclamation program for residential use. Some of the stakeholders speculated that there was a disconnect between the city's pre-established conservation focuses and the RGWO. This finding emphasizes the importance of fitting newly established policies into existing political efforts or frameworks.

7.2 Exosystem (Community) Level Barriers

Author's interpretation of McLeroy et al. (1988)

7.2.1 Collective Action

The theme of collective action at the neighborhood scale emerged as an overlooked aspect of the RGWO implementation. Tucson has fostered a citywide culture around water conservation; participants highlighted the latent potential for communities to work together at the grassroots level to improve their neighborhoods through graywater and rainwater harvesting if communities were orchestrated to do so. One of the builders participating in the study acknowledged that one of the largest issues encountered was a lack of planning as to how to effectively utilize the graywater once a system was installed. Integrating both large neighborhood scale planning (contouring, plot size planning, the potential of sharing irrigation systems) and home site planning into the process of designing residential graywater systems. Directing multiple graywater systems to a shared feature (a park for example) could have a much more powerful outcome for neighborhoods, but there is no overarching organization to make this happen. There is also potential for individuals to work together to collectively grow shared vegetation or shading trees:

> For example, a HOA could easily do this. It's very feasible if people just band together. They could set up graywater and rainwater systems to collectively grow fruit trees or other shading plants, but right now the burden is on the homeowner to do all of this themselves (Residential Builder).

Homeowners may want to implement their own graywater systems but not have the ability to do so at a collective scale:

> Yes graywater is an underutilized resource, yes we need to start using it, but we need people on board for it to work. We need to plan how to utilize the water.

> For a while there was this graywater craze here, people got really into it, but there wasn't enough time spent thinking about how the water would be used or what they might do if they encountered problems. That's why I think it really needs to be thought out better. We could all use more water on our properties (Residential Builder).

Climate adaptive policies may have more impact if they are planned to operate at the community scale and engage private property owners. The field of landscape architecture has acknowledged public engagement as a pathway towards ecological climate adaptive planning (Cerra 2017). Similarly, engaging the potential of grassroots endeavors may amplify the acceptance and integration of water policy and create stronger regional impacts.

7.3 Mesosystem (Organizational) Level Barriers

Author's interpretation of McLeroy et al. (1988)

7.3.1 Feedback Loops

Graywater activists and researchers expressed a frustration at the lack of available knowledge on the repercussions of the RGWO. Although newly built homes were inspected for compliance to the ordinance, research efforts were not made to determine how or if homeowners understood or used their dually plumbed homes for graywater reuse. Builders and graywater activists cited the lack of information as one of the barriers to revising the ordinance to mandate more specific design parameters:

> I'd like to know whether people are aware that their homes are plumbed for graywater use. If they don't know what a stub-out is, I'd like to know what they thought it was and where it was. What do they think graywater harvesting is? What problems have they had? How do they deal with maintenance? (Water Conservation Activist).

There appeared to be a disconnect between what some builders and activists expected and the city's expectations for the ordinance.

> There really is a need to review how and if graywater systems are being used, because we're not seeing what's installed, there's no feedback from the homeowner. The city didn't set up that feedback loop. I'm not really sure why (Water Conservation Activist).

Incorporating plans for evaluating the success of climate adaptive policies can enable better feedback and adjustment of the policy, while also providing insight for other municipalities considering similar initiatives.

7.3.2 Incentives

The city of Tucson's Water Rebate Program offers rebates up to US $1000 and graywater workshops when a permanent graywater irrigation system is installed in a home residence. However only 104 of the rebates had been used by August, 2016 although 773 people attended the workshops (D. Ransom, personal communication, August 11, 2016). Participants speculated that the rebates were not as well utilized because the rebate process was time consuming and because rerouting water from washing machines (laundry to landscape) was relatively inexpensive and easy to do without financial aid. Participants emphasized that architects, builders, and developers were overlooked in the incentivization process, although their actions determine the ease of use for the home owner.

> There are not enough incentives for installing graywater systems, and in new construction, builders were not incentivized to put in graywater systems, even though doing so provides easy access to graywater use in the future (Architect).

The use of incentives can be a powerful motivator if directed towards stakeholders with the most leverage in implementing the policy at hand.

7.3.3 Habitual Routine

Graywater educators suggested that residential graywater use is limited by the habits and routines of individuals and organizations avoidant of new or risky techniques. Practitioners of many fields retain the methods and techniques introduced during their education. Resistance to changing techniques may be due to fear of liability, but also to a lack of educational opportunities.

> I'm not sure why they [plumbers, architects, builders] are so resistant to graywater, it might be a fear of failure, it might be because they're looking at old materials. The ordinance really needs to push gravity fed systems; they're the simplest, the cheapest, and require the least amount of maintenance (Water Conservation Educator).

Architects and builders also expressed frustration at misunderstandings expounded by some graywater activists, explaining that the technical reasons graywater was difficult to design for gravity fed graywater systems was not only restricted to habit and routine but to larger building restrictions based on codes, costs and standardized building practices.

7.4 Microsystem (Interpersonal) Level Barriers

Author's interpretation of McLeroy et al. (1988)

7.4.1 Education

To ensure smooth delivery of policy mandates, educational systems need to be in place to support the introduction of new techniques or new fields. Because designing for graywater systems is still relatively new, many architects, builders, landscape contractors and plumbers were not equipped with the information they needed to install or design for graywater, nor are they necessarily trained to communicate with one another in such a way that integrates architectural and site design. It became evident that a service gap existed for installing and troubleshooting graywater systems. One graywater user recalled his failed attempt to install a valve to easily divert graywater from his washing machine due to an inability to find a plumber who knew how to do the work. Another discussed her confusion over how personal care products can harm plants. Graywater educators advocated for educational workshops for designers, plumbers and contractors, not just homeowners:

> There's also a need to help people trouble shoot their problems. Right now there isn't an easy way for people to get help with their graywater systems. If I were a homeowner who didn't know how to work a graywater system, I don't think I'd know who to call for help. There's a personnel gap; there aren't enough people who know how to work and install graywater systems (Environmental Consultant and Graywater User).

Considering the flow of disseminating information requires complex systems analysis and ongoing stakeholder engagement. Adaptive policies might consider how education for policy implementers could be incorporated into the policy itself.

7.5 Individual

Author's interpretation of McLeroy et al. (1988)

7.5.1 Graywater Awareness

Many stakeholders expressed doubt over whether or not new homeowners were made aware that their homes were plumbed for graywater use. Graywater educators and researchers were unaware of any effort on the part of the city or developers to inform homeowners of the potential for graywater reuse. Many also hypothesized that if residents became aware of their home's potential for graywater use, it was through efforts of the community or larger water conservation efforts expounded by the city. Because the ordinance only impacts residential development built after 2010, some stakeholders expressed concern over different values of long term residents (who tend to live in older homes) compared to incoming residents. This finding implied that more community oriented educational efforts could be directed towards incoming residents to make them aware of Tucson's commitment to water conservation and the role that they might play in such efforts.

7.5.2 Inconvenience

One of the largest barriers to residential graywater use is the inconvenience of installation. Because the RGWO does not require that graywater irrigation systems be installed with new homes, only that the homes be built to facilitate graywater use at a later date, effort from the homeowner is required even to install the most basic laundry to landscape gravity fed irrigation systems. As one builder noted:

> Even if all houses were plumbed and set up with a graywater system, I bet only 50% or so would use it. It's not a one time investment, it's something you have to work on year after year. So graywater reuse is no one fix for everyone (Residential Builder).

As mentioned earlier, education, cost, and the availability of trained professionals can make this a daunting task for many home owners. For people wanting to utilize graywater from multiple parts of their home (showers, hand sinks, etc.) a pump is usually required (depending on the structure of the building) to redistribute water to the landscape. Pumps can range in price but are generally much more expensive and maintenance intensive than simple gravity fed systems.

7.5.3 Education and Environmental Literacy

When planning how to best reuse residential water, homeowners must consider both local and regional environmental contexts. Soil types, site topography, and precipitation can alter the impacts of graywater use. One stakeholder emphasized the climactic variation occurring in the late summer season:

> Maintaining the systems can be a lot of work, because you know we have a monsoon season, pretty much the only season where we're getting a lot of water, and if you're using a catchment area, those areas can fill up with water and be breeding grounds for mosquitoes, but people continued to flush their graywater onto the landscape, so we need a better way of educating people about responding to situational changes (Residential Builder).

Safe residential graywater use requires careful attention and awareness to not only how systems are designed and used, but also to what personal care products (PCP's) are entered into the water stream (Daughton 2003). For example, many soaps contain salts that can harm plant life with extended use although more information on this is still needed (Roesner et al. 2006). Some advocates claim that understanding how PCP's impact plant growth and soil quality is not only good for graywater systems, but for the watershed at large. However, substantial educational and behavioral barriers make graywater use a challenge for many would be users.

> Education is the biggest problem, and you know, it's not for everyone. Some people are really busy, some people don't want to have fruit trees in their yard, some people don't want to do the maintenance. It's not for everyone (Residential Builder).

As one participant pointed out, "Ultimately it comes down to the property owner to incorporate graywater into their daily routine." (Water Conservation Consultant).

7.5.4 Aesthetics

Unless carefully designed, graywater systems may not meet the aesthetic standards of some homeowners. Because most graywater research has revolved around safety and feasibility, the aesthetics (both indoor and out) can be overlooked. As one graywater educator noted:

> These systems aren't always beautiful. Maybe I'm too comfortable with a rough aesthetic. I realize not everyone is comfortable with that.

For stakeholders who are comfortable with designs catering to the pragmatic, it can be difficult to recognize aesthetics as a barrier for new homeowners. As one graywater user stated:

> I think that it's important to design things that are elegant and attractive to use. Everything should be designed to be attractive. Some of the activists don't get that, they're more concerned with practicality and making things work. They have a different sense of aesthetics (Graywater User).

He went on to explain that aesthetic concerns extend from inside the home, to the lawn, and to the wider neighborhood.

> People also want to fit in. If graywater is really going to take off, these systems need to be designed to 'fit into the neighborhood aesthetic.

Currently, aesthetics remains a barrier in need of more recognition from graywater system designers at all scales.

8 Conclusion

Government agencies have advocated for the use of wastewater as a water conserving strategy (U.S. Environmental Protection Agency 2016; Congressional Budget Office 2002). However, most movements towards graywater reuse will likely be initiated at the state level. Therefore, policies initiated at the state and regional level (like the Residential Gray Water Ordinance) are essential to widespread adoption of distributed graywater management (Yu et al. 2013). Because many climate adaptive policies will need to be tailored to specific regional and social contexts, it is important to consider the experience and needs of stakeholders involved in policy implementation. The RGWO provides one example of a conservation oriented policy that requires a chain of interrelated stakeholders, including residential homeowners, for successful implementation. To encourage water conservation and make better use of potable water resources, policies encouraging graywater reuse should consider stakeholders at multiple levels of influence, including individual, interpersonal, organizational, community and policy scales (Bronfenbrenner and Morris 2007; Bronfenbrenner and Evans 2000; McLeroy et al. 1988).

Considering the roles specific stakeholders will play in the policy implementation is paramount to understanding how the policy might 'look on the ground' as it is disseminated through specific social actors.

Summary of findings:

- Non prescriptive but performance based climate adaptive state policies have the potential to reduce liability concerns while encouraging creative policy adaptations to local issues, thereby enabling innovative regional and local solutions that may be relevant to other municipalities.
- The use of incentives can be a powerful tool if directed towards stakeholders with the most leverage in implementing the policy at hand.
- The effectiveness of a policy can be difficult to gauge if systems of evaluation and feedback are not planned before the policy is implemented, therefore integrating research methods into new adaptive policies can provide valuable information for both the local government and other municipalities striving for similar initiatives.
- Nesting policies into other long term pre existing conservation efforts may reduce political friction and make the new policy more relevant to a wider range of political actors.
- Climate adaptive policies may also have more impact if they are planned to operate at the community scale to take advantage of preexisting social networks and norms. Engaging the potential of grassroots endeavors may amplify the acceptance and integration of the policy. Developing institutions or nonprofits to facilitate connections between private property owners could help cities invent more flexible strategies for water conservation.

This research serves as part of a larger study that will later evaluate the impact of the RGWO and barriers residents face in installing and maintaining graywater systems, this case study offers a new perspectives on integrating sustainably focused policies by evaluating social and political barriers encountered at the multiple ecological levels. The results of this study contribute social insight for future climate adaptive policy initiatives.

References

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

Bronfenbrenner, U., & Evans, G. W. (2000). Developmental science in the 21st century: Emerging questions, theoretical models, research designs and empirical findings. *Social development*, *9*(1), 115–125.

Bronfenbrenner, U., Morris, P. A. (2007). The bioecological model of human development. *Handbook of Child Psychology 1*(14), 793–828.

Cerra, J. (2017). Emerging strategies for voluntary urban ecological stewardship on private property. *Landscape and Urban Planning, 157,* 586–597.

City of Tucson. (2010). Residential Gray Water Ordinance 10579. Retrieved from: https://www.tucsonaz.gov/files/agdocs/20080923/sept23-08-527a.pdf.

City of Tucson. (2011). *Reclaimed Water Basics: For Residential Customers*. Retrieved from: https://www.tucsonaz.gov/files/water/docs/rw-basics_res_print-2011.pdf

Congressional Budget Office. (2002). Future investment in drinking water and wastewater infrastructure. The Congress of the United States. Retrieved from: https://www.cbo.gov/sites/default/files/cbofiles/ftpdocs/39xx/doc3983/11-18-watersystems.pdf.

Cupp, J, Nichols, A. (2011). Residential graywater information guide. The City of Tucson, Arizona. Retrieved from: https://www.tucsonaz.gov/files/water/docs/GrayW_Info_Guide_6-11.pdf.

Daughton, C. G. (2003). Pharmaceuticals and personal care products (PPCP's) as environmental pollutants: Pollution from personal actions. Presented at U.S. EPA Region 5's Regional EPA-Tribal Environmental Conference (RETEC), Chicago, IL, March 4–6, 2003. https://cfpub.epa.gov/si/si_public_record_report.cfm?direntryid=66501. Accessed Sept 2016.

DeOreo, W. B., Mayer, P. W., Dziegielewski, B., & Kiefer, J. (2016). *Residential end uses of water, version 2*. Water Research Foundation.

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Hawthorne: Aldine de Gruyter.

Holway, J. (2009). Adaptive water quantity management: Designing for sustainability and resiliency in water scarce regions. In L. A. Baker (Ed.), *The water environment of cities*. New York: Springer Science and Business Media.

Lancaster, B. (2006). *Rainwater harvesting for drylands* (Vol. 1). Arizona, USA: Rainsource Press.

Little, V. L. (2000). *Residential Graywater Reuse: The Good, the Bad, the Healthy in Pima County, Arizona: A Survey of Current Residential Graywater Reuse*. Water Resources Research Center.

Ludwig, A. (2006). Create an oasis with graywater: Choosing, building, and using graywater systems includes branched drains fifth edition.

Makropoulos, C., & Butler, D. (2010). Distributed water infrastructure for sustainable communities. *Water Resource Management, 24,* 2795–2816.

McLeroy, K., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15,* 4.

Mehta, M. (2009). Water efficiency saves energy: Reducing global warming pollution through water use strategies. Natural Resources Defense Council. Accessed September 28, 2016. Retrieved from: https://www.nrdc.org/sites/default/files/energywater.pdf.

Moskell, C., & Broussard, S. (2013). Integrating human and natural systems in community psychology: An ecological model of stewardship behavior. *American Journal of Community Psychology, 51,* 1–14. http://doi.org/10.1007/s10464-012-9532-8.

National Academies of Sciences, Engineering, and Medicine. (2016). *Using graywater and stormwater to enhance local water supplies: An assessment of risks, costs, and benefits*. Washington, DC: The National Academies Press. doi:10.17226/21866.

Rosner, L., Qian, Y., Stromberger, M., & Klein, S. (2006). Long-term effects of landscape irrigation using household graywater: Literature review and synthesis. Water Environment Research Foundation and the Soap and Detergent Association. Retrieved from: http://www.aciscience.org/docs/SDA-WERF%20Graywater%20Lit%20Review.pdf.

Schensul, J. J., & Trickett, E. (2009). Introduction to multi-level community based culturally situated interventions. *American Journal of Community Psychology, 43*(3–4), 232–240. doi: http://dx.doi.org/10.1007/s10464-009-9238-8.

Sharevelle, S., Roesner, L., Qian, Y. Stromberger, M. Azar, M. N. (2012). Long-term study on landscape irrigation using household graywater–Experimental study. The Urban Water Center Colorado State University. WERF: Water Environment Research Foundation.

Sokolow, S., Godwin, H., & Cole, B. (2016). Impacts of urban water conservation strategies on energy, greenhouse gas emissions and health: Southern California as a case study.

Stokols, D. Grzywacz, J. McMahan, S., & Kimari, P. (2003). Increasing the health promotive capacity of human environments. *American Journal of Health Promotion*. Retrieved from: http://www.activelivingresearch.com/files/AJHP_4_Stokols_0.pdf Accessed on September 20, 2016.

Tufvesson, A. (2009). *Graywater Treatment and Technology*. Retrieved from: http://www.worldplumbinginfo.com/greywater-treatment-and-technology.

Urwin, K., & Jordan, A. (2008). Does public policy support or undermine climate change adaptation? Exploring policy interplay across different scales of governance. *Global Environmental Change, 18*(1), 180–191.

U.S. Environmental Protection Agency. (2008). Energy efficiency in water and wastewater facilities: A guide to developing and implementing greenhouse gas reduction programs. Retrieved from: https://www3.epa.gov/region9/waterinfrastructure/.

U.S. Environmental Protection Agency. (2016). A closer look: Temperature and drought in the southwest: Climate change indicators. Retrieved from: https://www.epa.gov/climate-indicators/southwest. Accessed on September 5, 2016.

Yu, Z., Rahardianto, A., DeShazo, J. R., Stenstrom, M., & Cohen, Y. (2013). Critical review: Regulatory incentives and impediments for onsite graywater reuse in the United States. *Water Environment Research, 85,* 7.

Young, O. R. (2002). Institutional interplay: the environmental consequences of cross-scale interactions. *The drama of the commons*, 263–291.

Author Biography

Laura Bell is a master of science candidate focusing on Sustainable Design Studies in Human-Environment Relations at Cornell University (2017). She also holds a BA degree in Anthropology and a minor in Urban and Environmental Planning from the University of Virginia (2012). Her current research interests include urban ecological design for water management, user experience in policy initiatives, and social impact design.

Organizational Characteristics in Residential Rental Buildings: Exploring the Role of Centralization in Energy Outcomes

Elizabeth Hewitt

Abstract

Organizational literature often points to decentralization as a driving force behind the success of organizations, but centralization can have benefits as well, particularly for energy efficiency initiatives in particular contexts. This paper conceptualizes the multifamily residential building as an organization, and posits that in large, multifamily rental properties a measure of centralization is helpful and even necessary for the effective management of energy conservation. This research relies on qualitative interviews, site visits, and publicly available energy data from a sample of New York City residential properties to examine the organizational characteristics that contribute to the building's energy consumption. Findings indicate that certain organizational characteristics lend themselves to more centralized building management. These types of residential rental buildings, in turn, performed better than expected in annual energy consumption compared to other properties. This research carries important implications for social science and behavioral researchers, as well as building owner organizations and management firms, who can better craft programs and policies in buildings to capitalize on these organizational characteristics.

Keywords

Energy consumption · Residential buildings · Organizations

E. Hewitt (✉)
Department of Technology & Society, Stony Brook University, 100 Nicolls Rd, Stony Brook, NY 11794-4404, USA
e-mail: elizabeth.hewitt@stonybrook.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_10

1 Introduction

The building stock represents one of the most important pieces of the climate change puzzle. Despite the monumental growth in the green building market, the majority of buildings are still operated and powered using fossil fuel sources, and contribute a significant portion to global CO_2 emissions. Building operations comprise approximately 40% of total annual CO_2 emissions in the U.S., and the residential sector accounted for 1105 million metric tons of CO_2 emissions in 2013, an increase of 141 million metric tons from 1990 (U.S. Energy Information Administration 2014). Additionally, buildings tend to have far longer lifespans than goods in other sectors, such as the automobile, which limits the opportunity for rapid turnover and technological innovation; a significant portion of the buildings we inhabit today will still be occupied decades from now (Biggart 2013). Thus, reducing energy consumption in buildings—new *and* existing—is crucial to meeting any substantial carbon reduction goals in coming decades. In addition, tackling the built environment helps to achieve broader goals of sustainability. Definitions of sustainability are complex, far-reaching, and at times contradictory, but in aligning with the hierarchy presented by Marshall and Toffel (2005), reducing building energy consumption meets multiple goals at multiple scales, including long-term global resource conservation as well as local-scale, immediate term quality of life improvements for occupants.

In addition to the role of physical retrofits to the systems of existing buildings, one way to tackle this sector is to develop a better understanding of how existing buildings are operated and maintained, and how they are used by occupants. Indeed, buildings are not merely static structures; they are dynamic and active collectives of individuals, actors, and agents. The built environment is inherently social, and buildings are important for more than just shelter; they create and enforce norms, and have the potential to drive social dynamics (Hall 1990; Hillier 1998; Sommer 2008). This calls for an interdisciplinary approach to building energy consumption that blends technological and engineering factors with social science and qualitative nuance (Biggart 2013).

One fruitful approach to understanding building energy consumption through a social science lens is to draw from the field of organizations. Indeed, this work posits that buildings themselves—in particular multifamily residential buildings, the focus of this work—can be conceptualized as organizations. Formal organizations have distinct characteristics, including a hierarchical structure, procedures that have been standardized or systematized, a larger size, and more complex activities (Kleindorfer et al. 1993). Multi-family residential buildings typically have all of these traits, including some form of hierarchy that helps determine how the building is managed and operated, interaction between multiple individuals at a variety of scales in order to function in the larger real estate market, and some measure of standardization of the building's functions and operations, regardless of size. Buildings have an additional unique advantage as an organization: They offer a physical—and not just symbolic or social—structure to bound the organization, making the relationships and interactions within its walls all the more coherent and visible. Behavior and decision-making within organizations is ultimately an exploration of the interrelation between agency and structure within firms (Andrews 2008). In the case of buildings, that structure is partly physical.

Further, an organizational approach to buildings is valuable because there is evidence that organizations can influence energy consumption and efficiency (Prindle and Finlinson 2011). Some researchers (Axon et al. 2012; Janda 2014; Schelly et al. 2011) are beginning to apply an organizational approach to the study of energy in buildings, and this emerging work opens up potential for new and unique inquiries in the field.

Organizational literature often points to decentralization as a driving force behind the success of organizations; decentralized operations can empower members of the organization and lead to a culture of bottom-up innovation (Ashkenas et al. 1995; Mintzberg 1992). However, decentralization may not always spur innovation in energy efficiency in residential buildings. This work posits that in some properties—namely, rental buildings—a measure of centralization is helpful (and perhaps even necessary) for the effective deployment of energy conservation, especially when other organizational characteristics are present. This research relies on qualitative interviews, site visits, and publicly available energy data from a sample of New York City residential properties to examine the organizational characteristics that contribute to a building's successful operation in a centralized or decentralized manner, and impacts this may have on energy consumption.

2 Organizational Characteristics in Buildings

A number of organizational characteristics become relevant when extending an organizational approach to buildings. This work focuses on organizational structure, organizational size, and the role of members of the organization. Ultimately, these attributes are studied for their contribution in shaping centralized or decentralized building operations, and impacts on energy consumption. Each of these characteristics will be described below.

2.1 Organizational Structure/Type in Buildings

Organizational structure is an overarching, high-level characteristic that drives many other organizational characteristics. A common theme that emerges from the theories of organizational structure across many disciplines is that a vast array of theories can be boiled down to a more limited number of structures and forms that are repeated often in organizations (George 2012; Mintzberg 1992; Scott 1991, 2013; Shwom 2009). The structure of an organization is most commonly explained as the way labor is divided among unique tasks and how those tasks are managed (George 2012; Mintzberg 1992).

In extending an organizational lens to buildings, the characteristic of a building that best defines its organizational structure is its ownership type. For purposes of this work, buildings can be categorized into three primary property types: Rental, condominium, and cooperative. A rental building will have a management company, occupants that act as customers, and an organizational mission of profit and resident retention; a cooperative building will have a board comprised of residents, occupants that serve as key decision makers, and an organizational mission of operational efficiency and/or strengthening the resident community. In this way, organizational structure is the key independent variable from which all other characteristics are derived (Scott 1991).

2.2 Organizational Size in Buildings

It is typically the case that the larger the organization the more structured, formalized, and complex its operations, by necessity (Mintzberg 1992; Perrow 2014; Scott 1991). Complex organizations are also not as flexible and cannot undergo change as quickly as smaller, less complex organizations. Size can be measured or quantified in a number of different ways, depending on the type of organization, its function, and the goal of the analysis; for instance, good measures of size include number of employees, square footage of space occupied, annual sales, number of products manufactured, or number of people served or assisted, among others (Scott 1991). Like structure, size is a structural characteristic that acts as an independent variable in determining other organizational characteristics like centralization and formalization (Scott 1991).

In buildings, this work posits that size is best determined by number of households (so, in instances of multiple buildings owned by the same organization, this might be quantified as 5 buildings serving 500 households, for example). Taking this approach, size also dictates level of formalization in buildings. Very large buildings, by nature of having to provide services for many households, are likely to have automated operating systems, organizational complexity, common area functions that are pre-programmed or operated by staff on a set schedule, and a cohort of building operators with clearly defined tasks and varying areas of expertise.

2.3 Organizational Member Role in Buildings

Researchers approach the discussion of “organizational members” in a variety of ways. Some seek to define the amount of power and control certain individuals may have over others and the delineation of tasks (George 2012; Scott 1991); others discuss how decisions are made by individuals in organizations (Kleindorfer et al. 1993). Most researchers use the term “employee” to describe member role, but for purposes of extending this conversation to buildings, “member” is a more appropriate term; not all members of the organization need be employed by the building organization in order to impact and play a role in the organization. In buildings, this research takes a finer level of specificity by focusing on the role of ***residents*** as members; it is assumed that employees of the owner organization will necessarily play a decision-making role, but the role of the resident will vary across buildings.

Residents can take one of three primary roles in a building: customer, stakeholder, or decision-maker (full member). In some buildings (rentals in particular), residents play the role of customer; they are outside of the main decision-making locus and, in fact, are likely not interested in being a part of it. They have expectations for level of service and amenities, and view the owner or management company as a service provider. The management company, in turn, is accountable to the residents owing to the monetary transaction that occurs in the payment of rent in exchange for services each month. Their primary goal is ensuring customer (resident) satisfaction and, hopefully, retention. In a condominium, residents play a more significant role in the operation and management of the building, but are likely not making key decisions; they are stakeholders in the process due to their financial stake in the property. In cooperative buildings, where residents comprise the cooperative board and are fully responsible for budgetary decisions, bill-paying, capital improvements, and other major decisions, the residents are the organization and constitute it fully themselves; they are not simply customers or stakeholders of the organization. In each of these three categorizations of residents, economic considerations may play a larger or smaller role depending on the building and resident characteristics. For instance, some residents-as-customers in expensive luxury buildings will pay little attention to the costs they incur for electricity each month, while others will pay more attention and adjust their behavior accordingly.

2.4 Centralized Versus Decentralized Building Organizations

A decentralized organization is one where the locus of power or decision-making rests not with a single individual, but with members across the organization; power is dispersed (Mintzberg 1992). Decentralization can lead to more innovation and creativity among members at lower levels of the organization, and can be beneficial by dispersing "soft" knowledge and understanding of the organization's operations out from the center (George 2012; Mintzberg 1992). Centralization, on the other hand, is indicative of tighter, top-down control and more traditional organizational hierarchy, with decision-making occurring at one point in the organization (Mintzberg 1992). Although some empirical research indicates higher levels of innovation and knowledge production in decentralized structures (Pertusa-Ortega et al. 2010; Rangus and Slavec 2017), organizational theorists explain that there are benefits to both organizational forms (Scott 1991). Centralization can streamline decision-making and the flows of information, ultimately reducing transaction costs for firms (Scott 1991). Importantly, centralization and decentralization rest along a continuum as two ends of a spectrum, not black and white organizational characteristics (Mintzberg 1992).

In the residential multi-family building, the impact of centralization and decentralization on building operations and whole-building energy consumption should be carefully explored. Both condominiums and cooperatives offer shared ownership, although they vary in the extent to which individual owners wield decision-making power within the building. Rental buildings rely more heavily on a property management team for all decision-making within the building; occupants primarily pay rent for the provision of shelter and services, but do not participate in the daily operation of the building itself. Thus, in alignment with definitions of centralization and decentralization described above, it can be assumed that owner-occupied properties will have more decentralized operations, while rental properties will be more centralized.

2.5 The Current Study

The organizational characteristics described above may also be linked to energy consumption in buildings. Indeed, a large body of existing research exists to support the claim that owner-occupied properties typically consume less energy, primarily because the principal-agent misalignment is eliminated (Ástmarsson et al. 2013; Levinson and Niemann 2004; Maruejols and Young 2011; Panayotou and Zinnes 1994; Prindle and Finlinson 2011). Decentralization, as an organizational characteristic of owner-occupied buildings, supports this—owner-occupied residents of decentralized buildings are highly connected to decision-making and price signals, and have organizational capacity to innovate. Rental properties, in which principal-agent misalignments complicate matters relating to energy consumption, are likely to be higher consumers of energy, and centralization, as a key characteristic of a rental property, does little to mitigate this. Indeed, centralization keeps building occupants at arms-length from high-level decision-making, economic or other cost-benefit information regarding consumption, and the ability to take participatory or innovative action in the building.

However, this work attempts to challenge these assumptions regarding the role of centralization and decentralization in the specific context of energy consumption in multifamily buildings. This research poses the following question: In rental properties, where no collective ownership exists, is it possible that centralization can be beneficial? The following sections outline a methodology and approach to answering these questions.

3 Methodology

This work relies on a combination of fieldwork, qualitative interviews, and a publicly available dataset. Five residential buildings were investigated; this data collection included site visits to observe common space design and use, one or more qualitative interviews (described below), and the collection of energy consumption data. A summary of the collected building data and a brief description of each building can be found in Table 1.

Annual energy consumption data is in the form of source energy use intensity (EUI) in kBTUs per gross square foot (kBtu/ft2) from publicly available New York City benchmarking data from 2013. EUI measures whole-building energy consumption and is self-reported by the building owner using the Environmental Protection Agency's Portfolio Manager tool. Property owners must report energy use in order to meet New York City requirements for annual benchmarking of properties greater than 50 k SF as mandated under Local Law 84 (LL84) (City of New York 2014). The median site EUI for a multifamily building in New York City in 2013 was 121 kBtu/ft2 (City of New York, Office of the Mayor 2014).

Approximately 20 qualitative interviews were conducted over a 6-month period of time in 2014 and 2015 with individuals who are members of the residential building community in New York City. This included residents of rental buildings (13), residents of condominium buildings (1), residents of cooperative buildings and members of cooperative boards (2), building managers of both rental and owner-occupied units (2), and representatives from corporate owner and property management firms (2). Interview questions attempted to gather information about social norms, interactions, and organizational aspects of residents and their buildings to help triangulate energy findings and connect them with the organizational characteristics described in Sect. 2.

Some of the above interviews were conducted with individuals not affiliated with the five study buildings. No other data was collected for these buildings, so they are not listed in Table 1, but interview findings are included where applicable in subsequent sections of this work. For both interviews and site selection, snowball sampling was used, relying on initial contacts in the residential building industry who then provided additional suggestions of other individuals and buildings that would prove useful. Buildings were carefully chosen to represent a range of types (rental, condo, cooperative), sizes, neighborhoods, and price tiers (luxury, market rate, rent stabilized). It should be acknowledged regarding methodology that the qualitative approach used here and the small sample size necessarily overlook important and valuable technological and physical attributes of the buildings that play a role in energy consumption. Although beyond the scope of this qualitative study, holding constant these independent drivers of energy consumption in buildings is an important consideration for any future work relying on the public NYC dataset.

4 Results and Analysis

4.1 Energy Consumption

See Fig. 1 for a graphic representation of whole-building energy consumption in the five study buildings. The results highlight a few important findings. First, Building 4, a cooperative building, consumed the least amount of energy of the

Table 1 Building Sample

Building	Type	Description	Neighborhood	Borough	Size (units)	Year Built	Data	Energy Data Available? (whole bldg)
1	Rental	Market rate	Upper west side	Manhattan	498	1986	Site visit, resident interview	Yes
2	Rental	Rent stabilized	Upper east side	Manhattan	237	1902	Site visit, resident interview	Yes
3	Condo	Luxury	Fort Greene	Brooklyn	108	2008	Resident interview	Yes
4	Coop	Market rate	Ditmas Park	Brooklyn	189	1932	Resident interview	Yes
5	Rental	Luxury green	Fort Greene	Brooklyn	369	2007	Resident interview	Yes

Note: Additional interviews were conducted with residents and managers of other buildings not listed above. No other data was collected for these buildings (and no energy data was available), so they are not listed here, but interview findings are included where applicable throughout the research sample (89.7 kBtu/ft^2), and approximately 25% less energy annually on a normalized per-square-foot basis than an average New York City multifamily property. This is in line with expectations regarding energy consumption in owner-occupied properties. While it is difficult to discern which criteria in this particular property play a role in driving the building's low energy consumption, some characteristic (or combination of) is helping the building operate efficiently.

Next, Building 3, a condominium property, consumed the highest amount of energy of the five properties at 259.5 kBtu/ft^2, far more than the median NYC multifamily building. As an owner-occupied property, this finding was surprising. Unlike Building 4, the collective ownership of this property did not contribute to more efficient energy consumption within the building. However, Building 3 has a hybrid mix of both rental and condominium units; thus, although the property has some element of a resident board, it lacks a true resident-as-organization structure, and it has a number of residents who are uninvolved in the building's operation, thus perhaps overriding the impact this partial resident board may have. In addition, the physical characteristics of the building (glass-façade high-rise with luxury amenities not designed to green building standards) likely come into play. Taken together, these characteristics may be key drivers of the building's poor performance.

Finally, Buildings 1, 2 and 5, all rental properties, consumed fairly close to the median NYC multifamily building (135.8 kBtu/ft^2, 97 kBtu/ft^2 and 149.6 kBtu/ft^2, respectively). As rental buildings, they were not, as predicted, the highest consumers of energy, or significant outliers from the median. A number of factors contribute to this finding that—again—cannot be quantitatively accounted for here, such as physical factors like building age and construction type that may contribute to better performance (with older buildings tending to perform better in New York City due to thicker and more insulating building envelopes than newer all-glass facades). Building 2, for instance, was built in the early 1900's. Also, economies of scale, especially when the property is very large (as in the case of Building 1 with nearly 500 units), may further contribute to efficiency gains within the building.

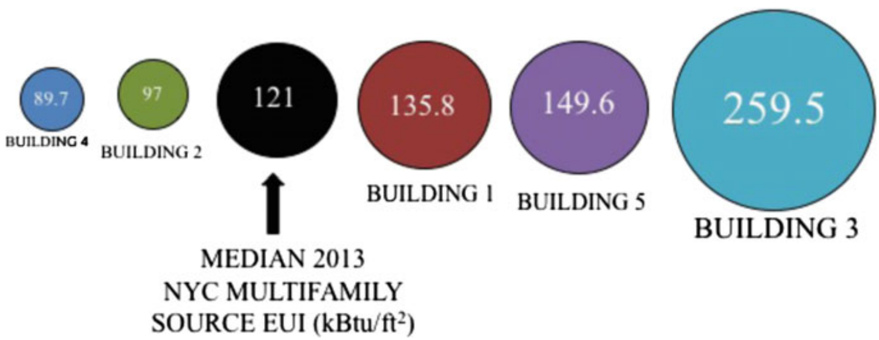


Fig. 1 Study buildings ordered by energy consumption. (2013 source EUI (kBtu/ft^2))

More importantly for this work, the finding leads to a discussion regarding organizational attributes of these properties. All three properties are centralized. More specifically, the three rental properties are aligned in the three organizational characteristics described in Sect. 2—(organizational structure/type, organizational size, and member role). Namely, the three properties are (1) Structured organizationally as rentals, (2) large organizations, and (3) have residents in the role of customer, not stakeholder or decision maker. These characteristics have implications on the role of centralization, and will be discussed below.

4.2 Organizational Characteristics

4.2.1 Organizational Structure/Type

Interviews with residents of buildings with various ownership types helped to highlight some of the distinctions between buildings structured organizationally as rentals, condominiums and cooperatives. Residents of rental buildings tended to report patchy and random interactions with neighbors based primarily only on the shared use of a building common area, little to no involvement in initiatives or events in the building, little communication among residents, and interactions with staff only on a professional level as related to service provision in the building or their apartment. When asked how well she knew her neighbors, a rental occupant of Building 1 explained:

> I don't know my neighbors at all. I think it's the funniest part about New York living, you live next to someone for years and you don't know their name. The people I know are random. I'll see people at the gym a lot. And I'll say hi. But I don't know anyone on my floor. I think it's an apartment building thing, a lot of people have that anonymity thing, they want to be anonymous.

When asked the same question, a rental occupant from another building said:

> I know my neighbors very little. I know the people immediately next to me, because I'll run into them, but I probably don't know even half the people on my floor.

Both of these were large, luxury rental buildings, but this was a consistent finding even in smaller or less amenity-rich rental buildings. When asked if the building provided any social programming or activities, or if there were any informal social gatherings formed by residents, the renter of Building 2, a rent-stabilized property said:

> No. The residents never voice anything. And the building doesn't do anything. No events or anything like that. That's just not what happens here.

One resident of a 300 + unit rental building reported that any social interaction in her building was driven primarily by the fact that she has a child, and so she occasionally makes use of the community playroom. This same resident noted that the resident portal that residents use to pay their rent, and which has sections for events, lost and found, and for sale, has no postings. Thus, communication and interaction is low, and this pattern was evident in nearly all rental buildings where interviews were conducted. This would make it difficult to engage residents on energy efficiency initiatives based on social norms or shared goals.

Residents of condominium and cooperative buildings tended to report a higher level of interaction with their neighbors, more knowledge about the operations and initiatives in the building, more communication among residents, and more interaction with management. The occupant of a large condominium building explained:

> I think there can be attachment to the building. Here there's some kind of board you can be on. There are two online forums that exist for the building. There's a woman who's sort of the gardener, she's a professional and she's here a lot. And there are definitely people who hang around in the lobby to socialize.

Cooperative building residents had different experiences to share. One resident of a small co-op, when asked to describe the building in three adjectives, said:

> The first things that come to mind are community, because we're so small, friendly, because we're all basically friends with each other and hang out in the backyard all the time, and starter, because it is most people's first home purchase.

While the tight-knit culture of this building may have something to do with its small size, another resident of Building 4, a large (nearly 200 unit) cooperative building also said:

> "I know my neighbors really well. I know a lot of people in the building. I've been to their apartments. Our kids hang out." This same resident also explained, "We have a building Google group list-serve, and that has people asking for advice or complaining about stuff. And the board is also on that list, so they can hear and read everything. There are also giveaway piles in the lobby."

Interview findings highlight the differences in social interaction and participation in rental properties versus owner-occupied properties, and begin to shed light on the individual differences among the buildings studied here.

4.2.2 Organizational Size

Of the five buildings studied here, all are large, with over 100 units, but the three rental properties (Building 1, Building 2, and Building 5) are the largest buildings. Building 1 is the largest, with nearly 500 units, followed by Building 5 with 369 units, and Building 2 with 237 units. This would indicate that the three rental properties are likely to have a more formalized management, more organizational complexity, and a large staff so that they are able to successfully provide services to hundreds of households. This tighter control would allow for more top-down implementation of measures to save energy in the building, likely in common areas and relating to base building systems and operation, and the ability to control them more successfully.

4.2.3 Organizational Member Role

Interviews with residents of buildings with various ownership structures helped highlight some of the distinctions between the role an occupant can play as a member of a building organization. When asked if they believe people form attachments to their buildings and what unique things their buildings add to their lives, residents of rental buildings consistently commented on the use and provision of a certain level of amenities in their buildings, including children's playrooms, gyms, pools, rooftop gardens, etc., framing their role as a customer. The rental occupant of Building 1 commented:

> I feel like the staff adds to it (what the building provides to residents), and the amenities, there's a little gym and a little pool, and a laundry room. I think those kinds of things help it feel more like a home. Little personal touches, like how they decorate the lobby and welcome you when you come home. And the rooftop is nice too.

When asked about unique things the building adds to their lives, residents of cooperative buildings spoke more frequently about a sense of shared community and things like resident initiatives in and around the property. The resident of Building 4, a large cooperative, explained:

> People definitely have an attachment to the building. It's a very distinctive building. We're improving the building a lot. We just did a garden, we're fixing the outside. Also, it's very big so it's like its own neighborhood, there's a critical mass.

Interestingly, during interviews renters consistently tended to refer to the initiatives, amenities, and events in the building using terms like "them" and "they", while cooperative residents tended to use "we" and "us" when referring to the building. Even renters in older, rent-stabilized properties without higher-end amenities referred to "the building" as an autonomous offsite entity, a "them" not a collective "us." Some residents noted differences even between condos and coops, although both are owner-occupied. One resident of a small cooperative explained:

> It is different here (in our co-op) than the condo buildings we looked at when we were ready to buy; because it's a co-op, it's more shared space. Serving on the board means you're basically a volunteer, there's nothing that says you have to serve, but the common understanding is that we all bought into this.

This comment highlights the shared accountability and decision making that is more likely to occur in a cooperative building. This distinction—between customer, stakeholder and decision-maker—heavily impacts the process the building must undertake to implement long-term goals and capital improvement projects, and generally keep the building operational in a sustainable and forward thinking way. Of the five buildings studied, interviews illustrate that occupants of the rental properties play a primary role in the organization as customers, and the occupants of the owner-occupied properties play a role as a stakeholder or member.

4.3 Implications for Energy Use

Qualitative fieldwork has established that out of the five buildings studied, the three rental properties (Buildings 1, 2, and 5) share some primary organizational characteristics. First, they are organizationally structured as rentals, which has implications for the extent of resident involvement and the extent of social interaction. Second, they are large, indicating organizational complexity, hierarchy, and formalization. Finally, they are occupied by individuals that are clear customers, not primary decision-makers of the organization. In addition to these organizational factors, all three rental properties consumed energy that was in line with the New York City median multifamily building, and did not consume far more than owner-occupied properties, as would be expected.

These interesting organizational findings indicate the need to re-evaluate the role of centralization in rental buildings. It is often assumed that buildings with a high level of centralization would be less energy efficient, owing to the argument that decentralized operations that disperse power and decision-making among residents are more likely to result in innovation, visible price-signals and, ultimately, more energy efficiency engagement. However, as evidence presented here suggests, both decentralization and centralization can be beneficial in a residential building depending on building-specific characteristics and context. In particular, the findings here highlight that when the resident plays the role of a customer, as in most rental buildings, especially when the property is large, some level of centralization may be *necessary* in order to implement and enforce energy efficiency measures within the building.

Thus, a new hypothesis emerges that posits that centralization is *dependent upon* the defining organizational characteristics of the building. To that end, it is argued here that groups of organizational characteristics hold together (much like a factor analysis). More specifically, it is argued that three characteristics—organizational type, organizational size, and member role—determine if decentralization or centralization is the more beneficial operation for the building. If a building organization is large, operating under a rental structure, and therefore has residents that act as customers, it is likely to benefit more from centralization. All three rental properties studied here fall into this category.

5 Conclusion

This research explored the role of centralization and decentralization in urban residential multifamily buildings in New York City. More specifically, it took a unique approach by conceptualizing the building as an organization and, as such, applied key organizational criteria to the analysis of the building's management and occupant social interactions in order to determine potential impacts on energy consumption. Findings indicated that of the sample of five buildings studied, the three rental properties all exhibited organizational characteristics of similar structure (rental), similar size (large), and similar occupant role (customer). Taken together, it is argued that these three characteristics lend themselves to more successful management when centralized. Centralization in these instances is likely to help, not hinder, the implementation of energy efficiency initiatives, as the property owner and management firm are likely to need top-down control and high-level decision-making power in order to implement successful strategies. Residents that act solely as customers are unlikely to be engaged in or motivated to implement building-wide energy efficiency strategies on their own.

From a management perspective, these findings become important for building owners and property management companies, as they allow these groups to better understand what strategies may or may not be successfully deployed within their building type. For instance, some large rental properties may try to engage residents on energy efficiency campaigns through social engagement, team building, or other collective activities, but it is unlikely that these types of programs will be successful if residents do not feel connected to the building or their neighbors. Similarly, policymakers may find these outcomes interesting because they indicate potential targets for programs and policies. For example, financial incentives to install "smart" building automation technology in residential properties may be more successful in rental properties, because it would allow management companies to install more efficient technology without relying on behavior change from residents-as-customers.

It is important to also mention some limitations in this research, which lend themselves to further analysis and later work. First, building technology and characteristics (such as building envelope material and building age) are very important to this analysis, but there is no way to accurately and truly assess their impact on energy consumption without being able to hold constant these variables in a quantitative statistical analysis. The sample size of five buildings does not allow for this level of analytical detail here. Thus, subsequent analyses could attempt to do this using the full New York City benchmarking dataset. It is also acknowledged that the current work is qualitative and context-driven. Findings are not generalizable to the wider building stock. Additional studies with more data collection (such as building-wide surveys) that focus on only a single building type (e.g. cooperatives only) would be helpful.

Additionally, in taking an organizational approach, this research necessarily overlooks other important lenses for the empirical study of energy efficiency in buildings. One such approach is an economic analysis, which is clearly an important factor when weighing distinctions between owner-occupied and rental properties. An economic lens would account for price signals, elasticity of price and demand, and a deeper understanding of principal-agent misalignments.

Ultimately, this research presented a typology of organizational characteristics that could extend well to buildings and deepen the conversation about energy performance in buildings. It adds to current research by offering a unique buildings-as-organizations lens, and contributes to emerging work linking organizational studies to building energy consumption.

Acknowledgements Portions of this abridged work were originally published in thesis form in fulfillment of the requirements of the author's doctoral degree in 2015. Thanks to Drs. Clinton Andrews, Joseph Seneca, Rachael Shwom, and Richard Wener for their comments and input on earlier versions of this work. Funding provided to the author by the National Science Foundation through the IGERT program from 2011–2015 to undertake interdisciplinary energy-related doctoral research.

References

Andrews, C. (2008). Changing a firm's environmental performance from within. In M. Ruth & B. Davidsdottir (Eds.), *Changing stocks, flows and behaviors in industrial ecosystems* (pp. 83–101). Northampton, MA: Edward Elgar Publishing Inc.

Ashkenas, R., Ulrich, D., Jich, T., & Herr, S. (1995). *The boundaryless organization: Breaking the chains of organizational structure*. San Francisco: Jossey-Bass Inc Pub.

Ástmarsson, B., Jensen, P. A., & Maslesa, E. (2013). Sustainable renovation of residential buildings and the landlord/tenant dilemma. *Energy Policy, 63,* 355–362. doi:10.1016/j.enpol.2013.08.046.

Axon, C. J., Bright, S. J., Dixon, T. J., Janda, K. B., & Kolokotroni, M. (2012). Building communities: reducing energy use in tenanted commercial property. *Building Research & Information, 40*(4), 461–472. doi:10.1080/09613218.2012.680701.

Biggart, N. W. (2013). *Constructing green: The social structures of sustainability*. (R. L. Henn & A. J. Hoffman, Eds.). Cambridge, Massachusetts: The MIT Press.

City of New York. (2014). *LL84 Benchmarking Data Disclosure Definitions*. Retrieved from http://www.nyc.gov/html/gbee/downloads/pdf/nyc_2014_ll84_data_disclosure_overview_definitions.pdf.

City of New York, Office of the Mayor. (2014). *New York City Local Law 84 Benchmarking Report September 2014*. City of New York, Office of the Mayor. Retrieved from http://www.nyc.gov/html/planyc/downloads/pdf/publications/2014_nyc_ll84_benchmarking_report.pdf.

George, J. M. (2012). *Understanding and managing organizational behavior* (6th ed.). Boston: Prentice Hall.

Hall, E. T. (1990). *The hidden dimension*. New York: Anchor.

Hillier, B. (1998). *Space is the machine: A configurational theory of architecture*. Cambridge: Cambridge University Press.

Janda, K. B. (2014). Building communities and social potential: Between and beyond organizations and individuals in commercial properties. *Energy Policy, 67,* 48–55. doi:10.1016/j.enpol.2013.08.058.

Kleindorfer, P. R., Kunreuther, H. G., & Schoemaker, P. J. H. (1993). *Decision sciences: An integrative perspective*. Cambridge: Cambridge University Press.

Levinson, A., & Niemann, S. (2004). Energy use by apartment tenants when landlords pay for utilities. *Resource and Energy Economics, 26*(1), 51–75. doi:10.1016/S0928-7655(03)00047-2.

Marshall, J. D., & Toffel, M. W. (2005). Framing the elusive concept of sustainability: A sustainability hierarchy. *Environmental Science and Technology, 39*(3), 673–682. doi:10.1021/es040394k.

Maruejols, L., & Young, D. (2011). Split incentives and energy efficiency in Canadian multi-family dwellings. *Energy Policy, 39*(6), 3655–3668. doi:10.1016/j.enpol.2011.03.072.

Mintzberg, H. (1992). *Structure in fives: Designing effective organizations* (1st ed.). Englewood Cliffs, N.J.: Prentice Hall.

Panayotou, T., & Zinnes, C. (1994). Free-Lunch economics for industrial ecologists. In R. Socolow, C. Andrews, F. Berkhout, & V. Thomas (Eds.), *Industrial ecology and global change* (pp. 383–398). Cambridge: Cambridge University Press.

Perrow, C. (2014). *Complex organizations: A critical essay*. Brattleboro, Vermont: Echo Point Books & Media.

Pertusa-Ortega, E. M., Zaragoza-Sáez, P., & Claver-Cortés, E. (2010). Can formalization, complexity, and centralization influence knowledge performance? *Journal of Business Research, 63*(3), 310–320. doi:10.1016/j.jbusres.2009.03.015.

Prindle, W., & Finlinson, S. (2011). How organizations can drive behavior-based energy efficiency. In F. P. Sioshansi (Ed.), *Energy, sustainability and the environment; technology, incentives and behavior* (pp. 305–335). Burlington: Butterworth-Heinemann.

Rangus, K., & Slavec, A. (2017). The interplay of decentralization, employee involvement and absorptive capacity on firms' innovation and business performance. *Technological Forecasting and Social Change*. doi:10.1016/j.techfore.2016.12.017.

Schelly, C., Cross, J. E., Franzen, W. S., Hall, P., & Reeve, S. (2011). Reducing energy consumption and creating a conservation culture in organizations: a case study of one public school district. *Environment and Behavior, 43*(3), 316–343. doi:10.1177/0013916510371754.

Scott, W. R. (1991). *Organizations: Rational, natural, and open systems* (3rd ed.). Englewood Cliffs, N.J: Prentice Hall College Div.

Scott, W. R. (2013). *Institutions and organizations: ideas, interests, and identities* (4th ed.). Los Angeles: SAGE Publications Inc.

Shwom, R. (2009). Strengthening sociological perspectives on organizations and the environment. *Organization & Environment, 22*(3), 271–292. doi:10.1177/1086026609345216.

Sommer, R. (2008). *Personal space; updated, the behavioral basis of design* (Updated edition). Bristol: Bosko Books.

U.S. Energy Information Administration. (2014). *Monthly energy review September 2014*. Retrieved from http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf.

Author Biography

Dr. Elizabeth L. Hewitt is an assistant professor of energy policy in the Department of Technology and Society at Stony Brook University. She focuses on the technological, social, and policy-based challenges surrounding energy consumption in the built environment. Dr. Hewitt is trained as an urban planner and social scientist, and received her PhD from the Edward J. Bloustein School of Planning & Public Policy at Rutgers University. Dr. Hewitt also holds a Master of Urban Planning degree from New York University and a Bachelor of Fine Arts degree from the State University of New York, FIT. She is LEED-accredited by the United States Green Building Council.

Re-shuffling the Deck on Environmental Sustainability: Using a Card Sort to Uncover Perceived Behavioral Categories, Effort, and Impact in a College Environment

Casey G. Franklin and Abram Alebiosu

Abstract

Definitions of sustainability in social settings can vary widely across contexts and age groups. The aim of this experiment is to identify actions college students classify as sustainable within their everyday context, how such actions are grouped into behavioral categories, the perceived effort and impact of actions, and ways that public spaces can limit these actions. A card-sort, co-current interview, and ranking task was conducted with ten students (ages 20–27). Student listed sustainable actions and behavioral categories were compared against a researcher-generated list of categorized actions possible within their college environment. Ranking data of perceived effort and impact was used to identify which behaviors would be easy and difficult to encourage in college buildings. Key findings are that students' perceptions of effort and impact varied widely, students categorized actions based on many types of commonalities, students consistently placed actions appropriately in predetermined categories, and that educational environments contain social and physical norms limiting perceived ability to act. In the future, these methods could be replicated to identify perceptions influencing sustainable behaviors in multiple contexts.

Keywords

Sustainable behaviors · Categorization · Card-sort · User perceptions
Behavioral effort · Sustainable impact

C.G. Franklin (✉)
Design & Environmental Analysis, Cornell University,
1411 Martha Van Rensselaer Hall, Ithaca, NY 14853, USA
e-mail: cgf44@cornell.edu

A. Alebiosu
Arts & Sciences, Psychology Department, Cornell University,
211 Uris Hall, Ithaca, NY 14850, USA
e-mail: aaa265@cornell.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_11

1 Introduction

Sustainability is a major goal for universities and has become a feature of their identity which can impact student enrollment. Since the 1970's, higher education institutions have focused research and financial resources on environmental sustainability following the Clean Air Act (1970) and the Clean Water Act (1972) (Barlett and Chase 2004). According to the annual Guide to Green Colleges, some universities provide students with scholarships, grants, and research opportunities to encourage a more sustainable campus (Princeton Review 2016). Robust sustainability requires more than LEED certifications and scholarships though; to meet sustainable behavioral goals substantial student engagement is needed.

To achieve this, colleges need buy-in from students that can be only be gained through understanding the motivations for this age group. Dinas (2010, p. 11) believes that, "young adults are deemed to possess common characteristics that make them a relatively homogeneous group, rightly distinguishable from older cohorts," noting, "they gradually develop firm political attitudes as they accumulate political experience." Understanding students' perspectives and positions on sustainability can help assure that sustainable messaging is a good fit for a cohort's attitudes, perspectives, and contexts.

Technologies assisting behavioral change, such as energy monitors, smartphone applications, and social media, are becoming increasingly common. While having real-time data and communication holds the potential to increase outreach to students, if information does not make sense to students or ignores the influences of context, then it is unlikely to have a behavioral impact. For instance, in a study of business owners with energy monitors, owners ignored information from monitors which failed to align with personal perspectives and business priorities (Franklin 2014). Behavioral campaigns using persuasive technology to change behavior or attitudes, should design messaging and interfaces that aligns with a community's pre-existing definitions and views of sustainability.

In addition to context, message framing can also impact behavioral outcomes. Davis (1995, p. 286) found in environmental messages, "negatively framed outcomes associated with inaction are more persuasive than positively framed outcomes associated with action," as well as messages emphasizing current losses. Block and Keller (1995) studied interactions among perceived efficacy, depth of processing, and message framing and found low-efficacy conditions motivated in-depth processing. When subjects process more in-depth, negative frames persuade more than positive ones, while a high efficacy condition leads to equally persuasive and less effortful message processing (Block and Keller 1995). Explicit communications are as important as communication media. Effectively communicating ideal sustainable-action-achievement methods should remove unnecessary cognitive hoops for users. Examining behavioral actions and categories from a cognitive, information science, and environmental-psychology perspective will cover the parameters impacting student group actions, related to information architecture and the built environment.

1.1 Cognition, Information Architecture, and the Built Environment

Criteria used to form categories can explain how sustainable actions are perceived relative to one another. From a cognitive psychology perspective, categorization consists of mental grouping, or chunking, which helps people comprehend the surrounding world by combining useful information pieces. Tulving and Craik (2000, p. 12), define a chunk as a similarly related collection of more elementary units that have been inter-associated and stored in memory repeatedly, acting as a coherent integrated group when retrieved. Correct recall is more likely when the chunking process is actively enabled (Miller 1956). Furthermore, Lindley (1966) concluded that when chunking occurred, the resulting groups and categories had meaning to the person who grouped them, making the subsequent recollection and maintenance of information easier. Since chunking is personal, user perceptions are relevant to defining category parameters.

Once chunking has occurred, the category exists in long term memory for the same stimulus. Schematization is a more cognitively complex form of grouping. Schemas are defined as a systematic pattern of thoughts and behaviors categorizing information from item relationships (DiMaggio 1997). Schemata are cognitive structures founded on personal preconceived ideas and environments used for perceiving, organizing, and understanding information. The schemata's main influence is on the process of acquiring new knowledge, at this stage new and incoming information is regulated and modulated by schemes. It is at this stage that individuals make the critical distinction if information fits into their schema and whether contradictory information can be distorted and re-analyzed to fit a specific and existing schema (Nadkarni and Narayanan 2007). Schemata are very adaptive for humans since they rarely change and since this automatic process organizes new perceptions quickly without the need for higher-level cognition (Kleider et al. 2008). Knowing criteria-defining schemas could aid in predicting new action categorization.

Categories are defined as, "groups of distinct abstract or concrete items that the cognitive system treats as equivalent for some purpose," with equivalency being determined by "mental representations that encode key aspects about the category members" (Markman and Ross 2003, pp. 592). Object, abstract concepts, substances, events, and roles related to context define categories (Markman and Ross 2003). Markman and Ross (2003) posit, "what people remember about some item is specific to the way they interact with that item," and therefore there is no singular cognitive category-learning method. To communicate clearly with communities, sustainable actions and categories should relate to users' pre-existing categories and contexts.

Quantitative and qualitative card-sort data can describe item associations and categorization parameters. Categorizations are used to classify known and unknown objects, make predictions, communicate ideas with others, and form preferences (Markman and Ross 2003). Cognitive processes seek simplicity and rely on learned knowledge, subsequently, "to predict what people learn from a task they perform, it is necessary to analyze the task they are performing and the context in which the task is performed" (Markman and Ross 2003, p. 596). There is a need to understand how categories are formed in relation to context, so that we can communicate appropriate to context.

Understanding cognitive groups can ease communication with users by matching information architecture to cognitive categorizations, and for this reason card sorting has become a popular method of user-experience design research which identifies information structures. Almost any type of information can be written out on cards, and researchers can administer the study without in-depth training. Reviewing the pros and cons of card sorts, Canter et al. (1985) explain an individual's worldview is the basis of internal classifications and categorizations. Card sort studies can assess participant's cognitive groupings representative of an individual's information architecture. "Information architecture (IA) is the practice of effectively organizing, structuring, and labeling the content of a website or application," and card sorts help discover important IA structures (Righi et al. 2013, p. 70). The underlying assumption is that categories created in a card-sort study are representative of participants' knowledge structures and internal categorization.

Environmental psychology studies human behavior and environment bidirectional interactions. Behavioral limitations imposed by the built environment on users impact how actions may be perceived. In this study of a college setting, a categorized behavioral list was created listing actions possible within the college. These categorized actions were intended for future use in sustainable behavioral campaigns, smartphone application navigation, and associated behavioral messaging. Persuading behavior changes in the built environment necessitates knowing student perceptions of environment-behavior limits. In other words, we cannot help students change behaviors without knowing what barriers they think they face. Our objectives in this study were verifying our pre-determined actions list for comprehension, alignment with students' actions, and category content. Furthermore, we wanted to know:

1. What explanations do participants provide of how they personally define sustainability, categorization, effort, and impact?
2. Specifically regarding categorization, what parameters do participants identify as category differentiators in self-identified behaviors?
3. What behaviors can and cannot be conducted in their university setting, and why or why not?

2 Methodology

2.1 Sample

This study used a purposive sample of students from a major research institution in the northeastern region of the United States of America (U.S.A.). The sample consisted of ten participants (m = 6, f = 4) with a mean age of 23.2 (ages 20–27).

Most participants grew up in urban or suburban areas (n = 8) within the U.S.A. (n = 8), and the majority of participants lived in apartments (n = 7). Researchers used this sample to test the study methods ability to establish user perceptions and categorical reasoning as pilot for future deployment to a larger sample.

2.2 Experiment Methods

Multiple moderated card sorts, ordinal rankings, and a concurrent interview were conducted to gather quantitative sorting-and-rank data along with qualitative explanations of perceived category criteria, effort, and impact (Table 1). Open and closed card-sort data assessed if a researcher-created list of categorized actions (Table 2) was comprehensive and aligned with students' listed actions and categories. The pre-determined behavioral list was created for a behavioral campaign design, intended for future sustainable messaging to students and navigating within a persuasive smartphone application.

In the study's first phase, participants wrote down their typical sustainable behaviors, sorted the behaviors into categories based on how they associated

Table 1 Interview questions

1. Please state all of the actions that you do on a regular basis that you believe are sustainable and write each of them on an index card (one per card). Take your time and please make sure to list all of those that you can remember
2. Of those that you have just listed, can you sort them into categories based on commonalities and then label each category? You are encouraged to think out loud
3. Can you re-sort these sustainable behaviors into other categories based on similarities? I want you to do this until you can no longer categorize them into different categories. Again you are encouraged to think out loud
4. Can you sort these into the categories of Can do at school and Cannot do at school? You are encouraged to think out loud
5. Can you put these in order of most impactful actions to least impactful actions? You are encouraged to think out loud
6. Can you put these in order of the effort required to complete the action? You are encouraged to think out loud
7. Next I will give you a list of sustainable behaviors (from the Behavior List), please try to group behaviors based on associations & create labels for groups. You are encouraged to think out loud
8. Can you put these in order of the most impactful actions to the least impactful actions? You are encouraged to think out loud
9. Please try to put these behaviors in order from least to greatest in terms of effort
10. Last, please try to put each behavior under the pre-defined categories

Table 2 Researcher's list of categorized actions, given to participants in part II

Unplug	Thrive	Connect
•Turned off lights when leaving a room •Unplugged electronics •Unplugged chargers •Used a solar powered charger •Used only task lighting •Used natural light	•Ate vegetarian •Ate USDA organic •Ate local •Ate vegan •Refilled a water bottle •Took the stairs	•Helped a friend get a sustainable app •Helped a friend compost •Green event volunteer •Helped a friend recycle •Helped a friend reuse something •Helped a friend take the stairs
Innovate	Move	Reuse
•Suggest a Sustainable Change	•Took the Bus •Rode a Bike •Carpooled •Walked	•Recycled waste •Printed doubled sided •BYO utensils •Reused a cup •Reused school supplies •Used tupperware

behaviors with one another, and gave their behavioral categories names. Participants also ranked their actions on a scale from 1–*n* with 1 being the least impactful and the highest ranking being the most impactful. What impactful meant was up to interpretation of each participant, and they were asked to note how they perceived impact. Additionally, they ranked actions from 1–*n* with 1 being the behavior requiring the least effort and n requiring the most effort. Again, the determination of what effort meant was left open, which allowed students to express their own views of what type of effort different behaviors entailed. This provided ordinal-rank data for the students' perception of their own effort level and sustainable impact. Lastly, participants identified how the built environment affected their actions by sorting actions based on their own ability to perform them at school.

In the second part of this study, defined actions were used in an open sort for which participants generated category labels and, subsequently, given categories. An interviewer moderated card sorts, taking notes on participant feedback. Participants were asked to think out loud while working on the experiment tasks such as, "*Can you sort these into the categories of can do at school and cannot do at school? You are encouraged to think out loud*" (Table 1). Although interview questions were pre-determined, interviewers encouraged participants to elaborate on their interpretation of the questions and how their personal experiences with sustainability had shaped their views and behavioral categorizations.

2.3 Analysis Methods

In *Card Sort Analysis Best Practices*, Righi et al. (2013) suggest card sort data analysis include an item by item matrix determining strength between individual items as representative of a category and a dendrogram, which helps visually represent this relationship. Binary categorical data obtained in the card-sort exercises (0 = not in category, 1 = in category) was analyzed through similarity matrices and a hierarchical-cluster analysis. A similarity matrix looks for co-occurrence, which is, "a relationship that calculates the number of times two cards are sorted together independent of the group or topic in which they are sorted" (Paul 2014, p. 91). Therefore, it excludes cases which match as co-absences (0), which were not useful in this coding scheme.

Cluster analysis has a wide range of research uses such as identifying customer segments in marketing, classifying astronomical objects from large data sets, determining diagnosis categories, analyzing weather data, and identifying tool uses in archeology (Everitt et al. 2011). Additionally, cluster analysis is a popular technique for card-sort studies focused on information architecture in user-interface design. A dendrogram, or tree diagram, illustrates the clustering procedure with the root containing all items sorted and terminal nodes representing individual items. Ordinal ranking data was assessed using the sample median and range.

Approximately 33 pages of qualitative interview data resulted from participants. Participants explained how they interpreted various behaviors and interview questions, and how the actions they listed functioned in context. Interview data was recorded via note taking during the study, and was subsequently transcription, and coding using Atlas.ti software. Researchers coded interviews with descriptive coding, pattern-coding for thematic analysis, and memoing as needed. Several themes emerged revealing how participants categorized, viewed, and defined sustainable actions.

3 Findings and Analysis

3.1 Defining Sustainability, Effort and Impact

Since we wanted to know students' perspectives, no concrete definitions of *sustainability*, *effort*, or *impact* were provided. Students questioned the parameters of their own definitions of these words by asking, *how often, under what conditions, does preventative count,* and if they could list *things they were already doing* or *things they also hoped to do*. Frequency of actions also impacted participant listed behaviors, with answer like: *daily habits of sustainability, everyday behaviors, used to this, most times, and not really*. Furthermore, actions listed contained time modifiers like: *fly only once per year, usually, mostly,* or *if I can*. These questions hint at the wide range of definitions of sustainability and its dependence on temporal limitations. What we can take away from this is that sustainable behaviors are thought of within the context of limits of student's perceptions of time and behavioral frequency.

3.2 Daily Sustainable Actions

Researchers compared their action list to participants' lists for differences. In total, participants listed 128 daily sustainable behaviors (Fig. 1). After removing actions already on our list, 72 actions were left of which 38 were similar or repeated actions. Finally, after eliminating those actions unsupported by a college, the following 20 were left:

•Donate/use electronics as long as possible	•Use natural ventilation or no AC
•Reuse clothing as cleaning rags	•Warm clothing/blankets in winter
•Repair/wear clothes and shoes as long as possible	•Turn off tap when not actively using it
•Hybrid rental car	•Only flush toilet when necessary
•Read and send digital files instead of printing	•Actively research sustainability
•Reuse grocery/ziplock bags	•Purchase environmentally friendly cleaning/health/other products
•Buy eco-friendly or no packaging goods/food	•Drink water only
•Cloth napkins and towels instead of paper	•Healthy diet (low sugar)
•Produce my own food (garden)	•Good Samaritan
•Eat leftovers	

These behaviors are potentially rewarding in a college environment and could be a useful addition in behavioral change campaigns. If students are already engaged in sustainable actions off-campus, it may make sense to provide them the opportunity to continue those behaviors while on-campus. This could be done by adding facilities that would support behaviors such as eating leftovers, using cloth napkins, or gardening on campus in this case. Sustainable impacts of individual actions may be small, but allowing students an opportunity to perform their behaviors of choice could increase overall engagement.

Fig. 1 Word cloud of actions, with frequently listed larger

3.3 Perceived Behavioral Effort

Students pointed out that effort related to sustainable actions can be financial, need based, physical, temporal, social, self-control, and memory based. For instance, comments such as, "high effort can be if you have to buy something," conveys the financial or time-based effort required by some actions. Another participant noted, "some of these just require slight self-control, or poverty." Participants communicated that sometimes the default behavior is easy, for instance not turning on lights if there is daylight, not because it is sustainable, but because it is unnecessary. Carpooling or helping a friend requires having close acquaintances capable of favors or interested in listening to sustainability discussions. Actions requiring forethought are difficult because the behavioral trigger is disassociated with the timing of actions. For example, remembering to bring a reusable bag to the store. In the open sort, some participant-categories reflected a level of effort and associated feelings: *none of my business, too much effort, not too bad, can manage it/doing it, love this, think of this as exercise, would love to,* and *of course!*

Ordinal-rank data for perceived effort was analyzed by finding the median ranking for each item, with 1 requiring the least effort and 29 the most (Table 3). While items from categories were scattered throughout the range, many actions related to food were found to require more effort than other actions. The range of effort-rank was in some cases quite large, for example, to propose a sustainable change, ranked anywhere from 1–29 in terms of effort. This indicates that students did not agree on the amount of effort required for that behavior. However, both "use Tupperware" and "eat vegan" had a lower range (8 and 3) indicating that students mostly agreed it was easy to use Tupperware and difficult to eat vegan.

3.4 Perceived Behavioral Impact

While students knew that their listed actions had some impact, the amount and effect of these actions were generally unknown. One participant began to question if her/his listed actions really were sustainable, another questioned exactly what the outcome of their defined sustainable actions was. Interestingly, it was also noted that without being sure of how often or how long they conducted behaviors, they could not be sure of how impactful their behaviors were. Researchers left it up to the participant to determine such parameters to avoid influencing their perspective. Participant categories from the open sort that referenced the impacts of actions included: *carbon footprint reduction, efficient resource use, eco-friendly initiative, physical waste reduction, saving h20, saving trees,* and *reducing energy/light use.* While participants noted that, *scientific knowledge can guide their personal perception of how environmentally impactful an action is*, actions could also be views as impactful when:

Table 3 Effort ranking of items, where 1 = least effort required and 29 = most effort required

Item	Median	Mean	Min	Max	Range
Turn off lights when leaving a room	5	6.89	2	21	19
Printed double sided	5	8.56	1	21	20
Refill a water bottle	6	6.56	2	10	8
Use Tupperware	7	9.67	1	21	20
Use natural light	9	7.56	1	15	14
Take the stairs	11	10.44	2	18	16
Help a friend download a sustainable app	11	14.00	5	25	20
Reuse a cup	12	11.56	5	20	15
Reused school supplies	12	12.33	4	22	18
Unplug chargers	12	14.22	8	25	17
Take the bus	13	12.67	3	20	17
Used only task lighting	13	14.11	4	23	19
Help a friend compost	13	15.33	4	27	23
Help a friend take the stairs	14	15.67	7	27	20
Walked	15	12.78	1	21	20
Carpooled	15	14.44	1	24	23
Help a friend recycle	15	14.78	3	26	23
Recycled waste	16	12.44	1	20	19
Unplug electronics	18	16.33	8	25	17
Propose a sustainable change	18	16.44	1	29	28
Use a solar powered charger	18	17.56	2	29	27
Help a friend reuse something	19	16.22	5	28	23
Bring your own utensils	19	18.44	10	27	17
Eating USDA organic	20	20.33	11	27	16
Rode a bike	22	19.00	2	27	25
Green event volunteer	23	17.78	2	27	25
Eating local	23	20.33	2	28	26
Eating vegetarian	27	25.67	14	28	14
Eating vegan	29	28.33	26	29	3

- they could be done by that individual repeatedly
- they had control over the actions
- they included someone else and doubled their impact
- they passed their knowledge on through education

One participant pointed out that some actions have an indirect or unseen impact, such as recycling which can help prevent pollution, but others like reusing a water bottle they have some direct experience of, which can make them perceived as more impactful because they could personally observe the entire process related to that action. The category of "perceived sustainable activity" was used to indicate that some behaviors can easily be seen, while others are more ambiguous. Furthermore, an action may be inclusive of another by preventing it, such as riding the bus which indicates that driving was prevented. In other cases, a preventative action may be entirely unseen. For example, defining sustainability as, *trying to live a frugal life,* references many behaviors without a singular outcome because it is preventative of consumption on many levels. Preventing rather than reducing behaviors is more impactful; however, inaction can be more difficult to perceive as representative of sustainability.

Ordinal-rank data for perceived impact was analyzed by finding the median ranking for each item, with one (1) having the least impact and twenty-nine (29) having the most (Table 4). While items from categories were mostly scattered, some patterns did exist. Items related to transportation were often grouped together,

Table 4 Impact ranking of items, where 1 = least impactful and 29 = most impactful

Item	Median	Mean	Min	Max	Range
Unplug chargers	7	10.3	2	28	26
Bring your own utensils	8.5	8.8	3	15	12
Unplug electronics	9	12.1	1	28	27
Reused school supplies	9.5	9.4	1	18	17
Eating USDA organic	10	11.6	3	25	22
Printed double sided	10	12	6	29	23
Use Tupperware	10	12.1	2	22	20
Help a friend download a sustainable app	10.5	11.5	1	24	23
Reuse a cup	11	10.1	4	16	12
Use a solar powered charger	12	12.8	3	22	19
Take the stairs	13.5	12.3	3	23	20
Used only task lighting	13.5	12.7	2	24	22
Refill a water bottle	13.5	15.6	5	28	23
Help a friend take the stairs	14	13.3	1	24	23
Help a friend reuse something	15	15.6	2	26	24
Use natural light	16	14.8	6	25	19
Take the bus	17	18.2	9	27	18
Carpooled	17	19.3	11	26	15
Rode a bike	17.5	19.3	14	28	14
Walked	18	19.2	13	29	16
Turn off lights when leaving a room	19	17.6	5	27	22
Propose a sustainable change	20	17	1	29	28
Eating local	20	18.8	3	29	26
Help a friend recycle	20.5	17.7	5	26	21
Green event volunteer	21	16.9	2	29	27
Recycled waste	21	18.7	4	27	23
Help a friend compost	22	19.3	3	27	24
Eating vegetarian	24.5	17.1	2	28	26
Eating vegan	25.5	17.5	1	29	28

many actions related to electricity consumption were viewed as less impactful, and while thrive and connect actions were distributed throughout levels, a small group was viewed as more impactful.

By examining the ranges, we can see that answers generally had a high range of difference in scores, with the smallest range being 12. This indicates that there is no real consensus on individual item rankings. Looking at the median scores, we can see that easy one-time behaviors like unplugging chargers and electronics are perceived to have less impact, while behaviors that take sustained dedication, like eating vegetarian, are considered to have a greater impact. Interestingly, eating organic is ranked low although eating vegan and vegetarian are ranked highly.

3.5 Impact versus Effort

A comparison of ratings shows some behaviors perceived as insignificant and subsequently unworthy of the effort required to complete them (Table 5). On the other hand, actions viewed as impactful and low effort are easy student engagement targets.

Table 5 Effort to impact level comparison by action

Substantially more effortful than impactful	•Bring your own utensils •Eating USDA organic •Unplug electronics
Less impactful than effortful	•Use a solar powered charger •Unplug chargers •Rode a bike •Help a friend reuse something •Eating vegan
Near equal in impact and effort	•Eating local •Eating vegetarian •Reused school supplies •Green event volunteer •Reuse a cup •Help a friend download a sustainable app •Help a friend take the stairs •Used only task lighting •Carpooled •Propose a sustainable change •Take the stairs •Use tupperware
More impactful than effortful	•Take the bus •Printed double sided •Recycled waste
Substantially more impactful than effortful	•Help a friend recycle •Use natural light •Refill a water bottle •Help a friend compost •Turn off lights when leaving a room

3.6 Limitations of Space

The environments where behaviors occur also influence how much effort they take. Participants sometimes distinguish between different environments, or levels of support in their actions and associated categories. For instance, the participant-action categories of *home, school, both, parents house, apartment, on campus, local/town/city scale*, *personal/home scale*, *societal thematic behaviors*, *environmentally supported*, *moderate environmental support*, *and not well supported* all reference how physical places relate to sustainable actions. Participants also noted that if something is not available, like compost, it can make being sustainable more difficult; but it can also make it easier, like not having a dishwasher which removes the choice of a less sustainable option.

To investigate this further, participants were asked which behaviors they could and could not perform in their college buildings. Behaviors listed fell into categories related to heating and ventilation control, transportation choices, clothing reuse, water conservation, food purchasing and production, and consumerism. Behaviors listed that related to control, like *not using AC* or *using natural ventilation*, make sense because students rarely have control over these aspects of a building. They also highlight the fact that if users did have control over this they may use it as an alternate to the imposed heating/ventilation. Clothing choices did not fit their school environment but could with modifications. Most comments about food communicated that students wished to *buy food with less packaging*. Currently, all meals bought at the cafeteria come in either plastic or cardboard boxes, and packaging is unavoidable.

Overall, students listed behaviors that they are mainly unable to achieve because they lacked a choice, for example the thermal conditioning of the building, or because they associate that behavior with their home environment, such as washing clothes or *doing dishes by hand.* There were also some behaviors listed which are possible, such as *dual flush toilets* and *taking short showers*. It is possible that students are not aware of all sustainable technologies or amenities available within the college, and therefore, disassociated those behaviors from the space.

3.7 Category Parameters

In the open sort, participants created a variety of behavioral categories defined by actions, items associated with actions, the outcome of actions, to whom actions related, and how they felt about these actions (Fig. 2). Some examples were:

Actions: *conservation, reducing, reuse*
Action Timing: *everyday behaviors, most times*
Items: *food, energy, waste, transport, tech*
Outcomes: *sustainability, efficient resource use, saving trees*
Self-Association: *identity, perceived sustainable behaviors, ego-driven actions, I can be effective*

Fig. 2 Word cloud of categories, with frequently listed larger

Relationships: *try to do this because of my mom's reminders, helping to influence others*
Reactions: *too much effort, would love to*

Interestingly, there were many categories which emphasized either that the actions were a choice, related to person's identity, or that they were for show.

With binary data obtained from the card sort exercises an item by item similarity matrix was constructed to assess the percentage rate that each action appeared in the same group as another action, and thus their group-similarity strength. Similarity matrices serve to identify relationships without researcher bias that could impact researcher interpretations of groupings (Fincher and Tenenberg 2005). This was done for both the open and closed card sorts, as well as the differences between the two to assess how group placement varied between open and given categories (Fig. 3).

Using this similarity matrix, a hierarchical cluster analysis was performed with the Jaccard matching coefficient, and used to produce a dendrogram for each sorting, which is a graphic representation of the cluster analysis (Fig. 4). As can be seen, the groupings in closed and open sort were for the most part similar. The end group amount was different, with the open sort having three main categories and the closed sort having five. This indicates that either students saw actions as more closely related without given category labels, or that they had difficulty creating a wider range of categories on their own. When given categories, one participant noted, "more categories make it easier to sort."

In the closed and open sort, *take the stairs* was associated with *move* and *refill a water bottle* was associated with *reuse*. Although the intent of *thrive* was to reference health behaviors, data shows students perceive a better fit in other categories. Otherwise, category groupings matched researcher categorizations, indicating that the actions were representative of the categories they were placed in originally.

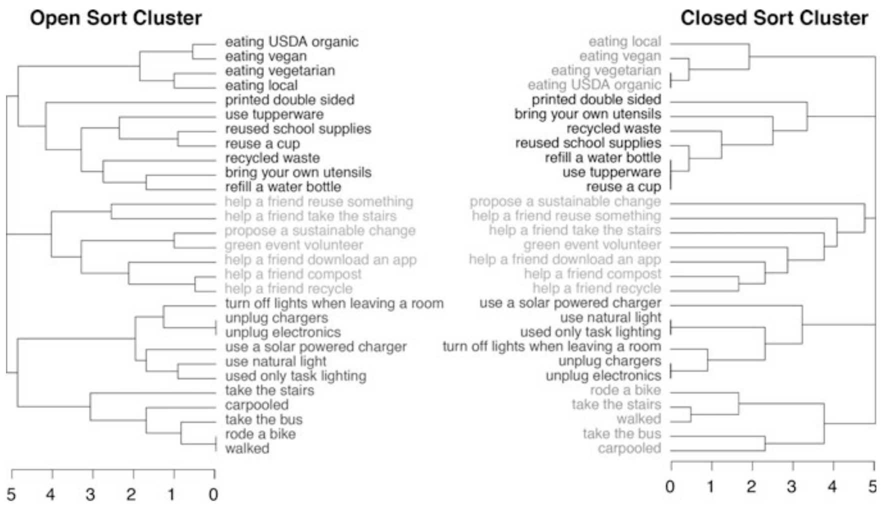


Fig. 3 Open sort matrix

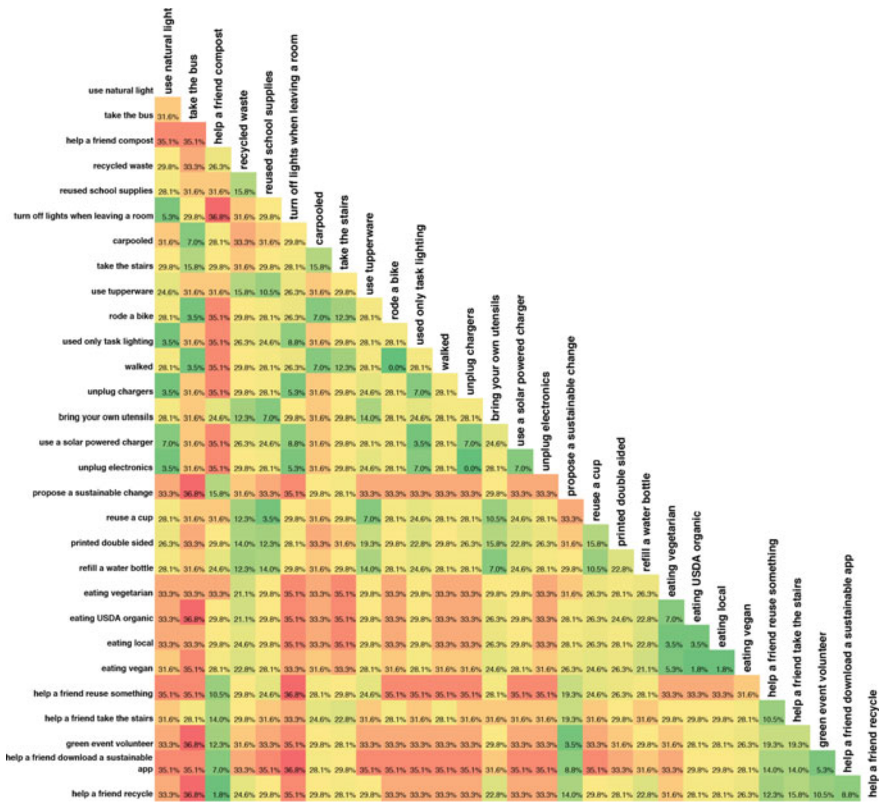


Fig. 4 Cluster analysis dendrogram for open and closed sorts

4 Discussion

Given our findings, behavioral campaigns should consider sustainability a fluid concept, adapting it to a variety of individual perceptions. In designing behavioral campaigns, views of sustainable actions and their effort and impact should be assumed to vary even amongst peer groups. While basic behaviors such as turning off lights are likely to be included by multiple people, fringe behaviors such as *reusing clothing as rags* or *buying captive breed instead of wild caught reptiles* can also be viewed as sustainable.

In this study, we demonstrated that our categorization of actions matched that of participants by using a hierarchical cluster analysis on binomial card-sort data. Although we performed this exercise in person, doing this online may quickly provide visualizations of navigational structures and category data. To maximize the sustainable technology user experience and interfaces, a technique like this can establish or verify navigational designs.

Sample size, word choice in pre-determined actions, and setting could be limitations of this study. This sample size is acceptable for interview data but is small for predictive statistics. Markman and Ross (2003) relay that noun categories indicate that the category supports more items. It is possible that the given verb categories in the second half of the study could have had lower levels of inclusion. In laboratory studies of classification, participants commonly use one categorical differentiator instead of multiple parameters (Markman and Ross 2003). Therefore, participants could have used a single categorical differentiator, like materiality, thus producing fewer overall categories.

5 Conclusion

Often sustainable change requires more than asking people to change or giving them the means to. Good design practice can help eliminate miscommunication between users and behavioral messaging by matching communications and information architecture to users' views. In this study, we sought to explore students' perceptions of sustainable behavior with respect to categorization, effort, impact, and their environment. The end goal is to use that information to make design changes in how sustainable behavior goals are communicated to students. We found that there is a wide range of actions that students consider to be sustainable, with little consensus about the amount of effort needed or the level of impact of behaviors. Students listed many expected actions, and several unique actions which could be incorporated into a college environment. Since behaviors like washing dishes were associated with home, students categorized them as impossible at school. Students felt they were unable to alter environmental thermal levels, natural ventilation, and lighting. Furthermore, some behaviors were incorrectly identified as impossible within the college. By increasing the control students have over environmental qualities and pointing out the lesser known amenities, colleges could expand behavioral options and awareness of them, and possibly increase sustainable behaviors. Future studies should confirm and expand these initial findings by examining differences in views across multiple populations to encourage sustainability across a variety of contexts and viewpoints.

References

Barlett, P. F., & Chase, G. W. (2004). *Sustainability on campus: Stories and strategies for change*. Cambridge: MIT Press.

Block, L. G., & Keller, P. A. (1995). When to accentuate the negative: The effects of perceived efficacy and message framing on intentions to perform a health-related behavior. *Journal of Marketing Research, XXXII,* 192–203.

Canter, D., Brown, J., & Groat, L. (1985). A multiple sorting procedure for studying conceptual systems. *27th research interview: uses and approaches.* London: Academic.

Davis, J. J. (1995). The effects of message framing on response to environmental communications. *Journalism & Mass Communication Quarterly, 72*(2), 285–299.

DiMaggio, P. (1997). Culture and cognition. *Annual review of sociology, 23,* 263–287.

Dinas, E. (2010). *The impressionable years: The formative role of family, vote and political events during early adulthood*. Florence: European University Institute.

Everitt, B. S., Landau, S., Leese, M., & Stahl, D. (2011). Hierarchical clustering. *Cluster Analysis, 5th Edition, 2011,* 71–110.

Fincher, S., & Tenenberg, J. (2005). Making sense of card sorting data. *Expert Systems, 22*(3), 89–93.

Franklin, C. G. (2014). *The impact of energy information upon small business owners*. Lawrence: University of Kansas.

Kleider, H. M., Pezdek, K., Goldinger, S. D., & Kirk, A. (2008). Schema-driven source misattribution errors: Remembering the expected from a witnessed event. *Applied Cognitive Psychology, 22*(1), 1–20.

Lindley, R. H. (1966). Recoding as a function of chunking and meaningfulness. *Psychonomic Science, 6*(8), 393–394.

Markman, A. B., & Ross, B. H. (2003). Category use and category learning. *Psychological bulletin, 129*(4), 592.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological review, 63*(2), 81.

Nadkarni, S., & Narayanan, V. K. (2007). Strategic schemas, strategic flexibility, and firm performance: The moderating role of industry clockspeed. *Strategic management journal, 28*(3), 243–270.

Paul, C. L. (2014). Analyzing card-sorting data using graphic visualization. *Journal of Usability Studies, 9*(3), 87–104.

Princeton Review. (2016). Guide to Green Colleges 2016.

Righi, C., James, J., Beasley, M., Day, D. L., Fox, J. E., Gieber, J., et al. (2013). Card sort analysis best practices. *Journal of Usability Studies, 8*(3), 69–89.

Tulving, E., & Craik, F. I. (2000). *The Oxford handbook of memory*. Oxford: Oxford University Press.

Author Biographies

Casey Franklin is a Ph.D. student in Human Behavior & Design at Cornell University with a background in architectural research. She is interested in how environmental design and persuasive technologies can help increase sustainable behaviors.

Abram Alebiosu is an undergraduate liberal arts student at Cornell University's College of Arts & Sciences. With a double-major in psychology and Africana Studies, he is interested in why different demographics perceive differently.

Wind Energy and Rural Community Sustainability

Sarah Mills

Abstract

Because it is a carbon-free source of electricity, wind energy is often unquestioned as an environmentally sustainable technology. But is this technology sustainable when considered within the context of the rural communities in which it is often sited? This paper uses survey data from paired rural communities with and without utility-scale wind energy projects to understand the economic and social impacts of wind energy development on these predominantly agricultural communities. It finds clear economic benefits to the communities that host wind turbines—namely, that wind developers' payments to landowners are largely re-invested in farming operations, leading to economic stability and increasing expectations that a younger generation will want to stay on the farm. The social impacts of wind development are more nuanced, and depend upon the windfarm's business model. Specifically, windfarms are least disruptive of the social structure in rural communities when wind developers employ a business model that gives more community members a direct financial stake in the project.

Keywords

Wind energy · Social impacts · Rural sustainability

S. Mills (✉)
Gerald R. Ford School of Public Policy, University of Michigan, Ann Arbor, MI, USA
e-mail: sbmills@umich.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_12

1 Introduction

Given the global urgency to address climate change, we may run the risk of labeling any energy technology that offers reduced carbon emissions as "sustainable." When full life-cycle carbon emissions and other environmental, economic, and social considerations are taken into account, renewable energy technologies—including wind energy—consistently emerge as options that perform well across this broader range of sustainability metrics (Weisser 2007; Gallego Carrera and Mack 2010).

Much of this sustainability analysis, however, has focused on the technology's impact at the national or global scale, not necessarily on the local impacts on the communities where these technologies would be placed (Whitton et al. 2015). Indeed, in looking at public acceptance for wind energy, a number of studies have contrasted the positive attitudes toward wind energy among the general public with opposition in locations of proposed wind projects (Bell et al. 2005; Devine-Wright 2005a; Wolsink 2007). Research shows these differences are not just NIMBYism. Instead, more pessimistic views are tied to anticipation of negative impacts and the localized disturbance caused during construction, and these negative local attitudes often reverse once the windfarm is operating (Warren et al. 2005; Devine-Wright 2005b; Wilson and Dyke 2016).

But even this relatively robust literature about public opinion of wind energy is really only a proxy for the technology's effect on local social and economic sustainability. The aim of this paper is to look beyond public opinion to better understand the social and economic impacts of wind energy development on the communities in which they are sited, focusing in particular on agricultural communities in the American Midwest.

2 Rural Dynamics and Wind Development in the American Midwest

Perhaps more than on other issues, social sustainability is intertwined with economic sustainability for many Midwestern farming communities. The industrialization of agriculture has led to farm consolidation, a decrease in the absolute numbers of farmers living in these communities, and an aging farm population as fewer young people choose farming as their occupation (Salamon 1992; D'Souza and Gebremedhin 1998). In farming communities that are more remote from metropolitan areas, this in turn has led to precipitous population loss, closure of rural schools and—in some cases—abandonment of small towns.

Wind development, and the money that it brings to rural landowners and rural communities, may have the potential to help reverse some of these intertwined social and economic trends. At least that is the claim that has been made by proponents of wind energy (Union of Concerned Scientists 2003; Napier 2012), and which was found to underlie support for wind energy among farmers in Indiana (Mulvaney et al. 2013).

Most of the existing academic work has looked at monetary benefits that accrue community-wide in the form of job creation or tax payments. While some temporary local jobs are created during construction, far fewer rural communities gain more than one or two full-time positions once the windfarm is in operation (Munday et al. 2011; Slattery et al. 2011; Brown et al. 2012). Even so, in rural communities with few other employment opportunities, any job growth is welcome (Black et al. 2014). Additionally, taxes assessed on energy production equipment are usually collected by local governments, and so may be used to improve locally funded public services (e.g., schools, roads, parks, human services), or to reduce the local property tax burden on all landowners (Kahn 2013). Indeed, these community-wide economic benefits are the primary socio-economic impacts noted by residents in Slattery et al. (2012) study of counties with wind development.

What is less researched, but which may have an even bigger impact on rural social sustainability, are wind developer's direct payments to rural landowners. While wind developers usually own the wind turbines, they very rarely own the land on which those turbines are sited. Instead, these wind developers enter into long-term leases to site the turbine on the landowner's property, paying the landowner annually for the land that is taken out of agricultural production and often also paying a royalty: a fixed percentage of the profits from the energy that is produced and sold to the electric utility. This income may help diversify farmers' income streams with a guaranteed revenue source that helps them weather the year-to-year variability in crop yields (Swofford and Slattery 2010; Sutherland and Holstead 2014). In the American Midwest, most wind developments are sited on small to medium-sized parcels of land throughout a rural community, with landowners hosting one or more turbines on their properties. As a result, a larger number of landowners may receive these direct benefits. While the quantitative impact of these direct payments is known (U.S. Department of Energy (DOE) 2015), there has not been any assessment on whether such payments are helping to reduce farm consolidation and ultimately population loss in these communities. This paper aims to fill that gap by considering:

1. Do individual-level windfarm revenues increase farm succession planning?
2. Do individual-level windfarm revenues result in increased farm investment?
3. What other social impacts does the wind development business model have on farming communities?

3 Methodology

To assess the connected social and economic impacts of wind development on farming communities, four windfarm communities in the state of Michigan were chosen using a diverse case study approach (Seawright and Gerring 2008) to cover a wide spectrum of historical population trends and wind development business

Table 1 Characteristics of Case Study Windfarms

Case	1	2	3	4
Year Windfarm Operational	2008	2012	2012	2008
Number of turbines	46	33	40	29
Business model	Traditional	Traditional	Pooled Royalty	Pooled Royalty
2000–2010 population change	−3%	−9%	−17%	+3%

models.[1] While not intending to be representative of all wind development in the Midwest, this case selection technique does aim to be broadly representative of windfarms in Michigan.

All four cases are in predominantly-agricultural areas. Key characteristics of the selected windfarm cases are shown in Table 1. In addition, four matched case (non-windfarm) communities in Michigan were selected to provide a comparison with a similarly-situated agricultural community without wind development. The selection was based upon population trends, land use characteristics (e.g., size of parcels, type of ground cover), and median income.

A mail survey was sent to all owners of farmland in all eight communities (four with wind turbines; 4 without). Formatting and survey administration were conducted according to best practice (Dillman et al. 2009), with multiple contacts, personalized communications, a pre-paid incentive (Groves and Couper 1998), and strategic timing based on the schedules of the target population (Pennings et al. 2002). In total, 1231 respondents returned useable surveys, resulting in a final response rate of 71.9% (AAPOR RR2).

The 12-page survey included a range of both opinion questions related to wind energy, as well as more factual questions about whether or not the respondent had a wind turbine on their property (obviously "no" for those respondents in the matched case communities), details about the respondent's farming operation, and their future plans for their farm.

[1]In the traditional wind development business model, only landowners with turbines on their property are directly compensated. An alternated "pooled royalty" business model spreads this same amount of money among all landowners who initially expressed willingness to have a turbine on their property, regardless of whether they ultimately received a turbine on their property or not, on a per-acre basis. In these pooling arrangements, the royalty share of the lease payment is diluted as it is shared among more landowners, but a higher proportion of community members receive direct payments from the wind developer.

4 Results and Analysis

4.1 Succession Planning

One way to measure whether farmers are expecting to pass their farm off to a younger generation—rather than to sell their land off to a neighboring farmer—is to ask whether or not they have a succession plan in place for their land. Overall 62% of respondents to the survey indicated in the affirmative. However, there is a large difference based on whether or not the landowner has a wind turbine on their property. Among those landowners with turbines on their property, 80% have a succession plan in place, compared to only 62% of their neighbors (i.e., all other farmland owners in the windfarm communities) and 57% of landowners in the matched case community (see Table 2).

A binomial logit regression model finds that the likelihood of having a succession plan increases with each additional acre farmed, which might be expected as those who farm more acres are more likely to expect to pass that large operation off in the future. However, even after accounting for the size of the farming operation, landowners with turbines on their property are 2.5 times as likely to have a succession plan in place as respondents in the matched case (no-turbine) communities who farm just as many acres. Notably, neighboring landowners in windfarm communities are also more likely (1.34 times) than matched case landowners to have a succession plan, but this is not nearly as statistically significant.

The survey did not ask landowners when they created a succession plan, so it is unclear whether windfarm revenues are helping landowners to solidify succession plans. An alternate explanation for the difference in succession planning is that those landowners who had pre-existing succession plans may have been more inclined to diversify farm income and therefore would have proactively sought out wind leases. This theory, however, conflicts with the fact that in all of the case studies, it was the wind developer and not the farmland owners who initiated the windfarm leasing process. Furthermore, while this alternate explanation may explain differences in succession planning between landowners with turbines and their neighbors, it does not adequately explain differences between the turbine group and their matched case counterparts who have not (yet) been approached by a

Table 2 Prevalence of succession plans among survey respondents

			Wind Respondents	
	All Respondents	Matched Case Respondents	Neighbors	Turbines
Yes	62%	57%	62%	80%
No	38%	43%	38%	20%
Number of respondents	1164	471	559	134

wind developer but include a number of landowners who—according to their survey responses—would welcome wind development. As a result, the most likely explanation is that the supplemental income that the wind turbines provide is helping convince the next generation of farmers to stay on the farm.

4.2 Farm Investment

Another way to gauge farmers' longer-term expectations for their land is look at recent farm investments. Those who invest more in their farms likely expect that they—or their heirs—will be farming longer than those who do not invest in their farms (Adelaja et al. 2011). In order to capture the investments that owners of farmland have been making to their property, the survey sent to landowners asked four parallel questions: "Since 2008, about how much money have you spent on improvements to your [… home? …outbuildings? …drainage and irrigation? … new or used farm equipment including trucks, tractors or other farm machinery?]"

When looking at the data from all respondents, the results show that the average investment per landowner is consistently higher in communities with wind turbines than in the matched case communities. This is true for all types of investments, though most pronounced for investments in farm equipment. Landowners in communities with windfarms spend on average $29,813 more on farm equipment than their counterparts in communities without windfarms (see Table 3). When all investment types are combined, the difference in spending between landowners in matched case and windfarm communities is $47,456 over this five-year period.

There are even larger differences, though, between respondents in windfarm communities with turbines on their property and their neighbors without turbines. In most of the investment categories, landowners with turbines invest nearly twice as much as their neighbors. Furthermore, landowners with turbines reported spending over $250,000 more than both their neighbors and the landowners in the matched case communities on improvements to their properties over the five-year period. Notably, this increased investment likely exceeds the total of the revenues the landowner received from the wind developer over that same period,[2] which may be yet another indication that the wind income is helping families solidify succession plans and leading to a surge in investment in the farming operation.

[2]Many wdevelopers require leaseholders to keep lease terms confidential, but in interviews with local officials in the case study communities, the annual payments to landowners are likely less than $12,000 per turbine per year. Considering that most landowners have only one or two turbines on their property, few would be receiving $50,000 per year.

Table 3 Mean landowner investment in home and farm, matched case versus windfarm communities

				Wind Respondents	
Type of Investment	All Respondents	Matched Case Communities	Wind Communities	Neighbors	Turbines
Home	$26,897	$24,035	$28,829	$25,681	$41,970
Outbuildings	$36,521	$29,639	$41,118	$33,786	$71,780
Drainage/Irrigation	$25,321	$22,105	$27,474	$20,236	$57,863
Equipment	$125,027	$107,208	$137,021	$102,901	$279,539
Total Investment	$215,433	$186,899	$234,355	$183,593	$449,087
Number of respondents[a]	1096	437	659	533	126

[a]The number displayed is the number of respondents who answered all four investment-related questions

4.3 Social Impacts Dependent upon the Wind Business Model

Given the large differences in financial impact between landowners within wind-farm communities, one might imagine that wind development is causing strain in these communities. Indeed, in an open-ended section of the mail survey, a number of landowners noted that wind energy was causing tension in the community. Their comments include, "This type of energy has ripped apart farmland and communities, neighbors and families," and "Wind turbines have created a strong divide (and rightfully so) between people owning large tracts of land and those owning small parcels."

There are differences, though, based on the business model used by the wind developer. In Cases 1 and 2, where pooling is not used, more survey respondents commented on the divisive aspects of the project, and more often attributed community tension to the *greed* of the small number of landowners who were receiving royalty checks. One respondent in Case 1 wrote:

> Greed has led to the deterioration of the landscape and relationships with total disregard to anyone but themselves. There is absolutely no benefit to these monstrosities to anyone but the landowners that have signed leases and the wind power companies that receive huge subsidies for them.

Another implored, "Put greed aside and be logical!!! This is not good for our community."

There were still a handful of comments about community tension in Cases 3 and 4, where royalty pooling is the business model, but respondents instead explained suggested that it is motivated by *jealousy* on the part of those few who chose not to participate. One respondent in Case 3, who him/herself was not in the royalty pool wrote, "We have a very vocal minority against wind energy. I believe they are motivated by several things: (1) jealousy: if I'm not getting the money and controlling everything, I'm against it…."

Thus, in both cases it is those in the minority who are seen to be causing community discord. In communities where the traditional model is used those few landowners who receive direct payments are considered by the others to be greedy, while in communities where royalties are pooled and more landowners are directly compensated, the jealousy of those who oppose the projects is seen as the cause of the tension.

Notably in all of the case study windfarms, the wind developer pays property taxes to the local government and local schools, serving as an indirect monetary benefit to the whole community. However, it is the equity of the *direct* payment that is pointed to as an explanation of community discord. This underscores the importance of distributional justice (Hall et al. 2013) and fairness (Whitton et al. 2015) in assessing the social impact of wind energy development, and suggests that wind business models that allow for all community members to have a direct financial stake in the project may help minimize disturbing the social order in the communities in which turbines are sited. Indeed, models where the community itself owns the windfarm, much more common in Europe than the U.S., have been found to be both better received in the community and to have a larger impact on household budgets (Warren and McFadyen 2010; Phimister and Roberts 2012).

5 Conclusion

Through surveying agricultural landowners in communities with and without windfarms, this paper aimed to understand the social impact of wind energy as deployed in a Midwestern state (Michigan). It found that landowners with wind turbines on their property are more likely to have a succession plan in place for their farm and are investing significantly more money into on-farm improvements, as compared to both their neighbors without turbines on their property and survey respondents in non-windfarm communities. Both of these findings suggest that the individual-level economic benefits of wind energy may help reverse a decades-long trend of population loss by enabling a younger generation of farmers to take over the family farm. However, this research also cautioned that the influx of cash, particularly when concentrated in the hands of just a few landowners, has the potential to create tensions in the community.

This research just begins to explore the socio-economic impacts of wind energy, and further research is warranted to both explore other aspects of social sustainability and to understand how well these findings hold up beyond the study area. This study, for example, does not consider owners of non-agricultural parcels who are less likely to be receiving wind turbine income and so may have less of a financial incentive to remain in the community. Furthermore, all four of the windfarms studied were relatively new additions to the landscape when this research was conducted. It would be instructive to return to these communities in a decade or two to determine the longer-term social and economic impacts. Finally, while the cases selected were broadly representative of wind development in Michigan, they do not take into account the vast diversity of rural social and economic structures around the country

(Salamon 1992) and world (Alterman 1997; Ellis et al. 2009). More work could be done to understand how contextual factors, including state and national-level policies, impact the social impacts of wind development.

This research reminds us that as our understanding of sustainability matures to incorporate social and economic considerations at various scales, so too must our assessment of environmental technologies. We must look not just at the global and local environmental benefits or improvements of these technologies, but also at the impacts that they have on the social fabric of the communities in which they are deployed.

References

Adelaja, A., Sullivan, K., & Hailu, Y. G. (2011). Endogenizing the planning horizon in urban fringe agriculture. *Land use policy, 28,* 66–75. doi:10.1016/j.landusepol.2010.05.002.

Alterman, R. (1997). The challenge of farmland preservation: Lessons from a Six-Nation comparison. *J Am Plan Assoc, 63,* 220–243.

Bell, D., Gray, T., & Haggett, C. (2005). The "Social Gap" in wind farm siting decisions: Explanations and policy responses. *Env Polit, 14,* 460–477.

Black, G., Holley, D., Solan, D., & Bergloff, M. (2014). Fiscal and economic impacts of state incentives for wind energy development in the Western United States. *Renewable and Sustainable Energy Reviews, 34,* 136–144. doi:10.1016/j.rser.2014.03.015.

Brown, J. P., Pender, J., Wiser, R., et al. (2012). Ex post analysis of economic impacts from wind power development in U.S. counties. *Energy Econ, 34,* 1743–1754. doi:10.1016/j.eneco.2012.07.010.

D'Souza, G. E., & Gebremedhin, T. G. (1998). *Sustainability in agricultural and rural development*. Brookfield, VT: Ashgate.

Devine-Wright, P. (2005a). Local aspects of UK renewable energy development: Exploring public beliefs and policy implications. *Local Environment, 10,* 57–69. doi:10.1080/1354983042000309315.

Devine-Wright, P. (2005b). Beyond NIMBYism: Towards an integrated framework for understanding public perceptions of wind energy. *Wind Energy, 8,* 125–139. doi:10.1002/we.124.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2009). *Internet, mail, and mixed-mode surveys: The tailored design method* (3rd ed.). New York: Wiley.

Ellis, G., Cowell, R., Warren, C., et al. (2009). Wind power: Is there a "Planning Problem"? Expanding wind power: A problem of planning, or of perception? The problems of planning—a developer's perspective wind farms: More respectful and open debate needed, not less planning: Problem "Carrier" or proble. *Plan Theory Pract, 10,* 521–547.

Gallego Carrera, D., & Mack, A. (2010). Sustainability assessment of energy technologies via social indicators: Results of a survey among European energy experts. *Energy Policy, 38,* 1030–1039. doi:10.1016/j.enpol.2009.10.055.

Groves, R. M., & Couper, M. P. (1998). *Nonresponse in household interview surveys*. New York: Wiley.

Hall, N., Ashworth, P., & Devine-Wright, P. (2013). Societal acceptance of wind farms: Analysis of four common themes across Australian case studies. *Energy Policy, 58,* 200–208. doi:10.1016/j.enpol.2013.03.009.

Kahn, M. E. (2013). Local non-market quality of life dynamics in new wind farms communities. *Energy Policy, 59,* 800–807. doi:10.1016/j.enpol.2013.04.037.

Mulvaney, K. K., Woodson, P., & Prokopy, L. S. (2013). A tale of Three Counties: Understanding wind development in the rural Midwestern United States. *Energy Policy, 56,* 322–330. doi:10.1016/j.enpol.2012.12.064.

Munday, M., Bristow, G., & Cowell, R. (2011). Wind farms in rural areas: How far do community benefits from wind farms represent a local economic development opportunity? *J Rural Stud, 27,* 1–12. doi:10.1016/j.jrurstud.2010.08.003.

Napier, A. (2012). Wind power: Economic growth for rural America. Washington, DC: American Wind Energy Association. http://www.aweablog.org/wind-power-economic-growth-for-rural-america/.

Pennings, J. M. E., Irwin, S. H., & Good, D. L. (2002). Surveying farmers: A case study. *Rev Agric Econ, 24,* 266–277.

Phimister, E., & Roberts, D. (2012). The role of ownership in determining the rural economic benefits of on-shore wind farms. *Journal of Agricultural Economics, 63,* 331–360. doi:10.1111/j.1477-9552.2012.00336.x.

Salamon, S. (1992). *Prarie patrimony: Family, farming, and community in the Midwest*. Chapel Hill: University of North Carolina Press.

Seawright, J., & Gerring, J. (2008). Case selection techniques case study research: A menu of qualitative and quantitative options. *Political Research Quarterly, 61,* 294–308.

Slattery, M. C., Johnson, B. L., Swofford, J. A., & Pasqualetti, M. J. (2012). The predominance of economic development in the support for large-scale wind farms in the U.S. *Great Plains. Renew Sustain Energy Rev, 16,* 3690–3701. doi:10.1016/j.rser.2012.03.016.

Slattery, M. C., Lantz, E., & Johnson, B. L. (2011). State and local economic impacts from wind energy projects: Texas case study. *Energy Policy, 39,* 7930–7940. doi:10.1016/j.enpol.2011.09.047.

Sutherland, L.-A., & Holstead, K. L. (2014). Future-proofing the farm: On-Farm wind turbine development in farm business decision-making. *Land use policy, 36,* 102–112. doi:10.1016/j.landusepol.2013.07.004.

Swofford, J., & Slattery, M. (2010). Public attitudes of wind energy in Texas: Local communities in close proximity to wind farms and their effect on decision-making. *Energy Policy, 38,* 2508–2519. doi:10.1016/j.enpol.2009.12.046.

U.S. Department of Energy (DOE). (2015). *Wind vision. A new era for wind power in the United States*. Washington, DC: US Department of Energy.

Union of Concerned Scientists. (2003). Farming the wind: Wind Power and Agriculture. Cambridge, MA: Union of Concerned Scientists.

Warren, C. R., Lumsden, C., O'Dowd, S., & Birnie, R. V. (2005). "Green on Green": Public perceptions of wind power in Scotland and Ireland. *J Environ Plan Manag, 48,* 853–875.

Warren, C. R., & McFadyen, M. (2010). Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland. *Land use policy, 27,* 204–213. doi:10.1016/j.landusepol.2008.12.010.

Weisser, D. (2007). A guide to life-cycle greenhouse gas (GHG) emissions from electric supply technologies. *Energy, 32,* 1543–1559. doi:10.1016/j.energy.2007.01.008.

Whitton, J., Parry, I. M., Akiyoshi, M., & Lawless, W. (2015). Conceptualizing a social sustainability framework for energy infrastructure decisions. *Energy Res Soc Sci, 8,* 127–138. doi:10.1016/j.erss.2015.05.010.

Wilson, G. A., & Dyke, S. L. (2016). Pre- and post-installation community perceptions of wind farm projects: The case of Roskrow Barton (Cornwall, UK). *Land use policy, 52,* 287–296. doi:10.1016/j.landusepol.2015.12.008.

Wolsink, M. (2007). Wind power implementation: The nature of public attitudes: Equity and fairness instead of "backyard motives". *Renewable and Sustainable Energy Reviews, 11,* 1188–1207. doi:10.1016/j.rser.2005.10.005.

Author Biography

Sarah Mills holds a master's degree in engineering for sustainable development from the University of Cambridge and a bachelor in mechanical engineering from Villanova University. She earned her PhD in urban and regional planning at the University of Michigan. She currently serves as a postdoctoral fellow at the University of Michigan's Center for Local, State, and Urban Policy (CLOSUP), where she serves as project manager for two ongoing large-scale surveys. Her research interests are at the intersection of environmental and land use policy, particularly as they relate to rural communities.

Achieving a Climate-Neutral Campus: A Psychological Analysis of the Participation Process with the Stage Model of Participation

Stefan Zimmermann, Thomas Bäumer and Patrick Müller

Abstract

The complexity of social transformations requires participative approaches to research. One such approach to meeting this need is the so-called "Living Lab", in which the participation of all stakeholders lies at the heart of the research process. This article presents a stage model as a way of describing the psychological aspects involved in participatory processes in an environmental context. The purpose of the model is to show the psychological parameters underlying a successful participatory process as a basis for finding suitable participatory measures for different project settings. It is the aim of this article to introduce the elaborated model with its different levels of environmental participation as well as to demonstrate its application. Three case studies demonstrating the application of the model are presented from the "climate-neutral city campus" Living Lab at the University of Applied Sciences Stuttgart. The case studies show participation opportunities using (1) interviews with employees about sustainability measures, (2) the integration of sustainability-related topics into teaching, and (3) the support of mobile apps for achieving climate-neutrality. So far, three important findings have emerged: (1) Depending on the degree of involvement, different forms of participation are appropriate. (2) Participation at higher levels of involvement is difficult to achieve when people's motivations at the lower levels are not adequately addressed. (3) The participatory process in the environmental context can be described using the proposed model and it provides useful insights how to better implement appropriate measures in order to achieve social transformations.

S. Zimmermann (✉) · T. Bäumer · P. Müller
Business Psychology, Hochschule für Technik Stuttgart (University of Applied Sciences), Schellingstraße 24, 70174 Stuttgart, Germany
e-mail: stefan.zimmermann2@hft-stuttgart.de

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*, World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_13

Keywords
Participation · Environmental psychology · Environmental awareness
Procedural fairness · Self-determination theory · Intrinsic motivation

1 Introduction—the Growing Importance of Participation

In recent years, the question of participation has become more prominent in a variety of different research areas and fields of application (Reinau and Ungern-Sternberg 2013). Urban planning is one of the areas in which participation is seen as being crucial for undertaking larger projects (Rambow et al. 2014). For example, the German "Energiewende" (energy transition) has amply demonstrated that the citizens wish to co-create and have a say in decision-making and solution finding processes (Itten and Mono 2014). It is important to make the best use of this societal change, since the complexity of the impending processes of social transformation cannot be mastered without the participation of the people who are affected by those changes. The German mega-project to construct a main railroad station completely underground—called "Stuttgart 21"—is a prominent example of how citizens protest against projects if they feel that they have not been adequately consulted. The vehemence of the conflict and the emotional connection with the building project clearly indicate that there was more at issue here than just a decision about a new station. This psychological phenomenon is often observed when people affected by the final decision are not—according to their own view—sufficiently involved in the decision-making process.

In the organizational context, the benefits of participation have been recognized for a long time. A large number of studies in this area show the importance of involving employees in decision-making (e.g. Cawley et al. 1998; Cerasoli and Nicklin 2014). Therefore, the business context is a good example where participation is widely researched and it plays a decisive role in successful companies. For example, the organization and management culture of modern businesses endeavors to see employees not as employees alone but also as stakeholders, with the aim of making their work more meaningful to them. Organizational participation also brings about positive effects at the individual level, such as ensuring more self-efficacy, delivering greater work satisfaction and increasing commitment to the organization (e.g. Michael 2016). These positive interactions can also be observed in other forms of participation. In a quasi-experimental field study in Switzerland, Stutzer and Frey (2000) have shown that the degree of participation has an influence on people's life satisfaction. Such findings suggest that the potential inherent in the various forms of participation should be extended further.

We believe, that various areas of social sciences—such as psychology—are helpful in order to better understand the influences underlying participation processes. In this article, a specially developed stage model which provides knowledge about intrapersonal operations of participants along the participation process in the environmental context will be introduced. The model is useful to identify the relevant psychological preconditions for certain participation measures. In addition, findings from the communication science are integrated into the model to classify the participation process itself in a meaningful and practical way. Finally, the purpose of the model is to enable a more goal-oriented planning process regarding the selection of suitable participation measures.

A detailed definition of the participation concept is given by the International Classification of Functioning, Disability and Health (ICF): "The ICF defines participation as involvement in a life situation or as the lived experience of people in the actual context in which they live, while the activity is defined as the execution of a task or action by an individual" (Piškur et al. 2013, p. 3). Furthermore, from a psychological perspective, the following statement corroborates the above-mentioned link between participation and life satisfaction, describing participation in the context of "[…] one's ability to advance in the world and change it creatively through physical or mental activities. […] active participation in and mastery of the environment are important ingredients of an integrated framework of positive psychological functioning" (Ryff 1989, p. 1071). In this article, participation refers to the characteristics described above and is also understood as being a prerequisite for sustainable development. A participatory process can thereby refer to diverse topics. In any participatory process, each participant may have to pass through various "psychological steps of participation", which will be discussed below (cf. Sect. 3).

Based on the relevance of this topic, many different methods of participation have been developed over the years (Voß and Amelung 2016). The benefits of the methods depend strongly on the context in which they are used. In addition to the purpose of engaging and empowering people, it is imperative to envisage the actual goal that should be achieved with the involvement of the relevant stakeholders. This may seem trivial, but even though it is of fundamental importance for a successful outcome, it is often attributed only secondary importance when participatory processes are being designed. With this in mind, the outcome of a participatory measure must be adjusted to the actual goal that is being targeted in the end (e.g. a train station project which is open and transparent to the public, which considers their various expectations and needs, and is ultimately endorsed by a clear majority of the city's population). Furthermore, the initiators of participatory measures must create realistic expectations among the stakeholders involved, as well as having them themselves. In that connection, it is most helpful to consider the various psychological factors which affect people's degree of engagement. As mentioned above, the model presented in this article examines crucial psychological factors with respect to the participation process in the environmental context (cf. Sect. 3). Here, the participation measures can be classified according to the two dimensions "procedural justice" and "intrinsic motivation" (cf. Sect. 2). To illustrate the model, three case studies from the "climate-neutral city campus" Living Lab are presented in this article (cf. Sect. 4). Before describing the stage model, the underlying psychological aspects of participation will first be described in the following section.

2 Psychological Aspects of Participation

Several specific factors contribute to the participation process at a psychological level. Among them are the *sense of justice* during a participation process and the various factors underlying participants' *motivation* to engage themselves in the participation process. The following section therefore focuses on these psychological aspects by dealing with: (1) procedural justice as a framework for participation, and (2) motivational factors for participation and the importance of intrinsic motivation.

2.1 Procedural Justice as a Framework for Participation

Most projects in the area of sustainability affect people's personal environment. Such changes often create uncertainty, since it is seldom possible to assess a new situation in its entirety (cf. Kotter 2011). In most cases, uncertain situations are perceived as negative (e.g. Lind and van den Bos 2002). If changes are made externally, the perceived insecurity of the affected persons can be influenced significantly by their sense of justice. Perceived justice ensures reliability and the change process becomes more tenable (Lind and van den Bos 2002). Previous research has identified several dimensions of the justice concept (cf. Colquitt et al. 2001). Most relevant for the participation process is the dimension of *procedural justice*, which refers to the planning processes preceding a decision. The present section focuses on procedural justice as a central aspect consisting of the following four factors (Tyler 2000): (1) the possibility of expression, (2) dealing respectful with stakeholders, (3) confidence in the motives of the decision-makers, and (4) the neutrality of the decision-makers.

The *possibility of expression* is not a question of influencing the decision, but rather of being able to be represented and heard (Tyler 2000). Even if a person has no actual influence on the decisions, the process is nevertheless regarded as more just when there is a possibility of expression (Lind et al. 1990). An individual's perception that a particular process is fair triggers many favorable attitudes and behaviors towards the decision-making instance, regardless of the outcome of the process. This well-researched phenomenon is called *fair-process effect* (Folger 1977; Streicher and Öttl 2013) and can be found in many areas of social life (e.g. Colquitt et al. 2013). The second factor refers to a *respectful approach* which strengthens identity and self-esteem. In addition, interpersonal interactions and the type of behavior exhibited towards individuals allow conclusions to be drawn about the status and position of a person in a group. It serves to enhance a person's positive self-image if they are an acknowledged member of a group (Streicher and Öttl 2013). In uncertain situations or when dealing with strangers, it is particularly important that they have *confidence in their motives*. If a process is perceived as being negative or unfair, mistrust ensues (Streicher and Öttl 2013). If there is a trusting relationship to the decision-maker, the fear of being exploited is reduced.

Neutrality is guaranteed if the decisions are made independently of the persons involved, i.e. not because of personal preference. Decisions must be made on the basis of facts and the actualities of the situation (Tyler 2000). Finally, it should be noted that the absence of procedural justice can trigger negative emotions as well as destructive behavior and even sabotage (Tyler and Lind 1992). These findings suggest that a program for a participation process should aim for procedural justice to increase its chances of success. It is therefore imperative that these factors are observed during the participatory process in order to promote the acceptance of the participation process—and especially its results—by all stakeholders in an optimal way.

2.2 Motivational Factors for Participation and the Importance of Intrinsic Motivation

In addition to the dimension of procedural justice described above which can positively influence people's acceptance of a process, intrapersonal conditions govern people's motivation to participate. In general, demonstrating and expanding one's own competence is one of the central motivational factors of social action. According to Deci and Ryan (2002), *competence*, together with the *needs for autonomy* and *social integration*, form the three motives of the *self-determination theory*. Competence is beneficial for a person's commitment, as it holds out the promise of success and outweighs the fear of failure, just as it does with motivation in a school or company setting (Preiser 2013). Autonomy is described as an attempt to shape one's own actions and co-design one's surroundings. The need for autonomy is closely linked to the concept of control in the form of self-determination and co-determination (Preiser 2013). The motive for achieving social integration can be comprehended as the need for security and can be linked to aspects of procedural justice: trust and a respectful approach.

Depending on a person's degree of involvement in a participation process, it is of crucial importance whether a person is *extrinsically* (through external stimuli such as rewards or avoiding punishment) or *intrinsically* (pleasure deriving from the activity itself) motivated. Several studies have demonstrated the importance of intrinsic motivation in the workplace (e.g. Thomas 2009). Especially the level of intrinsic motivation is associated with a high degree of involvement. Involvement represents an individual's connectedness with a topic. In the context of this article—and thus in the context of participation—involvement is understood in the sense of motivational factors described in the *self-determination theory* (competence, autonomy, social integration). In addition to these factors, the existence of *self-efficacy* is also helpful for increasing intrinsic motivation. On the one hand, the construct of self-efficacy refers to the expectation of results and, on the other, to self-efficacy expectations (Bandura 1977). In expecting results, those convictions are described according to which certain actions lead to certain results. The conviction that it is possible to mobilize the cognitive and motivational resources necessary to show the desired actions and cope with any challenges are self-centered and termed self-efficacy expectations. Self-efficacy is therefore closely related to the competency construct described above. In a discussion about the influence of self-efficacy and motivational factors on learning motivation, Krapp and Ryan concluded (2002) that the degree of self-efficacy had an impact on a person's degree of learning motivation and was therefore able to predict fairly accurately the cognitive and motivational aspects of behavior regulation. However, the two researchers went on to say that the theoretical range for explaining human motivation through self-efficacy was overstated, and that it was necessary to supplement it with the findings of self-determination theory.

The more a person should be engaged in a participation process, the more the program for participation should appropriately address the underlying aspects of intrinsic motivation. The model introduced in this article represents this by using an axis for "level of intrinsic motivation" which includes the psychological aspect of motivation, something which has just been described above as involvement (competence, autonomy, social integration). Consequently, these aspects must be present to an appropriate degree if a person is to be engaged—depending on the phase of the participation process.

3 A Psychological Stage Model of Participation for the Environmental Context

The following section takes up the psychological aspects outlined previously by describing the *Stage Model of Participation* (SMoP) for the environmental context. In addition, the following two components are included in the model: (1) the different meanings of *environmental awareness* according to Spada (1990), and (2) the *forms of communication* (cf. Sinning 2005) or the *phases of participation* (Eimer 2016) respectively, as they are named in the SMoP. However, before these additional components are discussed, the purpose of this model needs to be explained. Existing models which also describe various steps in the participation process have all been developed for a specific context, e.g. for children and teenagers (cf. Hart 1997), policy (cf. Lüttringhausen 2000) or health promotion (cf. Wright et al. 2007). *The Cultures of Participation Theory* (Fischer 2011), with its socio-technical approach, is a further model for participation which seeks to contribute to a better understanding of how technological innovations interact with societal change, and describes five different roles of participation in this context. However, there are still no specific models for participation in the environmental context. Furthermore, the underlying psychological aspects are not addressed (to the same extent) as is the case in the SMoP proposed in the current paper, which clearly increases the explanatory value of the model.

The requirement to involve all stakeholders comes from sustainability research and has been adopted in many other scientific fields. As mentioned above there are many different participation methods which have also been applied in a diverse range of areas. However, there are almost no practical planning tools with a deeper understanding of the participation process. The SMoP tries to close this gap as a tool for setting appropriate objectives for the planned participation measures.

Spada (1990) has identified various meanings of environmental awareness which contribute substantially to the explanatory power of the SMoP. He distinguishes between a narrow range (environmental experience and concernment), a medium range (plus environmental knowledge, environmental value orientations and environment-relevant behavioral intentions) and a wide range of meanings (plus environmentally relevant manifest behavior). This classification is particularly interesting for the process of participation in environmental contexts, since the various "stages of environmental awareness" are constructed on top of one another and a psychological development process is described—from rather passive experience and consternation, through to the manifest behavior. It is possible to view this development not only as an extension of environmental consciousness, but also as an increase in intrinsic motivation or involvement if participation in the environmental context is required.

The development of a participation process can be divided into three phases which are analogous to the three forms of communication as described by Sinning (2005): (1) information (one-way communication), (2) participation (two-way communication) and (3) co-operation (multi-way communication). This subdivision is also found in models from the scope of application, e.g. at the *phases of participant work* (Eimer 2016). We adapted those phases of participation work and added psychological explanations. Those three phases with its corresponding five steps are explained in the next paragraph.

First and foremost, it is the goal of this first phase to acquire a realistic assessment of the topic and to deal with it. This is the intention behind Step 1 *Experience and Concernment* which seeks to build a basic prerequisite for the emergence of the intrinsic motivation to participate. Doing this means appealing to existing motivations when addressing people. In the marketing context, this is known as need-oriented approach (Tapp et al. 1999). By informing people, (environmental) knowledge (Step 2) can be accumulated and activated. Phase II "Convince/Engage" is intended to aligning peoples attitude with the goal of the related project and enable them to contribute their own ideas. Building on the first two steps, it is therefore possible to form environmental value orientations based on specific attitudes (Step 3). Good arguments must be provided here in order to allow a thorough understanding of the facts and information in the sense of the *central route*. According to the *Elaboration Likelihood Model* (Petty and Cacioppo 1986), a person will invest considerable cognitive effort under the central route while considering the presented information thoughtfully. Consequently, persuasion is likely to result from it, together with an enduring and resistant attitude change. The resulting self-reflection should further support the participation process, so that environment-relevant behavior intentions (Step 4) arise from it in a next step. Based on this intention, co-operation and co-determination (Phase III) should result in environmentally relevant manifest behavior (Stage 5). In this process, the commitment of the participant is used to jointly develop concrete measures and

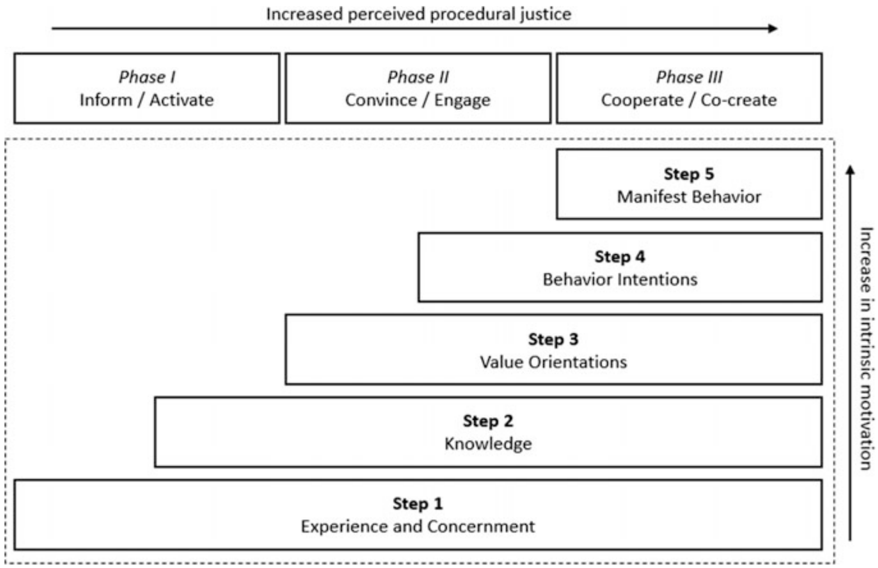


Fig. 1 Stage Model of Participation (SMoP) for the environmental context

implement them if necessary. The three phases of participation are presented together with the psychological aspects addressed in the SMoP (Fig. 1).

As participation intensifies over the course of the phases (horizontal axis), the four factors of procedural justice must also be considered—the possibility of expression, a respectful approach, confidence in the motives, and neutrality of the decision-makers (cf. Sect. 2.1)—so that the perceived procedural justice increases. Intrinsic motivation (vertical axis) increases based on the stepwise inclusion of the motivation factors: competence, autonomy, and social integration (cf. Sect. 2.2).

In exceptional situations, it can be the case that there are already strong environment-related value orientations for the relevant participation context, or even behavioral intentions in this respect. In these cases, the first or the second phase can be shortened and designed more easily, and the third phase can be passed relatively quickly. Normally, however, the phases should be carefully addressed as described, with a focus on the respective steps, if those involved are to engage in the participation process.

The characteristics of the participation process can be depicted on the model's two axes. The positioning of the stakeholders in the SMoP can support the development of a suitable strategy for this process and, based on this, the development of appropriate measures. The classification into the three phases with a focus on the respective steps provides a clear and above all purposeful structure. The model is also suitable for formative evaluation (to adjust current participation processes) and summative evaluation (in order to gain reflexive insights).

The following paragraph describes three examples from an ongoing research project in order to show how this model can help to understand and communicate (complex organizational change) projects in the environmental context.

4 Empirical Case Studies—Examples of Participation in the Field

All three case studies are part of a research project entitled “EnSign—climate-neutral city campus” which has the character of a Living Lab. The acronym EnSign is composed of “En” for energetic and the word “sign”, which together stands for setting an energetic example. The findings from EnSign are intended to help achieving the goal of the state government to form a largely climate-neutral administration by 2040. At the heart of EnSign lies the transformation process for creating a climate-neutral university. The measures to be developed during the project in order to reach this goal include the improvement of constructional substance and plant engineering, or the provision of renewable energies on the campus. The internal processes are to be optimized and new financing models for the energetic renovation of public buildings are to be developed. The behavior of the users also exerts a considerable influence on CO_2 emissions, which is why this aspect is also being considered. By including its students, office and technical staff as well as researchers and lecturers, the campus user group is very heterogeneous. The following three cases show different types of participation in this project: (5.1) Participation of employees—through the integration of user acceptance when evaluating sustainability measures; (5.2) Participation of students—through the integration of sustainability topics into teaching; (5.3) Facilitating Participation—through the integration of mobile apps.

4.1 Participation of Employees—Integration of User Acceptance

The issue of participation is of particular relevance in an organization throughout the implementation process of sustainability measures. In order to meet operational sustainability objectives (such as the reduction of carbon dioxide emissions) and the increased regulatory requirements, organizations such as universities have to decide which measures are best suited to achieve these objectives. Such measures include the installation of programmable thermostats to save energy for heating, or the retrofit of older lighting systems to save electricity. However, it is not possible to meet targets without the employees’ support as their individual attitudes and corresponding behaviors may influence other co-workers and a negative social norm may evolve from this (Bäumer et al. 2017).

As the employees are affected by the integration of sustainability measures the conditions for Step 1 *Experience and Concernment* in the model are given in this case study. As a first approach, we conducted interviews with some of the staff members about the topic “energy consumption behavior on the campus”. In doing so, we also informed them about some planned sustainability measures for the building they were working in and asked them for their opinion in order to gain some information from them as well. With reference to the model, these interviews fulfilled Step 2 *Knowledge*. Both steps of Phase I *Inform/Activate* are therefore included in this case study.

A total of 23 in-depth interviews were conducted in three buildings on the campus. The employees were categorized according to certain criteria (employee status, floor, gender). After agreeing to participate, the candidates were sent an “energy diary”, which they prepared for the interview. The results of the survey need not be discussed in detail here. In summary, however, the interviews showed that the employees believed the university had considerable potential for energy savings. Concerning the suggested sustainability measures, the interviews were particularly useful in the case of programmable thermostats which were planned to be installed in the offices. The acceptance of this measure was very low. One main reason that was mentioned was the feeling that technology takes over and makes decisions without giving the user chance to have the final say on the matter. A second main reason was the expected difficulty of operating and programming the thermostats. As these thermostats represent a very attractive sustainability measure from a technical and economic perspective (high potential for energy savings, easy to install, relatively cheap), this measure should be implemented despite these reservations. But given the concerns mentioned above, only a limited number were installed in the first instance in order to gather experience: firstly on how the employees coped with them, and secondly on how to establish close technical support, which had been set up beforehand. This approach has proven to be successful, showing good user satisfaction and high adoption rate of the thermostats.

This case study is an example of a win-win situation which can result from a participation process. When integrating sustainability measures in organizations, employees greatly appreciated being included in that process. If a “culture of participation” is established in an area, this can also improve support for less popular measures if the appropriate reasons are given (cf. Fair-Process-Effect). If the users’ opinions are taken into account, knowledge about the acceptance of possible measures is acquired. In addition, a positive effect on employees’ attitudes and behavior towards the measures can be expected (cf. Procedural Justice). Furthermore, one can also avoid simply implementing unpopular measures or measures that are given a low priority by users, something that tends to hinder their implementation.

That the employees were affected by those measures is one main reason for this success. They experience the spatial surroundings at their workplace for about forty hours a week. Even though the level of involvement in this participation process was not very high (Step 1 and Step 2), simply informing them about the planned sustainability measures and asking them a few questions about their opinion (Phase I *Inform/Activate*), ensured their full support. Based on this solid foundation, participatory measures have a good chance of succeeding when applied properly. Further forms of participation would consequently help to place more employees at higher levels in the model—*Convincing* and *Engaging* (Phase II) them so that matching *Value Orientations* (Step 3) can evolve. This leads not only to the acceptance of the measures themselves (if the significance of the measures and a corresponding line of argument is provided), but also to broad support among the employees for participating in this context (increase in intrinsic motivation).

4.2 Participation of Students—Integration of Sustainability Topics into Teaching

It is important for universities to impart social values. In a case study, this was achieved by integrating research questions from the EnSign project into the curriculum of the Bachelor program in Business Psychology. Throughout the whole program, research questions from the Living Lab were used as assignments for research projects in the students' courses on research methodology. An interdisciplinary project-based course was also used for this purpose. Prior to this article being published, twelve student groups were working on the topic of energy consumption behavior. One line of student projects from the experimental field is described more precisely because it shows the potential of participation in an interdisciplinary research field particularly well.

The case study presented here is located in Step 2 *Knowledge* and Step 3 *Value Orientations* in the SMoP and therefore on the threshold between Phase I *Inform/Activate* and Phase II *Convince/Engage*. The applied participation measure with respect to *Knowledge* is not only to lecture, but also to guide and advise the students about the professional aspects. In addition, we invited the students to be creative when drafting the concepts for the experiments, and to explore the environmentally relevant aspects. Allowing them to participate in the overall EnSign project is an opportunity to build a spirit of collaboration for the "climate-neutral city campus" project, which is related to *Value Orientations* (Step 3). The task at hand was to carry out experiments in computer rooms at our university with the goal of persuading students to shut down their PCs after using them by presenting them with a prompt (sign attached to the computer screen) that included a justification for this behavior. An online tool was used to measure the effect of the interventions. This tool was developed by Computer Science students in an interlinked study project. The online tool continuously monitored the state (on/off) of each computer. Students and researchers can select individual computer rooms on a web page and display usage (number of PCs) and consumption (extrapolated kilowatt-hour consumed), and download the data. The tool was specifically designed to create an open data platform for use in subsequent research, such as psychological field studies. The collaboration between the two departments transpired to be very fruitful, not only with regard to the initial research question, but also in stimulating further collaborative research projects. In addition to the aim of initiating a participatory process through the student projects, the results were also helpful for EnSign. Ideas for the design of prompts were derived using the example of the experiments in the computer rooms. In the long term, these prompts can contribute to strengthening energy consciousness at the university. Further experiments are planned on this topic as part of an information campaign to increase awareness of the EnSign project at the university. The interdisciplinary character of the student projects is an additional benefit. The focus, however, is to integrate topics relevant to sustainability into teaching and to encourage students to work independently in such contexts.

Phase I in the model is where people are informed and activated with the aim of establishing environment-related value orientations in Phase II. Following these students projects, it is expected to convince the students of the relevance of the topic so that they pass on the idea of "climate-neutrality" beyond the campus, thereby performing as multipliers. However, as Step 1 (Experience and Concernment) is not adequately met by most students with the aim of a climate-neutral campus alone, the foundation upon which environment-relevant knowledge (Step 2) can be built is to be classified as insufficiently stable in a large proportion of the students.

4.3 Facilitating Participation—Integration of Mobile Apps

Smartphones are omnipresent, and mobile phone applications can therefore help to facilitate participation. One example is the "ecoGIS" app, which was developed by the Department of Geoinformatics at our university to provide quick and easy feedback on the buildings (Fridrihsone and Kettemann 2015). The aim of the app is to enable all university members to report environment-relevant observations with a minimum of effort. It will also be used for site assessments and audits at the university within the Eco-Management and Audit Scheme (EMAS), which is provided by the European Commission. Currently, it is very labor intensive and time consuming, and the results are hard to analyze, update and communicate. This feedback app is not only a practical instrument for simplifying the regular audits and therefore improving the condition of the building stock and the campus as a whole. It is also a great opportunity for allowing more people to participate in that process. From a psychological point of view, the primary question is: How can the students—as the main target group—be encouraged to use the app (regularly) so that the relevant crowd can be constituted for the crowdsourcing?

This is no easy undertaking, as we want the students to *Engage* (Phase II) and *Cooperate* (Phase III) and therefore operate at a high level in the participation process—according to the model Step 4 *Behavior Intentions* and Step 5 *Manifest Behavior*. The difficulty here is that the earlier steps are not achieved to a sufficient degree: Even though the students spend some time at the campus, they are not as much affected as employees who work in their offices full time (Step 1 *Experience* and *Concernment*). There is also not much information available (yet) about the sense and purpose of the app and the sizeable benefits which can accrue if numerous people use it (Step 2 *Knowledge*). Given the absence of the first two steps, it is most likely that only a few students will (already) have appropriate *Value Orientations* (Step 3) upon which to build—with the aim of inducing them to use the app (regularly).

As depicted in the SMoP, (environmentally relevant) *Manifest Behavior* represents the highest level of participation. Whilst we are aware of the "fragile foundation" described above, we have identified a number of ways to strengthen it. The launch of the app has to be supported by a well-conceived campaign which induces a sense of concern in the recipient and provides information and incentives for using the app – carrying out Phase I *Inform/Activate* to achieve Step 1 *Experience* and *Concernment* and Step 2 *Knowledge*. Potential users should be able to build up a high degree of intrinsic motivation. For example, this could be achieved by initiating a competition (e.g. between faculties) or creating a story that addresses students' motives so that they identify with it (e.g. as "eco-detectives")—which is in line with Phase II *Convince/Engage* to achieve Step 3 *Value Orientations* and Step 4 *Behavior Intentions*.

5 Different Forms of Participation—Discussion

Different forms of participation require different levels of intrinsic motivation (the different steps in the model). The extent to which the stakeholders affected should be involved depends on the purpose of their participation. When planning a participatory process, the question of objectives must therefore be clarified first. With the application of the SMoP, an analysis can be carried out beforehand in order to derive appropriate measures and to obtain a realistic assessment of their effects.

In the first case study, concernment was given among the employees (solid foundation) and with the conducted interviews, a good starting point for the participation process has been achieved. The positive effect on the respondents—firstly on the planed sustainability measures and secondly the appreciation of being asked at all—is extremely beneficial and can be seen as the starting point for the emergence of a "participatory culture" in this area. If all steps during the participation process can be carried out, this could also lead to long-term behavioral and attitudinal changes.

At higher levels of participation it is difficult to achieve success if no motive has been (sufficiently) addressed and therefore no basic interest is present. This was the case with some of the EnSign student projects (second case study). Even though, with the award of credit points and a grade, there were enough extrinsic motivators and the students have been motivated and committed and the projects have been performed very well. Creating environmental value orientations (Step 3) is not to be expected on this basis. The goal of transferring sustainability related values by integrating corresponding topics into teaching should be the cause of more concern. Furthermore, the projects have to be more closely connected with the students' motives. For example, students of business psychology are primarily interested in exciting business enterprises. One could initiate attractive student projects in cooperation with corresponding companies involved in the EnSign project and thus create more enthusiasm among the students for similar research questions.

The possibilities to flank participation processes by technical support—such as the application of mobile apps—are promising (third case study). But before launching the ecoGIS app, a lot of effort should be invested in developing a target group-adequate information campaign in order to generate concern (Step 1). In addition to the information about the app itself, one must appropriately convey the environmentally-relevant knowledge (Step 2) and put it in the right context (ideas how this could be done has already been discussed with the description of the case study). According to the SMoP, it is of fundamental interest to establish the first steps before higher levels of participation can be achieved—like in this case with the (regularly) use of the app.

The SMoP includes the most relevant psychological parameters underlying participatory processes. However, there are other effects not included into the model. Apart from the psychological aspects of procedural justice (fair process effect) and intrinsic motivation included in the model, there are other psychological factors which also influence the participation process. This includes, for example, the effect of *psychological ownership*, which describes how a person feels closely connected to an object or an idea (Pierce et al. 2001). Also, when people contribute to solving a problem together or by themselves, the activity is enhanced and the probability increases that the persons involved have time and energy to apply it, something which is known as the *Ikea Effect* (Ariely 2010). Values, as abstract and global attitudes (Kroeber-Riel and Gröppel-Klein 2013), can be seen as a kind of threshold to environmentally-relevant behavior. To prevent a state of stress or tension between a person's actions and values, something which is known as dissonance as described in *Cognitive Dissonance Theory* (Festinger and Carlsmith 1959), values can be adapted according to a person's behavior. In the long term, values are therefore formed or changed. Thus, attitudes can be influenced by individuals through participation measures, which, in the long run, can lead to significant value changes in a society.

Apart from this, the major shortcoming of the SMoP so far is the lack of supporting data, e.g. by using an experimental approach in order to gather evidence about the structure of the model. In addition, it is necessary to empirically link concrete participation measures with the steps in the model. Finally, the SMoP has been applied only in the university area so far. Therefore, other areas of application could provide valuable information about the possible general usefulness of the model.

6 Conclusion

The psychological approach presented in this article achieves a high level of understanding about individual parameter underlying a (successful) participatory process. For an in-depth evaluation of the presented step model of participation (in the environmental context), corresponding instruments have to be developed and tested. This is already planned as part of the EnSign project. Such further research is necessary since the assumptions made on the basis of the SMoP have not been validated yet (with the use of experimental and comparative studies for example). Moreover, the SMoP will also be used for the planning of participatory measures in order to gain more knowledge for its practical use. Setting appropriate objectives for the planned participation measures can be derived with the application of the SMoP, as shown in this article. Further research should provide a more detailed account of which methods are specifically recommended for the respective phases and stages in the participation process. However, by examining the case studies presented above, the SMoP—with its applied psychological concepts—has already proved its worth for gaining valuable insights into the participation process. In conclusion, three important findings have emerged: (1) Depending on the degree of involvement, different forms of participation are appropriate. (2) Participation at higher levels of involvement is difficult to achieve when people's motivations at the lower levels are not adequately addressed. (3) The participatory process in the environmental context can be described using the proposed model and it provides useful insights how to better implement appropriate measures in order to achieve social transformations.

Acknowledgements This research within EnSign project is founded by the Ministry of Science, Research and the Arts Baden-Württemberg, Germany. We also thank our reviewers for their helpful comments regarding an earlier version of the paper.

References

Ariely, D. (2010). *The upside of irrationality—the unexpected benefits of defying logic at work and at home*. New York: Harper Collins.

Bäumer, T., Worm, D., Müller, P., Zimmermann, S., Popovic, T., & Pagel, C. (2017). So tell me what you want, what you really really want—Including the user perspective before implementing measures of sustainability. In W. Leal Filho, C. Skanavis, A. do Paço, J. Rogers, O. Kuznetsova, & P. Castro (Eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education* (Vol. 2). Berlin: Springer.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavior change. *Psychological Review, 84,* 191–215.

Cawley, B. D., Keeping, L. M., & Levy, P. E. (1998). Participation in the performance appraisal process and employee reactions: A meta-analytic review of field investigations. *Journal of Applied Psychology, 83*(4), 615–633.

Cerasoli, C. P., & Nicklin, J. M. (2014). Intrinsic motivation and extrinsic incentives jointly predict performance: A 40-year meta-analysis. *Psychological Bulletin, 140*(4), 980–1008.

Colquitt, J. A., Conlon, D. E., Wesson, M. J., Porter Christopher, O. L. H., & Ng, K. Y. (2001). Justice at the millennium: A meta-analytic review of 25 years of organizational justice research. *Journal of Applied Psychology, 86*(3), 425–445.

Colquitt, J. A., Scott, B. A., Rodell, J. B., Long, D. M., Zapata, C. P., & Conlon, D. E. (2013). Justice at the millennium, a decade later: A meta-analytic test of social exchange and affect-based perspectives. *Journal of Applied Psychology, 98*(2), 199–236.

Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research*. Rochester, NY: University of Rochester Press.

Eimer, U. (2016). EPC Projektberatung & Kommunikation, Essen/Berlin https://difu.de/sites/difu.de/files/archiv/veranstaltungen/2015-06-23_special/2015-06-23_special_eimer.pdf. Accessed: 11 Jan. 2017.

Festinger, L., & Carlsmith, J. M. (1959). Cognitive consequences of forced compliance. *The Journal of Abnormal and Social Psychology, 58*(2), 203–210.

Fischer, G. (2011). Understanding, fostering, and supporting cultures of participation. *Interactions, 18*(3), 42–53.

Folger, R. (1977). Distributive and procedural justice: Combined impact of voice and improvement on experienced inequity. *Journal of Personality and Social Psychology, 35*(2), 108–119.

Fridrihsone, A., & Kettemann, R. (2015). *Eco GIS—Spatial facility management as ArcGIS online app*. San Diego, California: Paper presented at the Esri user conference paper sessions.

Hart, R. (1997). *Children's participation: The theory and practice of involving young citizens in community development and environmental care*. London: Earthscan.

Itten, A., & Mono, R. (2014). Bürger als Investoren und Produzenten – Wie Bürger die Energiewende mitgestalten. *Ökologisches Wirtschaften, 29,* 20–21.

Kotter, J. P., & Seidenschwanz, W. (2011). *Leading Change: Wie Sie Ihr Unternehmen in acht Schritten erfolgreich verändern*. München: Vahlen.

Krapp, A., & Ryan, R. M. (2002). Selbstwirksamkeit und Lernmotivation. Eine kritische Betrachtung der Theorie von Bandura aus der Sicht der Selbstbestimmungstheorie und der pädagogisch-psychologischen Interessentheorie. *Zeitschrift für Pädagogik, 44,* 54–82.

Kroeber-Riel, W., & Gröppel-Klein, A. (2013). *Konsumentenverhalten* (10th ed.). München: Verlag Franz Vahlen.

Lind, E. A., Kanfer, R., & Earley, P. C. (1990). Voice, control, and procedural justice: Instrumental and noninstrumental concerns in fairness judgments. *Journal of Personality and Social Psychology, 59*(5), 952–959.

Lind, E. A., & van den Bos, K. (2002). When fairness works: Toward a general theory of uncertainty management. *Research in Organizational Behavior, 24,* 181–223.

Lüttringhausen, M. (2000). *Stadtentwicklung und Partizipation. Fallstudien aus Essen Katernberg und der Dresdner Äußeren Neustadt*. Bonn: Stiftung Mitarbeit.

Michael, M. (2016). Psychological ownership, job satisfaction, and middle manager entrepreneurial behavior. *Journal of Leadership & Organizational Studies, 23*(3), 272–287.

Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. *Advances in Experimental Socia Psychology, 19,* 123–205.

Pierce, J. L., Kostova, T., & Dirks, K. T. (2001). Toward a theory of psychological ownership in organizations. *Academy of Management Review, 26,* 298–310.

Piškur, B., Daniëls, R., Jongmans, M., Ketelaar, M., Smeets, R., Norton, M., et al. (2013). Participation and social participation: Are they distinct concepts? *Clinical Rehabilitation, 28* (3), 1–10.

Preiser, S. (2013). Gesellschaftliche Partizipation als Wegbereiter von Integration und Inklusion. In Berufsverband Deutscher Psychologinnen und Psychologen e. V. (BDP) (Ed.), *Inklusion, Integration, Partizipation. Psychologische Beiträge für eine humane Gesellschaft* (pp. 17–23). Berlin: Deutscher Psychologen Verlag GmbH.

Rambow, R., Moczek, N., & Hofmann, M. (2014). Aneignung, Teilhabe, Wohlbefinden – Städtische Räume und ihre Nutzung. *Einführung in das Schwerpunktthema. Umweltpsychologie, 35*(2), 3–9.

Reinau, H., & Ungern-Sternberg, J. (2013). *Politische Partizipation – Idee und Wirklichkeit von der Antike bis zur Gegenwart*. Berlin: Walter de Gruyter.

Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology, 57*(6), 1069–1081.

Sinning, H. (2005). Planungskommunikation und Nachhaltigkeit in der Stadt-, Regional- und Umweltplanung. In J.Godemann & G. Michelsen, (Eds.), *Handbuch Nachhaltigkeitskommunikation: Grundlagen und Praxis* (pp. 274–286). oekom verlag: Lüneburg.

Spada, H. (1990). Umweltbewußtsein: Einstellung und Verhalten. In L. Kruse, C.-F. Graumann, & E. D. Lantermann (Eds.), *Ökologische Psychologie*. München: PVU.

Streicher, B., & Öttl, M. (2013). Gerechtigkeitsaspekte in Organisationen. In M. Gollwitzer (Ed.), *Soziale Gerechtigkeit. Was unsere Gesellschaft aus den Erkenntnissen der Gerechtigkeitspsychologie lernen kann* (1st ed., pp. 113–135). Göttingen: Hogrefe.

Stutzer, A., & Frey, B. (2000). Stärkere Volksrechte – Zufriedenere Bürger: eine mikroökonometrische Untersuchung für die Schweiz. *Swiss Political Science Review, 6*(3), 1–30.

Tapp, A., Lindsay, G., & Sorrell, R. (1999). Towards a branding framework for cause-, funding- and need oriented charities. *Journal of Marketing Communication, 5,* 39–50.

Thomas, K. W. (2009). *Intrinsic motivation at work: What really drives employee engagement* (2nd ed.). San Francisco: Berrett-Koehler.

Tyler, T. R. (2000). Social justice: Outcome and procedure. *International Journal of Psychology, 35*(2), 117–125.

Tyler, T. R., & Lind, E. A. (1992). A relational model of authority in groups. *Advances in Experimental Social Psychology, 25,* 115–192.

Voß, J.-P., & Amelung, N. (2016). Innovating public participation methods: Technoscientization and reflexive engagement. *Social Studies of Science, 46*(5), 749–772.

Wright, M., Block, M., & von Unger, H. (2007). *Stufen der Partizipation in der Gesundheitsförderung*. 13. Bundesweiter Kongress Armut und Gesundheit.

Author Biography

Stefan Zimmermann born 1980 in Lörrach, Germany, completed an apprenticeship as merchant in wholesale and foreign trade and worked several years as commercial employee. In 2014 he received his master degree in Applied Psychology. From 2012 to 2015 he worked as a research assistant in the field of user-behavior at the Fraunhofer-Institute for Solar Energy Systems ISE. Since 2015 he works as a research assistant at the department of Business Psychology at the University of Applied Sciences Stuttgart HFT. His main research interests are: environmental psychology, business psychology, sustainable economics and management, organizational development, consumer behavior.

Sustainability and Civic Engagement: A Communications Engagement and Education Plan

Madhavi Venkatesan, Jordan Remy and Andrew Sukeforth

Abstract

Across the United States primarily on a town or city basis, the increasing public awareness and understanding of the detrimental impact of human activity on the environment is fostering the development and visibility of grassroots sustainability efforts. This is most readily noted in plastic bag, Styrofoam, and plastic bottle bans. These efforts have been typically facilitated by education campaigns focused on the symbiotic relationship between human life and the planet and the intrinsic or non-market derived value of the ecosystems we inhabit. However, often the communication strategy employed has been limited by an appeal to a like-minded stakeholder constituency, reducing the traction benefit from engaging other stakeholders and the subsequent en masse alignment with regulatory intent. This paper details a grassroots effort and the stakeholder engagement process related to a specific ban. It describes the development and implementation process as carried out through a university-town partnership, where the approach taken includes proactive stakeholder engagement inclusive of a consumer survey instrument. Though survey results reveal interest and even concern for the environment, interestingly the results also highlight a self-evaluation bias among respondents. Results show that respondent perception of environmental concern is inconsistent with their actions, providing an entry point and justification for multi-channel education and communications strategies differentiated by stakeholder grouping.

M. Venkatesan (✉)
Bridgewater State University, 131 Summer Street, Bridgewater, MA 02325, USA
e-mail: mvenkatesan@bridgew.edu

J. Remy · A. Sukeforth
Masters in Public Administration (Intern), Bridgewater State University,
Bridgewater, MA 02325, USA

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_14

1 Introduction

Having in large part emerged as a result of the environmental movement of the 1960s and 1970s, U.S. environmental policy has arguably been a reactive component of regulation and political attention (Cooper et al. 2006). Primarily dependent on citizen action following an adverse consequence, government intervention has been slow to evolve and enforcement has relied predominantly on perceived regulatory channels. Consistent with history, at present, the catalyst for environmental policies can be attributed to increasing grassroots awareness and concern related to the anthropogenic attribution of the speed of current climate change.

Evidence exists that regulatory interventions specific to smaller geographic areas relative to the size of the U.S. as a whole have been successful. One such example is found in the Republic of Ireland, whose policy and implementation process will be highlighted in the discussion and evaluation of the Bridgewater plastic bag efforts, the subject of this paper.

1.1 Ireland's Successful Implementation

Given the heightened focus on greenhouse gas emissions and non-renewable fuels along with waste creation, disposal and impact of the same to the environment and its ecosystems, one of the most visible policies adopted by many countries has been the banning of plastic bags. Specific to successful implementation, the Republic of Ireland (Ireland) is among a growing number of countries to adopt policies to deter the use of plastic shopping bags and promote the behavioral modification of consumers to choose recyclable shopping bags instead of photodegradable, petroleum-based plastic bags.

In March of 2002, with increasing public awareness of the growing litter impact of plastic shopping bags, Ireland simultaneously imposed both a tax, approximately 15 cents per bag, and an educational outreach campaign to its citizens that addressed the environmental impact of single use plastic bags (Department of Housing, Planning, Community, and Local Government, 2016). The catalyst for the action was the increasingly apparent deterioration of the aesthetic countryside. The Ministry of the Environment estimated that about 1.2 billion free plastic bags were being handed out every year in Ireland, leading to windblown bags littering Irish streets and the countryside. In the three months after the tax was introduced, shops handed out just over 23 million plastic bags, approximately 277 million fewer than normal according to government reporting. The anti-plastic bag effort was widely successful in reducing the distribution of plastic bags and in its ultimate goal, to affect consumer behavior. There was "a decrease in plastic bag usage from an estimated 328 bags per capita to 21 bags per capita… to an estimated 14 bags per capita in 2014" (Department of Housing, Planning, Community, and Local Government, 2016). On as overall basis, this led to a reduction in plastic bag usage by 90% across the country and was widely successful in eliminating litter, one of the primary catalysts for the original regulation (Convery et al. 2007). After a year after the imposed tax, nearly 3.5 million Euros in revenue had been raised as a result of the tax, with the proceeds being deployed to support domestic environmental initiatives.

1.2 Significance of Stakeholder Engagement

One of the primary factors credited to the success of the anti-plastic bag campaign has been the engagement of all stakeholders by the government, including but not limited to, "the retail industry, Ministry of Finance, the local authorities, the revenue commissioners, and consumers" (Convery et al. 2007). Due to the fact that all stakeholders were continuously engaged in the process of not only the writing of the law, but also its implementation, there was stakeholder alignment with the intent of the regulation.

The original regulation proposed that all plastic would be banned at all points of sale. However, the government allowed cases to be heard from affected retailers (Convery et al. 2007). The consultation efforts yielded both the opportunity for modification as well as promotion of intent. A tax replaced the original ban, and a widespread education effort focused on engaging all stakeholders created a behavioral shift that prompted self-policing, as the attitude toward plastic bag use deteriorated to a socially unacceptable behavior (Convery et al. 2007).

2 Environmental Rationale for the Plastic Bag Ban

The creation of the thin-film single use plastic bag began with the invention of high-density polyethylene (HDPE) in 1953. HDPE is made from petroleum and has a high strength-to-density ratio, giving it the versatility to be used in a variety of different forms including plastic bottles and piping. In 1960, Swedish company Celloplast filed a U.S. patent for the first plastic bag-a flat, tube-like plastic for packaging that could be sealed at one end that allowed for items to be placed inside and carried. Five years later, Celloplast perfected the "t-shirt plastic bag" design by punching out holes on the open end to create handles that allowed the bag to be easily carried with one hand (Laskow 2014). Mobil Oil produced its own plastic bags in the 1970s to increase HDPE's popularity in the market place, despite initial customer opposition due to sturdiness and reliability (Larsen and Venkova 2014).

Interestingly, plastic bags were initially perceived as an environmentally superior alternative to paper bags; the environmental impact of paper bags is estimated to equate to 70% more air pollution and 50 times more water pollution compared with the process to make plastic bags (Thompson 2014). In 1985 author Vince Staten stated to the Society of Plastic Engineer's Newark Section that plastic bags costs $24 per one-thousand, compared to paper which costs $30 per one-thousand

(Laskow 2014). Plastic bags were introduced to the United States in 1979 and retail giants Kroger and Safeway began using them in 1982.

As of 2014, it is estimated that Americans use over 100 billion plastic bags every year (Larsen and Venkova 2014), and 90% of Americans reuse plastic bags in their homes for a range of purposes (trash bags, animal waste, etc.) (Thompson 2014), but plastic bags ultimately end up discarded. People who dispose of plastic bags put them in the garbage to be taken to landfills or erroneously put in general plastic recycling bins, causing damage to expensive machinery (plastic bags must be recycled separately from other plastics). Given their lightweight and lack of biodegradability, plastic bags can end up in rivers, waterways, storm drains, landfills, and oceans where they pose a significant threat to marine animals. Plastic does not biodegrade but rather photodegrades into smaller pieces less than 1 cm in length called micro plastics. As a result, plastic is not eliminated from the environment and can stay in its manufactured form for up to a thousand years (Cozar et al. 2014).

All forms of marine animals ranging from small fish, whales, dolphins, sharks, seals, seabirds and sea turtles mistake pieces of plastic for food; however, it possesses no nutritional value and cannot be digested. Consequently, plastic has been found at toxic and life threatening levels within the stomachs of these organisms (Cozar et al. 2014). Plastic creates problems further up the food chain as the concentration of toxicity related to plastic increases and the chemicals from the plastic are absorbed into the predator's bloodstream or tissue (Barclay 2013). Studies of seabirds have shown that a seabird's ability to store fat reserves essential for migration, reproduction and molting (shedding and producing new feathers) are compromised due to the accidental ingestion of plastic as food. In addition, bird remains indicate physical damage to the intestines that blocks gastric enzyme secretion (Hutton 2004) as a result of prolonged plastic ingestion. Further, the damage ingested plastic causes to vital processes of digestion and reproduction kills hundreds of thousands of marine animals die every year (Nhamo 2008).

Technology exists to recycle plastic, but the recycling process is not necessarily intended for plastic bags. In general, plastic bags must be recycled separately from other plastics because they jam recycling equipment and contaminate stacks of recycled material (Thompson 2014). Some grocery stores participate in plastic bag recycling programs. However, only 1–3% of plastic bags are recycled worldwide (Westminster College Plastic Bag Facts 2013).

Largely as a result of the environmental costs both in production and disposal as well as the adverse animal impacts during the plastic bag lifecycle, there has been increased focus on the short-term consumer use of the product relative to its potential for damage. This in turn has created a domestic effort in the U.S. on smaller disaggregated scale that in Ireland.

On an ad hoc basis where not prevented by legislation (Harvey 2016), communities and cities in the United States have implemented bans of their own. These bans have taken place primarily due to citizen action or grassroots efforts. A domestic example of a grassroots effort targeted at reducing the distribution of plastic bags is found in Bridgewater, Massachusetts.

3 Grassroots Citizen Action: Bridgewater Massachusetts

Bridgewater, Massachusetts, home to Bridgewater State University a commuter/residential state university serving approximately 12,000 undergraduate and graduate students, is one of the latest towns in the state of Massachusetts to legislate the use of plastic bags. Located 25 miles south of Boston Massachusetts and 35 miles east of Providence Rhode Island, Bridgewater (Town) is a predominantly blue-collar town. With a population of approximately 26,000, the Town has two historical attributions: it is home to United States' first "normal school" (teachers' college), now known as Bridgewater State University and the Old Colony Correctional Center, a men's minimum and medium security prison. The Town is relatively conservative with respect to regulatory implementation in the sense that regulation is used in a limited manner to impose behavioral change. However, promoting the rationale for regulatory intervention is a growing environmental grassroots base.

The Bridgewater Green Committee comprised primarily of retirees has pursued and advocated for environmental policies. In 2011 the group initiated the first citizen petition in the Town seeking to ban the use of single-use plastic bags but this initial effort garnered little traction. After nearly four years, and following the passage of other similar bans in the state and the development of a yet to be ratified state policy on plastic bags, the Town's elected officials were challenged to review the deployment of a Bridgewater plastic bag initiative as a viable action.

In later 2015, the Bridgewater Town Council meetings provided a public forum for revisiting the plastic bag issue. In live-streamed meetings archived for on-demand access concerned stakeholders engaged in discussion on the merits and rationale, as well as perceived cost and inconvenience of the proposed ban. A petition of 700 student signatures from Bridgewater State University introduced college student engagement on the issue and provided the sensitivity of the temporal impacts on the environmental and human health, while a representative from the business community articulated merchant concerns ranging from financial costs to loss of patronage due to customer preference for plastic bags. Members of the Green Committee presented in large number and on an individual basis the adverse environmental impact, human health impact and aesthetic impact of the distribution of plastic bags. Over the course of month's Town Council deliberations, including a hold on the initial vote, the Plastic Bag Reduction Ordinance was passed in March 2016. The Ordinance limited the distribution of plastic bags by size and retailer. Plastic bags 2.5 mils (1 mil is one-thousandth of an inch, a typical grocery store plastic bag is between 0.5 mil and 1.0 mil) were prohibited from being distributed by retailers having stores of 3000 square feet in size and larger as well as by chain stores operating two or more locations within the state.

Due to restrictions on the imposition of taxes, the Town was unable to impose a tax directly on consumers, as a result, the merchant focus was the channel directed to promote a point of sale behavioral shift. The merchant ban was effective

180 days after passage and the interim period served to provide an education outreach to the community along with an opportunity to survey affected individuals.

Following the passage of the Ordinance, the Town began a communication strategy in conjunction with a Bridgewater State University faculty-led partnership to ensure that impacted merchants would be in compliance by the Ordinance effective implementation date. Though the communications from the Town were limited to merchants, the partnership with Bridgewater Sate University, incorporated consumer outreach and a survey instrument to enable understanding of citizen alignment and educational needs.

3.1 Survey Instrument/Methodology

A survey instrument (see Appendix) consisting of twelve questions was developed to gauge citizen understanding of the environmental and economic rationale for the Ordinance. The questions and related categorical groupings are provided below. The surveys were taken across the retail operating day and an effort was made to include all affected retail stores. Each survey was administered individually to a store patron. The surveyors included one Bridgewater State University faculty member and two Masters of Public Administration interns. Over the course of three-weeks, 120 total hours were spent administering surveys to customers as they entered retail establishments affected by the Ordinance. The total number of respondents equaled 200.

3.1.1 Age and Education

The first two questions on the survey were "What is the age range you fall under?" and "What is your educational attainment level?" Both questions had multiple categorical responses. These questions are basic demographic questions, but can be used to reveal attitudes towards the environment. While some scholars have ruled out age as a proper factor in determining pro-environmental attitudes, the survey was coded in a way that could be broken down and tested to see if age had a positive or negative correlation with other variables. Scholars have found that "younger adults may be more open to social change generally and therefore more accepting of arguments made in favor of protecting the environment" (Daniels et al. 2012).

Education has also been a point of contention among scholars specific to whether or not it should be positively or negatively related to environmental attitudes. As expected some researchers have found a positive correlation with years of completion while others have found a limited to negligible impact (Daniels et al. 2012).

3.1.2 Support of the Plastic Bag Reduction Ordinance

Question three of the survey was simple and straightforward, "Do you support the Plastic Bag Reduction Ordinance?" This question was asked to achieve not only a response that could be easily interpreted and presented as a raw number, but could also be used in relation to the demographic questions to find statistical relevance.

3.1.3 Willing to Pay for Consumer Goods

The fifth question on the survey was as follows: "Would you be willing to pay more for consumer goods if it meant protecting the environment?" If the respondent answered, "yes" to the question, an open-ended question was asked to the respondent: "What percent of your consumption expense would you be willing to pay?" The latter question has precedence in the Ireland implementation process. When determining the amount of the tax, the Department of the Environment, Heritage and Local Government commissioned a survey specific to the maximum willingness to pay for a plastic bag (Convery et al. 2007).

3.1.4 Environmentally Conscious?

The sixth question addressed self –perception: "Do you consider yourself to be environmentally conscious?" This question was meant to revel consumer self-perception regarding their relationship with the environment. While this question yielded interesting results, there could be a reason for this, social desirability bias. This "refers to the tendency of research subjects to give socially desirable responses instead of choosing responses that are reflective of their true feelings" (Grimm 2010). It was not feasible to avoid this kind of bias because the interviewer had to physically be there to ask the question and record the answer in front of the respondent. It would clearly be a hard thing for a respondent to say "no" to the question and give consistent answers for the rest of the survey.

3.1.5 Reusable Bags

The seventh question was as follows: "How often would you say you take reusable bags with you when you go shopping?" This question was a way of gauging the behavioral reconditioning required of consumers and also determine the consistency between consumer self-perception of environmental sensitivity and present action in support of the environment. As explained above, this question could also fall victim to social desirability bias, as those without plastic bags at the time could answer "yes" to avoid looking environmentally irresponsible to the interviewer.

3.1.6 Personal Responsibility to Environmental Issues

In our eighth question we asked the consumer to respond to the following statement on a Likert scale with the responses ranging from "strongly disagree," "disagree," "slightly disagree," "slightly agree," "agree," and "strongly agree." Question as asked: "I have a personal responsibility to help make a difference on environmental issues like waste, resource consumption, and water use." This question has a few issues. One problem with the wording of the question is that one may feel one way about resource consumption, but differently on water use. Another problem is that it is difficult to identify the degree of a respondent's sentiments. One respondent may have strong feelings about the issue, but only answer agree, while someone with less strong feelings may answer strongly agree.

3.1.7 Benefits to the Environment

The ninth question was, “Do you believe that reducing the use of plastic bags is beneficial to the environment?” If the respondent answered ‘yes’, then they were asked choose from a list of options. Most respondents reviewed the list and seemingly picked categories with little thought. This confirmed expectations as noted by Osman and Parker (1987) who found that “people generally seem to have a positive feeling toward the environment, but often do not know much about specific topic issues.”

3.1.8 Plastic Bags and Litter

The tenth question asked respondents, “Have you noticed plastic bags in trees and other areas?” If the respondent answered with ‘yes’, a follow up question was posed: “Do you view the Plastic Bag Reduction Ordinance as an opportunity to reduce this type of litter?” These questions were aimed at the respondent’s environmental awareness. The follow up question was an opportunity for the respondent to acknowledge their perception of the Ordinance relative to the problem.

3.1.9 Convenience of the Ordinance

Question eleven was aimed at a common criticism of the ordinance, convenience. The question was asked as follows: “Do you believe that the Plastic Bag Reduction Ordinance will be inconvenient for customers?” This question was an opportunity to see the numbers behind a popular criticism of the ordinance and observe if they have any merit. In a telephone survey by the government of Ireland, respondents were mostly neutral on the topic of convenience, with 45% of respondents being in the neutral camp, while 31% had positive feelings about convenience and 24% had negative feelings (Convery et al. 2007).

3.1.10 Opportunity for Stakeholder Engagement

The goal of the final question of the survey was to see if the opportunity for stakeholder engagement was possible and if the respondents were interested in this. The question was, “Would you like to learn more about the harmful ecosystem and health impacts of plastic?” The respondent was provided with specific channels for educational engagement: direct mail, email and a public forum.

3.2 Results

The Survey process was challenging given stakeholder predisposition to not actively engage in soliciations. Approximately, slightly more than 50% of store patrons were amenable to the survey process even after being told that the survey supported a Town effort.

However, though stakeholder engagement was an issue, the characteristic was noted by the research team to be an opportunity for further evaluation and development. Given that further development of communication channels and corresponding evaluation of the engagement process was outside the scope of the present initiative, the observation was provided in the summary assessment for the survey as a potential next step.

200 survey responses were manually collected at and with cooperation from Roche Brothers, Home Depot, CVS, Walgreens, Cumberland Farms and Tedeschi. The solicitation for survey participation was focused on patrons of affected retail stores and therefore, not limited to Town residents. The data collected was assessed in relation to age and education using simple frequency tabulation and correlation. The age distribution of the individuals surveyed is provided in Fig. 1 and the educational attainment of the group is depicted in Fig. 2.

Age and education were inversely correlated in the sample population, as over 80% of older respondents aged 60 or more reported having only a high school

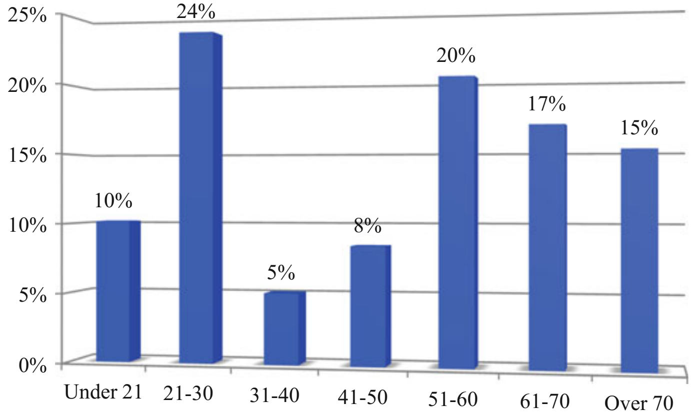


Fig. 1 Age distribution of survey participants

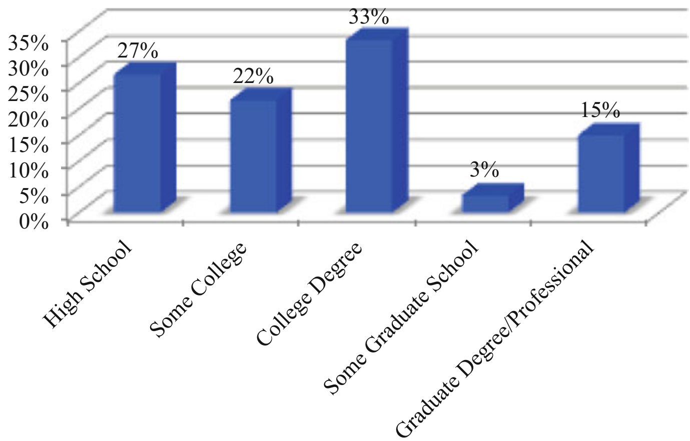


Fig. 2 Educational attainment of survey participants

education, while 90% of surveyed individuals under the age of 30 self-identified as having some college or at minimum a Bachelors degree.

Neither age nor education was found to be significant with respect to support for the Ordinance. As noted in Figs. 3 and 4, the majority of participants within each age and education category identified as being in support. On an aggregated basis, across all participants, 90% of all respondents noted their support for the Plastic Bag Reduction Ordinance.

In assessing self-perception of environmental consciousness, across all age and educational categories, 95% of the surveyed participants considered themselves to be environmentally conscious. The proportions by age and educational attainment are provided in Figs. 5 and 6.

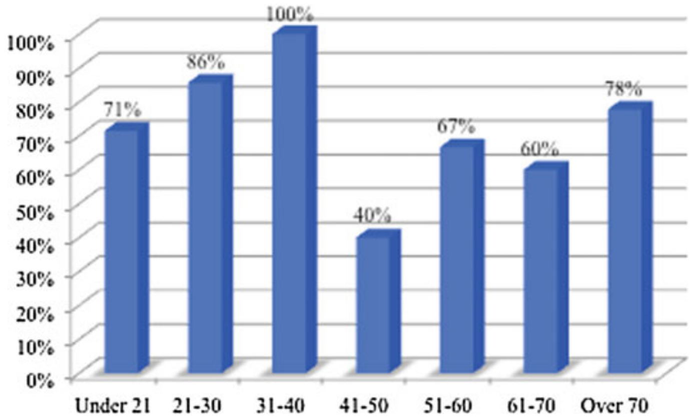


Fig.3 Plastic Bag Reduction Ordinance support by age

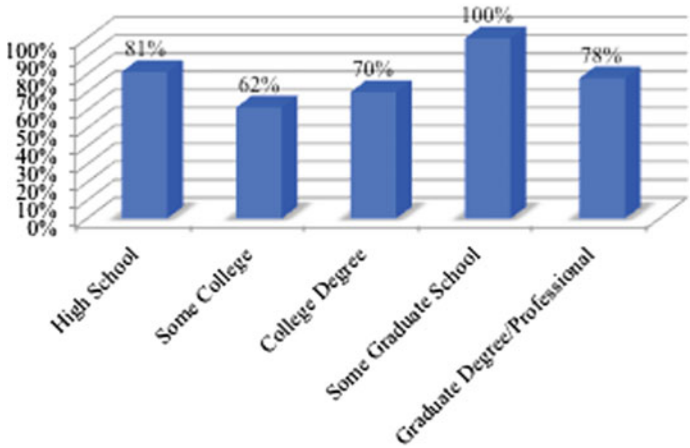


Fig. 4 Plastic Bag Reduction Ordinance support by educational attainment

Over all age groupings and educational attainment levels, all respondents noted one of the following descriptors specific to their perception of their responsibility to protect the environment (question 8):

- Slightly Agree
- Agree
- Strongly Agree

However, with respect to evidence of environmental sensitivity as it applied to their present use of reusable bags, the results were more mixed. There was a strong negative correlation between age and educational attainment and a positive correlation between age and use of reusable bags. Age skewed expectations, as it would be expected that education would be higher with age and that both age and

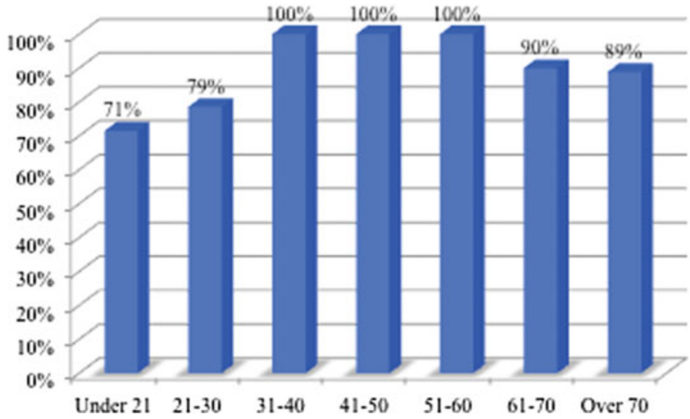


Fig. 5 Attribution of environmental consciousness by age

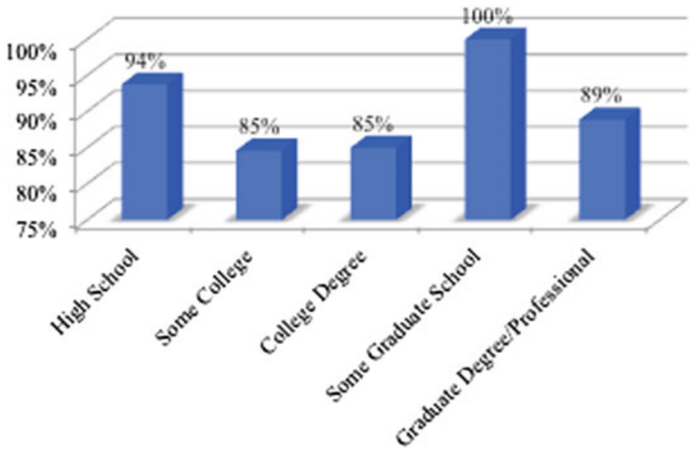


Fig. 6 Attribution of environmental consciousness by educational attainment

education would be positively correlated with environmental sensitivity. However, the anomaly was specific to the demographic of Bridgewater. Older individuals had lower educational attainment than younger counterparts, consistent with the blue-color economic foundation of the Town. From an economic perspective the average *willingness to pay* to protect the environnent was 5% over prevailing prices for all good and services. This was not consistent accros all age groups. Individuals 60 and above were concerned about additional expenses. 90% of individuals surveyed from this group reported that they would not be willing to pay more to protect the environment. Yet, as noted, this group was the most consistent with respect to the self-assessment of environmental consciousness and proactive environmental protection efforts.

- 70% of survey participants noted a *willingness to pay* of 1%.
- Survey participants' *willingness to pay* ranged from 1 to 20%.

60% of survey respondants did report that they would like to learn more about environmental and health issues related to plastic. This may offer an opportunity to enhance community involvement with respect to the present Ordinance, while establishing the foundation for greater potential stakeholder engagement related to future regulatory actions. The delivery method for information was fairly evenly split between public forum and direct mail/email.

3.3 Recommendations

Though the questions and sample size were limiting factors to survey results, given the inconsistency between self-perception of environmental sensitivity and action along with the limited understanding of the present externalizing of costs associated with the use of plastic bags, survey findings were supportive of the benefit of education on long-term traction and further implementation of environmentally sensitive policies. As a result, several next steps were suggested:

Development of an educational site on the potential hazards of plastic and other waste as well as emerging environmental risks to be hosted by the Town of Bridgewater on its website. The suggestion is that the site be constructed so that shoppers can be provided with a small informational card/paper referencing the site at checkout.

Recommend that cost-effective natural bags be distributed by the Town at cost to impacted and other vendors not having bags or wishing to show solidarity with the intent of the Ordinance, respectively.

Recommend an Ordinance campaign where affected vendors simultaneously offer reusable bags at a discounted or nominal cost with the duration of the launch set at minimum 6 months.

Recommend that assessment of the intent of the Ordinance is made at six-month intervals for a minimum period of 18 months following implementation on September 5, 2016.

Recommend development of community educational events focused on the environment.

Data on Town residents was not available, eliminating comparisons related to the sample and its representativeness. As a result a final recommendation was made for a Town census given the anomaly of standard census data, which represents the prison population from Old Colony Correctional Complex as part of the residential population.

In viewing the disconnect between self-perception and supporting action specific to environmental sensitivity, the Town is actively developing communication channels inclusive of the Internet, direct mail, public service communications, local paper and Town Council meetings to increase resident and consumer understanding and alignment with the need for active environmental protection. At present the Town is committed to a robust platform for the dissemination of environmental education, inclusive of both emerging and present issues where action will be or is being taken. Further the Town is actively engaging the university to assist with follow up surveys to better understand stakeholder sentiment toward the environment following implementation of the Ordinance. Given the difficulty of centralized engagement and a fairly disenfranchised citizen base, the Town is also looking at Ordinance-based stakeholder engagement as an opportunity to establish formal channels of communication and discussion with its resident and consumer population. All actions being taken are founded on the self-perception bias noted and build on the relationship between perception and self-actualization of perception bias (Berman and Zimpfer 1980). Fundamentally, the leverage for behavioral modification is embedded in the perceived desire to be environmentally sensitive.

3.4 Next Steps

Though not addressed in the case study presented, small population size assisted in the dissemination and regulatory process. In this manner, the Bridgewater effort shared a common stakeholder element with Ireland, whose efforts set the foundation for successful implementation.

However, unlike Ireland and as evident from the survey process, on a cultural basis there was limited engagement of the community with respect to regulation and interest in participatory regulation. This characteristic is not unique to Bridgewater and is a risk to the successful deployment of regulatory intervention. The degree of consumer information and understanding of the rationale for regulation has been referenced as the basis for differentiation between successful regulatory implementation and implementation that does not achieve intent (Bayly 2016).

In order to foster stronger dissemination and momentum related to grassroots sustainability efforts, further research related population size, community cohesiveness and their relationship to behavioral change remains needed. Ideally, research related to incentives and communication channels that support behavioral change should include sensitivity analysis related to population size and traction of community-centric sustainability efforts, de facto enabling a culture of sustainability.

3.5 Summary Rationale

Stakeholder engagement is both the basis of regulation and the device for successful traction. Arguably regulatory intent can only be ensured with stakeholder understanding of the rationale for regulation and support of the same.

Given the relationship between societal behavior and culture, ultimately a behavioral shift promotes cultural evolution and in turn culture establishes a framework for societal values.

> Culture shapes the way we see the world. It therefore has the capacity to bring about the change of attitudes needed to ensure peace and sustainable development which, we know, form the only possible way forward for life on planet Earth. Today, that goal is still a long way off. A global crisis faces humanity at the dawn of the 21st century, marked by increasing poverty in our asymmetrical world, environmental degradation and shortsightedness in policy-making. Culture is a crucial key to solving this crisis (UNESCO 2000).

Therefore, a shift in behavior related to plastic bags based on education should ultimately promote increased understanding of the symbiosis between human and planetary life and should target the role of human consumption choices; the need for holistic evaluation of consumption choices and ultimately; instill conscious consumption as a social norm; and thereby, a cultural attribute. In turn, these attributions justify the significance of successful stakeholder engagement.

Appendix

Stakeholder Survey

1. What is the age range you fall under?

    1. Under 21
    2. 21–30
    3. 31–40
    4. 41–50
    5. 51–60
    6. 61–70
    7. Over 70

2. What is your educational attainment level?

    1. High school
    2. Some college

3. College degree
4. Some graduate school
5. Graduate degree/Professional degree

3. What street do you live on in Bridgewater (only the street name)

____

4 Do you support the Plastic Bag Reduction Ordinance?

1. Yes
2. No
3. Not familiar—if this is the answer provide a copy and the lay explanation.

5. Would you be willing to pay more for consumer goods if it meant protecting the environment?

1. Yes
2. No
3. Not sure

If yes, what percent?

____

6. Do you consider yourself to be environmentally conscious?

1. Yes
2. No
3. Not sure

7. How often would you say you take reusable bags with you when you go shopping?

1. Always
2. Most of the time
3. Sometimes
4. Never

8. Please respond to this statement: I have a personal responsibility to help make a difference on environmental issues like waste, resource consumption, and water use.

1. Strongly Disagree
2. Disagree
3. Slightly Disagree
4. Slightly Agree
5. Agree
6. Strongly Agree

9. Do you believe that reducing the use of plastic bags is beneficial to the environment?

   1. Yes
   2. No
   3. Uncertain

   If yes, why? Please choose the most significant from these categories:
   Pollution in creation and disposal of plastic bags
   Litter and aesthetics
   Animal protection
   Use of non-renewable resources and dependency on the same
   Other ____
10. Have you noticed plastic bags in trees and other areas?

   1. Yes
   2. No

   If yes, do you view the Plastic Bag Reduction Ordinance as an opportunity to reduce this type of litter?

   1. Yes
   2. No

11. Do you believe that the Plastic Bag Reduction Ordinance will be inconvenient for customers?

   1. Yes
   2. No
   3. Maybe

   If yes or maybe why? Please choose from the following:
   Have to pay for a bag
   Have to carry a bag
   Other ____
12. Would you like to learn more about the harmful ecosystem and health impacts of plastic?

   1. Yes
   2. No
   3. Maybe

   If yes,
   Would you attend a public forum?
   Prefer direct mail—in your tax statements, for example.
   Other

References

Barclay, E. (2013). How plastic in the ocean is contaminating your seafood. *NPR*. Retrieved from http://www.npr.org/sections/thesalt/2013/12/12/250438904/how-plastic-in-the-ocean-is-contaminating-your-seafood.

Bayly, L. (2016, May 28). Ban the bag? Why plastic bag taxes and bans don't always work. *NBC News*. Retrieved from http://www.nbcnews.com/business/business-news/ban-bag-why-plastic-bag-taxes-bans-don-t-always-n580926.

Berman, J. J., & Zimpfer, D. G. (1980). Growth groups: Do the outcomes really last? *Review of Educational Research, 50*(4), 505–524.

Cózar, A., Echevarría, F., González-Gordillo, J. I., lrigoien, X., Úbeda, B., Hemández-León, S. et al. (2014). Plastic debris in the open ocean. *Proceedings of the national academy of sciences of the United States of America*, 111(28).

Convery, F., McDonnell, S., & Ferreira, S. (2007). The most popular tax in Europe? Lessons from the Irish plastic bags levy. *Environ Resource Economics*, 1–11.

Cooper, T. L., Bryer, T. A., & Meek, J. W. (2006). Citizen-centered collaborative public management. *Public Administration Review, 66,* 76–88.

Daniels, D., Krosnick, J., Tichy, M., & Tompson, T. (2012). *Public opinion on environmental policy in the united states*. Retrieved from https://pprg.stanford.edu/wp-content/uploads/5-Public-opinion-on-environmental-policy-in-the-United-States.pdf.

Grimm, P. (2010). Social desirability bias. In J. Sheth & N. K. Malhotra (Eds.) *Wiley international encyclopedia of marketing*. New York: Wiley.

Harvey, C. (2016, December 30). Yes, this is real: Michigan just banned banning plastic bags. *Washington Post*. Retrieved from https://www.washingtonpost.com/news/energy-environment/wp/2016/12/30/yes-this-is-real-michigan-just-banned-banning-plastic-bags/?utm_term=.97a099876762.

Hutton, I. (2004). Plastic perils for seabirds. *Nature Australia, 28*(2), 52–59.

Larsen, J., & Venkova, S. (2014). Plastic bag bans spreading in the United States. In *Earth- Policy.org*. Retrieved from http://www.earth-policy.org/plan_b_updates/2014/update122.

Laskow, S. (2014). How the plastic bag became so popular. *The Atlantic*. Retrieved from http://www.theatlantic.com/technology/archive/2014/10/how-the-plastic-bag-became-so-popular/381065/.

Nhamo, G. (2008). Regulating plastics waste: Stakeholder engagement and sustainability challenges in South Africa. *Urban Forum, 19*(1), 83–101.

Ostman, R., & Parker, J. (1987). *Impact of Education, Age, Newspapers, and Television on Environmental Knowledge, Concerns, and Behaviors*. 1–9.

Thompson, H. (2014). Recycling: You may be doing it wrong. *Smithsonian Magazine*. Retrieved from http://www.smithsonianmag.com/science-nature/recycling-you-may-be-doing-it-wrong-180951192/?no-ist.

Westminster College. (2013). Westminster College plastic bag facts. *Westminster College*. Retrieved from http://www.westminstercollege.edu/pdf/environmental_center/Plastic%20Bag%20Facts%20.pdf.

A Sustainable Touristic Place in Times of Crisis? The Case of Empuriabrava—A Superdiverse Mediterranean Resort

Dawid Wladyka and Ricard Morén-Alegret

Abstract
Empuriabrava is a cosmopolitan neighborhood located in Costa Brava and one of the world's largest residential marinas. About sixty-five percent of Empuriabrava's population are foreign residents from dozens of nationalities. Their profile constitutes an intersection of religions, languages, socio-economic statuses, and migratory histories. Previous research rooted in conflict and contact theories as well as studies based on the superdiversity paradigm underscored the contradictory effect that diversity may have on the sustainable development of local communities. This paper analyzes Empuriabrava's population daily life and community sustainability. The analysis is based on interviews with local key informants, both natives and immigrants, as well as analysis of statistical and documental sources. The results suggest that while superdiversity provides vast possibilities to empower sustainable development, a perceived lack of local authorities' involvement diminishes this positive effect. The economic downturn has been observed as enhancing conflict and limiting collaborative initiatives. However, the efficient management of superdiversity in tourism–oriented neighborhoods has been found to be a key asset, which may help to experience rejuvenation instead of decline in the resort life cycle model. In this sense, this paper shows practical sustainability lessons to be learnt from Empuriabrava recent history and present situation.

D. Wladyka (✉)
Department of Sociology and Anthropology, University of Texas Rio Grande Valley, Brownsville, USA
e-mail: dawid.wladyka@utrgv.edu

R. Morén-Alegret
Department of Geography, Autonomous
University of Barcelona/Universitat Autònoma de Barcelona, Barcelona, Spain
e-mail: ricard.moren@uab.cat

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_15

Keywords
Sustainability · Diversity · Crisis · Resort · Immigration · Spain

1 Introduction

Empuriabrava neighborhood lies within the boundaries of Castelló d'Empúries municipality. The municipality was inhabited by 11,794 residents in 2012 (INE 2012) and is one of the most important tourist destinations of North Catalonia, Spain (Fig. 1). The historic town center has mainly medieval origins and over two thirds of the municipality surface belong to natural protected areas (Generalitat de Catalunya 2010). Empuriabrava was constructed in 1967 as a large residential marina intersected by a network of navigable channels, and experienced intensive development empowered by North-Western European sun-seekers in the 1970s and 80s (Castelló d'Empuries 2010a). The arising urbanization was a leisure retreat with holiday homes offering Mediterranean climate combined with attractive beaches. This trend slightly changed in the 1990s when some developments were converted into permanent residencies. Today, with its 30 km of water channels, five thousand moorings and a sport airport, Empuriabrava is considered by the local authorities as one of the World's most significant and largest residential marinas (Castelló d'Empuries 2007, 2014). Additionally, it is known as a water-sports center and a destination for foreigners who look for an enjoyable place for retirement or investment. Still, the emergence of a larger number of permanent residents in the 1990s brought to life complexities of all-year public spaces maintenance and assurance of facilities (Castelló d'Empuries 2010a, b).

The development of the new neighborhood altered both the local economy and demography. Although the presence of various ethnic groups in Castelló d'Empúries has been noted from the Middle Ages, the new marina brought more attention to such a diverse population (Compte Freixanet 1976; Colls i Comas 2002). According to the 1986 municipal census, immigrants constituted 18% of the Castelló d'Empúries residents. At that time, 69% of the foreign residents in the Costa Brava region came from the European Economic Community countries, and about 25% came mainly from Morocco, Gambia and South America (Paunero i Amigo 1988). Since then, immigration from Africa and America has increased. The town experienced an intensive population growth especially from 1991 to 2001 (INE 2001). Many foreigners established their residences in Empuriabrava and immigration processes tripled municipal population (Cuadrado Ciuraneta et al. 2006). Between the years 2000 and 2007 the number of the town's residents born outside of Catalonia doubled to 4980 foreign residents in 2007. Most of them were from the EU, followed by immigrants from Africa, South America, non-EU European countries, Asia, Oceania, North and Central America (Castello d'Empuries 2010a). Nowadays, about 65% of registered residents in Empuriabrava are

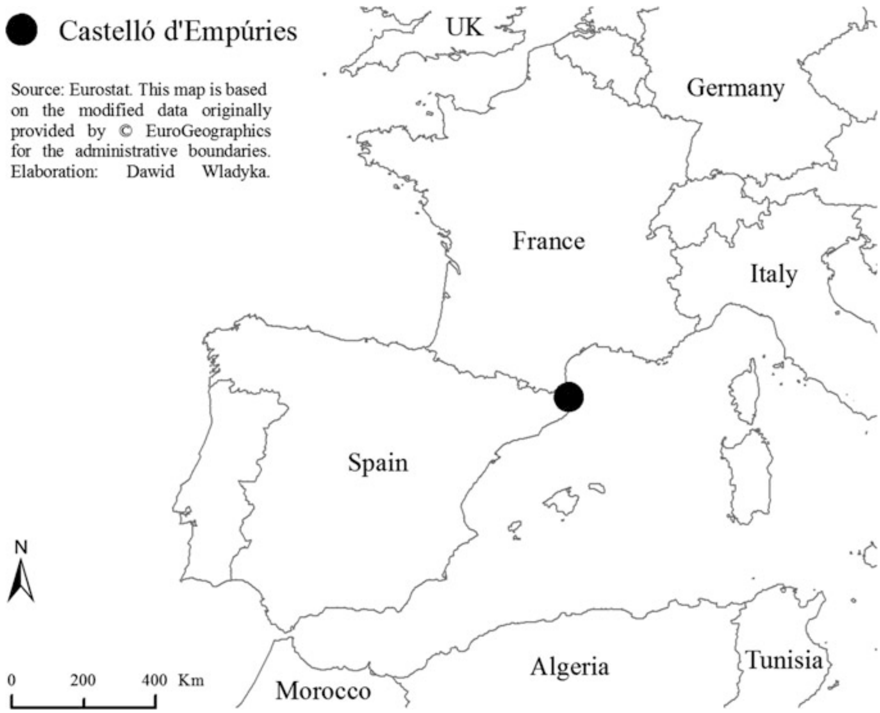


Fig. 1 Castelló d'Empúries within the Spanish, European and Mediterranean contexts. *Source* Eurostat. This map was elaborated by Dawid Wladyka and based on the modified data originally provided by © EuroGeographics for the administrative boundaries

foreign immigrants from dozens of national origins and various continents (see Table 1). Their profile constitutes an intersection of various religions, languages, cultures, socio-economic standings and migratory stories. Additionally, the native population is culturally and linguistically diverse, including presence of two co-official languages, Catalan and Spanish.

In order to understand how those groups live together, this study attempts to look at the neighborhood from the superdiversity paradigm perspective and gather various experiences and opinions among multiple actors present in the area (Vertovec 2007). This paradigm, originally, reflected a change in thinking about ethnic minorities in the UK. It not only captured the new waves of immigrants (e.g. Central and Eastern Europeans) that increased the UK's ethnic, linguistic, and religious diversity, but also highlighted that, within all of the immigrants groups, there is a mosaic of individuals characterized by distinct gender, socio-economic statuses, experiences, patterns, motives for migration, etc. Thinking about super-diverse societies promptly spread among the immigration researchers within and beyond the UK. Still, recent studies suggest that superdiversity should be taken more seriously, especially by local policymakers. For instance, analyzing

Table 1 The population of Empuriabrava by principal nationalities, 1st January 2011 (INE 2011)

Nationality	Number of Residents
Total population	**7873**
Spaniards	2771
Total foreigners	**5102**
Total EU	**3072**
Germany	854
France	1092
Italy	135
Poland	73
United Kingdom	157
Romania	385
Total Non-EU Europe	**479**
Russia	306
Ukraine	74
Total Africa	**1094**
Morocco	984
Total America	**375**
Argentina	75
Total Asia	**80**
China	45

immigrant entrepreneurship, Ram et al. (2013), highlight that some immigrants attempt to be self-sufficient and seek funding sources (e.g. development programs or bank credits) in order to start their own businesses, exactly as natives do. On the other hand, Blommaert and Rampton (2011) underline that, although the ongoing review of ideas about languages, speakers, and communication related to super-diversity take place in the academia setting, the world of commerce is still engaged in the traditional, somehow stiffer way of thinking about language and communication.

On the other hand, recent research more frequently includes a diverse range of spaces and relationships going beyond the issue of urban ethnic enclaves, which were formerly approached by the geography of ethnic relations (Jackson 2008). Additionally, researchers like Morén-Alegret (2005, 2008); Kasimis (2009); Jentsch and Simard (2009) have put emphasis on analyzing diversity in rural areas and small towns. Building on previous findings, this paper analyzes the effect that a superdiverse immigrant population might have on social and economic sustainability in a Euro-Mediterranean small town's neighborhood. The manuscript focuses on the contemporary interactions among diverse groups (e.g. immigrants and the native population). The analysis is mainly based on original semi-structured interviews with local key informants, both natives and immigrants, but it is also supplemented with analysis of various statistical and documental sources. The focus on a neighborhood as a research location allowed us not only to include the micro level spatial elements, but also to grasp the tensions between Empuriabrava and the historic center of the Castelló d'Empúries. This aspect of the study is crucial as previous research indicates that full time employment or economic stability are not sufficient to achieve sustainability. The factors analyzed below, like quality of the neighborhood, logistics, social support, and the welfare system are among the highlighted requirements that allow a territory to achieve sustainable communities (Hawkins 2005; Kates et al. 2005). In particular, the analyzed topics—based on previous research as well as on themes and patterns that have emerged during research process—have been congregated into five major issues that are discussed in the following sections: Tourist Paradise in Decline or Rejuvenation?; Underdevelopment Rooted in Residential Patterns; Intergroup Rifts and Synergies in Economic Development; Turbulent Linguistic Diversity; Social and Economic Sustainability Through Participation.

2 Methodology

Together with relevant documental and statistical information, this study presents original data mainly collected during fieldwork carried out during 2011 and 2012 in Castelló d'Empúries, as well as some posterior updates. In particular, insights gleaned from 38 interviews with native (both Catalan and Spanish speaking) and foreign immigrant (e.g. Belgian, German, Hungarian, Moroccan, Polish and Russian) key informants are offered. In the next paragraphs, a selection of the most illustrative interviewees'quotes is presented. The codes next to the citations provide some self-reported information about the interviewees: nationality-gender-age. The interviews were audio-recorded and the average duration was approximately one hour.

The interviewees were primarily selected on the basis of a previously prepared background report on Castelló d'Empúries. Subsequent interviewees were accessed using a snowballing technique. The interviews were previously scheduled or the contact was undertaken on site. Nevertheless, certain criteria were applied when making the decision about who would be the most relevant persons to be interviewed, including: their relative importance in the studied area, the need for variety, the need to recreate the structure of the neighbourhood's social fabric, gender, nationality and age. In general, the following dimensions of town's development were tackled during the interviews: economy, social tissue, environment and territory, culture and education, governance, corporate and global responsibility. The interviewed key informants are not fully representative of the resident population, rather the focus was given to ensure that a wide range of stakeholders at the local and regional levels were identified and engaged into the study. That lack of representation can be highlighted as a problem by positivists, but may be considered as irrelevant by other researchers because the aim of this paper is to promote an understanding of socio-spatial experiences (Mendoza and Morén-Alegret 2013).

3 Results

3.1 Tourist Paradise in Decline or Rejuvenation?

If the resort life-cycle model suggested by Richard W. Butler is taken into account (Butler 1980; Crang 2009), today Empuriabrava seems to be in a typical turning point linked to the consolidation/stagnation phase. Following that model, the fifth phase can be rejuvenation or decline. Several native and immigrant interviewees positively evaluated the construction of the neighborhood crossed by navigation channels in this location. The Neighbors' Association secretary (*Spanish-Female-57*) remembers that when she first arrived here, back in 1959, Castelló d'Empúries was a small farmers' town with barely any sewage system, and landlords were the wealthiest people in town. The Neighbors' Association president (*Spanish-Male-54*) also thinks that the construction of the marina was a turning point in town's contemporary development: "*Castelló was a cow's town. They have paved all the streets, and these houses currently cost a lot of money*". According to various key informants, the coastline and water channels are considered to be the Empuriabrava's pull factors for tourists (including second-home owners) as well as for wealthy immigrants searching for new homes (e.g. retirees and investors). The location of the neighborhood in the midst of the appealing and natural environment is often considered as an advantage of Empuriabrava by interviewees. Additionally, unpolluted air and surrounding natural parks are mentioned by some as additional pull factors.

Nowadays, as much as the interviewees appreciate the idea of the neighborhood's construction, they are not pleased with the current development policies provided by the local authorities. Similarly, several interviewed politicians express negative opinions on the current state and development of Empuriabrava. This problem appeared during the 2011 municipal elections and resulted with the foundation of UDEM, a relatively new neighborhood-based political party that obtained substantial voters support and 3 seats in the municipal council during the local elections held in May 2011 (and kept representation again in May 2015):

> Empuriabrava is about tourism, but […] I do not believe that hotels may attract customers without investing in quality […] since twenty or thirty years [ago]. There were no new formulas to attract people, to bring affluent tourists. Only cheap and massive tourism was promoted (Spanish-Male-30)

> There are zones in Empuriabrava which are really problematic. In small flats there are huge families living together (Spanish-Female-64)

> There is no library in Empuriabrava. There is one in Castelló. If a family does not have a car they have to walk to library (Moroccan-Male-35)

> The school drop-out rate rose significantly. We remain with an important volume of young people who do not study, who do not work, and moreover they have no means of transport. They search for work but lack of motivation is visible, some have told me it 'if my father does not work, how I can work?' (Spanish-Male-30).

All the interviewees see tourism as the municipality's most important income source. While the key informants related to the local government attempt to underline some economic diversity, the nautical companies or agriculture enterprises are considered to provide only a small share of the income. Some developments in that area seem to be hampered by the economic crisis. According to the Town Hall's coordinator of economic promotion, tourism and trade (*Spanish-Male-45*) the organic agriculture and small organic market places are impeded because of the price-oriented (and not quality-oriented) shopping behaviors related to the economic recession. On the other hand, recently, an international company based in Dubai announced that it was going to invest in the Empuriabrava airfield, a fact that may help in a potential rejuvenation process since the Empuriabrava parachuting school is one of the best in Europe (La Vanguardia 2013).

3.2 Underdevelopment Rooted in Residential Patterns

The interviewees noticed that instead of investments into the development of the marina, the local authorities overlook the neighborhood and allocate the resources in the Castelló d'Empúries historic center. Some of the immigrant interviewees explain budget-planning anomalies as caused by the ethnic patterns of residency (Fig. 2). According to their narrative, since the historic neighborhood is mostly inhabited by native Catalan-speaking people from whose ranks are drawn many of the local authorities, the municipality's budget has been designed to develop more the old town than Empuriabrava neighborhood. For some, the latter is believed to be treated by local authorities as nothing more than a lure for tourists, where the majority of inhabitants are immigrants/expats that do not have or do not exercise political control during the elections. Interestingly, residential patterns of the natives and foreign immigrants confirm the vast disproportion between natives and immigrants ratio in Empuriabrava and historic center. According to official data, the marina remains the residence for the 90% of the EU and 100% of Asian immigrants registered in Castelló d'Empúries. Although the majority of Africans and people from the Americas registered in Castelló d'Empúries also reside in Empuriabrava, a significant percentage of them (23% and 28% respectively) live in the old town. The residential trends of Spaniards are more balanced: 47% of them reside in Empuriabrava and 53% of them reside in the old town (INE 2010).

The native key informants related to Empuriabrava do not talk about ethnically driven political discrimination of the neighborhood in such a straightforward way. Still, some claim that parts of Empuriabrava have been converted into ghetto-like spaces due to flawed local investments that resulted in the vicious circle of increasing housing prices by constantly improving the historic center's infrastructure and converting apartments into one-family houses. The infrastructure improvements focused exclusively on the historic neighborhood and conversion of apartments into single family residences were indicated as the reasons for which the working class inhabitants (mainly economic immigrants) settled in some parts of Empuriabrava, which offers poorer quality apartments. In this way, in

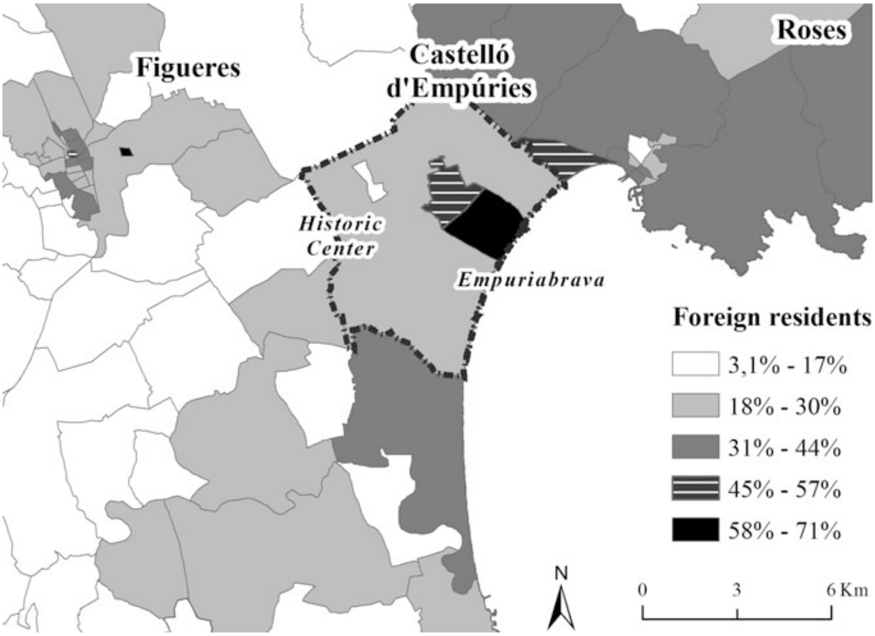


Fig. 2 Percentage of foreign registered residents at census section level in Castelló d'Empúries and nearby, 1st January 2012. Georeferenced data: ICC, IGN. Population data: INE (2012). Elaboration: Dawid Wladyka

Empuriabrava one can find both poor and wealthy immigrants living nearby. Some foreign key informants (*e.g. German-Female-47 and Moroccan-Male-35*) claim that lack of investment balance is provoked by political disempowerment of the Empuriabrava inhabitants (e.g., insufficient knowledge of Catalan, administrative procedures, or no voting rights as non-EU immigrants). Some of the immigrants (and very few natives) expressed also a support for the separation of Empuriabrava from the historic center so it could have its own authorities. Still, the majority of the interviewees' calls for better representation instead of separation.

"*[In Empuriabrava] we do not have minimal urban infrastructure and we are paying luxury taxes. […] Our waste waters are going to the beach […] The Town Hall was doing everything in their power to avoid the separation. […] They were not using 'Empuriabrava'. They tried to erase this name, using 'marina of Castelló' [instead]*" (*Spanish-Male-54*). Following this discourse, several interviewees focused on the neighborhood's scarce and degraded infrastructure. In this sense, after the May 2015 elections, when UDEM joined the new town council government coalition (with a woman as Mayor for the first time, Assumpció Brossa), their priority was to improve public spaces in Empuriabrava (Testart 2016). However, that new local government and the ephemeral governmental participation of UDEM just lasted a few months. In April 2016 a previous Mayor, Salvi Güell (2007–2011), returned to power after various political movements (Fuentes 2016).

The library and the health center are located in the historic part of the municipality and are very difficult to use on a daily basis without a car. Some complaints of economically disadvantaged immigrants address the lack of efficient public transport. The lack of well-planned bus service between the Empuriabrava coastline and the historic center make using the library and other facilities difficult, especially for the youth. The interviewed immigrants and natives frequently mention that car is needed to carry a regular life in Empuriabrava. Any positive opinions are usually related to a particular socio-economic status and life style. Therefore, the strongly positive comments about the public transportation were heard only from those interviewees that commonly drive a car, have stable employment and few or no interactions with residents of lower economic status. In light of the various opinions gathered during fieldwork, the slightly ironic comment of the Neighbors' Association president (*Spanish-Male-54*) is worth highlighting: "*Empuriabrava is a very large site, and it is created as an American city, and then here, a car is necessary*". That point of view is shared by other interviews with different walks of life:

> If there is good weather, you can go to the beach. But if it is cold and windy, there is nowhere to go, especially for a mom with kids. […] There is a bowling, but it is too expensive. There are no leisure activities. There is no cinema, no theatre (Polish-Female-30).

> The transport between Castelló historic center and Empuriabrava is poor and the communication between Castelló and Figueres is not frequent enough. Immigrants use the bus more [than natives], some of them use a bicycle, and some make the trip on foot (Spanish-Female-31).

> The public transport is well. There are buses to Figueres o Girona. There are no issues. I drive a car. I do not use public transport. It is very important to drive a car here. I do not know a person that uses public transport on a daily basis. Some use it to get to schools, the children have a school bus (German-Female-47).

However, since the May 2015 elections some changes occurred and new social infrastructure was set up in Empuriabrava, e.g. a civic center (Castelló d'Empúries 2016).

3.3 Intergroup Rifts and Synergies in Economic Development

The lack of improvements in Empuriabrava's infrastructure and the post-2008 economic recession were noted as reasons for the downfall of the job market. Interviewees observed a decrease of tourist visiting the Empuriabrava that led to closures of establishments and more unemployment. Furthermore, in some cases, return migration or emigration elsewhere is visible:

> Here the job profile is very seasonal, the statistical data of the past year showed that 80% were seasonal workers. […] Five, six years ago, the season was beginning in May/April to about the end of October. Nowadays it is reduced to July, August, September. I suppose

> that it is because of less tourism and crisis. There are people working the whole season, but the seasonal-contract employment period perhaps is shorter (Spanish-Male-30).

> Those are two worlds. A lot of people are in the tourist sector, with private stores, they evidently noticed the crisis, but their economic situation is quite good as it was good during many years. […]Still, with the crisis, some of them abandoned their shops and returned to their countries. […] And then there is a part that is suffering with the crisis, there are numerous families with tremendous problems. There were a lot of people who were living thanks to unemployment benefits. […] That has come to an end (Spanish-Male-54).

Native employers are believed to be in decay. The interviewees observed that mainly French and German investors are still active since their countries did not experience such a severe recession. Some immigrants, like Poles, emphasize the German purchasing power. They believe that previous collaboration (often due to some German language knowledge by Poles) allows them to still receive contracts, but other mention that the importance of Germans declines. The French are seen as the ones who currently take over the real-estate and tourist inflow. Similarly to Germans, they are seen as the investors, small-business owners, retired sun-seekers, employees, tourists, and lastly, those who are most visible in the bars and restaurants. The immigrants of the two abovementioned nationalities are considered the most numerous and important for the socio-economic life of the neighborhood. These perceived trends could be tracked while looking at registered resident population statistical data series (see Table 2).

Among other often mentioned European immigrants are: English, Dutch, Swiss, Austrians, Russians, Ukrainians and those described as having recently influenced the neighborhood life: Romanians. The English are described rather as permanent residents and retired sun-seekers. The Russians are mostly seen as rich tourists or temporary residents. Nevertheless, there is a small Russian community of economic

Table 2 German and French registered resident population in Castelló d'Empúries, 2000–2012 series (IDESCAT 2012)

	Total (1)	Foreign pop.	Germans	% of (1)	French	% of (1)
2012	11,794	5910	**911**	7.72	**1.193**	1012
2011	11,885	5941	**907**	7.63	**1.198**	1008
2010	12,220	6222	**1020**	8.35	**1.250**	1023
2009	12,111	6164	**1026**	8.47	**1.213**	1002
2008	11,653	5818	**984**	8.44	**1.129**	969
2007	10,629	4980	**897**	8.44	**962**	905
2006	10,021	4569	**828**	8.26	**719**	717
2005	9167	3932	**750**	8.18	**529**	577
2004	7777	2829	**535**	6.88	**323**	415
2003	8165	3385	**956**	11.71	**498**	61
2002	7530	3013	**920**	12.22	**458**	608
2001	6883	2479	**809**	11.75	**381**	554
2000	6266	1967	**658**	10.50	**285**	455

immigrants established in the neighborhood. Ukrainian immigrants are mentioned altogether with the aforementioned group of Russians:

> There are two different types of immigration. The Europeans are people with purchasing power. They come here to retire, they spend money here. Immigration from Africa is a labor force, mainly in construction or in agriculture. They do jobs that would not be done by the locals (Spanish-Male-49).

The informal economy and welfare abuse, according to several immigrant and native interviewees, appear to be important sources of local conflicts. The Romanian newcomers are frequently mentioned in the context of their illegal employment, but also beggary, robberies, procurement and prostitution. Their influence on the informal economy has also been mentioned by the former Castelló d'Empuries Mayor (1995–2007 and 2011–2015) Xavier M. Sanllehí i Brunet (*Spanish-Male-49*) in the following words: "*There are illegal groups of immigrants working in construction. They work with no permissions and propose dumping prices. They are mainly Romanians. We want to create official workplaces.*" However, the reality is more complex than that and the fieldwork allowed us to meet a number of Romanians working in the formal economy of Castelló d'Empúries.

Similarly, the Moroccan immigrants are depicted as the supposed authors of burglaries, thefts and drug dealers. Interviewees repeat that Moroccans have numerous offspring and/or regroup with immigrating relatives. The latter was also indicated by the Town Hall's Housing Technician (*Spanish-Female-30*) as affecting the living conditions. Moroccan females are perceived by some as taking advantage of the welfare funds while being stay-at-home moms. The overload of the local welfare system is frequently mentioned as the Moroccans' incidence on Empuriabrava's economy. Also, the unemployment statistics seems to confirm the high number of the Maghreb immigrants' welfare claims in comparison to other groups (Observatori d'Empresa i Ocupació 2010). Paradoxically, at the same time, Moroccan men are sometimes described as those who spoil the labor market by working for substandard wages. They are portrayed as those who are employed in most locally funded public works. Additionally, an Islamic Cultural Center (ICC) representative (*Moroccan-Male-35*) claims that Moroccan and Romanian immigrants accept every possible job. Furthermore, he is skeptical regarding financial help for the unemployed. He considers that nowadays it is harder to obtain any assistance, and that the job market during the crisis prefers natives. In his eyes, the financial difficulties caused by the crisis are the source of the public safety deterioration, especially robberies. Still, he indirectly shares the perceptions of some Romanians and Moroccans as being among the responsible ones: "*If one does not work and have nothing to eat, the first thing he does is to steal. Recently, there are lots of complaints. Most of the perpetrators are the people who do not work, Romanians and Moroccans, they say. Those that complain are in turn the wealthy people*". Again, reality is more complex than that and during fieldwork several Moroccan immigrants who run local shops and are part of local formal economy were also found.

3.4 Turbulent Linguistic Diversity

Most interviewed immigrants consider that some knowledge of languages like German, French, English, or Russian is needed to find employment in Empuriabrava. They claim that Spanish (and/or Catalan) is necessary in some jobs, but they would rather disagree with local employment office that it is essential. In fact, some interviewed immigrants mention that over a dozen years ago German was a vehicular language in Empuriabrava. This changed since the increase in number of French and other immigrants. Interestingly, although the Spanish language is perceived as growing in importance in everyday life it is still not considered as prevailing. Quite the contrary, it is English that is frequently regarded as a lingua franca and interviewed immigrants seem to appreciate that one can communicate in the Town Hall (with more or less success) in languages like French, German or English. On the other hand, they believe that any multilingual posters and leaflets are addressed to tourists only and that local authorities should develop communication in languages other than Catalan:

> There are two [local] magazines: 'Amigos' and 'Arena'. They publish in the main languages. […] The posters are only in Catalan. We make an effort to speak Spanish and they answer us in Catalan. And I think it is a problem. The more languages the better (German-Female-45).

> The information here is often only in Catalan. It is not good, but… Those who came here and do not know the language. I did not know any Spanish. I learned in one year, but then they spoke to me in Catalan and I did not understand. At the end I learned. This is difficult for foreigners. They learn some Spanish, then they get a document in Catalan and they do not understand (Belgian-Female-45).

In fact, recent formal political discourse indicates that Castelló d'Empúries attempts to recognize its "unusual" demography. At the beginning of the year 2010, the Mayor of Castelló d'Empúries, Salvi Güell explained that the municipality dealt with immigration for a very long time, but nowadays the situation changed along with the changes in immigrant's diversity. There are no longer only EU citizens, but also immigrants from North Africa, Eastern European countries and South America. According to him, the new immigrants are "treated in the same way as the other ones". The goal is to integrate the newcomers, "as soon as possible". For example, there is also special agent for integration for immigrants from Maghreb: "We have been adapting to the new circumstances"—concluded Güell (Europa Press 2010). While a tendency to acknowledge Empuriabrava's specific identity and concomitantly ethnic diversity seems to break through the politicians' discourse, the interviewed Town Hall's Integration Technician (*Spanish-Female-30*) suggested that Town Hall should communicate with local inhabitants only in Catalan. In fact, this informant points out the growing diversity of immigrants as the practical reason for why there would be no point in multilingual communication: *"According to the last statistics […] there are seventy various nationalities [in Castelló], so if we would like to cover all the seventy nationalities, how many leaflets should we prepare?*" (*Spanish-Female-30*).

3.5 Social and Economic Sustainability Through Participation

The possibilities for political activity in the neighborhood-based UDEM and other local parties were mentioned by some interviewees. Germans underline grassroots movements related to controversies caused by the former Spanish Coastal Law that would expropriate the land adjacent to water channels (Cerrillo 2011; Castedo 2011; Méndez 2012; BOE 2013). Furthermore, a Moroccan interviewee (*Moroccan-Male-35*) highlighted an *ad hoc* social movement that made demands related to the school bus funding. The religious gatherings are frequently considered one of the social-spaces that provide new immigrants with patterns of permanent socio-spatially fixed interactions (Wilson 1980). This is visible in interviewees' comments about either German or Polish Sunday masses in Castelló d'Empúries church or Moroccans participations in ICC based orations and activities:

> People come to the Islamic Center to pray. Children study Arabic language. We also have teachers who teach the Catalan language. There are also some lessons about integration. The local people help a little. The Town Hall gives us lessons sometimes in order to organize meetings (…) about integration. The private companies do not help (Moroccan-Male-35).

> There are associations, like the Islamic Center, that already for several years […] invited us to some activities and they want people from outside to visit them, but they have their own dynamic, and the majority [of immigrants] do not participate in other associations, like theater or to Catalan traditional dancing, these are two worlds a little apart. And European people neither [participate in other groups activities] (Spanish-Female-40).

It appears however that, following Wilson (1980), there might be a spatial distinction between these two examples of religious participation. In general, the space of individual's activity may be expanded as a result of commuting to work, school, religious activity, leisure, etc. On one hand, the participation of Polish and German immigrants' in masses located in Castelló d'Empuries historical center fits into that scheme and therefore appear to extend their socio-spatial patterns of interactions. On the other, the Moroccans' activities in the ICC located in the Empuriabrava's Puigmal sector highly inhabited by Moroccan immigrants do not expand their space of activity. Thus, in this spatial sense, for a number of residents, the organization fulfills the basic needs of individuals, but does not provide new stimuli. However, from a different perspective, a variety of activities provided by the ICC and its everyday activity is mostly possible because of its location. In a perspective of deficient public transport activists gain an easy access to their gathering space. That feature is crucial, especially taking into account other studies (e.g. Butler Flora and Flora 2013) that highlight the input that immigrants organizations in low-density ethnically diverse areas can have. Their presence may lead to further individual participation in previously established local organizations and development of community. In Empuriabrava, the presence of the ICC already brought some valuable synergies to the town. According to the ICC representative (*Moroccan-Male-35*), besides the majority of Moroccan immigrants, there are also some Senegalese and Gambians regularly visiting the facility. Still, those activities should be supported by the local authorities, but according to the multiple interviews, that was not the case in Castelló d'Empuries. Looking at the issue from more holistic perspective, the development of collaboration between Town Hall and immigrants organizations might produce economic gain for the town (Lanceen and Dronkers 2011). This was indeed the case when tourist skydivers from Qatar took advantage of the local airfield. One of the reasons why those wealthy tourists choose Empuriabrava was because there was a consolidated ICC that could provide an easily accessible Muslim oratory (Domènech and Escobar 2010).

4 Conclusion and Discussion

Whether Empuriabrava's future is analyzed from the perspective of rejuvenation/decline (Butler 1980), permanent maturation (Getz 1992), or reorientation (Agarwal 1994) it is crucial to underline that its development would be linked to how neighborhood's superdiversity is managed. In this sense, the sustainability of a superdiverse resort would not rely exclusively on visitors' needs, attractions' deterioration, settlement patterns and environmental perceptions. In fact, the public and private managers' actions in this case should be more related to social cohesion than tourism, and aim to promote cooperation while taming inter-group conflicts (compare Butler 1980; Cooper and Jackson 1989; Meyer-Arendt 1985). This study showed that cooperation and/or conflict in a superdiverse resort has a direct effect on all aspects of its sustainable development regardless if it is economic growth or environmental challenges. The international linkages of residents provided feasible gains to the neighborhood, a fact that has recently been highlighted by some media, e.g. regarding the international parachuting school (Oller 2015). The economic relations between employees and contractors of distinct nationalities were highlighted as fostering inter-group acquaintances. Also, a multi-ethnic work environment was related to further political engagement in local grass-root movements. Still, it should be remembered that ethnographic fieldwork revealed several challenges local authorities encountered while managing the aforementioned synergies. Some groups were scarcely represented in local political movements. Also, some negative comments about the presence of Moroccan and Rumanian immigrants might be driven by symbolic and economic threats (Stephan and Renfro 2002). In case of some nationalities (e.g. Poles), the negative attitudes toward Romanian and Moroccan immigrants could be enhanced by high vulnerability in context of economic recession (Pardos-Prado 2011) and perceived inequality of status (Pettigrew et al. 2011). The intersection of micro-geography with infrastructural (under)development appeared to play a major role in the accessibility of participative activities for residents that undergo economic hardship and therefore hampered inter-group synergies (Hickman et al. 2008). In this sense, local policies should take into account the presence of private and public interaction spaces, but also appropriate transport infrastructure while considering sustainability (compare Leal Filho et al. 2015). Those findings are in tune with previous works that call for interdisciplinary and/or neighborhood level approaches to socio-spatial features in analysis of sustainability and development in (super)diverse communities (Bergamaschi and Ponzo 2011; Fonseca 2012; Wilson 2011). In other words, in Empuriabrava rejuvenation and sustainability are linked to internationalization and diversity management in a geopolitically and economically complex context Thus it would be important to pay attention to the evolution of the institutional participatory process that is paving the way to the 50 Anniversary of Empuriabrava in 2017 (Punti 2016). Interestingly, the ad hoc official website set up by the town council in order to gather proposals and opinions is displayed in five languages: Catalan, Spanish, French, English and German (Castelló d'Empúries 2016b). At last but not least, national and international criminal networks looking for a haven among the Empuriabrava canals (Oller 2017) deserve also attention in future studies on this superdiverse neighbourhood.

Acknowledgements The research project upon which this paper is based was mainly funded by the Spanish Ministry for Science and Innovation, ref. CSO2009-13909. The authors would like to thank Sarah Ward, Research Assistant in the Disaster Studies program at the University of Texas Rio Grande Valley, for her assistance in formatting of the manuscript.

Annex. Summary of Interviews Script

A. **Economic Dimension**

A.1. Main current economic challenges for this town. A.2. (a) Proposals for overcoming the current financial and economic crises and/or local economic conflicts; (b) Good practices already being implemented in the town. A.3. Views about the current: (a) diversification; (b) seasonality; and (c) internationalisation of the local economy.

B. **Social Dimension**

B.1. Main current social and demographic challenges for the social cohesion and integration of this town. B.2. (a) Proposals for overcoming current social conflicts; (b) Good practices already being implemented. B.3. Views about: (a) Migration movements in town (in past, present and future); (b) Human diversity (or super-diversity) in town; (c) Evolution of inter-ethnic and intra-ethnic relations; (d) Languages spoken in town.

C. **Environmental-Territorial Dimension**

C.1. Main current environmental and territorial planning challenges in this town. Advantages and disadvantages of being a small town if compared both to large cities and small rural villages. C.2. (a) Proposals for overcoming current environmental and territorial conflicts; (b) Good practices already being implemented in the town. C.3. Views about the: (a) Relevance of Protected Natural Areas within the boundaries of the municipality and around it; (b) Importance given to adaptation to climate change at local level; (c) Perceptions about the transport infrastructures in town and region.

D. **Corporate Social Responsability (CSR)**

D1. Good practices already being implemented in this town regarding CSR. Particularly on: (a) Eco-labelling; (b) Responsible social investment; and (c) EMAS Environmental Management Systems.

E. **Cultural Dimension**

E.1. Main current cultural and education challenges in this town. E.2. (a) Proposals for overcoming current conflicts regarding culture and education; (b) Good practices already being implemented in town.

F. **Governance**

F.1. Main current challenges for democracy and social participation in this town. F.2. (a) Proposals for overcoming current political conflicts at the local level; (b) Good practices already being implemented in the town. F.3. Views about the: (a) Implementation of **Local Agendas 21**; (b) Availability/access to local government/administration; (c) Participation in local associations and in elections.

G. **Global Responsability**

G.1. Good practices already being implemented in this town regarding: (a) Official and Non-Official Development Aid; (b) Sustainable Development. G.2. Do you think that this town is sustainable in the mid and long terms? Why

References

Agarwal, S. (1994) The resort cycle revisited: Implications for resorts. In C. P. Cooper & A. Lockwood (Eds.), *Progress in tourism, recreation, and hospitality Management*, vol 5. Chichester: Wiley.

Bergamaschi, A., & Ponzo, I. (2011). Concordia Discors. Understanding conflict and integration in European neighbourhoods. GEITONIES Conference. University of Lisbon.

Blommaert, J., & Rampton, B. (2011). Language and superdiversity. *Diversities*, *13*(2). Retrieved from: http://www.unesco.org/shs/diversities/vol13/issue2/art1.

BOE. (2013). BOE-A-2013-567 'Ley 2/2013, de 29 de mayo, de protección y uso sostenible del litoral y de modificación de la Ley 22/1988, de 28 de julio, de Costas'. http://www.boe.es/diario_boe/txt.php?id=BOE-A-2013-5670. Accessed 14 Mar 2017.

Butler, R. W. (1980). The concept of a tourist area cycle of evolution–implications for management of resources. *The Canadian Geographer, 24*(1), 5–12.

Butler Flora, C., & Flora, J. L. (2013). *Rural communities legacy and change* (4th ed.). Boulder, Colorado: Westview Press.

Castedo, A. (2011). Canales públicos, acceso privado. El País. http://elpais.com. Accessed 23 Jan 2014.

Castelló d'Empúries. (2007). Signatura del conveni marc per a la modernització i millora de la marina d'Empuriabrava. http://issuu.com/entesa.cdee/docs/marina_dossier. Accessed 19 Jan 2014.

Castelló d'Empúries. (2010a). Memoria descriptiva de Castelló d'Empúries. Agenda 21 de Castelló d'Empúries.

Castelló d'Empúries. (2010b). Diagnosi estratègica de Castelló d'Empúries. Agenda 21 de Castelló d'Empúries.

Castelló d'Empúries. (2014). Declaració ambiental. Platja d'Empuriabrava 2014. http://www.castello.cat/wp-content/uploads/2014/02/Declaracio%CC%81-ambiental-2014.pdf. Accessed 9 Sep 2016.

Castelló d'Empúries. (2016a). http://www.castello.cat/comenca-un-nou-curs-al-casal-civic-empuriabrava/. Accessed 25 Sept 2016.

Castelló d'Empúries. (2016b). http://www.castello.cat/empuriabrava50anys/. Accessed 25 Sept 2016.

Cerrillo, A. (2011). Los propietarios de Empuriabrava pierden sus amarres y embarcaderos. La Vanguardia. http://www.lavanguardia.com. Accessed 27 Jan 2014.

Colls i Comas, J. (2002). Immigració francesa i repression a la Catalunya del segle XVI: alguns exemples del Comtat d'Empúries. *Annals de l'Institut d'Estudis Empordanesos*, *35*, 199–223.

Compte Freixanet, A. (1976). Geografía urbana de Castelló d'Empúries. Annals de l'Institut d'Estudis Empordanesos, vol 11. http://www.raco.cat/index.php/AnnalsEmpordanesos/article/viewFile/103800/168655. Accessed 27 Jan 2014.

Cooper, C., & Jackson, S. (1989). Destination life cycle: The Isle of Man case study. *Annals of Tourism Research, 16*(3), 377–389.

Crang, M. (2009). Resort life-cycle model. In D. Gregory, R. Johnston, G. Pratt, M. Watts, & S. Whatmore (Eds.), *The Dictionary of Human Geography* (5th ed., pp. 647–648). Chichester, United Kingdom: Wiley-Blackwell.

Cuadrado Ciuraneta, S., Durà Guimerà, A., & Estalella Boadella, H. (2006). La transformación de los asentamientos en el litoral turístico Catalán: análisis cartográfico y estadístico del Alt Empordà. *Investigaciones Geográficas, 40,* 159–182.

Domènech, A., & Escobar, B. (2010). Qatar acude al centro de paracaidismo de Empuriabrava para crear el club de saltos más grande del mundo. La Vanguardia. http://www.lavanguardia.com. Accessed 17 Jan 2013.

Europa Press. (2010). Los municipios españoles con mayor porcentaje de población inmigrante empadronada apuestan por la integración "de todos". http://www.europapress.es. Accessed 17 Jan 2013.

Fonseca, L., McGarrigle, J., Esteves, A., Sampaio, D., Carvalho, D., Malheiros, J., et al. (2012). *Modes of inter-ethnic coexistence in three neighbourhoods in the Lisbon Metropolitan Area: a comparative perspective*. Lisbon: Edições Colibri.

Fuentes, B. (2016). CiU i ERC pacten a Castello d'Empuries i Salvi Guell tornara a l'alcaldia. http://www.aragirona.cat/noticia/2016/04/22/ciu-i-erc-pacten-a-castello-d-empuries-i-salvi-guell-tornara-a-l-alcaldia. Accessed 25 Sept 2016.

Generalitat de Catalunya. (2010). Pla especial de protecció del medi natural i del paisatge dels Aiguamolls de l'Alt Empordà. http://parcsnaturals.gencat.cat/ca/aiguamolls-emporda/coneixeu-nos/instruments-planificacio-gestio/pla-especial/. Accessed 29 Sept 2016.

Getz, D. (1992). Tourism planning and destination lifecycle. *Annals of Tourism Research, 19*(4), 757–770.

Hawkins, R. (2005). From self-sufficiency to personal and family sustainability: A new paradigm for social policy. *Journal of Sociology and Social Welfare, 32*(4), 77–92.

Hickman, M., Crowley, H., & Mai, N. (2008). *Immigration and social cohesion in the UK: Rhythms and realities of everyday life*. London: Joseph Rowntree Foundation.

IDESCAT. (2012). Data extracted from the census database for 1st of January of 2012. http://www.idescat.cat. Accessed 29 Sept 2013.

INE. (2001). 2001 Population and Housing Census database. Instituto Nacional de Estadística. http://www.ine.es/jaxi/menu.do?type=pcaxis&path=%2Ft20%2Fe242&file=inebase&L=1. Accessed 27 Jan 2013.

INE. (2010). Census database for 1st of January of 2010. Instituto Nacional de Estadística. http://www.ine.es. Accessed 27 Jan 2013.

INE. (2011). Census database for 1st of January of 2011. Instituto Nacional de Estadística. http://www.ine.es. Accessed 27 Jan 2013.

Jackson, P. (2008). Afterword: New geographies of race and racism. In C. Dwyer & C. Bressey (Eds.), *New geographies of race and racism* (pp. 297–304). Aldershot, Burlington: Ashgate.

Jentsch, B., & Simard, M. (2009). Conclusion: Comparative perspectives on rural immigrants' integration. In B. Jentsch & M. Simard (Eds.), *International migration and rural areas: cross-national comparative perspectives* (pp. 179–196). London: Ashgate.

Lanceen, B., & Dronkers, J. (2011). Ethnic, religious and economic diversity in Dutch neighbourhoods: Explaining quality of contact with neighbours, trust in the neighbourhood and inter-ethnic trust. *Journal of Ethnic and Migration Studies, 37*(4), 597–618.

La Vanguardia. (2013). Impulso al Skydive de Empuriabrava con capital de Dubai. http://www.lavanguardia.com/local/girona/20130917/54385659245/empuriabrava-dubai-impulso-skydive-paracaidismo.html. Accessed 25 Sept 2016.

Leal Filho, W., Rath, K., Mannke, F., Vogt, J., Kotter, R., Borgqvist, M., et al. (2015). Fostering Sustainable Mobility in Europe: The Contributions of the Project "E-Mobility North Sea Region". In W. Filho & R. Kotter (Eds.), *E-Mobility in Europe* (pp. 3–25). Trends and Good Practice. In the series Green Energy and Technology: Springer.

Kasimis, C. (2009). From enthusiasm to perplexity and skepticism: International migrants in the rural regions of Greece and southern Europe. In B. Jentsch & M. Simard (Eds.), *International migration and rural areas cross-national comparative perspectives* (pp. 75–98). London: Ashgate.

Kates, R. W., Parris, T. M., & Leiserowitz, A. A. (2005). What is sustainable development? Goals, indicators, values and practice. *Environment: Science and Policy for Sustainable Development, 47,* 8–21.

Méndez, R. (2012). La Ley de Costas no se aplicará en 11 núcleos conflictivos. El País. http://sociedad.elpais.com/sociedad/2012/07/13/actualidad/1342183082_524877.html. Accessed 25 Sept 2016.

Mendoza, C., & Morén-Alegret, R. (2013). Exploring methods and techniques for the analysis of senses of place and migration. *Progress in Human Geography, 37*(6), 762–785.

Meyer-Arendt, K. L. (1985). The Grand Isle, Louisiana Resort Cycle. *Annals of Tourism Research, 12*(3), 449–465.

Morén-Alegret, R. (2008). Ruralphilia and Urbophobia versus Urbophilia and Ruralphobia? Lessons from Immigrant Integration Processes in Small Towns and Rural Areas in Spain. *Population, Space and Place, 14*(6), 537–552.

Morén-Alegret, R. (2005). Lugar, identidad territorial e inmigración extranjera en áreas rurales y pequeñas ciudades de España. Un estudio cualitativo exploratorio. Madrid: Observatorio Permanente de la Inmigración http://extranjeros.empleo.gob.es/es/ObservatorioPermanenteInmigracion/OtrosDocumentos/archivos/17._lugarx_identidad_territorial_e_inmigracixn_extranjera_en_xreas_rurales_y_pequexas_ciudades_de_Espaxa_2004.pdf. Accessed 20 Jan 2013.

Observatori d'Empresa i Ocupació. (2010). Database for December 2010. http://observatorideltreball.gencat.cat/ObservatoriDelTreball/default.html. Accessed 20 Jan 2013.

Oller, S. (2017). Disputa por los canales de una Empuriabrava que cumple 50 años. La Vanguardia. http://www.lavanguardia.com/local/girona/20170213/414283355451/empuriabrava-disputa-mantenimiento-limpieza-vigilancia-canales.html. Accessed 10 Mar 2017.
Oller, S. (2015). Empuriabrava: el emporio del paracaidismo. La Vanguardia. http://www.lavanguardia.com/vida/20150816/54434875532/empuriabrava-emporio-paracaidismo.html. Accessed 25 Sept 2016.
Pardos-Prado, S. (2011). Framing attitudes towards immigrants in Europe: When competition does not matter. *Journal of Ethnic and Migration Studies, 37*(7), 999–1015.
Paunero i Amigo, X. (1988). Els estrangers residents a la Costa Brava. *Revista de Girona*, *131*, 648–654.
Pettigrew, T. F., Tropp, L. R., Wagner, U., & Christ, O. (2011). Recent advances in intergroup contact theory. *International Journal of Intercultural Relations, 35,* 271–280.
Punti, J. (2016). Empuriabrava celebrarà el 50è aniversari el 2017. El Punt Avui. http://www.elpuntavui.cat/territori/article/6-urbanisme/988039-empuriabrava-celebrara-el-50e-aniversari-el-2017.html. Accessed 25 Sept 2016.
Ram, M., Jones, T., Edwards, P., Kiselinchev, A., Muchenje, L., & Woldesenbet, K. (2013). Engaging with super-diversity: New migrant businesses and the research–policy nexus. *International Small Business Journal*, *31*, 337–356. doi:10.1177/0266242611429979.
Stephan, W. G., & Renfro, C. L. (2002). The role of threat in intergroup relations. In D. M. Mackie & E. R. Smit (Eds.), *From Prejudice to Intergroup Emotions* (pp. 191–207). New York: Psychology Press.
Testart, M. (2016). Cobriran la placa de les Palmeres d´Empuriabrava per poder tenir mes usos. http://www.emporda.info/comarca/2016/01/19/cobriran-placa-palmeres-dempuriabrava-mes/299725.html. Accessed 25Sept 2016.
Vertovec, S. (2007). Super-diversity and its implications. *Ethnic and Racial Studies, 30*(6), 1024–1054.
Wilson, B. M. (1980). Social space and symbolic interaction. In A. Buttimer & D. Seamon (Eds.), *The human experience of space and place* (pp. 135–147). London: Croom Helm.
Wilson, D. S. (2011). The neighborhood project: Using evolution to improve my city, one block at a time. New York, Boston, London: Little, Brown and Company.

Social Justice and Sustainability Efforts in the U.S.-Mexico Transborder Region

Sylvia Gonzalez-Gorman

Abstract

The 1983 La Paz Agreement originally defined the U.S.-Mexico transborder region as 62.15 miles (100 km) on each side of the international border. The La Paz Agreement between the U.S. and Mexico created the first bilateral cooperation program on issues of environmental quality along the U.S.-Mexico border. Prior to La Paz, cities throughout the U.S. adopted and have continued to adopt various sustainability policies to address environmental concerns. However, in the U.S.-Mexico transborder region where cities are fundamentally unique from communities in the interior United States, local sustainability policies and issues of environmental social justice are still in their infancy and deficient environmental conditions continue to exist in some border areas. While sustainability and social justice are two important goals for city governments, harmonizing both values is challenging due to their conflicting policy natures. This study examines if transborder cities pursue social justice and sustainability simultaneously despite the challenge of balancing nebulous goals. This study focuses on factors that influence different levels of environmental sustainability measured by greenhouse gas (GHG) amounts among transborder communities. The results indicate that U.S. transborder cities with densely populated areas and the geographical size of the community contribute to higher levels of GHG emissions and less equitable sustainability.

Keywords

Transborder region · Sustainability · Social justice

S. Gonzalez-Gorman (✉)
Department of Political Science, University of Texas Rio Grande Valley, One West University Boulevard, Brownsville, TX, USA
e-mail: sylvia.gonzalezgorman@utrgv.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_16

This chapter is grounded on the assumption that sociopolitical and socioeconomic stratification are instruments in environmental degradation in borders between relatively wealthy and economically depressed countries. Take for example, the political, economic, and environmental challenges between the borders of the Dominican Republic and Haiti, Indian and Nepal, and the U.S. and Mexico. These complex intertwined geographical borders mean that populations residing along a border are susceptible to differential treatment, not only ecologically and politically, but also from a social justice perspective. This analysis examines adverse environmental conditions in U.S. communities along the U.S.-Mexico transborder region. Since both countries, share common-pool resources such as air and watersheds, contamination and pollution are not contained within international boundaries (Gerber et al. 2010) negative environmental conditions in one border community directly affect communities across the international divide.

The United States and Mexico share a spatially diverse 2000-mile border from the Pacific Ocean to the Gulf of Mexico. The Rio Grande River or Rio Bravo (as known in Mexico) divides the two countries highlighting sustainability and socioeconomic disparities. The U.S.-Mexico transborder region as defined by the 1983 La Paz Agreement converges of four U.S. states and six Mexican states and includes 62.15 miles (100 km) on either side of the international divide (Fig. 1). The region is semiarid with limited water resources that must meet the demands of continued development and industrialization on both sides of the border. It is a diverse landscape, with a large and rapidly growing minority population; it encompasses sparsely populated rural communities to large industrial urban areas. The divergent interests of continued industrialization and limited natural resources result in an environmentally stressed region. Adding to the ecological stresses of the region, are pocket communities with low educational attainment and low-income households perpetuating cyclical socioeconomic inequality. The distinctive nature of the transborder region provides sufficient conditions for high rates of poverty, low-wages, chronic disease, high rates of exposure to hazardous pollutants, and a large minority population (Grineski and Juarez-Carrillo 2012; Lusk et al. 2012). This spatial ecosystem characterized by economic and educational stratification creates conditions where populations are vulnerable to political, economic, and environmental injustice.

A paradox exists between the U.S. and Mexico, on one hand, the two countries are interdependent because of trade, and on another hand, economically and environmentally they operate in relative isolation from one another. Nonetheless, the transborder region is at the periphery of the United States economy (Lusk et al. 2012). U.S. border economies dependent on bilateral trade create conflicting priorities for local governments. As a result, local governments may not strategically prioritize sustainability initiatives due to the potential negative impact to continued urbanization and cross-border trade. Moreover, countries my place additional emphasis on “their” set of values and those values have the potential to influence environmental agendas and behaviors (Mohai et al. 2010) leading to conflicting sustainability initiatives between neighboring countries. The inconsistency in sustainability agendas may result in continued negative environmental conditions for marginalized populations.

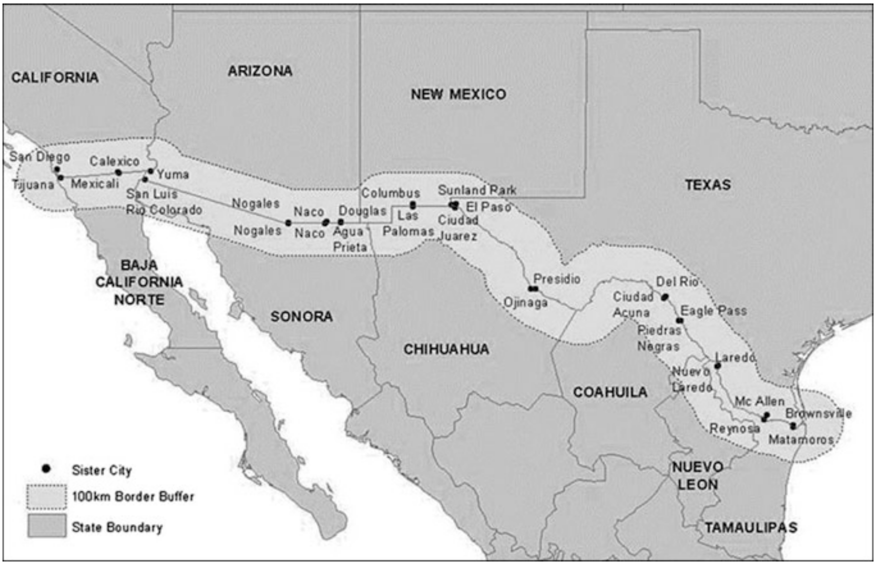


Fig. 1 Map of U.S.-Mexico Border Region. *Source* Environmental Protection Agency, U.S.-Mexico Border 2020 Program https://www.epa.gov/border2020

Since the mid-1970s, U.S. cities have adopted various sustainability initiatives in an effort to address economic and environmental concerns. Yet, after four decades, local sustainability policies in the U.S.-Mexico transborder region are still in their infancy and deficient environmental conditions such as pollution, strained water supplies, and inadequate waste management continue to exist in some border areas (Gonzalez-Gorman et al. 2016). Sustainability and environmental injustice concerns in the transborder region are well documented (Nunez and Klamminger 2010; Peterson et al. 2007), but not all U.S. border communities have received equal attention in the scholarly literature. While large urban areas such as El Paso and San Diego are routinely examined for their sustainability initiatives (Gonzalez-Gorman et al. 2016) and/or environmental injustice, this same attention has not been given to sparsely populated U.S. rural border communities within 62.15 miles (100 km) of the U.S.-Mexico border (Appendix 1). This chapter examines whether transborder cities are able to pursue sustainability initiatives and social justice simultaneously in spite of the challenge of balancing nebulous goals.

1 Environmental Justice

The concept of social justice has broad interdisciplinary connotations in the context of sustainability initiatives. Each discipline has its own approach in how they define, interpret, or assign a label of environmental justice or injustice. No universal definition or measure of environmental justice exists in the literature or academic studies. Common definitions of social justice that lend themselves to environmental justice include Rawls' (1971) theory of justice as fairness, which provides a framework where citizens are free and equal, and where society is fair. Rawls' theory of justice is based on an imagined contract where citizens decide what constitutes fair apportionment of resources, in the initial decision making process citizens lack the acumen to anticipate future personal risks or consequences (Mullard and Spicker 1998). Similarly, distributive justice is the fair distribution of resources in society (Schaffer and Lamb 1981; Burton 2000). In 1991, delegates of the First National People of Color Environmental Leadership Summit drafted and adopted 17 Principles of Environmental Justice, ranging from demanding public policies be based on respect to educating current and future generations about social and environmental issues (EJnet.org). Still yet, some scholars prefer a definition that acknowledges an unjust state, while at the same time moving towards a moral and political understanding aimed at achieving equal rights and collective solidarity by redistributing resources (Balaceanu et al. 2012) and requiring institutional oversight to redress structural inequalities affecting race, gender, and class (Campbell 2013). While, the Environmental Protection Agency (EPA) defines environmental justice as "the fair treatment of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (EPA 2016).

The debate of how justice is defined, measured, and categorized in regards to sustainability analysis is not the intent of this study. Instead, this research seeks to operationalize and bridge underlying commonalties in social justice that intersect with sustainability initiatives. The fundamental point is that sustainability is rooted in 'fairness.' Thus, this study considers if factors such as race/ethnicity, income levels, and binational agreements result in fair local government sustainability initiatives.

1.1 Race and the Environment

A vast body of research has examined the relationship between race and negative environmental conditions (Bullard 1997; Bullard et al. 2007; Olpadwala and Goldsmith 1992; Pezzulo and Sandler 2007). The literature has established that race is one of the most significant factors linked to environmental injustice. Areas populated by large numbers of minority or marginalized populations bear a disproportionate burden of environmental discrimination (Bullard 1997). In the 1980s, two key studies were conducted examining the implications of race and the environment. Researchers found race highly correlated with negative environmental conditions (UCCC 1987; U.S. GAO 1983). The U.S. General Accountability Office (GAO) conducted the first study in 1983. The findings of this study were published in "Siting of Hazardous Waste Landfills and Their Correlation with Racial and Economic Status Surrounding Communities," which substantiated claims that a disproportionate share of hazardous waste was primarily located in African

American communities. Similarly, in 1987 the United Church of Christ Commission for Racial Justice published their assessment of environmental conditions in communities of color. The report highlighted and reaffirmed environmental disparate impact among minority communities; communities of color were burdened with a disproportionate share of negative environmental land use policies (UCCC 1987).

Thirty years after the GAO and UCCC findings, more recent research on the role of race and environmental degradation continues to be supported (see Clark et al. 2014; Bullard et al. 2007; Mohai 2003; Pastor et al. 2001). In more recent research on exposure to air pollution in the U.S. data indicates that non-Hispanic Blacks and Hispanics were more likely to live in areas with the worst daily particulate matter air quality (Miranda et al. 2011). In addition, higher rates of poverty seem to be correlated with counties with the poorest daily particulate matter air quality (Miranda et al. 2011), while more affluent communities have greater environmental quality and resources when compared to less affluent minority communities (Swaynegedouw and Heynen 2003). Essentially, the race of a community is an important predictor in local sustainability efforts. U.S. communities in the transborder region are disproportionately populated with large minority populations. Thus, the transborder region should have higher levels of GHG emissions when compared to non-Hispanic white communities resulting in reduced environmental social justice.

1.2 Income Levels and the Environment

A vast number of studies have thoroughly examined the relationship between income, political participation, and sustainability efforts. The literature shows that income is a predictor of political participation (Brady et al. 1995; Leighley and Vedlitz 1999) and negative environmental conditions (Bullard 1997; Bullard et al. 2007; Olpadwala and Goldsmith 1992; Pezzulo and Sandler 2007). Citizens with lower levels of resources such as education and income are less likely to participate in the political process (Brady et al. 1995; Leighley and Vedlitz 1999) and are at risk of experiencing less environmental protection (Bullard 1997). As per capita income increases, there is a greater ability to influence consumption and production patterns (Heerink et al. 2001) and the opposite occurs as income decreases. Low-income households possess less economic and social capital to pressure elected officials for favorable environmental policy initiatives. In urban areas, unequal economic and political processes lead to marginalized communities enduring negative environmental challenges (Swynegedouw and Heynen 2003).

The transborder is known for low-wages, service industries, labor-intensive manufacturing, and agriculture sectors resulting in asymmetrical disparities in wages between the U.S. and Mexico (Lee et al. 2013). On average, wages in the U. S. are 8–10 times higher when compared to Mexico and these economic asymmetries are not likely to diminish in the near future (SCERP 1999). Although wage disparities exist between the two countries, U.S. border communities experience higher levels of poverty, unemployment, and lower incomes when compared to the interior U.S. Communities in the transborder region continue to have less political influence on issues of sustainability. While many factors may contribute to U.S. border cities pursuing sustainably efforts, it is likely that low-income households lack the social capital to pursue environmental efficacy when compared with more affluent communities. Social struggles such as race, ethnicity, class, and gender are not independent from sustainability efforts or the lack of effort (Swynegedouw and Heynen 2003). Fundamentally, sustainability crisis continue to exist in poor communities (Olpadwala and Goldsmith 1992). As such, this study expects that U.S. border communities with lower education and income levels and higher poverty rates are more likely to be associated with a less sustainable environment and less social justice.

2 International Agreements and Their Impact on Sustainability

Numerous attempts have been made by the United States and Mexico to address environmental concerns in the transborder region. Both countries are signatories to several environmental agreements that should conceivably reduce environmental injustice while promoting environmental sustainability in the transborder region. However, the dynamics of the border region pit a powerful neighbor state against and an economically and politically challenged state, the end-result is environmental degradation that ultimately affects both sides of the border.

In 1943, the U.S. and Mexico brokered the Bracero program, in which Mexico agreed to provide temporary laborers to aid the agriculture sector in the United States. The agreement between the United States and Mexico was a result of an impending fear that a labor shortage would occur in the agriculture sector (Calavita 1992) due to growing industrialization and U.S. participation in World War II. From 1942 to 1964 an estimated 4–5 million Mexicans were allowed entry into the United States to fill agriculture positions (Congressional Research Service 1980). In 1964, the United States officially terminated the Bracero Program. In 1965, in response to a large number of returning unemployed agricultural migrants, Mexico established the Border Industrialization Program (BIP) as a way to alleviate high unemployment rates in the transborder region (Fernandez Kelly 1983; Martinez 1996; Romo 2016). The program provided Mexican labor for U.S. companies that located their assembly plants along the U.S.-Mexico border, resulting in the creation of maquiladoras.

The maquiladora industry was created because of an economically stressed transborder region. Mexico a less powerful nation agreed to the industrialization of its border via the maquiladora program where U.S. corporations were free to transfer their hazardous industrialization to a neighboring country (Frey 2003). Historically, economically stressed weaker nations lack environmental enforcement tools and sacrifice environmental protocols for short-term economic gains (Adeola 2000; Pellow 2007). The maquiladora industry has tax-free domestic and foreign capital contributions (Quesada and Sanchez 2013) and allows for cross-docking, the temporary importation of raw materials, supplies, machinery for assembly and manufacturing in Mexico. Upon completion, the product is exported out of Mexico and typically imported back into the United States. Maquiladoras provide economic incentives to foreign assembly plants (mostly U.S. corporations) in the transborder region (U.S. EPA and SEMARNAT 2012).

In 1994, the North American Free Trade Agreement (NAFTA) took effect lifting most trade barriers between Canada, Mexico, and the U.S. In the U.S.-Mexico transborder region, NAFTA increased the rate of manufacturing and maquiladora development resulting in higher rates of air and water pollution. Because NAFTA does not focus on environmental issues—two side agreements were reached to address environmental concerns: the North American Agreement on Environmental Cooperation (NAAEC) and the U.S.-Mexico Border Environmental Cooperation Agreement (Gonzalez Jr. 1996). In 1994, NAAEC created the Commission for Environmental Cooperation (CEC) a trilateral agency tasked with fostering cooperative environmental improvements, sustainable development, and enhancing cooperative compliance in enforcement of environmental laws and regulations (Mumme and Duncan 1996). Structurally, each participating country appoints members to various positions tasked with resolving environmental claims. A structural critique of the CEC is that a powerful member country may have added leverage in deciding claims when compared to other members. Consequently, as investment in industrialization continues to grow so do the demands for natural resources, energy, and waste generation (Licón and Balarezo 2009) potentially creating a system where state power supersedes the collaboration of sustainable development in the transborder region.

Eighteen years after the creation of BIP, the 1983 La Paz Agreement was signed becoming the first bilateral accord to address environmental quality issues along the U.S.-Mexico transborder region. La Paz originally defined the U.S.-Mexico transborder region as 100 km on either side of the international divide. In 2004, the Border Cooperation Commission (BECC) and North American Development Bank (NADBank) charter amended the transborder region expanding it 300 km in Mexico with no change to the U.S. side. La Paz called for the creation of working groups from both the U.S. and Mexico to address environmental concerns significant to the border. La Paz is a cooperation agreement between the two states acknowledging the existence of poor environmental conditions. The agreement provides opportunities for participation at various levels of government. Federal governments work in conjunction with state and local governments, international government organizations, and non-government organizations that lend their expertise to the implementation of the agreement, only if the parties involved agree (Mumme and Collins 2014). Importantly, the agreement does not require either state to remedy environmental concerns; it simply provides alternatives for recourse for each government (Mumme and Collins 2014). In other words, the U.S. and Mexico are not obligated to resolve environmental issues or to investment in developing proactive solutions, it simply provides a process if they decide to move forward.

In 1987, the United Nations Brundtland Commission published its report on sustainable development entitled *Our Common Future*. The report placed significant emphasis on local governments and their role in advancing sustainable initiatives (WCED 1987). The Brundtland Commission (1987:8) helped to define sustainability as, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Since then, scholars have debated and developed multiple lines of research on the concept of sustainability. While, the Brundtland Commission offered a global perspective on sustainability, much scholarship has continued to take place examining the scope of the concept (Hempel 2009; Portney 2003, 2009: Portney and Berry 2010). Scholars have continued to examine the effect of education levels on sustainability (Jepson 2004; Krause 2011; Kwon et al. 2014; Portney and Berry 2010), the relationship between sustainability agendas and cities (Lubell et al. 2009; Saha and Paterson 2008), the effectiveness of sustainability (Fitzgerald 2010), and the role of form of local government (Feiock et al. 2010; Lubell et al. 2009; Opp et al. 2013; Svara 2011). More important, the extant literature on sustainability provides mixed results as to why cities pursue sustainability agendas and their effectiveness.

2.1 Sustainability Efforts at the Local Level

The U.S.-Mexico transborder region is a complex binational arena that has undergone rapid population growth and precipitous economic development. As such, the transborder region has evolved into a geopolitical and economic region where local governments must now consider sustainability agendas. Historically, U. S. cities have played an important role in promoting sustainability initiatives at the local level (Portney 2003). Prior scholarship has established that cities that receive fiscal resources are more successful in addressing environmental improvements especially upstream projects that could affect downstream communities (Fernandez 2004). Under La Paz, two entities were created to strengthen cross border cooperation and to fund environmental projects along the U.S.-Mexico border: the Border Cooperation Commission (BECC) and North American Development Bank (NADBank) (Gonzalez Jr. 1996). The primary function of BECC is to work with local governments and communities to develop, implement, and certify environmental infrastructure projects for funding (Bennett and Herzog 2000; Blatter 1997). BECC accepts projects from any public or private organization within 100-kilometers of the transborder region and is responsible for reviewing and deciding whether a project should be certified (Fernandez 2004). Certification allows organizations to obtaining funding for projects through loans and grants (Fernandez 2004). NADBank is tasked with providing funding for BECC certified environmental infrastructure projects and economic development in the transborder region (Bennett and Herzog 2000; Blatter 1997). The U.S. and Mexico each capitalize NADBank in equal parts with 90% of funds allocated towards environmental infrastructure projects and 10% of capital allocated for funding each countries' domestic programs (NADB 2012). Research indicates that signatories of environmental agreements are more likely to commit to environmental initiatives (Krause 2011; Svara 2011). Additionally, when local governments proactively develop sustainability initiatives it allows them to respond to urban growth in a more efficient manner (Sanchez-Rodriguez 2009). This leads to the following prediction: local governments with BECC certification and NADBank funding are more likely to incorporate equitable sustainability initiatives.

2.2 Methodology

Ninety-one U.S. transborder cities in four different U.S. states located within 100 km from the U.S.-Mexico borderline (AZ–11; CA–15; NM–11; and TX–54) were examined to determine if transborder cities have been successful in pursuing equitable sustainability measures despite the challenge of balancing nebulous goals. Although San Diego and Tucson are within the transborder region they are excluded based on their population size, which is significantly higher than other transborder cities in this analysis making them outliers on the dependent variable. The dependent variable was taken from the Center for Neighborhood Technology's Housing and Transportation Index (www.cnt.org) and is logged and measured by an objective amount of annual GHG (tonnes) emissions per acre from household auto use for each U.S. city in the study. GHG emissions have been shown to be a critical component in examining factors that influence sustainability efforts among U.S. transborder cities. The expectation is that cities with high minority percentages, poverty rates and low incomes should be susceptible to higher GHG and less equitable sustainability. Because the dependent variable is an interval variable an ordinary least square (OLS) model is used.

Several independent variables are also considered. To examine components of social justice three socioeconomic variables are examined: the percentage of non-Hispanic white residents in a city, the percentage of residents 18–24 years old without a high school diploma, and the percentage of citizens below the poverty level in each city. Communities in the transborder region have a higher percentage of minority populations, poverty, and lower levels of education resulting in less social capital and more susceptibility to negative environmental conditions due to a lessoned response from public officials. Data for the socioeconomic variables was drawn from the 2010 U.S. Census. To examine sustainability efforts at the local level a variable capturing BECC certification and NADBank funding is included. External funding for sustainability initiatives directly affect the levels of GHG emissions in the transborder region and indicate a city's willingness to participate in local sustainability efforts. Data on cities receiving NADBank funding between 2002 and 2013 was taken from NADBank Summary of Completed Projects. The funding timeline encompasses all projects specifically allocated for transborder cities. Population challenges can also affect local governments and their approach to fair sustainable initiatives. Densely populated areas and or cities that have experienced population growth are expected to have challenges with higher GHG emissions. As such, population challenges and land characteristics of each city are considered. Population density is measured as city population per square miles and population change is from 2000 to 2010. Population data derives from the 2010 Population Census. A physical land characteristic variable is also tested. City land area per square miles is a measure of the geographical size of a city. The expectation is that cities with larger land areas my experience higher GHG emissions due to agricultural and industrial development which results in the removal of plants and soil erosion leading to higher carbon dioxide (CO_2) emissions. Land area data was drawn from American FactFinder, U.S. Census.

2.3 Results and Analysis

This study began with the assumption that socioeconomic and sociopolitical stratification are instruments in environmental degradation in border communities, the findings suggests that geographical factors provide more explanatory influence in regards to equitable sustainability efforts when compared to other socioeconomic conditions. At least in this study, there was no evidence that socioeconomic factors such as income, educational attainment, and poverty levels influenced the increase in GHG emissions in the transborder region resulting in less environmental justice. The results for poverty were statistically significant, however, they run counter to the argument that socioeconomic conditions are tools used in environmental disparity. The lack of statistical significance is somewhat problematic, since there is consensus that socioeconomic conditions, while perhaps not the ideal measure of social justice, at least tap dimensions of social justice disparities. The case may be that since the transborder region is geographically vast and expansive it creates conditions where poor rural areas emit less GHGs when compared to more industrialized areas such as the 14 sister cities. Interestingly, the results for cities that received BECC certification and NADBank funding was not statistically significant. However, the findings do indicate that local governments in the transborder region do attempt to pursue equitable environmental infrastructure projects that have the potential of reducing GHG.

As expected, densely populated cities and a cities' land area in the U.S. transborder region were positively associated with higher levels of GHG emissions. Population growth in some U.S. border cities often results in increased auto emissions in conjunction with the high volume of transport vehicles involved in cross border trade. Moreover, industrialization in the transborder region may overwhelm existing institutional and physical infrastructural resources resulting in lower sustainability efforts and potentially higher incidents of sustainability injustice. A correction in sustainability efforts may occur once population and industrialization begin to stabilize, but the effect on environmental justice may not be as evident. The results from the analysis are presented in Table 1.

The aim of this chapter was to examine if transborder cities pursue social justice and sustainability simultaneously despite their conflicting nature. Although, the findings were mixed, they do suggest that there is some effort at the local level to pursue equitable sustainability agendas. Complicating the issue is the geographical

Table 1 Results Environmental Justice and Sustainability Efforts[a]

	Coefficient	Std. Err.
<Socioeconomic Factors>		
Non-Hispanic white population (%)	0.011	0.041
Median household income	0.016	0.024
Education (18–24 years with-out high school diploma)	0.066	0.059
Poverty levels (%)	−0.029*	0.015
<Local Sustainability Funding>		
BECC and NADBank	−0.005	0.324
<Population Challenges>		
Population density (log, population per square miles)	0.0003***	0.0000
Population change (2000−2010)	0.006	0.005
<Land Characteristics>		
City land area (square miles)	0.005*	0.004
State Dummy (AZ)	−0.264	0.703
State Dummy (CA)	−0.345	0.904
State Dummy (TX)	0.497	0.624
N = 68		
R2 = 0.4207		

[a]Dependent variable: log of GHG (tonnes) emissions per acre from household auto use
*p < 0.1, **p < 0.05, ***p < 0.01

size of the transborder area. Because of the diverse landscape, which includes sparsely populated areas and large industrial hubs, continued development and industrialization may outweigh local government's pursuit of equitable sustainability efforts. Binationally, trade between the U.S. and Mexico has steadily increased resulting in continued border industry expansionism. Trade between the two countries grew from $71 billion in 1995 to an estimated $255 billion in 2010 (Lee et al. 2013). Over 3000 maquiladoras in the transborder region receive, assemble, and ship product back to U.S. border cities on a daily basis. In addition, the economic partnerships between the 14 pairs of twin cities reliant on border industry production create strong economic inducements for continued trade. Consequently, local governments in the transborder region have continued to experience urbanization and industrialization, suggesting that the industrialization of the border plays a pivotal role in sustainability efforts. On a positive note, NADBank funding does seem to have a positive impact in reducing GHG emissions, but the extent of the impact is difficult to determine in this study.

U.S. border economies dependent on product from maquiladoras create conflicting priorities for local governments who may not prioritize sustainability programs due to the impact on urbanization and cross-border trade that drive their economies. Globally, this issue is not isolated to the U.S.-Mexico border region. Global industrialization will continue to have an impact on issues of social justice in sustainability agendas. Understanding how these forces work in relation to each other is critical in ecologically stressed regions. In spatially diverse regions with socioeconomic impediments, where powerful countries neighbor weaker states we must begin to address the challenges of pursing conflicting agendas by providing alternatives to governments and local citizens. Continued research is needed to untangle the dynamics of environmental degradation in border regions.

Appendix 1: Cities in the U.S. Transborder Region

State	**City**
AZ	Bisbee
AZ	Douglas
AZ	Gadsden
AZ	Nogales
AZ	Patagonia
AZ	Picture Rocks
AZ	San Luis
AZ	Sierra Vista
AZ	Somerton
AZ	Tombstone
AZ	Yuma
CA	Brawley
CA	Calexico
CA	Chula Vista
CA	Desert Shores
CA	El Cajon
CA	El Centro
CA	Escondido
CA	Heber
CA	Holtville
CA	Niland
CA	Oceanside
CA	Ramona
CA	Valley Center
CA	Vista
CA	Westmorland
NM	Anthony
NM	Columbus
NM	Deming
NM	Gage
NM	La Union
NM	Las Cruces

(continued)

(continued)

State	**City**
NM	Lordsburg
NM	Salem
NM	Santa Teresa
NM	Separ
NM	Sunland Park
TX	Alamo
TX	Alton
TX	Brackettville
TX	Brownsville
TX	Cameron Park
TX	Carrizo Springs
TX	Clint
TX	Combes
TX	Comstock
TX	Crystal City
TX	Del Rio
TX	Donna
TX	Dryden
TX	Eagle Pass
TX	El Paso
TX	Escobares
TX	Fabens
TX	Fort Hancock
TX	Harlingen
TX	La Feria
TX	La Grulla
TX	La Joya
TX	La Pryor
TX	Laguna Vista
TX	Laredo
TX	Los Fresnos
TX	Marathon
TX	Marfa
TX	McAllen
TX	Mercedes
TX	Mission
TX	Palmview
TX	Pharr
TX	Port Isabel
TX	Presidio

(continued)

(continued)

State	**City**
TX	Primera
TX	Progreso
TX	Raymondville
TX	Ranch Viejo
TX	Rio Grande City
TX	Roma
TX	Ryan
TX	San Benito
TX	San Juan
TX	Santa Rosa
TX	Sierra Blanca
TX	Socorro
TX	South Padre Island
TX	Sullivan City
TX	Tornillo
TX	Uvalde
TX	Valentine
TX	Van Horn
TX	Weslaco

References

Adeola, F. O. (2000). Cross-national environmental injustice and human rights issues-a review of evidence in the developing world. *American Behavioral Scientist, 43,* 686–706.

Balaceanu, C., Apostol, D., & Penu, D. (2012). Sustainability and social justice. *Procedia—Social and Behavioral Sciences, 62*, 677–681.

Bennet, V., & Herzog, L. A. (2000). U.S.-Mexico borderland water conflicts and institutional change: A commentary. *Natural Resources Journal, 40,* 973–988.

Blatter, J. (1997). Explaining crossborder cooperation: a border-focused and border-external approach. *Journal of Borderland Studies, 12*(1 and 2), 151−174.

Brady, H. E., Verba, S., & Scholzman, K. L. (1995). Beyond SES: a resource model of political participation. *The American Political Science Review, 89*(2), 271–294.

Bullard, R. D. (1997). Introduction. In R. D. Bullard (Ed.), *Unequal protection: environmental justice and communities of color*. San Francisco, California: Sierra Club Books.

Bullard, R. D., Mohai, P., Saha, R., & Wright, B. (2007). Toxic waste and race at twenty 1987–2007: a report prepared for the United Church of Christ Justice & Witness Ministries, Cleveland, Ohio

Burton, E. (2000). The compact city: just or just compact? A preliminary analysis. *Urban Studies, 37,* 1969–2001.

Calavita, K. (1992). *Inside the state: the bracero program, immigration, and the I.N.S*. New York: Routledge.

Campbell, S. D. (2013). Sustainable development and social justice: Conflicting urgencies and the search for common ground in urban and regional planning. *Michigan Journal of Sustainability, 1,* 75–91.
Center for Neighborhood Technology's Housing and Transportation Index. www.cnt.org. Accessed 18 Jan 2017.
Clark, L. P., Millet, D. B., & Marshall, J. D. (2014). National patterns in environmental injustice and inequality: outdoor NO_2 air pollution in the United States. *PLoS ONE, 9*(4), 1–8.
Congressional Research Service. (1980). Temporary worker programs: background and issues. A report prepared at the request of Senator Edward M. Kennedy, Chairman Committee on the Judiciary United States Senate for the use of The U.S. Government Printing Office: Washington. http://ufdc.ufl.edu/UF00087217/00001/1j. Accessed 20 Sept 2016.
EJnet.org. (1996). The principles of environmental justice (EJ). http://www.ejnet.org/ej/principles.html. Accessed 05 Jan 2017.
Environmental Protection Agency. (2016). Learn about environmental justice. https://www.epa.gov/environmentaljustice/learn-about-environmental-justice. Accessed 21 July 2016.
Feiock, R. C., Francis, N., & Kassekert, T. (2010). Explaining the adoption of climate change policies in local government. Low Carbon Cities Workshop. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.470.4620&rep=rep1&type=pdf. Accessed 01 Oct 2016.
Fernandez Kelly, M. P. (1983). *For we are sold, I and my people: women and industry in Mexico's frontier*. Albany, NY: Suny Press.
Fernandez, L. (2004). Revealed preferences of an international trade and environment institution. *Land Economics, 80*(2), 224–238.
Fitzgerald, J. (2010). *Emerald Cities: Urban sustainability and Economic Development*. New York: Oxford University Press.
Frey, R. S. (2003). The transfer of core-based hazardous production processes to the export processing zones of the periphery: the maquiladora centers of Northern Mexico. *Journal of World Systems Research*, *IX*:317–354.
Gerber, J., Lara-Valencia, F., de la Parra, C. (2010) Re-Imagining the U.S.-Mexico border: Policies toward a more competitive and sustainable transborder region. *Global Economy Journal,* 10(4):1–17.
Gonzalez, J. A. (1996). The north American free trade agreement. *The International Agreement, 30*(2), 345–366.
Gonzalez-Gorman, S., Kwon, S. W., & Patterson, D. (2016). Finding variation in local sustainability efforts among U.S.-Mexico border cities. Presented at the 47th annual Urban Affairs Association Conference. San Diego, CA.
Grineski, S. E., & Juarez-Carrillo, P. M. (2012). Environmental injustice in the US-Mexico border region. In M. Lusk, K. Staudt, & E. Moya (Eds.), *Social justice in the US the US-Mexico border region*. New York: Springer.
Heerink, N., Mulatu, A., & Bulte, E. (2001). Income inequality and the environment: aggregation bias in environmental Kuznets curves. *Ecological Economics, 38,* 359–367.
Hempel, L. C. (2009). Conceptual and analytical challenges in building sustainable communities. In D. A. Mazmanian & M. E. Kraft (Eds.), *Toward sustainable communities: Transition and transformations in environmental policy*. Cambridge, MA: MIT Press.
Jepson, E. J. (2004). The adoption of sustainable development policies and techniques in U.S. cities how wide, how deep, and what role for planners? *Journal of Planning Education and Research, 23*(3), 229–241.
Krause, R. M. (2011). Policy innovation, intergovernmental relations, and the adoption of climate protection initiatives by U.S. cities. *Journal of Urban Affairs, 33*(1), 45–60.
Kwon, M., Jang, H. S., & Feiock, R. C. (2014). Climate protection and energy sustainability policy in California cities: what have we learned? *Journal of Urban Affairs, 36*(5), 905–924.
Lee, E., Wilson, C. E., Lara-Valencia, F., de la Parra, C. A., Van Schoik, R., Patron-Soberano, K. et al. (2013). The state of the border report a comprehensive analysis of the U.S.-Mexico

border. In C. E. Wilson & E. Lee (Eds), Mexico Institute and Woodrow Wilson International Center for Scholars.

Leighley, J. E., & Vedlitz, A. (1999). Race, ethnicity, and political participation: competing models and contrasting explanations. *The Journal of Politics, 61*(4), 1092–1114.

Licon, C. V., & Balarezo, T. (2009). Municipal sustainable development possibilities along the US-Mexico border: an interdisciplinary evaluation effort. *Sostenibilidad Technologia y Humanismo, 4,* 97–113.

Lubell, M., Feiock, R. C., & Ramirez de la Cruz, E. E. (2009). Local institutions and the politics of urban growth. *American Journal of Political Science, 53*(3), 649–665.

Lubell, M., Feiock, R., & Handy, S. (2009b). City adoption of environmentally sustainable policies in California's central valley. *Journal of the American Planning Association, 75*(3), 293–308.

Lusk, M., Staudt, K., & Moya, E. (2012). Social justice in the US-Mexico border region. In M. Lusk, K. Staudt, & E. Moya (Eds.), *Social justice in the US the US-Mexico border region*. New York: Springer.

Martinez, O. J. (1996). *U.S.-Mexico borderlands: Historical and contemporary perspectives*. Wilmington, DE: Scholarly Resources Inc.

Miranda, M. L., Edwards, S. E., Keating, M. H., & Paul, C. J. (2011). Making the environmental justice grade: The relative burden of air pollution exposure in the United States. *International Journal of Environmental Research and Public Health, 8,* 1755–1771.

Mohai, P. (2003). Dispelling old myths: African American concern for the environment. *Environment, 45*(5), 11–26.

Mohai, P., Simoes, S., & Brechin, S. R. (2010). Environmental concerns, values and meanings in the Beijing and Detroit metropolitan areas. *International. Sociology*, *25*(6), 778–817.

Mullard, M., & Spicker, P. (1998). *Social policy in a changing society*. New York: Routledge.

Mumme, S. P., & Duncan, P. (1996). The commission on environmental cooperation and the U.S.-Mexico border environment. *Journal of Environment and Development, 5*(2), 1997–215.

Mumme, S. P., & Collins, K. (2014). The La Paz Agreement 30 years on. *The Journal of Environment and Development, 23,* 303–330.

North American Development Bank (NADB). (2012). Capitalization. http://www.nadb.org/about/capitalization.asp. Accessed 18 Jan 2017.

Nunez, G. G., & Klamminger, G. M. (2010). Centering the margins: The transformation of community in colonias on the U.S.-Mexico border. In K. Staudt, C. M. Fuentes, & J. E. Monarrez Fragoso (Eds), *Cities and citizenship at the U.S.-Mexico border the Paso del Norte metropolitan region*. New York: Palgrave Macmillan.

Olpadwala, P., & Goldsmith, W. W. (1992). The sustainability of privilege: reflections on the environment, the third world city, and poverty. *World Development, 20*(4), 627–640.

Opp, S. M., Osgood, J. L., & Rugeley, C. R. (2013). Explaining the adoption and implementation of local environmental policies in the United States. *Journal of Urban Affairs, 36*(5), 854–875.

Pastor, M., Sadd, J., & Hipp, J. (2001). Which came first? Toxic, minority move-in, and environmental justice. *Journal of Urban Affairs, 23*(1), 1–21.

Pellow, D. N. (2007). *Resisting global toxics: transnational movements for environmental justice*. Cambridge, Massachusetts: The MIT Press.

Peterson, M. N., Peterson, M. J., & Peterson, T. R. (2007). Moving toward sustainability: integrating social practices and material process. In R. Sandler & P. C. Pezzullo (Eds.), *Environmental justice and environmentalism the social justice challenge to the environmental movement* (pp. 189–221). Cambridge, Massachusetts: The MIT Press.

Pezzullo, P. C., & Sandler, R. (2007). Revisiting the environmental justice challenge to environmentalism. In R. Sandler & P. C. Pezzullo (Eds.), *Environmental justice and environmentalism the social justice challenge to the environmental movement* (pp. 1–24). Cambridge, Massachusetts: The MIT Press.

Portney, K. E. (2003). *Taking sustainable cities seriously: economic development, the environment, and quality of life in American cities*. Cambridge, Massachusetts: The MIT Press.

Portney, K. E. (2009). Sustainability in American cities: a comprehensive look at what cities are doing and why. In Toward sustainable communities: Transition and transformations in environmental policy, 2nd ed., edited by Daniel Mazmanian and Michael Kraft. Cambridge, MA: MIT Press.

Portney, K. E., & Berry, J. M. (2010). Participation and the pursuit of sustainability in U.S. cities. *Urban Affairs Review, 45*(1), 119–139.

Quesada, J. A. and Sanchez, H. (2013). *PwC-IMMEX maquiladora guide doing business in Mexico*. Price Waterhouse Cooper.

Rawls, J. (1971). A theory of justice. Harvard University Press: Cambridge, Massachusetts. Romo, HD (2016) Conclusion: is Mexican migration to the United States different from other migrations? In H. D. Romo & O. Mogollon-Lopez (Eds), *Mexican migration to the United States perspectives from both sides of the border*. Austin: University of texas press.

Romo, HD. (2016) Conclusion: is Mexican migration to the United States different from other migrations? In H. D. Romo & O. Mogollon-Lopez (Eds), *Mexican migration to the United States perspectives from both sides of the border*.

Saha, D., & Paterson, R. (2008). Local government efforts to promote the "three Es" of sustainable development: survey in medium to large cities in the United States. *Journal of Planning Education and Research, 28*(1), 21–37.

Sanchez-Rodriguez, R. (2009). Learning to adapt to climate change in urban areas. A review of recent contributions. *Current Opinion in Environmental Sustainability, 1*(2), 201–206.

SCERP. (1999). *The U.S.-Mexico Border Environment: A road to a sustainable 2020. Institute for Regional Studies of the California's, San Diego State University*. San Diego: San Die go State University Press.

Schaffer, B., & Lamb, G. (1981). *Can equity be organized? Equity, development analysis and planning*. Farnborough: Grower Publishing Company.

Svara, J. H. (2011). The early stage of local government action to promote sustainability. In The Municipal Year Book (Ed.), *2011*. Washington, D.C.: International City County Management Association.

Swyngedouw, E., & Heynen, N. C. (2003). Urban political ecology, justice and the politics of scale. *Antipode, 35*(5), 839–1042.

United Church of Christ Commission for Racial Justice (UCCC). (1987). Toxic waste and race in the United States. Cleveland: United Church of Christ.

U.S. Environmental Protection Agency Office of International and Tribal Affairs and Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT). 2012. *Border 2020: U.S.-Mexico Environmental Program*. EPA-160-R-12-001. Washington, D.C.

U.S. General Accounting Office (US GAO). (1983). Siting of hazardous waste landfills and their correlation with racial and economic status surrounding communities. Washington DC.

World Commission on Environment and Development (WECD). (1987). *Our common future*. New York: Oxford University Press.

Envisioning and Implementing Sustainable Bioenergy Systems in the U.S. South

John Schelhas, Sarah Hitchner and J. Peter Brosius

Abstract

Recent promotion and development of wood-based bioenergy in the U.S. South have targeted cellulosic liquid fuels for the transportation sector and wood pellets for power generation. Bioenergy development has promised to meet multiple sustainability goals including renewable energy, energy independence, new markets for wood, and rural development. On the other hand, it has garnered opposition from environmental groups for threatening forests and air quality and from conservatives who object to government subsidies and doubt climate science. A team of anthropologists undertook research on narratives, interests, and behaviors of various bioenergy stakeholders. We conducted multi-sited and cross-scale ethnographic research around emerging bioenergy facilities and at extension events, workshops, and conferences attended by landowners, managers, bioenergy industry representatives, and scientists. We also analyzed written materials from websites, news articles, and policy statements. We use the concept of imaginaries to analyze of the promotion of wood-based bioenergy as a new sustainable energy system, while noting the ways the dominant bioenergy imaginary excluded some sustainability goals and

J. Schelhas (✉)
Southern Research Station, USDA Forest Service, 320 Green Street,
Athens, GA 30602, USA
e-mail: jschelhas@fs.fed.us

S. Hitchner
Center for Integrative Conservation Research, University of Georgia, 321 Holmes-Hunter Academic Building, 101 Herty Drive, Athens, GA 30602, USA
e-mail: slhitchn@uga.edu

J. Peter Brosius
Department of Anthropology, University of Georgia, 250 Baldwin Hall,
Athens, GA 30602, USA
e-mail: pbrosius@uga.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_17

voices. As a result, counter-narratives emerged, success was limited, and landowners and communities received few of the expected benefits. This case provides important lessons for envisioning and implementing new sustainability technologies.

1 Introduction

Sustainability can be an "empty signifier," a vague term that represents and promotes the integration of diverse goals for society that cannot be articulated through current institutionalized discourses (Brown 2016). It is often promoted by politicians, community leaders, social and environmental activists, and others as an impetus for change. It is a goal that requires a transition from the current system to a new system that addresses the "triple bottom line" (Elkington 1999) of being ecologically sound, socially just, and economically viable. The process of transitioning to sustainability is propelled by a vision which often emerges from both scientific and public discussions and through a combination of discourse, policies, and incentives. The conditions for implementing such a vision tend to run counter to prior policies and existing market conditions and may only be partially realized, yet the process can have a transformative impact in real places. In this paper, we use multi-sited ethnography to address one such sustainability goal: achieving renewable energy through the process of envisioning and implementing a sustainable bioenergy system from woody biomass in the U.S. South.

A significant interest in bioenergy began to develop in the United States (U.S.) and the European Union (E.U.) in the early 2000s. McCormick and Kautto (2013) find that the ultimate goal of a new wood-based bioenergy system is neither the only renewable energy option nor achievable through a technological fix, but rather requires broad attention to sustainability and governance issues. While a review of the ideas, policies, and incentives promoting bioenergy use and production from woody biomass is far beyond the scope of this paper, there are several key factors that can be noted. Brown (2012), representative of public promotion of bioenergy, justifies biofuels production by noting that we have few other options for achieving a renewable energy future, particularly in terms of transportation fuels, that will meet future metrics of environmental, social, and political sustainability. Accordingly, policies in both the E.U. and the U.S. have promoted bioenergy development. In the E.U., a series of energy directives mandated that 20% of each country's energy portfolio come from renewable sources, with woody biomass playing a role in meeting this target (Lantiainen et al. 2014). A wood pellet industry developed in the U.S. in response to E.U. renewable energy targets (Aguilar 2014) and subsidies for electricity production. In the U.S., the 2007 Energy Independence and Security Act (EISA) set ethanol targets that included phasing in increasing quantities of biofuels made from cellulosic feedstocks (Dwivedi and Alavalapati 2009). To meet this target, cellulosic bioenergy development was aggressively promoted by the U.S. Department of Energy and other federal agencies (US DOE 2016). Additional incentives in agriculture, rural development, and forest sectors also supported these goals (Lantianen et al. 2014), reflecting the fact that promotion of bioenergy was driven by efforts to simultaneously address climate change, promote rural development, and achieve energy independence and security (Bracmort 2015; Mayfield 2007). The U.S. South, a major global producer of wood, is seen as having a comparative advantage in bioenergy, relative to other forms of renewable energy, due to its abundance of woody biomass available for power generation and liquid transportation fuels (Wear et al. 2010).

One way of thinking about the promotion of bioenergy development is through the concept of imaginaries. Eaton et al. (2014, pp. 227–228) draw our attention to the concept of socio-technical imaginaries for renewable energy technologies, including bioenergy derived from woody biomass, with their observation that:

> Imaginaries for bioenergy derive from state actors who envision a future where energy and economic interests will be met with homegrown resources …providing 'green' means to address salient social problems such as the nation's dependence on foreign and domestic fossil fuel supplies, climate change, pollution, environmental degradation, national energy security, and (rural) economic depression. The term *imaginary* connotes the way these visions provide an attainable end goal, or collective vision of a feasible, desirable future social order, provided by technological projects.

Strauss (2006), however, suggests that the concept of an imaginary can tend toward abstraction, reification, and homogenization. She states that imaginaries are most valuable when used to address real, rather than abstract, subjects through person-centered ethnographic methods that specify the extent to which imaginaries are shared across people and social groups. She calls elements of these shared imaginaries, such as ideas and phrases, "conventional discourses" and notes that these are passed among people both intentionally and unintentionally (Strauss 2012). Here we concur with Gasteyer et al. (2014) in suggesting that sustainable bioenergy development in the U.S. South can be understood as a socio-technical imaginary due to the aggressive and proactive promotion of new energy options through public discourse and policy, but we draw on Strauss (2006, 2012) to discuss how this imaginary has had concrete consequences and how different versions or elements of this imaginary have been joined, contested, or altered by particular actors. Numerous actors have been involved in bioenergy development in different ways: some have written science and policy reports, some have convened workshops and conferences, and others have funded or undertaken private and academic sector research on aspects of bioenergy technology, policy, logistics, and economics. Interest groups have also been bought into this imaginary to varying degrees and sometimes promulgated counter-narratives.

Industrial-scale plants for bioenergy production have been proposed, sometimes constructed, and—with uneven success—operated at a commercial scale in specific communities. Research is important to improve our understanding of how people in these communities envision and experience the cycles of development and disillusionment that have characterized bioenergy development initiatives. An ethnographic approach provides an opportunity for in-depth research on multiple actors and perspectives. To this end, we conducted ethnographic research centered on communities and landowners around proposed and developing bioenergy plants in the U.S. South, as well as at events focused on bioenergy which were attended by different types of actors. Our purpose here is to provide an empirical examination of the perceptions of the sustainability of these bioenergy developments through analysis of broad public discourse on bioenergy and interviews from our field research. Because sustainability often involves similar interactions between socio-technical imaginaries, conventional discourses, and concrete developments on the ground, we suggest that our analysis has broader relevance for sustainability in general.

2 Methodology

Methods. We undertook a study of the social acceptability of bioenergy through ethnography as a response to policy-makers' recognition that technical research alone would not be sufficient for achieving a sustainable bioenergy system. We chose *multi-sited* ethnography because, in a world that is rapidly becoming more globalized and integrated, the idea that a research site can be defined as a bounded set of social relations that can be studied and compared to other such bounded sets of social relations has become increasingly untenable (Falzon 2009; Marcus 1995). Lassiter (2005, p. 93) notes that ethnography is now often conducted in an "ever-changing, shifting, and multi-sited field." Our study of the process of envisioning and implementing sustainable bioenergy involved actors and discourses found in multiple sites, including both places and events, and therefore was well-suited to multi-sited ethnography where people, connections, associations, and relationships are followed across space and time (Falzon 2009). In this interconnected world, field site boundaries are inherently arbitrary and defined by the researcher (Candea 2009), and we chose to focus our research on the process of bioenergy development with field research on the ground around new bioenergy facilities, ethnography at bioenergy events, and analysis of publicly available written materials. Specifically, we focused on the way people talk about bioenergy using the idea of conventional discourses—common ways people talk and think about a topic—situated within the context of commonly shared public cultural discourses and imaginaries linked to the promotion of a new, sustainable bioenergy system (Strauss 2006, 2012). This research focus reflects our interest in using talk as a window into human values and social processes (Quinn 2005), as well as the challenges we encountered in studying a constantly shifting landscape of bioenergy development in the U.S. South, a topic that we found to be both discursive and concrete.

Using participant observation and semi-structured interviews, we conducted ethnographic research in three communities in Georgia and Mississippi with different types of bioenergy facilities. We spent three months living in each of these three main field sites and interviewing many different stakeholders: landowners, community members, local development board members, school board members, local politicians, cooperative extension agents, loggers and others employed in the forest industry, and employees of bioenergy facilities. We took detailed notes during semi-structured interviews on both questions and responses and immediately transcribed them. We also transcribed fieldnotes about the location of the interview, relevant observations about the interviewee, and our reflections on the interview. We conducted about 175 interviews, lasting between thirty minutes and three hours (averaging about an hour) in these three primary sites. We participated in community activities and temporarily joined local organizations, where we participated in ongoing group activities and introduced ourselves as researchers interested in interviewing community members. In this way, we met directly and were introduced to a number of interviewees. We also briefly visited communities in Georgia, Alabama, and Louisiana that also had bioenergy facilities and conducted about thirty interviews in these areas with extension agents, forest professionals, forest landowners, and employees of bioenergy facilities.

We also conducted event ethnography (Brosius and Campbell 2010) through attendance at a series of eighteen regional conferences and workshops on bioenergy and participation in at least twenty-seven regional and national bioenergy-related webinars and conference calls. This was also a key part of our research methodology, as at these events we focused not only on the content presented during the sessions but also on the observable interactions between various actors. These meetings, which range from fully public to invitation-only, are utilized as venues for public announcements about new technological breakthroughs, biofuel facility openings, or developments in bioenergy policies. We view these events as an extension of community-based fieldwork in the primary and secondary sites; the network of actors that attend these regional workshops and conferences could also be considered a “community.” Additionally, we systematically collected on-line and print materials on bioenergy development, including position papers, white papers, commercials, advertisements, news stories, editorials, and blogs to analyze for public, media, and stakeholder framings of bioenergy development. The latter material provides the basis for our discussion of imaginaries.

We used NVivo qualitative analysis software to conduct content analysis of ethnographic data collected in our three primary field sites (transcripts of interviews and fieldnotes) and at bioenergy events (transcripts of formal talks and fieldnotes), as well as on-line and print materials. We analyzed these datasets in order to understand how various actors use specific phrases related to bioenergy strategically in order to evoke images and emotions. Specifically, we examined metaphors and conventional discourse related to bioenergy development, forests, and communities to identify some of the ways that these phrases and ideas travel within and between different actors and influence perceptions of bioenergy.

Research Sites. The three primary field sites for our place-based ethnographic research were Soperton, Georgia; Columbus, Mississippi; and Waycross, Georgia. We chose these communities because they were home to well-developed bioenergy plants with key differences: one a highly publicized liquid fuel plant that had undergone a significant setback (bankruptcy), one the first to produce liquid fuel at a commercial scale from woody biomass, and one pellet plant purchasing large volumes of woody-biomass from nearby landowners (unlike the liquid fuel plants). These communities, and the bioenergy facilities located within them, are briefly described below.

1. *Soperton, Georgia* (*Range Fuels/LanzaTech*): Construction began on Range Fuels in November 2007, after securing over $400 million in public and private funds. Range Fuels was expected to produce 40 million gallons per year of cellulosic ethanol using gasification technology and yellow pine as a feedstock but only produced one batch of methanol. In rural and economically depressed Treutlen County, the initial announcement of the plant was met with great enthusiasm, as it would bring many jobs and a new market for wood products, and the ground-breaking was attended by high-ranking government officials including the U.S. Secretary of Energy. The local and national implications of Range Fuels' bankruptcy and closure in 2011 have been profound, leading to public anger over what is seen as a waste of taxpayer money. In 2012, LanzaTech purchased the facility at auction for $5.1 million and renamed it the Freedom Pines Biorefinery. LanzaTech has retrofitted the facility for use as a research and development facility that will focus mainly on chemicals produced using proprietary microbes and synthetic biology, though it has recently made the news for producing jet fuel from waste gases from steel mills as a result of a business partnership with Virgin Airline.
2. *Columbus, Mississippi* (*KiOR*): After building a successful pilot plant in Pasadena, Texas in 2010, KiOR built a demonstration facility and then the world's first commercial-scale cellulosic biocrude plant in Columbus, Mississippi, which began production in 2012. It used a proprietary biomass fluid catalytic cracking (BFCC) technique to convert biomass feedstock, specifically southern yellow pine, into crude oil that could be refined into gasoline, diesel, and aviation fuels. KiOR received a twenty-year no-interest $75 million loan from the state of Mississippi as incentive to locate there, in addition to private investor funds. Promises by the company to provide over 1000 jobs by the end of 2015 were not fulfilled, as the facility never reached full capacity and filed for bankruptcy in October 2013 (after we completed fieldwork there). Following the Chap. 11 bankruptcy, there have been a series of class-action lawsuits by shareholders, accusing the company of deliberately misleading them about chances of the company's success. Columbus is a larger community and has a more diversified economy than our other primary sites.
3. *Waycross, Georgia* (*Georgia Biomass*): Georgia Biomass, which began operation in 2011, has the capacity to produce 750,000 tons of pellets per year from local forests, which requires about 1.5 million metric tons of fresh wood per year (Gibson 2010). Pellets, unlike cellulosic liquid fuels, are a proven technology, and we included a pellet plant to gain insight into community and landowner perspectives to actual harvesting of wood for bioenergy. Georgia Biomass is a wholly-owned subsidiary of the German utility company Innogy SE (which is a subsidiary of RWE), and these pellets are shipped from the port in Savannah,

Georgia, to supply biomass power plants and co-generation facilities in Europe. Waycross, while more developed than Soperton, is also rural, with an economy heavily dependent on the forest products industry; the Georgia Biomass plant directly employed over eighty people and created over 300 indirect jobs. In June 2014, the facility was offered for sale as RWE shifted its focus to other renewables. Although rumors of a sale have continued, as best we can determine as of January 2017 the Georgia Biomass facility continues to operate as a subsidiary of Innogy SE.

3 Results and Discussion

3.1 Bioenergy Imaginaries

In the United States, energy imaginaries, which entail energy security and energy independence, have long been part of the rhetoric of politicians, and this language, which crosses party lines, has intensified in the U.S. since the terrorist attacks of September 11, 2001. In 2006, George W. Bush lamented the United States' "addiction to oil," while in 2007, Barack Obama promoted freedom from the "tyranny of oil" (Bryce 2008). This rhetoric evokes emotional reactions in citizens in support of alternate sources of energy and merges with environmental discourses about renewable energy reducing emissions and mitigating climate change, thus strengthening the power of a sociotechnical imaginary promoting bioenergy development (Hitchner et al. 2016). This imaginary came to the U.S. South through a variety of means, including the U.S. DOE's "Billion Ton" reports (Perlack et al. 2005; U.S. DOE 2011, 2016). In another example, the organization 25x'25 (which defines itself as "a diverse alliance of agricultural, forestry, environmental, conservation and other organizations that are working collaboratively to advance the goal of securing 25% of the nation's energy needs from renewable resources by the year 2025") stated, "Liquid biofuels provide an incredible opportunity for farms, ranches and forests to contribute to America's clean energy future" (25x'25 2010, p. 9).

We found more than one bioenergy imaginary in the U.S. South, with certain individuals and organizations promoting alternatives. Different stakeholders promote or subscribe to different imaginaries, and they have different motives for doing so. One is the tendency to see biofuels as a scam, selling an unviable product to enrich its proponents (Hitchner et al. 2016). Government subsidies for biofuels, ranging from those for the Range Fuels plant (Chapman 2012) to military spending on the Great Green fleet, a military effort to develop alternatives to conventional fuels (Cardwell 2012), have been criticized as wasteful government spending. A second imaginary focuses on public health and environmental justice. Supplying pellets to Europe's wood-burning power generating plants, often called "biomass incinerators" by opponents, is sometimes referred to as turning the U.S. into a European resource colony (Schlossberg 2013). Interpreting biomass power plants as incinerators calls attention to air pollution concerns related to burning wood, and it has raised environmental justice concerns when these plants are located near minority communities (Bullard 2011; Hitchner et al. 2014). A third alternative imaginary revolves around ecological impacts. Questions about renewability and carbon neutrality have been raised (McBride 2011; Phillips 2015). Environmental groups have maintained that bioenergy threatens to push forests—valuable for sustainable forest products, tourism, and as cultural resources—to the brink of disaster by causing irreparable harm through deforestation and degradation (Quaranda nd). Environmental and conservation organizations have expressed concern that bioenergy can have potential impacts such as soil erosion, decreased water quality and quantity, and conversion and deterioration of wildlife habitat in exchange for only modest greenhouse gas reductions (McGuire 2012).

3.2 Communities, Landowners, and Sustainability

Our research enables us to examine the conventional discourses that community members and landowners use when talking about bioenergy and its sustainability, both in general and in relation to concrete bioenergy projects. Here we follow a longstanding practice in sustainability research of organizing our discussion according to economic, ecological, and social dimensions of sustainability.

Economic sustainability: Facilities using woody biomass tend to be located in forest areas because it often becomes uneconomical to transport raw material, such as logs or chips, over long distances. The poverty that is prevalent in forest-dependent communities in the U.S. South has been linked to low employment levels relative to agriculture and industry (Bliss and Bailey 2005). All of the communities we studied were somewhat hollowed out from their agricultural past, in terms of extensive out-migration of young adults and many empty storefronts in older commercial districts, and all had local development authorities actively pursuing new industry as a means of economic development. In all cases, employment numbers were higher during plant construction than projected for plant operation, and construction jobs were often specialized and likely to go to outsiders. All jobs were appreciated, but jobs for local businesses and people were most desirable; however, they were only partially realized. The closures of the cellulosic fuel plants were obviously detrimental for economic sustainability. In the Range Fuels case, one local electrical contractor who did receive a construction contract was left unpaid when the company declared bankruptcy. Bankruptcies had other effects on communities. Companies constructing plants received government incentives, tax abatements, and other investments, and communities made industrial sites available to them. Bankruptcies provide few benefits while continuing to tie up sites and resources, and they are perceived as setbacks for local development goals and may sour communities on engaging in efforts to attract industry in general. In Soperton, which had little industrial development but high hopes for the compatibility of the Range Fuels plant with local forestry operations, failure was particularly demoralizing (Hitchner et al. 2017). Community members living near plants, and in a few cases organized interest groups, opposed bioenergy development due to noise, truck traffic, and safety concerns. Nevertheless, in all the sites a broad cross-section of the community viewed a successful bioenergy plant as a positive development that fit well with local economies. It was common however, for community members to complain about government subsidies and intervention in "free markets," although bioenergy proponents often pointed out that the oil and gas industry received many subsidies and that government assistance was therefore necessary to get the bioenergy industry up and running.

Enthusiasm for bioenergy plant proposals was often linked to prospects of better markets for local wood. During the development stages, there was generally talk about plants taking waste wood for which there was no other market, such as tops, limbs, and very small-diameter trees that need to be harvested for forest health reasons. Use of these materials proved difficult due to inefficiencies in transporting whole trees and the high cost of in-woods chipping. As a result, plants ended up essentially purchasing pulpwood (medium sized trees that are easy to harvest and transport, but not yet suitable for lumber). Georgia Biomass was the only plant purchasing significant quantities of wood, and some landowners in that region complained that these purchases had done nothing to improve pulpwood prices. However, foresters involved in wood procurement in that area suggested that it had at least prevented pulpwood prices from dropping to further lows, as a number of pulp and paper plants in the South have closed recently, resulting in increased supply and lowered demand for pulpwood.

At both community and landowner levels, bioenergy plants fit well into community economies but have made only modest economic contributions. The gap between the imaginaries associated with liquid fuels and plant bankruptcies was stark and a cause of disillusionment toward the bioenergy industry in particular and government-promoted energy programs in general among local people. Many people compared these failures to Solyndra, a well-known solar energy failure that received significant federal investment.

Ecological sustainability: One of the sharpest differences between the dominant bioenergy imaginary and various counter-narratives is found in environmentalist claims that bioenergy development threatens forests. The power of the Southern woody biomass imaginary, backed by strong discourse, policies, and subsidies that envisioned cellulosic biofuels playing a major role in both the U.S. energy sector and Southern wood product markets, may have provoked this strong backlash from environmental groups. Foresters we talked to often pointed out that it would always be impractical to collect large amounts of waste wood and sweep up all the woody biomass after harvest, and in fact we did not observe woody biomass harvests that involved any trees other than traditional pulpwood harvests. However, in conferences and workshops, researchers often talked about their experiments with in-woods chipping, short-rotation pines, and exotic species such as eucalyptus, which suggested a level of change to Southern forests in accordance with the large-scale transition to bioenergy envisioned in the imaginary and in line with environmental concerns.

It was also common for forest owners and foresters to say that strong markets for wood products are the best way to "keep forests in forests," by providing economic incentives to landowners to plant and manage forests. Large areas of the South were reforested in the latter part of the 20th century, both through plantations in association with the rise in the forest product industry and through natural regeneration as marginal farmland was abandoned and agriculture intensified on prime farmland or moved to other regions of the U.S. While the relative impact of each of these two factors has not been completely sorted out (see Rudel 2001), wood markets clearly promoted more plantation forestry. But the general term "forest" may mask differences in the way it is used by different stakeholder groups, who may be referring to different forest types (e.g., plantations versus natural regeneration) that provide different mixes of products, as well as ecosystem services and values. Similarly, claims by foresters and landowners that managed forests provide "wildlife" habitat generally refer to commonly hunted species such as deer and turkey, rather than a broader definition of wildlife that would include non-game species and biodiversity.

The contribution of bioenergy to reduction of greenhouse gases is another area where environmentalists often contest the Southern bioenergy imaginary. Life cycle analysis to address this has not been thoroughly explored, and differences in accounting procedures allow each side to make their own claims. Representatives of pellet companies that we interviewed maintained that their analyses showed European electricity generation from Southern wood pellets to be carbon negative, but their data was not made publicly available. For the most part, however, widespread disbelief in climate change in the rural South meant that climate motivations for bioenergy were rarely discussed, particularly in public and landowner events (Schelhas et al. 2014). Instead, bioenergy was promoted for benefits like rural development, new wood markets, and as a domestic substitute for foreign fuel. Sustainability certification for forests and forest products, which seem likely to be demanded for publicly supported bioenergy programs, were of little interest to family forest owners who saw them as outside interference and representative of distrust of their own management. Some of this again revolves around definitions, with forest owners tending to have a more traditional forestry definition of "sustainability" as sustainable yield of forest products, compared to the broader definition generally used in public policy.

Social sustainability: Racial and economic disparities were present in all communities. Local promotion of bioenergy development was generally driven by development authorities, which had some diversity but were often more representative of elite interests. There was also often little transparency in decision-making when bioenergy companies were recruited to communities. The results of this were reflected in low levels of information and even awareness among the general public in communities, and perhaps in a lack of attention to the overall issue of local employment, particularly labor, in agreements negotiated for plant siting.

At the landowner level, even where forest product markets are strong and many landowners sell timber at some point, timber production is rarely a top ownership objective for family forest owners (Butler 2008). Forests are also highly valued at the local level for hunting and wildlife, aesthetics, and watershed values. These other values, along with the speculative nature of managing for long-term woody biomass, meant that most landowners expressed little interest in alternatives to the plantation systems they were currently using, which were generally 20 + year rotations for loblolly pine, 30 + year rotations for slash pine, and 40 + year rotations for longleaf pine (all native species), with prescribed burning and periodic thinning for pulp and chip-and-saw. Pine trees have been marketable through many larger economic changes for products ranging from naval stores, pulp and paper, and various types of timber markets. Thus a preference for pine trees, along with the long-term nature of forestry decisions and the importance of sawtimber as the major economic driver of plantation forestry, meant that few landowners were interested in exotic species or short-rotation trees. This is likely positive for ecological sustainability, as forestry research on bioenergy often promotes alternative species and shorter rotations.

4 Conclusion

Brown (2016) maintains that "sustainability" as an empty signifier presents opportunities for co-option of the term by powerful interests, as well as opportunities to develop new discourses that stimulate radical change toward sustainability. In the case of wood-based bioenergy, many people saw both their own self-interest and public interest in the bioenergy imaginary, and it gained momentum and funding far beyond what proven technologies and economics would have suggested. A bioenergy imaginary was promoted by interest groups who found support in it for their conventional and institutionalized activities and avoided reordering of societal priorities. As a result, alternative discourses and contestation took place outside of dominant institutional structures, and critical sustainability elements were neglected. At the same time, the imaginary produced very mixed benefits and responses from landowners and communities, suggesting that a slower and more inclusive promotion and development process might have allowed more careful evaluation of options, better accounting of measurable sustainability goals, and avoidance of catastrophic failures and disillusionment.

Imaginaries can mobilize action, but they can also themselves come apart or be influenced by events. The imaginary of a large bioenergy industry from woody biomass grown in Southern forests has, to a significant extent, unraveled over the past few years with lower fossil fuel prices due to abundant natural gas, environmental opposition, and the failure of any plant to produce economically competitive cellulosic fuels. Pellet plants have continued to operate, although long-term E.U. policy may change in response to concerns about forest sustainability and limited carbon reduction benefits. At the same time, there is an ongoing but slow-moving process by which bioenergy facilities, in association with pulp mills, saw mills, and other wood product industries, continue to find synergistic ways to grow using residual wood products. Simultaneously, interest remains for targeted biomass harvest, for example of small diameter trees on Forest Service lands, to meet forest health and fuel reduction objectives. At the practical level, these lessons sound a cautionary note for other sustainability ventures driven by powerful imaginaries. At the theoretical level, our research reinforces Strauss's (2006) call for paying ethnographic attention to concrete actors and exploring conventional discourses when conducting research on imaginaries.

Acknowledgements We gratefully acknowledge funding from Southern Research Station, USDA Forest Service (Agreement 11-JV-11330144-024) and USDA National Institute of Food and Agriculture - Agriculture and Food Research Initiative (NIFA-AFRI) Sustainable Bioenergy Challenge Area (USDA-NIFA Award No. 2012-67009-19711) that supported this research.

References

25x'25 (2010) 25x'25 Meeting the goal: A progress report. www.25x25.org.

Aguilar, F. X. (2014). Wood energy in the EU and US: Assessment and outlook to 2030. In F. X. Aguilar (Ed.), *Wood energy in developed economies: Resource management, economics, and policy* (pp. 306–327). London: Earthscan.

Bliss, J. C., & Bailey, C. (2005). Pulp, paper, and poverty: Forest-based rural development in Alabama, 1950–2000. In R. G. Field & D. R. Field (Eds.), *Communities and forests: Where people meet the land* (pp. 138–158). Corvallis, OR: Oregon State University Press.

Bracmort, K. (2015). The Renewable Fuel Standard (RFS): Cellulosic Biofuels. Report 7-5700. Congressional Research Service, Washington, DC.

Brosius, J. P., & Campbell, L. M. (2010). Introduction: Collaborative event ethnography: Conservation and development trade-offs at the fourth world conservation congress. *Conservation and Society, 8*(4), 245–255.

Brown, T. (2016). Sustainability as empty signifier: Its rise, fall and radical potential. *Antipode, 48* (1), 115–133.

Brown, R. C., & Brown, T. R. (2012). *Why are we producing biofuels? Shifting to the ultimate source of energy*. Ames IA.: Brownia.

Bryce, R. (2008). *A gusher of lies: The dangerous delusions of energy independence*. New York: Public Affairs.

Bullard, R. D. (2011). Dismantling energy apartheid in the United States. Dissident voice http://dissidentvoice.org/2011/02/dismantling-energy-apartheid-in-the-united-states/, Accessed 7 December 2011.

Butler, BJ. (2008). *Family Forest Owners of the United States, 2006*. Gen. Tech. Rep. NRS-27. Northern Research Station, USDA Forest Service, Newtown Square, PA.

Cardwell, D. (2012). Military spending on biofuels draws fire. *New York Times.* August 27, 2012.

Chapman, D. (2012). Warnings ignored in Range fuels debacle. *Atlanta Journal-Constitution.* September 2, 2012.

Dwivedi, P., & Alavalapati, J. R. R. (2009). Stakeholders' perceptions on forest biomass-based bioenergy development in the southern U.S. *Energy Policy, 37,* 1999–2007.

Eaton, W. M., Gasteyer, S. P., & Busch, L. (2014). Bioenergy futures: Framing sociotechnical imaginaries in local places. *Rural Sociology, 79,* 227–256.

Elkington, J. (1999). *Cannibals with forks: The triple bottom line of 21st century business*. North Mankato, MN: Capstone Publishing.

Falzon, M. A. (2009). *Multi-sited Ethnography: Theory, Praxis and Locality in Contemporary Research*. Farnham: Ashegate.

Hitchner, S., Schelhas, J., & Brosius, J. P. (2016). Snake oil, silver buckshot, and people who hate us: Metaphors and conventional discourses of wood-based bioenergy in the rural southeastern U.S. *Human Organization, 73,* 204–217.

Hitchner, S., Schelhas, J., & Brosius. J. P. (2017). “Even our Dairy Queen shut down”: Risk and resiliency in bioenergy development in forest-dependent communities in the U.S. South. *Economic Anthropology*, *16*, 395–417.

Hitchner, S., Schelhas, J., Hujala, T., & Brosius, J. P. (2014). Public opinion on wood-based bioenergy. In F. X. Aguilar (Ed.), *Wood energy in developed economies: Resource management, economics, and policy* (pp. 32–74). London: Earthscan.

Lantiainen, S. M., Song, N., & Aguilar, F. X. (2014). Public policy promoting wood energy in the EU and US. In F. X. Aguilar (Ed.), *Wood energy in developed economies: Resource management, economics, and policy* (pp. 189–222). Oxon: Routledge.

Lassiter, L. E. (2005). Collaborative ethnography and public anthropology. *Current Anthropology, 46,* 83–106.

Marcus, G. E. (1995). The emergence of multi-sited ethnography. *Annual Review of Anthropology, 24,* 95–117.

Mayfield, C. A., Foster, C. D., Smith, C., Gan, J., & Fox, S. (2007). Opportunities, barriers, and strategies for forest bioenergy and bio-based product development in the Southern United States. *Biomass and Bioenergy, 31,* 631–637.

McBride, A. (2011). Biomass energy sustainability. Biomass energy data book. U.S. department of energy: Oak Ridge, TN.

McGuire, B. (2012). *Assessment of the bioenergy provisions in the 2008 Farm Bill*. Washington, DC: Association of Fish and Wildlife Agencies.

McCormick, K., & Kautto, N. (2013). The bioeconomy in Europe: An overview. *Sustainability, 5,* 2589–2608.

Perlack, R. D., Wright, L. L., Turhollow, A. F., Graham, R. L., Stokes, B. J., & Erbach, D. C. (2005). *Biomass as a feedstock for a bioenergy and bioproducts industry: The technical feasibility of a billion-ton annual supply*. Oak Ridge National Laboratory, Oak Ridge, TN: US Department of energy and U.S. Department of Agriculture.

Phillips, A. (2015). American companies are shipping millions of trees to Europe, and it’s a renewable energy nightmare. Climate Progress https://thinkprogress.org/american-companies-are-shipping-millions-of-trees-to-europe-and-its-a-renewable-energy-nightmare-ef1fdcca1cb4#.gy0p0alup. Accessed September 9, 2016.

Quaranda, S. (no date). Don’t log the forests for the fuel: A position paper on the potential environmental and economic impacts of the cellulosic ethanol industry in the southern United States. Dogwood Alliance, Asheville, NC.

Quinn, N. (2005). *Finding culture in talk: A collection of methods*. New York: Palgrave MacMillan.

Rudel, T. K. (2001). Did a green revolution restore the forests of the American South? In: Angelsen A, Kaimowitz. D (Eds.) Agricultural technologies and tropical deforestation. CABI, Wallingford. pp 53–68.

Schelhas, J., Hitchner, S., & Brosius, J. P. (2014). “What’s climate got to do with it?” perceptions of bioenergy and climate change in the rural U.S. South. Paper presented at the panel on “engaging ‘wicked’ problems: producing knowledge of the anthropocene at the nexus of climate, consumption, and energy.” American Anthropological Association Annual Meeting, Washington, DC. December 2–7, 2014.

Schlossberg, J. (2013). Biomass industry reveals plans to turn U.S. into European resource colony. *The Biomass Monitor.* August 4, 2013.

Strauss, C. (2006). The imaginary. *Anthropological Theory, 6,* 322–344.

Strauss, C. (2012). *Making sense of public opinion: American discourses about immigration and social programs*. Cambridge, England: Cambridge University Press.

US DOE, (2006). Breaking the biological barriers to cellulosic ethanol: A joint research agenda. Report from the December 2005 Workshop, DOE/SC-0095. U.S. Department of Energy Office of Science. (www.genomicscience.energy.gov/biofuels/).

US DOE, (2011). U.S. Billion-ton update: Biomass supply for a bioenergy and bioproducts industry. R. D. Perlack, B. J. Stokes (Leads). ORNL/TM-2011/224. Oak Ridge National laboratory, Oak Ridge, TN.
USDOE (2016) 2016 Billion-ton report: Advancing domestic resources for a thriving bioeconomy, Volume 1: Economic availability of feedstocks. M. H. Langholtz, B. J. Stokes, L. M. Eaton (leads). ORNL/TM-2016/160. Oak Ridge National laboratory, Oak Ridge, TN.
Wear, D., Abt, R., Alavalapati, J., Comatas, G., Countess, M., & McDow, W. (2010). The South's outlook for sustainable forest bioenergy and biofuels production. http://www.treesearch.fs.fed.us/pubs/36461.

Author Biographies

John Schelhas is a Research Forester with the Southern Research Station of the USDA Forest Service in Athens, GA. His research centers on the relationship between people and forests. The primary focus is on private forest landowners and rural communities, addressing the topics of land use decision-making, environmental values, race and ethnicity, forest-based rural development, relationships between protected areas and their neighbors, invasive plants, bioenergy, and climate change. He has conducted research in Latin America and the U.S. South. He holds a Ph.D. in Renewable Natural Resources with a Minor in Anthropology from the University of Arizona.

Sarah Hitchner is an Assistant Research Scientist at the Center for Integrative Conservation Research at University of Georgia. She received her Ph.D. in Anthropology from UGA, and her dissertation research focused on collaboratively documenting the cultural landscape of the Kelabit Highlands in Sarawak, Malaysia. Recently, she has conducted ethnographic research in the southeastern United States on several topics: local impacts of bioenergy development, perceptions of climate change in urban and rural communities, and intergenerational transfer of land within African American families.

J. Peter Brosius is a Distinguished Research Professor of Anthropology at the University of Georgia. He received his Ph.D. from the University of Michigan. Much of his career has been devoted to research in island Southeast Asia, where he has worked with several groups of indigenous people, particularly Penan hunter-gatherers in the Malaysian state of Sarawak on the island of Borneo. His research has mostly focused on the political ecology of conservation, with a particular focus on the impact of environmental degradation on local communities and the multiple linkages that connect those communities to global institutions and processes. He is the founding director of UGA's Center for Integrative Conservation Research, which promotes interdisciplinary research collaborations that foster integrative approaches to analyzing complex trade-offs in conservation and development.

Living Well and Living Green: Participant Conceptualizations of Green Citizenship

Erin Miller Hamilton, Meaghan L. Guckian and Raymond De Young

Abstract

For many people, sustainable behavior can be clearly articulated through an array of consumer choices made every day based on: where products come from, the environmental impact of the ingredients in household products, and how products are disposed of at the end of their life cycle. But outside of consumerism, are there other avenues an individual might explore in the pursuit of living a sustainable lifestyle? In an activity called Conceptual Content Cognitive Mapping (3CM) completed by environmentally-concerned academics and professionals, this study asked what it means to be a green citizen. Green citizenship, as understood and lived by our participants, transcends multiple levels of involvement that extend beyond consumer behavior. Green citizens embrace their individual agency to affect change, while recognizing the socially embedded nature of their actions. Beyond the support of community networks, green citizens also identify higher institutional structures as both conduits and barriers to change. Implications for constructing supportive pathways to sustainable participation focusing on the whole citizen, rather than just the consumer, will be discussed.

E.M. Hamilton (✉) · R. De Young
School for Environment and Sustainability, University of Michigan, 440 Church Street, Ann Arbor, MI 48109, USA
e-mail: emham@umich.edu

R. De Young
e-mail: rdeyoung@umich.edu

M.L. Guckian
Department of Environmental Conservation, University of Massachusetts, 160 Holdsworth Way, Amherst, MA 01003, USA
e-mail: mguckian@umass.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_18

Keywords
Green citizen · Green consumer · Conceptual content cognitive map (3CM)

1 Introduction

For many people, sustainable behavior can be represented by the choices we make as consumers every day. After all, consumer household purchases are responsible for up to 40% of calculated environmental damage (Joshi and Rahman 2015). A recent review of Americans' views of environmental issues cited that an impressive nearly three-quarters of Americans believe "the country should do whatever it takes to protect the environment" and even 4 in 10 Americans would identify themselves as environmentalists (Anderson 2016). So when faced with worsening environmental problems, the likely behavioral response for the environmentally-concerned citizen would be to "green up" their consumption habits. In effect, the green product industry has grown drastically in recent years, being one of the only industries to show continued growth through the economic recession (Walker 2013).

However dutifully our society may accept the role of the green consumer, changing the products we consume and how we dispose of them is likely insufficient to adequately respond to the challenges ahead. Rather, the realities presented by a future of climate change and diminished energy resources necessitate a wide range of behavioral responses.

Fortunately, humankind is equipped to meet these challenges. As one of the largest contributors of global greenhouse gas emissions (U.S. Environmental Protection Agency 2017), if citizens in the United States alone adopted more environmentally responsible household behaviors such as reducing driving, lowering thermostats in the winter, and line-drying one's clothes, climate scientists predict a reduction of greenhouse gas emissions by 20% over the next ten years (Dietz et al. 2009). Thus, rather than funnel human environmental concern toward increased consumerism, albeit green, we might instead seek to support the cultivation of other behaviors that are more sufficient to the challenge, and in which people find greater long-term satisfaction. Thus, the aim of this paper is to explore what it means to be a green citizen, apart from and including green consumerism.

2 Environmental Behavior

There has been considerable effort in the field of conservation psychology to address environmental challenges through the paths of individual or group behavior change. This research has revealed myriad psychosocial and situational variables

(Ajzen 1991; Bamberg and Schmidt 2003; Kaplan and Kaplan 2009; Stern 2000) that influence a person's daily behaviors and decision-making, as well as an extensive toolkit of strategies (See Abrahamse et al. 2005) one might employ in trying to support, increase, or change these behaviors. What is consistent in this body of literature is the focus on changing one or a close suite of behaviors.

Other approaches to changing environmental behavior begin from a broader stance, asking not how to elicit a specific behavior, but what do we know about people who already participate in these desired behaviors? Research with long-term volunteers in environmental stewardship programs report two consistent motivations to continue their work: the opportunity to do something meaningful to benefit the environment and the chance to learn something new (Ryan and Grese 2005; Ryan et al. 2001). Additionally, De Young's (2000) work on motivation and satisfaction has found that human beings find satisfaction in a number of ways including frugality, participation, and competence.

The propensity with which our western culture pursues growth (Meadows et al. 2004) seems inconsistent with the notion that we might find the greatest satisfaction through intangible means such as participating in meaningful projects, learning new things and frugality. Yet, it is no surprise given our actual relationship to consumerism and the effect it has on our well-being. This difference is clearly articulated in looking at the relationship between types of well-being and our physical health. Hedonic well-being refers to the "sum of an individual's positive affective experiences" while eudaimonic well-being results from "striving toward meaning and a noble purpose beyond self-gratification" (Fredrickson et al. 2013, p. 13684). In Fredrickson, et al.'s study of healthy adults who were assessed for hedonic and eudaimonic well-being, subjects reported similar levels of happiness, yet in adults with high levels of hedonic well-being, there was an increased expression of pro-inflammatory genes and a decreased expression of genes that assist with the synthesis of antibodies. The inverse was true for adults with high levels of eudaimonic well-being. Thus, pursuing happiness through either self-gratification or through meaning is likely to result in differences in physical health related to one's ability to fight off disease. Pursuing personal happiness or striving to make a meaningful environmental impact through purchasing decisions seems to inherently conflict with what is known to support long-term well-being in humans. Today, the oft referenced "American Dream" boasts the potential to achieve power, image, and status (Sheldon et al. 2011) through hard-work and commitment. These "American" ideals are often realized through material ownership: a personal vehicle, single-family home, and constant economic growth. So ubiquitous is this social norm of constant consumption, that our society has now legitimized the negative ramifications of living on the hedonistic treadmill. *Affluenza*, a negative psychological state characterized by chronic dissatisfaction, stress, and social isolation, results from excessive materialism and consumerism ("Affluenza" 2017). Yet, Americans need not resign themselves to current interpretations of "living the dream." The American Dream is also defined by democracy, equality, and opportunity. When presented with other nationally held values of self-expression, family and generosity, Americans recommend pursuing less growth and smaller ecological footprints, in pursuit of the American Dream (Sheldon et al. 2011). Despite evidence and experience to the contrary, the myth of growth persists. Even in the face of grave environmental challenges, a predominant role in which people are cast is that of the green consumer, thus prompting inquiry as to other potential, more impactful and meaningful, avenues that environmentally-concerned citizens might pursue.

3 Ecological Citizenship

While the term "green citizen" did not appear until more recently, a comparable term, "ecological citizenship," has been heavily theorized. The current research will adopt the term "green citizen" in order to distinguish from previous conceptualizations associated specifically with ecological citizenship. Still, it is useful to examine how this term informs current thinking about green citizenship, beginning with how this term has evolved since it first appeared in the mid-1990s amid the politically oriented field of citizenship studies.

Early theorists focused mostly on expanding traditional, political definitions of citizenship beyond liberal and civic republican forms of citizenship that were defined by the articulation of human's rights/entitlements (in the former) and duties/responsibilities (in the latter) within the public sphere of behavior (Dobson 2003). One of the key initial expansions to this concept included consideration of the rights of non-humans, referring to non-human nature and to future generations of humans not yet in existence (Dean 2001).

By far one of the most heavily cited political theorists in this domain is Andrew Dobson, whose definition of ecological citizenship (Dobson 2003) assumes that the ecological citizen's behavior is driven by five underlying attitudes or orientations: (1) Non-contractual Responsibilities, (2) Non-reciprocity, (3) Virtue of Equity/Justice, (4) the blurring of Private and Public Spheres, and (5) Non-territoriality. The driving force behind Dobson's ecological citizenship is the equitable distribution of ecological space, or the total "pie" of the Earth's resources. Herein, he uses the ecological footprint calculator as a tool to illustrate how the lifestyles of a minority of earth's inhabitants unjustly consume a vastly disproportionate share of the earth's resources. The virtues of Justice and Equity necessitate non-reciprocal action (2003, p. 121) on the part of ecological citizens to rectify past inequalities caused by their disproportionate consumption of ecological space. The title of ecological citizen thus belongs to those who have overconsumed, rather than those whose meager consumption barely meets minimum levels of subsistence.

Further distinguishing ecological citizenship from earlier types of citizenship, ecological citizenship is explicitly non-territorial in nature, as environmental problems cannot be restricted to national boundaries in their effects (Dobson 2003, p. 97). Finally, these underlying attitudes or orientations drive ecological citizens to consider not only their behavior in the public sphere (in former models of citizenship pertaining mostly to political engagement), but private sphere behaviors (such as travel mode choice and consumer behavior) are equally, if not more so, important because of their impact on the public: within one's community, nation and beyond.

Existing empirical work in ecological citizenship is confined by the strict Dobsonian definition of the concept, using variables that are relevant mostly to the citizenship studies discourse described earlier. A related limitation in this empirical work is that there is no literature that uses participant-driven conceptualizations and measures of green citizenship, although green citizenship is fundamentally about everyday lived experiences. Dobson states, "All actions in the home have a public impact, in the specific sense of the creation of an ecological footprint…Ecological citizenship is all about everyday living" (Dobson 2003, p. 138).

In addition to how the conceptual definition of ecological citizenship has been measured, the behavioral manifestations of Dobson's ecological citizenship characteristics are similarly limited in empirical research. Many studies adopt a largely economic focus suggesting that the private, "specifically economic, realm of individual lives" (Wolf et al. 2009, p. 515) is one of the chief measures distinguishing ecological from more traditional conceptualizations of citizenship.

4 Methods

Given the predominance of consumer messaging and consumption-oriented environmental behavior research, the present study sought to explore alternate pathways in which environmentally-concerned citizens choose to implement their values through behavior. Additionally, rather than rely solely on the Dobsonian theorization of what it means to be an ecological citizen, this study aimed to collect participant-driven understandings of green citizenship to support the development of future theory and more informed ways of interacting with the public around behavior change.

4.1 Participants

The 43 people who participated in this study were volunteers from a prior brief survey on every day environmental behaviors. Online survey participants were recruited in person at a local sustainability festival in Ann Arbor, MI, as well as through three online listservs populated by individuals working or interested in the fields of environmental science, conservation or environmental psychology, and sustainability science. Of 110 survey participants who initially indicated they would be interested in participating in future research, 58 people agreed to have the study materials mailed to them and 43 people ultimately completed the study. Of the 58 people to whom the study materials were initially mailed, approximately 10% (n = 5) lived internationally, with the majority (n = 53) of participants residing within the United States. The country of origin of the 43 participants who actually completed the study is unknown, however all were English speakers.

4.2 Data Collection/Instruments

All data for this study were collected through the mail, as participants resided across the United States and internationally. Detailed instructions were given to participants to ensure the correct procedures were followed.

4.2.1 Conceptual Content Cognitive Mapping ("3CM")

The data for this study were generated using a technique called the Conceptual Content Cognitive Map ("3CM") and analyzed using hierarchical cluster analysis in R. 3CM (Kaplan and Kearney 1997) is a tool designed to help participants visually communicate their unique understanding of a complex domain. This methodology has been applied broadly across many disciplines: healthcare, urban and regional planning, sustainable resource management, and education, to name a few. (See Guckian et al. 2018 for a more thorough literature review). Using either pre-written or blank cards, participants sort and arrange the cards such that the cards that are physically grouped together are conceptually related and the overall array of groups of cards depicts both the content and structure (Kaplan and Kearney 1997) of one's understanding. A full explanation of the 3CM technique and its function in this study is explored in further detail in Guckian et al. 2018. However, a cursory overview of how this study implemented the 3CM technique will be provided.

The 3CM may either be closed, wherein the researcher provides all of the content written on cards, or open, wherein the participants are given blank cards and are able to write in the content as they see fit. This study employed a hybrid 3CM design by providing the participants with 88 pre-written cards, but allowing participants to also create cards of their own. As always, participants were also permitted to omit cards that did not fit with their conceptualization of the prompt.

The list of 88 words/phrases written on the cards were developed in consult with the literature and through pilot testing and revision based on feedback received from individuals knowledgeable within the fields of environmental sciences, conservation and environmental psychology, and sustainable systems. Ultimately, the cards bridged topic areas covering every day environmental behaviors, motivations, values, attitudes, as well as the key criteria identified as defining ecological citizenship.

4.3 Procedure

4.3.1 The Prompt

The 3CM begins with a series of statements and questions intended to prompt the participant to conjure up their mental model, or unique way of understanding, a particular topic. This research was primarily concerned with how environmentally-minded individuals conceived of green citizenship, and secondarily how this conception relates to that of the green consumer. To answer these two closely related questions, the project used two prompts and randomly assigned participants to different prompt groups.

Participants who received Prompt A (n = 22) were asked to imagine that someone they know was seeking their perspective on the idea of green citizenship. They were asked to consider what things they would be most likely to mention when discussing this issue, how might they differ or be similar to the green consumer, what words or terms they would use, and how they would organize their thoughts. Of note here is the mention of the term green consumer. Although this prompt is primarily concerned with the novel term green citizenship, the likely more familiar term, green consumerism, was used as a way to orient participants' thinking and to assist them in developing a mental model for green citizenship if they had never thought about it before. Other than this one instance, green consumerism did not appear elsewhere in the directions.

Participants who received Prompt B (n = 21) were similarly asked to imagine that someone was seeking their perspective, but on the two issues of green citizenship and green consumerism. In addition to above questions, the prompt also urged participants to compare and contrast these two issues in tandem. Directions throughout the rest of the procedure referred simultaneously to these two concepts in order to reinforce the dual focus of the prompt.

4.3.2 Mapping Conceptual Content

Following the prompt, participants were asked to go through the deck of cards and select cards to convey their understanding of the green citizen (Group A) or the green consumer and then the green citizen (Group B). Any cards that did not fit within the participants' mental model could be discarded. Second, participants were instructed to create new cards by adding any necessary words or phrases onto provided blank cards in order to accurately portray their conceptualization of the prompt. Participants then began sorting the cards into meaningful piles of related cards that explained their understanding of the notion of green citizenship (Group A) or green consumerism and green citizenship (Group B). Once the cards were sorted into groups, participants used separate blank cards to label each category of cards. Finally, participants collected each group into small piles, placed them in individual small envelopes, and then mailed the larger return envelope to the researchers.

5 Results

5.1 Item Selection

Group A (n = 22) selected on average 73 cards from the provided deck and created 4 new cards. Seventeen out of the 22 participants chose to add words, while 19 people omitted cards. Similarly, Group B (n = 21) included an average of 66 cards from the original deck and added 5 cards. Again, 17 out of the 21 participants added new words or phrases to the deck, while all 21 participants eliminated at least one card from the deck. The fact that the majority of participants added and removed cards supports the notion (Kaplan and Kearney 1997) that this exercise helped to reveal the *unique* cognitive map of the participant. Participants did not simply arrange a given set of cards without reflecting on how the content of these cards accurately depicts their mental models.

5.2 Categories and Category Labels

Group A divided their items into a range of 3–11 categories, with an average of 7 categories. Similarly, Group B divided their items into 4–12 categories, averaging 8 categories overall. The slightly larger number of categories among the 3CMs in Group B make intuitive sense, as participants were asked to convey their understanding of two concepts (green consumerism and citizenship) as opposed to just one (citizenship). Figs. 1 and 2 depict the category labels along with the items included within each category and the percentage of participants who used that item.

5.3 Defining Green Citizenship—Using Hierarchical Cluster Analysis

The data collected from the 3CMs were analyzed using hierarchical cluster analysis, which produces a composite tree graph called a dendrogram of all participants' conceptual models. The dendrogram from Prompt A is shown in Fig. 3 as an example.

All 88 items are listed on the left side of the dendrogram. The branches of the dendrogram represent the similarity, or correlation, among how participants grouped the items into meaningful clusters. Hierarchical cluster analysis produces the dendrogram by calculating a similarity matrix, which is populated by the correlations among all the items in the provided word bank. The dendrogram represents how each item is clustered together with the other items, one at a time, in order of the two most similar items (i.e. the two items people most often grouped together), followed by the next most similar item, etc. Thus, the dendrogram portrays a hierarchical structuring of the relationships among the 88 items. According

TRANSACTION

- 86% Support local business
- 95% Buy organic foods
- 95% Buy seasonal products
- 91% Purchase green products
- 95% Buy local products
- 91% Purchase fair trade goods

EFFICIENCY/CONSERVATION

- 95% Use alternative transportation (bike, bus, carpool)
- 91% Reduce personal travel
- 95% Turn off lights
- 91% Unplug appliances
- 100% Avoid waste
- 100% Save water
- 91% Take shorter showers
- 91% Use energy-efficient light bulbs

CURTAILMENT

- 95% Share resources
- 95% Reduce material consumption
- 95% Grow own food
- 95% Compost
- 91% Use reusable mugs
- 95% Use reusable grocery bags
- 95% Recycle
- 82% Less packaging
- 91% Buy used clothes
- 86% Donate old clothes

STATUS QUO BIAS

- 55% Security
- 50% Pride
- 64% Resource availability
- 32% Trust green labels
- 59% Consumption
- 32% Maintain status quo
- 59% Economic growth

CIVIC PARTICIPATION

- 86% Improve your community
- 82% Community support
- 91% Civic engagement
- 91% Community involvement
- 91% Political engagement
- 86% Join environmental organizations
- 95% Donate to environmental causes

PROGRESSIVE ENVIRONMENTALISM

- 91% Conserve natural resources
- 100% Prevent pollution
- 86% Technological innovation
- 73% Carbon taxing
- 68% Product life cycle
- 64% Hybrid cars
- 95% Alternative energy

CONTESTED RADICALISM

- 50% Radical change
- 45% Sacrifice
- 55% Major lifestyle change
- 68% Population management
- 77% Limits to growth

DOMINANT ISSUE FRAMING

- 82% Resiliency
- 77% Adaptation
- 86% Mitigation
- 91% Biodiversity
- 91% Climate change
- 91% Social equity and justice
- 100% Future generations

PERSONAL WELL-BEING

- 77% Personal satisfaction
- 68% Enhance personal growth
- 77% Sense of competence
- 64% Sense of confidence
- 95% Quality of life
- 73% Meaningfulness
- 86% Personal health
- 82% Psychological well-being

DRIVERS AND MOTIVATIONS

- 95% Find new ways to do things
- 100% Adopt new habits
- 91% Being resourceful
- 86% Learn new skills
- 86% Awareness
- 82% Moral obligation
- 91% Environmental concern
- 86% Benefit the environment
- 91% Efficiency
- 95% Personal responsibility
- 82% Public impact of private behaviors
- 95% Consider long-term consequences
- 95% Global awareness

CHARACTER STRENGTHS AND VIRTUES

- 77% Simplicity
- 64% Frugality
- 50% Independence
- 68% Self-reliance
- 64% Patience
- 91% Open to change
- 95% Hopefulness
- 86% Mindfulness
- 91% Connectedness
- 100% Contact with nature

Fig. 1 Cluster analysis solution for Prompt A, N = 22. Numbers reflect percentages of participants who selected that item

to Aldenderfer and Blashfield (1984, p. 36), "At the lowest level, all [88 items] are independent; at the next level, they have been merged into one group and [86] independent cases; finally, at the highest level, they are joined into one large group." Interpretation of the dendrogram is a subjective process wherein the researcher attempts to identify meaningful conceptual separation among the clusters. This is done as part of an iterative process of reviewing the dendrogram and the qualitative data generated by the participants in the form of categories and category labels. Each of the researchers completed their own assessment of the dendrograms and data and then compared their findings to come to a consensus about the conceptual structure of green citizenship revealed in this study.

	TRANSACTION
90%	Purchase green products
90%	Buy organic foods
86%	Support local businesses
86%	Purchase fair trade goods
81%	Buy local products
81%	Buy seasonal products
76%	Buy used clothing
90	Less packaging
81%	Reduce personal travel
76%	Hybrid cars
100%	Use energy-efficient light bulbs

	CURTAILMENT
95%	Compost
86%	Grow own food
81%	Donate old clothes
100%	Recycle
95	Use reusable grocery bags
95%	Use reusable mugs
100%	Save water
95%	Take shorter showers
100%	Use alternative transportation (bike, bus, carpool)
95%	Turn off lights
95%	Unplug appliances

	PROGRESSIVE ENVIRONMENTALISM + STATUS QUO BIAS
81%	Efficiency
48%	Maintain status quo
67%	Consumption
57%	Economic growth
81%	Product life cycle
57%	Trust green labels
100%	Alternative energy
90%	Technological innovation
81%	Carbon taxing

	CIVIC PARTICIPATION
81%	Join environmental organizations
86%	Donate to environmental causes
95%	Civic engagement
100%	Political engagement
81%	Improve your community
67%	Community support
100%	Community involvement

	NECESSARY CITIZEN ACTIONS
86%	Find new ways to do things
71%	Adopt new habits
90%	Share resources
86%	Prevent pollution
95%	Reduce material consumption
100%	Avoid waste

	CONTESTED RADICALISM + DOMINANT ISSUE FRAMING
33%	Sacrifice
48%	Major lifestyle change
52%	Radical change
62%	Limits to growth
52%	Resource availability
57%	Population management
76%	Contact with nature
90%	Biodiversity
86%	Climate change
71%	Adaptation
76%	Mitigation
81%	Resiliency
57%	Security

	PERSONAL WELL-BEING
86%	Personal health
33%	Enhance personal growth
62%	Psychological well-being
57%	Personal satisfaction
43%	Learn new skills
38%	Sense of competence
24%	Sense of confidence
86%	Being resourceful
38%	Pride
62%	Frugality
90%	Quality of life
71%	Simplicity
43%	Independence
57%	Self-reliance

	CHARACTER STRENGTHS AND VIRTUES
76%	Awareness
67%	Mindfulness
43%	Patience
76%	Open to change
43%	Meaningfulness
57%	Hopefulness

	DRIVERS AND MOTIVATIONS
90%	Conserve natural resources
86%	Benefit the environment
76%	Environmental concern
76%	Connectedness
81%	Global awareness
62%	Public impact of private behaviors
86%	Consider long-term consequences
71%	Moral obligation
71%	Personal responsibility
95%	Social equity and justice
100%	Future generations

Fig. 2 Cluster analysis solution for Prompt B, N = 21. Numbers reflect percentages of participants who selected that item

5.3.1 Green Consumerism and Other Aspects of Green Citizenship

The overall structure of the dendrograms produced by analyzing both the green citizen and green citizen/consumer prompts revealed a strong consumer-citizen dyad embedded in how people conceptualize green citizenship.

5.3.2 Green Consumer Realms of Action

The overall *Consumer* cluster was the most homogenous in terms of how frequently the items within this cluster were endorsed by participants (all above 80%), suggesting the notion of what it means to be a consumer is more universally understood among participants. This is consistent given the novel nature of the concept of green

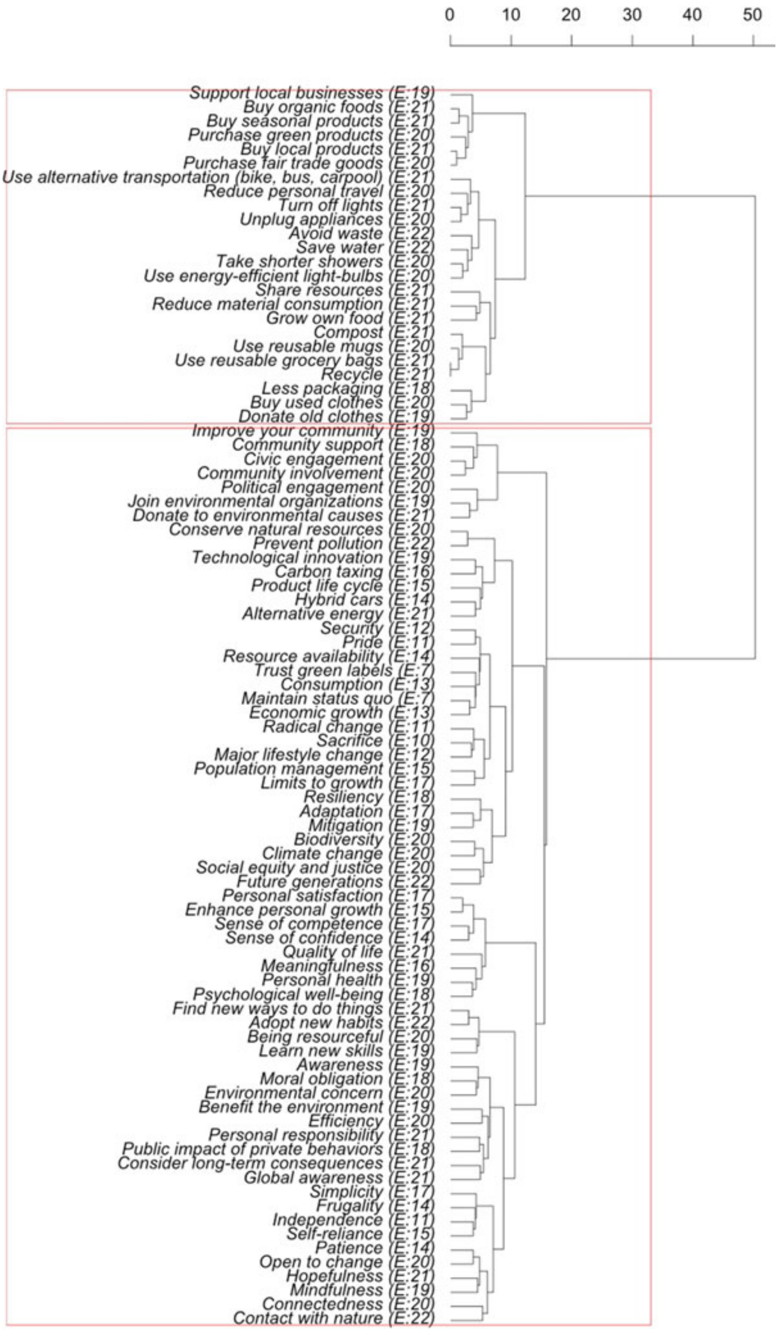


Fig. 3 Dendrogram analysis from Prompt A, N = 22

citizenship and the prevalence of green consumerism as a viable environmental role in our society. The overall *Consumer* cluster contains three distinct sub-clusters: *Transaction*, *Efficiency/Conservation*, and *Curtailment*.

Transaction

The *Transaction* consumer sub-cluster emerged for both groups A and B. This cluster consists of items that indicate the exchange of purchasing a conventional product for one that is more sustainable. Items in this cluster include "buying organic foods," "buying seasonal or local foods," "buying green products," etc. These actions are perhaps facilitated by the prevalence of the green consumer industry itself as the increased availability and accessibility of product labeling makes transactional behaviors easier to adopt at the point of purchase without additional changes to behavior patterns.

Efficiency/Conservation

Efficiency/Conservation emerged as a distinct sub-cluster in group A only. The items in this cluster relate to conserving natural resources and reducing emissions. Participants endorsed "avoiding waste" (100%) and "saving water" (100%), as well as "turning off the lights" (95%) and "using alternative transportation" (95%) most frequently in this cluster, suggesting these are salient themes in how we think about greening our consumption. Participants in group B endorsed these items at near equal levels (see Fig. 2), although the items were organized into the sub-clusters of *Transaction* and *Curtailment.*

Curtailment

Curtailment emerged as an interesting transitional sub-cluster between the larger clusters of *Green Consumer* and *Green Citizen. Curtailment* includes actions that allow participants to bypass participating in conventional product consumption and waste cycles in a variety of ways. The common items across groups A and B include "growing one's own food," "composting," "using reusable mugs and grocery bags," and "recycling," and "donating old clothing." Participants in group A also identified "sharing resources," "reducing material consumption," and "less packaging" as relevant items in this cluster.

5.3.3 Other Aspects of Green Citizenship

In addition to the *Green Consumer*, participants' conceptualization of green citizenship includes a larger, more complex cluster of the *Green Citizen,* which can be broken into about 7 sub-clusters including: *Civic Participation; Necessary citizen actions; Personal well-being; Character strengths and virtues; Drivers and motivations, Progressive environmentalism and status quo bias; and Contested radicalism and dominant issue framing.*

Civic Participation

Civic Participation emerged as a strong identical cluster for both groups A and B. The actions included in this cluster highlight a distinctly different means of being "green" than through green consumerism. Participants identified the importance of a green citizen who is involved in and works to "improve her community," who is "politically engaged," and who "joins environmental organizations." The only economic-based item involves "donating to environmental causes," which is a frequently used behavior in empirical studies on ecological citizenship (Jagers 2009; Jagers et al. 2013). In a qualitative analysis of all the items added to the 3CMs by participants, some of the most frequently added items also relate to the *Civic Participation* cluster: the importance of democracy, collaboration, as well as community health and working to fight corruption.

Necessary Citizen Actions

Necessary citizen actions is a small cluster that emerged only in the group B 3CMs. "Sharing material resources," "reducing consumption," and "avoiding waste" were items that were included among the group A *Consumer* sub-clusters, but in response to being prompted about both green consumerism and citizenship, group B participants shifted these items over to *Green Citizenship* and identified them through their category labels as essential, normative behaviors that green citizens should adopt.

Personal Well-Being: A Precursor and a Benefit

The *Personal well-being* sub-cluster of *Green Citizenship* emerged in the data from both groups A and B. Including items like "personal health," "psychological well-being," "enhanced personal growth," and "quality of life," participants labeled this group of items in two distinct ways. Participants identified these items predominantly as benefits of green citizenship, referring to the positive outcomes from being a green citizen. Participants also label these items as supporting green citizenship, describing them as "foundations of environmental citizenship." Additional items indicating how personal well-being is a precursor to green citizenship were articulated in the items participants added, including sleep, love, self-trust, and restoration.

Character Strengths and Virtues

The *Character strengths and virtues* sub-cluster also emerged across both groups A and B. Participants described this cluster as factors that facilitate green citizenship; one participant stated that green citizenship "requires this of me internally." Most highly endorsed within groups and in common across groups were "mindfulness" and "openness to change". Both groups also identified "hopefulness" as an attribute that supports green citizenship.

Drivers and Motivations

Drivers and motivations include many items that induce green citizens to take action. Participants included a wide range of motivations within this cluster including items related to care for the environment ("environmental concern," "benefit the environment," "conserve natural resources"); social orientation concerns ("connectedness," "global" "awareness," "social equity and justice," "future generations"); and personal motivations ("adopting new habits," "being resourceful," and "learning new skills").

Progressive Environmentalism and Status Quo Bias

Progressive environmentalism and *status quo bias* are two clusters that appeared independently in group A but conjoined in group B. *Progressive environmentalism* in group A uniformly consisted of what can be considered policies or high-level responses to climate change and energy descent, like "carbon taxing." This cluster offers green-tech solutions including "technological innovation," "hybrid cars," and "alternative energy." In group B, *Progressive environmentalism* subsumes the *status quo bias* cluster, including "trusting green labels," "maintaining the status quo," "consumption," and "economic growth."

The *status quo bias* cluster was one of the most contentious clusters created in thinking about green citizenship. Not only did it contain three out of seven of the least endorsed (</=50%) items in group A and two out of the ten in group B, but participants who included the items used them both positively and negatively. "Trusting green labels" (32%) is an example of one item that was used both ways, indicating on one hand the utility of green labels to aid in sustainable decision making and on the other, a recognition that behaviors that can be decided by green labels are an insufficient response. "Pride" was also lowly endorsed (50%), but when used, reflected positive associations with being proud of one's actions as a green citizen. Lastly, "maintaining the status quo" (50%), along with "economic growth" (59%) were both used unanimously negatively. Although roughly half of participants included these terms in their map of green citizenship, they all grouped them under negative labels, like "overemphasized in modern society," "error in our ways," "green citizen is not," and one particularly passionate label including an expletive. The contentious nature of these clusters suggests current approaches in progressive environmentalism are conceptually bound by assumptions of economic growth and clinging to the status quo, which participants find ill-suited to the spirit of green citizenship.

Contested Radicalism and Dominant Issue Framing

Dominant issue framing and *contested radicalism* share a similar relationship as between *Progressive environmentalism* and *status quo bias.* In group A, *dominant issue framing* contains the most prevalent vocabulary surrounding environmental issues today. All highly endorsed items, the items in this cluster reflect the broad scale goals with which green citizens might be concerned, including "resiliency," "adaptation," "mitigation," "biodiversity," and "social equity and justice." In group B, *dominant issue framing* subsumes *contested radicalism*, which is an independent cluster in group A.

Contested radicalism, similar to *status quo bias*, is fraught with tension. Items are among the lower endorsed items of the group and when included, participants use them both positively and negatively to describe attributes of green citizenship. The items "radical change" and "major lifestyle change" were both endorsed by approximately 50% of the participants. "Sacrifice" was the least endorsed item included in this cluster at between 33–45% endorsement. Together, these three items reflect a disconnect between how a green citizen perceives their lifestyle and how they assume the public perceives them from the outside. Namely, participants identified that people generally think that being a green citizen would necessitate radically changing one's life and sacrificing many comforts to which one has grown accustomed. Participants indicate these assumptions are likely negative frames of green citizenship that likely discourage people from changing their behavior. From the insider perspective, green citizens may accept that they have made significant changes in their lives, but they do not embrace the negative connotation conveyed through "radical change" and "sacrifice." The fact that *contested radicalism* converges with *dominant issue framing* in group B suggests two insights: (1) participants recognize, on one hand, that responding well to the charges of resiliency, adaptation and mitigation will likely involve major lifestyle change and sacrifice, but (2) these lifestyle changes have thus far not felt as radical as one might have predicted.

6 Discussion

6.1 Broad Spectrum of Green Citizenship Behaviors

Participants in this study outlined a rich map of behaviors, motivations, benefits, and assumptions that are associated with their conception of what it means to be a green citizen. Above all, the results of this study suggest that green consumerism, while familiar and well-defined (Dobson 2003), is perhaps outdated as the only means to being "green". However, the path to citizenship beyond green consumerism is less defined. Clear actions are specified through *Civic participation*, but the other *Green Citizen* clusters identify fewer concrete actions and more about the character of the green citizen. The picture of green citizenship painted by participants embraces a spirit of openness to respond to the demands of the situation rather than seeking to occupy a static course. The green citizen seeks opportunities to learn new skills, to be resourceful, to live simply and frugally. The green citizen derives satisfaction from these opportunities, enjoying a sense of competence, personal growth and quality of life that are otherwise not associated with green consumerism alone. This broader understanding of green citizenship provides fruitful areas in which to study how to foster pro-environmental behavior. Rather than focusing on the behavioral outcome, environmental psychology might shift focus to creating the conditions in which people will be open to respond to change and to embrace lifestyle changes as opportunities for learning, skill-building, and satisfaction (Kaplan and Kaplan 2008).

6.2 Implications for Issue Framing

Dobson's ecological citizen (Dobson 2003) was motivated almost exclusively by altruistic or pro-social motives, including accepting personal responsibility for the environmental and social impacts of one's actions, recognizing that personal behaviors have public ramifications, and the moral obligation born out of one's interconnectedness with people around the world. While participants in this study did support these altruistic motives, they also identified motives and values characterized as biospheric (environmentally-motivated) and egoistic (self-interested). Together with altruism, these three value-orientations reflect a range of concerns which might motivate a green citizen to act. Stern (2000) articulates these three values in the Value-Belief-Norm model, which suggests that environmentally significant behavior may result from the starting point of any of the three value-orientations. Green citizens may be motivated by saving the environment, helping others, benefits to the self or some combination of the three. Thus, in thinking about supporting green citizenship, behavioral interventions and environmental messaging would benefit from using multiple value frames to appeal to the public.

6.3 Self-Interest and Sacrifice

This study revealed a tension between recognizing the insufficiency of pursuing the status quo (progressive environmentalism, green tech solutions, and assumptions of perpetual economic growth) with a hesitation to don the burden of sacrifice. Yet when including "sacrifice" and "major lifestyle change" among the characteristics of green citizenship, participants highlighted how the reality of living in this way did not match the negative connotation of sacrifice. In a qualitative analysis of participants' self-generated category titles, participants grouped "sacrifice" and "major lifestyle change" under categories often named, "misconceptions about green living," "what green citizenship is not," and "barriers to adopting new behaviors."

Empirical research investigating the motivation and satisfaction associated with pro-environmental behavior defies prominent consumer messages urging the public to purchase their happiness and meaning. Rather, as mentioned earlier, committed volunteers in environmental organizations report being motivated by the opportunity to learn something new and to do something meaningful and other research has found that people are intrinsically satisfied by situations that allow them to use their skills, to be frugal, and to participate (De Young 1996; Grese et al. 2000). In defining green citizenship, participants clearly articulated these benefits as solely belonging to the sphere of green citizenship, rather than green consumerism.

These benefits to self or aspects of personal well-being, while highly endorsed among group A, were among the lowest endorsed items in group B. Six out of ten items less than or equal to 50% endorsement belonged to the *personal well-being cluster* in group B. Even among environmentally-minded individuals, benefits to the self in the context of thinking about the environment may be hard to expect. Participants found it challenging to reconcile the mental image of life as a green citizen being pleasurable when juxtaposed against life in our consumer-oriented society—often the loudest, most colorful messages we receive speak to the contrary.

Behavior change interventions would likely benefit from steering away from messages involving sacrifice, as it is both alienating to those starting new behaviors and not a concept that accurately reflects the experience of green citizens. Rather, self-interest may be useful as a frame to highlight the many benefits from engaging in green citizenship.

7 Strengths and Limitations

The most significant strength of this study is that it allows for a broader understanding of the nature of green citizenship, as conceptualized by environmentally-minded individuals. Current theoretical and empirical research in the field of ecological citizenship (by Dobson and others) has produced a relatively narrow picture of the values and behaviors that define this concept. Specifically, empirical studies of ecological citizenship operationalize the concept exclusively through an economic and consumeristic lens. This study asks participants to think beyond these familiar frames to define green citizenship from a novel perspective: the everyday lived experience of people as they negotiate desires for certain patterns of living with the challenges of a changing climate.

The exploratory nature of this study resulted in a very large bank of terms (88) that participants were given at the start of the study. Prior research using 3CMs has suggested using around 30–50 cards to minimize the mental load for participants as they sort and categorize the concepts (Kaplan and Kearney 1997). While the 88 cards used in this study were carefully curated through pilot studies, the number was perhaps too large for participants to effectively use. In a small number of 3CMs, participants eliminated cards only to duplicate the card when creating their own. It is possible that reducing the number of cards in the original deck would both ease the cognitive load of performing the task and reveal clearer patterns of words added/removed.

The use of two prompts with two randomly assigned sample groups was experimental. While the principle goal of this research was to explore the definition of green citizenship, a secondary goal was to see how and if this concept related to green consumerism. The hierarchical cluster analyses produced from the 3CMs participants created in response to the two prompts were very similar, prompting the question of whether green consumerism is actually viewed as being inextricably embedded within green citizenship, or whether the two prompts were too similar to prompt any qualitatively significant differences in the 3CMs. As stated earlier, Prompt A, the green citizen prompt, made one reference to green consumerism in order to orient the participant to an unfamiliar topic. However, this inclusion of green consumerism in the prompt may have been enough to shift the mental map to convey *both* green consumerism and green citizenship. Future studies should consider prompting participants with entirely different prompts, making no mention of topics other than the single concept being studied. A possible research design might include using three sample groups in which each group will focus on *only* the green citizen, *only* the green consumer, or the relationship between these concepts.

Lastly, the 3CM methodology would benefit from additional qualitative methods in the form of follow-up interviews with participants. As the 3CM prompt only asks a single question, the interview could be used to probe for additional information, seeking both reasoning and clarification that would otherwise be unavailable to researchers. In this study, the meaning of participants' choices was often inferred by examining the qualitative data of category labels, however, more information could be gained and the study would be strengthened by interviewing participants directly.

8 Conclusions and Implications

The results of this study point to a conceptualization of green citizenship that broadens the economic focus of empirical studies on ecological citizenship. Further, in the popular realm of people's everyday lived experience, this study suggests that individuals identify alternate paths of engaging with environmental concern that are not limited to the behavioral roles defined by green consumerism. Finally, this study supports the value of integrating questions of sustainability with the social sciences. The multiple perspectives gained in this study revealed a unified picture of people as problem-solvers and citizens, indicating a readiness to move beyond the one-size fits all environmental solution of green consumerism.

References

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology, 25*(3), 273–291. doi:10.1016/j.jenvp.2005.08.002.

Affluenza. (2017). Retrieved February 6, 2017, from https://www.merriam-webster.com/dictionary/affluenza.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50,* 179–211.

Aldenderfer, M. S., & Blashfield, R. K. (1984). Cluster analysis. In *Quantitative applications in the social sciences*. Beverly Hills, CA: Sage Publications. http://doi.org/http://dx.doi.org.proxy.lib.umich.edu/10.4135/9781412983648.n3.

Anderson, M. (2016). For Earth Day, here's how Americans view environmental issues. Retrieved September 30, 2016, from http://www.pewresearch.org/fact-tank/2016/04/22/for-earth-day-heres-how-americans-view-environmental-issues/.

Bamberg, S., & Schmidt, P. (2003). Incentives, morality, or habit?: Predicting students' car use for university routes with the models of Ajzen, Schwartz, and Triandis. *Environment Behavior, 35* (2), 264–285. doi:10.1177/0013916502250134.

Dean, H. (2001). Green citizenship. *Social Policy & Administration, 35*(5), 490–505. doi:10.1111/1467-9515.t01-1-00249.

De Young, R. (1996). Some psychological aspects of a reduced consumption lifestyle: The role of intrinsic satisfaction and competence. *Environment and Behavior, 28*(3), 358–409.

De Young, R. (2000). Expanding and evaluating motives for environmentally responsible behavior. *Journal of Social Issues, 56*(3), 509–526.

Dietz, T., Gardner, G. T., Gilligan, J., Stern, P. C., & Vandenbergh, M. P. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Sciences of the United States of America*, *106*(44), 18452–18456. http://doi.org/10.1073/pnas.0908738106.

Dobson, A. (2003). *Citizenship and the environment*. New York, NY: Oxford University Press.

Fredrickson, B. L., Grewen, K. M., Coffey, K. A., Algoe, S. B., Firestine, A. M., Arevalo, J. M. G., …& Cole, S. W. (2013). A functional genomic perspective on human well-being. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(33), 13684–13689. http://doi.org/10.1073/pnas.1305419110.

Grese, R. E., Kaplan, R., Ryan, R. L., & Buxton, J. (2000). Psychological benefits of volunteering in stewardship programs. In P. H. Gobster & R. B. Hull (Eds.), *Restoring nature: Perspectives from the social sciences and humanities* (pp. 265–280). Washington, DC; Covelo, CA: Island Press.

Guckian, M., Hamilton, E. M., & De Young, R. (2018). Cognitive Mapping as Participatory Engagement in Social Science Research on Sustainability. In W. Leal, J. Callewaert, & R. W. Marans (Eds.), *Handbook of Sustainability and Social Science Research*. Springer.

Jagers, S. C. (2009). In search of the ecological citizen. *Environmental Politics, 18*(1), 18–36. doi:10.1080/09644010802624751.

Jagers, S. C., Martinsson, J., & Matti, S. (2013). Ecological citizenship: A driver of pro-environmental behaviour? *Environmental Politics, 23*(3), 434–453. doi:10.1080/09644016.2013.835202.

Joshi, Y., & Rahman, Z. (2015). *Factors Affecting Green Purchase Behaviour and Future Research Directions*. *International Strategic Management Review* (Vol. 3). Holy Spirit University of Kaslik. http://doi.org/10.1016/j.ism.2015.04.001.

Kaplan, S., & Kearney, A. R. (1997). Toward a methodology for the measurement of knowledge structures of ordinary people: the conceptual content cognitive map (3CM). *Environment and Behavior, 29*(5), 579–617.

Kaplan, R., & Kaplan, S. (2008). Bringing out the best in people: A psychological perspective. *Conservation Biology: The Journal of the Society for Conservation Biology, 22*(4), 826–829. doi:10.1111/j.1523-1739.2008.01010.x.

Kaplan, S., & Kaplan, R. (2009). Creating a larger role for environmental psychology: The reasonable person model as an integrative framework. *Journal of Environmental Psychology, 29*(3), 329–339. doi:10.1016/j.jenvp.2008.10.005.

Meadows, D. H., Randers, J., & Meadows, D. L. (2004). *Limits to growth*. White River Junction, VT: Chelsea Green Publishing.

Ryan, R. L., & Grese, R. E. (2005). Urban Volunteers and the Environment: Forest and Prairie Restoration. In P. F. Bartlett (Ed.), *Urban place: Reconneting with the natural world* (pp. 173–188). Cambridge, MA; London, England: The MIT Press.

Ryan, R. L., Kaplan, R., & Grese, R. E. (2001). Predicting volunteer commitment in environmental stewardship programmes. *Journal of Environmental Planning and Management, 44*(5), 629–648.

Sheldon, K. M., Nichols, C. P., & Kasser, T. (2011). Americans Recommend Smaller Ecological Footprints When Reminded of Intrinsic American Values of Self-Expression, Family, and Generosity. *Ecopsychology, 3*(2), 97–104. doi:10.1089/eco.2010.0078.

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues, 56*(3), 407–424.

U.S. Environmental Protection Agency. U.S. Department of Energy. (2017). Global greenhouse gas emissions data. Retrieved from https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data#Country.

Walker, L. (2013). Green product growth outpaced others during recession. Retrieved September 30, 2016, from http://www.environmentalleader.com/2013/06/11/green-product-growth-outpaced-others-during-recession/.

Wolf, J., Brown, K., & Conway, D. (2009). Ecological citizenship and climate change: Perceptions and practice. *Environmental Politics, 18*(4), 503–521. doi:10.1080/09644010903007377.

Part III
Methods and Evaluation Strategies

Cognitive Mapping as Participatory Engagement in Social Science Research on Sustainability

Meaghan L. Guckian, Erin Miller Hamilton and Raymond De Young

Abstract

What does it mean to be a green citizen? To date, discussion of green citizenship has been heavily rooted in theory, drawing largely from political and consumer studies. The scant empirical evidence exploring the behavioral components of this concept has overwhelmingly focused on individuals' identification as "green" via their role as consumers. However, little empirical research exists exploring *participant-driven* understandings of what it means to be a green citizen and how this role relates to and expands upon that of the green consumer. This study seeks to resolve these gaps by expanding the definition of green citizenship through a participatory process called the Conceptual Content Cognitive Mapping exercise (3CM). Through this modified card-sorting task, participants are able to visually communicate their lived understandings of green citizenship by arranging and categorizing labeled cards into networks of meaning that reflect their personal understandings of this abstract concept. This chapter will focus on the 3CM exercise as a fruitful methodology to promote participant engagement in social science research on sustainability in general, and green citizenship in particular.

M.L. Guckian (✉)
Department of Environmental Conservation, University of Massachusetts, 160 Holdsworth Way, Amherst, MA 01003, USA
e-mail: mguckian@umass.edu

E.M. Hamilton · R. De Young
School for Environment and Sustainability, University of Michigan, 440 Church Street, Ann Arbor, MI 48109, USA
e-mail: emham@umich.edu

R. De Young
e-mail: rdeyoung@umich.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*, World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_19

Keywords
Conceptual content cognitive map (3CM)

1 Introduction

> Each of us owns a great treasure that far surpasses any technological wonder on the market. Our treasure is a storehouse of an enormous amount of information. It gives us access to our past and even enables us to conjure up the future. It can reveal things we had not realized were available. It can also provide indications of whether the information is positive or negative, reassuring or threatening…it is our brain, the home of our mental models.
>
> (Kaplan, 2015, p.26)

The world is constantly changing. Physically, glaciers are giving way to rising temperatures as new infrastructures are erected across our landscapes. Culturally, the speed with which we are constantly exposed to new ideas, technologies, and norms uniquely reshapes our social and conceptual environments. These changes have provided society, researchers, and practitioners with new questions to address and solutions to discover all while managing for increasingly diverse stakeholder perspectives, beliefs, and values. While recognizing the gravity and immediacy these issues present, we often overlook some of the simplest though most profoundly informative questions that should be asked and of whom.

How do tribal communities conceptualize the co-management of natural resources? How do new homeowners think about energy efficiency and curtailment behaviors within their home? How do people understand adaptation and mitigation policies? Addressing theses types of questions can provide a unique lens of how individuals' experience and understand social-ecological change, shed light on avenues for behavior change implementations, create trust between experts and non-experts, and offer more effective solutions to address climate change. Thus, attempts to answer these questions should not rest solely on the foundations of theoretical conjecture, but perhaps, leverage an underutilized methodology that taps into peoples' mental models while concurrently facilitating greater ownership, understanding, and exploration of the environmental challenges society faces.

The notion that people rely on 'mental models' (e.g., the theorized mechanisms that house our knowledge structures) to interpret and store information has long been accepted and studied in the field of cognitive psychology (for review see Jones et al. 2011). Not only do these structures store information, but they also influence individuals' perception, decision-making, and behavior. Despite, a common theme when addressing environmental problems has been the failure to acknowledge and understand others' mental models with regard to particular issues and places (Kearney and Kaplan 1997). These perspectives are critical and ignoring individuals' knowledge and personal experiences can have negative effects on both the relationship between experts and the public, and the quality of information obtained in social science research.

Eliciting and understanding others' mental models would aid not only in understanding how people perceive and respond to problems, but more importantly, how to effectively share information, improve collaboration, and design strategies for changing behavior (Kearney 2015). In recognizing this need for greater transparency, Kearney and Kaplan (1997) developed a tool for externalizing and measuring individuals' mental models called Conceptual Content Cognitive Mapping (3CM). In effect, Kearney and Kaplan (1997) provide a necessary framework and tool for capturing the plurality of perspectives that people possess and use to interpret and respond to the world around them.

This paper focuses on the 3CM exercise as a fruitful methodology to promote participant engagement in social science research on sustainability in general, and green citizenship in particular. First, an overview of literature on mental models as a cognitive theory for how people interpret and store information about the world around them is provided. The utility and appropriateness of 3CM is then described as a methodological tool. Finally, an example of the 3CM process is detailed while highlighting a research project, which sought to address how individuals perceive and experience the notion of 'green citizenship'. For full study analysis and discussion of the green citizenship study, please see Hamilton et al. (2017), which is concurrently featured in this book (chapter 18).

1.1 The Environment and Mental Models

In response to the dual challenges presented by climate change and declining natural resource availability, many scholars and practitioners have refocused on how individuals differentially experience and address these issues. These efforts are evident in the emergence and emphasis on knowledge co-production (Jasonoff 2004), the collaborative management of natural resources (Carlsson and Berkes 2005), and universities' commitment to interdisciplinary collaboration. What these approaches commonly underscore is the need to attend to, understand, and integrate diverse perspectives, expertise, and experiences in order to effectively address the complexity of society's environmental dilemmas. Yet, the process of overcoming personal biases in order to recognize, understand, and integrate others' perspectives and expertise is inherently difficult.

To date, attempts to better understand individuals' attitudes, beliefs, and values with regard to social-ecological issues have relied on traditional social science research methods including focus groups, surveys, and interviews. Surely, these methods provide a window into these issues, yet they fail to address and detail more in-depth insights on how people understand and have experienced them. The study of mental models and 3CM offers a unique framework for understanding the often-overlooked notion of starting 'where people are at' (Kaplan and Kearney 1997; Kearney 2015). This is important, as social science researchers are increasingly being tasked with generating effective communication, implementing behavior change programs, and generally serving as the conduit between the hard sciences and diverse public audiences.

Over the past decade, for example, emerging ideas and concepts like sustainability (Brundtland 1987), green consumption (Gilg et al. 2005), voluntary simplicity (Elgin 1993), and ecological citizenship (Dobson 2003) have contributed to the discourse on alternative lifestyle patterns that entail consuming. Despite the necessary lens that these terms provide in redefining society's relationship with nature, consumption, and future generations, it is unclear how these theoretically derived ideas are understood and lived by the very people they are meant to direct.

Realizing the potential of understanding others' lived experiences relies on a methodology that can effectively externalize individuals' mental models. The utility and applicability of 3CM in sustainability initiatives, natural resource management, and conservation is vast. To uncover individuals' understanding and lived experiences, a participant-driven 3CM was employed to tap into individuals underlying knowledge structures of what it means to be a green citizen.

2 Mental Models Defined

Kenneth Craik (1943) first suggested that individuals formulate 'small-scale models' of external reality that enables them to interact with the world. For instance, people may possess mental models of physical spaces like their place of business, New York City or even a baseball diamond. We also carry with us mental models of concepts or processes like sustainability, photosynthesis, democracy, and social justice. Mental models have further been conceived as the cognitive mechanisms responsible for recognizing patterns, making predictions, evaluating situations, and taking necessary action (Johnson-Laird 1983; Kaplan 1973). Mental models also provide a framework for responding to new information, situations, and/or problems (Kaplan and Kaplan 1982). More simply, mental models form the basis of human perception, decision-making, and behavior (for review see Jones et al. 2011).

Provided that mental models are built through experience throughout an individual's life, the capacity and richness of an individual's mental model about a given topic is limited to personal experience. For this reason, mental models are described not as a small-scale model of reality, but rather as an incomplete representation of one's *experienced* reality. Yet, what might be construed as a limitation of mental models is also the benefit; mental models speak to the multitude of perspectives and knowledge held by different audiences. Recognizing how mental models are uniquely constructed from person to person sheds light on the myriad levels of expertise, familiarity, and perspectives that exist. Thus, studying mental models can be of great value to researchers or practitioners interested in such issues as the co-management of resources, effective communication, and design (Kearney 2015).

Kearney (2015) suggests multiple benefits derive from acknowledging and understanding others' perspectives: (1) better understanding of *one's own way of thinking*. Above all, mental model research helps researchers and practitioners facilitate a greater understanding of diverse stakeholder perspectives and acknowledging their own personal biases. (2) *Encouraging greater participation and engagement*. By actively taking the time to engage stakeholders in the process, not only can facilitators identify contested areas, but the process itself also encourages collaboration and trust. (3) *Facilitating more effective communication*. Providing and receiving information effectively is aided by collective understanding. Effective communication is an iterative process of discovery and delivery, in which new information is communicated to build upon understood existing knowledge. (4) *Creating better designs for people*. Whether building new infrastructures or designing behavior change campaigns, understanding peoples' needs and expectations is critical to successful implementation. Realizing these potential benefits, thus, relies on appropriate methods and tools that can effectively externalize individuals' mental models.

3 Conceptual Content Cognitive Mapping (3CM)

The goal of 'starting where people are at' or knowing your audience has resonated with communicators and educators in the environmental domain in an attempt to increase transparency and understanding of diverse stakeholders (Basu and Kaplan 2015; Kearney 2015). To that end, 3CM strives to measure and capture what is already in peoples' heads, not necessarily what is absent. Kearney and Kaplan (1997) note that this is an important distinction when compared to previous literature and discourse in the environmental domain that either sought to address and exploit gaps in individuals' knowledge or that dismissed or devalued local knowledge all together (Kollmuss and Agyeman 2002).

Kearney and Kaplan (1997) first developed the participant-driven technique that blends qualitative and quantitative methods to assist individuals in externalizing their mental model of a topic or domain. 3CM builds on methods in 'wayfinding' and city planning research (Lynch 1960), as well as card-sorting techniques employed in user experience designs for web site navigation (Hudson 2005). Instead of detailing physical spaces like the Grand Canyon, 3CM asks individuals to draw and organize their mental models of conceptual topics such as 'sustainability'.

3.1 Overview of 3CM Process

The 3CM procedure involves multiple steps. On the most basic level, an individual selects concepts that relate to their understanding of a particular topic or domain (e.g., knowledge content) and then organizes how those concepts 'hang together' (e.g., knowledge structure) in their mind (See Fig. 1; Kearney 2015). Although the content of participants' models may not differ, how individuals' differentially organize or structure their knowledge can be the most revealing. The result of the 3CM exercise is a visual display or representation of one's mental model that includes various groups of meaningful and interrelated concepts unique to the individual's lived understanding of the topic. In a structured 3CM (detailed below), individual maps can be combined to form an aggregated map to visualize how a group conceives a particular topic.

3CM has been employed to investigate a range of topics including coping with cancer (Lehto 2004), perceptions of rural character (Tilt et al. 2007), forest management (Kearney et al. 1995), carpooling (Kearney 1993), sustainable development (Byrch et al. 2007) and wild and scenic river designation (Amtmann 1996). Scheuer (2007) used a 3CM to examine how knowledge structures among otherwise comparable individuals (e.g., builders) varied with gains in professional experience.

Basic 3CM procedure:

1. "Activate mental model through a specific scenario along with additional prompts.
2. Participant identifies important factors or concepts that they perceive relevant to the topic. Concepts are self-generated (open-ended 3CM) or selected from a provided list (structured 3CM).
3. Each concept or factor is written on a separate card (or provided).
4. Participant groups cards into categories according to what goes together in their mind.
5. Participant labels each category, indicating why they grouped those concepts together.
6. Optional: Participant can rate their cards based on importance OR indicate the cards as negative or positive."

Adapted from Kearney (2015)

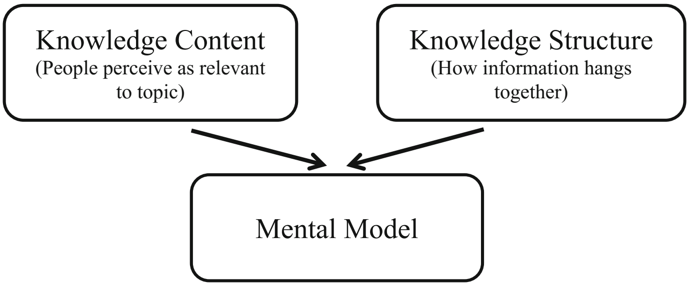


Fig. 1 Components of the Conceptual Content Cognitive Map (3CM) method. Adapted from Kearney (2015)

Constructing an appropriate scenario that accurately targets the mental model of interest is essential. As Kearney (2015, p.278) details, "you want to place people in a particular mental space and have them tell you the 'things' that occupy that space," while assuring participants that you are only interested in their unique view of the issue and further, that there is no correct or incorrect way of responding. To help avoid the use of jargon, a common approach is to use an '*imagine if…'* scenario, and ask participants to describe their understanding of the topic '*as if'* they were speaking to someone who was completely unfamiliar with the topic like a friend or acquaintance (Kearney 2015). To support the initial scenario, Kearney (2015) suggests asking three to five prompting questions that address the topic in a slightly different manor.

3.2 Structured Versus Open-Ended 3CM

The exercise can be administered either as an open-ended or structured 3CM. In the open-ended 3CM, participants are asked to generate their own list of concepts or factors that are relevant to their understanding of the topic or domain (Kearney and Kaplan 1997). An important aspect to consider for the open-ended approach is to have participants focus on single characteristics, elements, or factors (Kearney 2015). Thus, Kearney (2015) suggests framing the scenario in terms of 'things' to help avoid the use of long descriptions. Open-ended 3CMs can be effective when dealing with small sample sizes or in the case of exploratory studies where little is known about the subject (Kearney 2015; Kearney and Kaplan 1997).

The structured 3CM approach is recommended for use with larger groups, when more robust statistical analysis is desired, (e.g., hierarchical cluster analysis), or if a timelier process is needed (Kearney 2015). For the structured approach, facilitators provide participants with an established list of concepts from which participants are then able to freely select. These lists can be compiled from pilot tests of open-ended 3CMs, interviews, focus groups, surveys, or existing literature (Kearney and Kaplan 1997; Kearney 2015). Creating an appropriate and representative list can be challenging. To limit potential researcher biases, piloting concept lists is strongly recommended (Kearney 2015). Importantly, participants should explicitly be informed that not all concepts have to be used. The goal is for participants to construct their own uniquely experienced mental model, rather than what the researchers posit it should entail. To keep the task reasonable and in order to reduce cognitive demand, Kaplan and Kearney (1997) suggest generating a list with roughly 30–50 concepts.

The 3CM exercise is flexible to researchers' needs. A hybrid approach allows participants to both select concepts from a structured list in addition to adding any concepts they felt were missing, yet still relevant to their understanding. 3CM can also be administered as a pre- and post-test. Wells (2005) employed the first longitudinal 3CM while exploring the relationship between low-income urban mothers and their residential environments following a housing relocation. Consistency in the participants' pre- and post-move 3CM data suggested that it is a stable instrument (Wells 2005).

3CM can be administered with individuals or in group settings, and in person or indirectly. Materials for the process can be as simple as a set of sticky notes and a pen or pencil (Kearney 2015), though mail techniques or online alternatives structurally similar to the 3CM are available. However, most participants who engage in the 3CM process report satisfaction from the hands-on approach and actively rearranging their concept cards, which was a significant reason the researchers on the 'green citizenship' project chose to use a mail procedure. Most participants complete the task within 20–30 min (Kearney and Kaplan 1997).

3.3 Analysis of 3CM

As with any research, approaching data analysis should be informed and structured by what questions you intend to answer at the outset of the research. Analyzing 3CM data can be as simple and as transparent as posting individuals' mental models as a way of sharing perspectives to galvanize group discussion. 3CM data can also be summarized in a more structured and meaningful way by looking at individuals only, at the aggregated group level or by comparing across separate groups. Qualitative analysis is available for open-ended 3CMs in which patterns can be identified in concept generation, category designations, and groupings.

Structured 3CM approaches lend to more statistical analysis, including descriptive statistics, hierarchical cluster analysis, and multidimensional scaling (Aldenderfer and Blashfield 1984; Kruskal and Wish 1978). One simple way to analyze the data is to look at the frequency of card selection (or omission). What were the most frequently used cards among participants? The least? Dendrograms, which are tree diagrams illustrating the arrangement of groupings produced by the hierarchical cluster analysis, can be used to visualize the structure of participants' aggregated 3CMs (Aldenderfer and Blashfield 1984).

In the next section, an example implementation of a hybrid 3CM is illustrated, while detailing a study on green citizenship (Hamilton et al. 2017). The 3CM methodology was selected in order to explore how this novel, theoretically rooted concept is conceived and lived through the minds and experiences of those within the environmental domain.

4 Green Citizenship Example 3CM

To date, discussion of green citizenship has been heavily rooted in theoretical discourse, drawing largely from political and consumer studies. The scant empirical evidence exploring the socio-behavioral components of this concept has overwhelmingly focused on individuals' identification as "green" via their role as consumers. However, little empirical research exists exploring *participant-driven* understandings of what it means to be a green citizen and how this role relates to and expands upon that of the green consumer. As such, little guidance exists for how green citizenship is experienced by people, how it can be cultivated, and communicated to the broader public. The present study employed a mail-based, structured and open-ended hybrid 3CM exercise to explore how individuals working in the environmental domain understand and conceptualize the notion of 'green citizenship'.

4.1 Method

For this initial exploration into a publically uncommon concept, individuals who possessed a more robust understanding of the environmental domain were recruited. Participants were recruited both in person at a local sustainability festival in Ann Arbor, MI, in addition to three online listservs, which serve individuals working or interested in fields such as environmental psychology and sustainability science. A total of 110 participants agreed to participate in further research, of which 58 provided mailing addresses, which the study materials were mailed to. Half of the participants received envelops containing instructions for the green citizenship only 3CM (returned n = 22), while the other half received envelops containing instructions for the green citizenship and green consumer comparative 3CM (returned n = 21). These tasks differed in that the latter 3CM task asked participants to differentiate between the two respective notions, while the citizenship only 3CM asked participants to sort cards only relevant to their conceptualization of green citizenship. For the remainder of the paper, only the green citizenship 3CM exercise will be referenced.

Hybrid 3CM

Provided that 'ecological' or 'green' citizenship has been rooted in theoretical discourse over the past ten years, we suspected that the target audience would not possess an enriched mental model of the topic. Rather, participants might rely on their mental models of topics closely related to their understanding of green citizenship such as traditional 'citizenship' or 'green consumption', plus everyday environmental behaviors. Thus, a structured 3CM approach was used. However, since this was an exploratory study, we also wanted to capture the full range of perspectives that might exist so we also provided participants with the opportunity to add additional concepts. The result was a structured and open-ended hybrid 3CM exercise.

Concept list

To generate the concept list, we drew from relevant literatures including Dobson's (2003) 'ecological citizenship' work that promotes concepts and ideas like, 'moral obligation', 'public impact of private behaviors' and 'social equity and justice.' In addition, we pulled from other relevant literatures that describe a suite of pro-environmental behaviors (e.g., Gilg et al. 2005), motivations, values, and concepts. Common concepts created by participants in the pilot study were also included in the final list as well as those created by the research group. In total, a list of 88 concepts was generated for the study. Although, Kaplan and Kearney (1997) suggest using about half the amount, participants in the pilot study commented that they did not feel overwhelmed.

Piloting

Ten individuals actively working in or studying environmental issues related to ecology, sustainability, and environmental education participated in the pilot study. Participants were asked to provide initial feedback on the instructions and scenario in addition to the concepts that were provided (or not provided) on the structured list. The most common feedback was to refine the instructions so that participants were ensured that there was no right or wrong answer. Since this would be a mail-based 3CM, the pilot forced the researchers to consider how to best frame the scenario and craft the instructions so participants could easily move through the 3CM process in the absence of a facilitator. Some concepts were dropped based on feedback from the pilot, while other cards like 'biodiversity' were added.

Process

Participants were each mailed a packet that included the 3CM task instructions, 12 mini envelops to package the final categories, 88 blue cards with the structured concepts, 15 green cards for new concepts, 15 purple cards for category labels. The purpose of the colored-coded cards was to ease comprehension of the instructions. We provided participants a one-month window to complete and return the 3CM. The instructions for the 3CM outlined six task instructions. The following 3CM scenario and prompting questions were used:

1. QUESTION: Imagine someone you know recently heard about the idea of green citizenship. Since you are familiar with the idea they are interested in getting your perspective. *What are the things you would be most likely to mention when discussing this issue? How might they differ or be similar to the green consumer? What words or terms would you use? How would you organize your thoughts?*

The opening scenario introduces participants to the topic and provides the initial structure to what they would be doing. That is, starting to think about relevant ideas or concepts that may relate to their definition they would tell a friend, and how they would organize their thoughts. The opening scenario also positions the participant as an 'expert' so to speak, in that their friend is interested in hearing about their familiar understanding. Next, participants were asked to work with the structured item list:

2. SELECT THE BLUE CARDS: Each blue card has a word or phrase on it relating to everyday environmental behaviors, concepts or ideas. First, go through all the blue cards selecting as many or as few as you wish to use. Discard the cards you do not use into the mini-envelope labeled 'Unused Cards.'

The important aspect of the second set of instructions is to ensure that participants understand that it is their decision to select as few or as many cards as *they so choose or wish.* Again, the primary interest is of participants' experienced mental model of green citizenship, not what researchers hope to see. After selecting from the structured concept cards, participants were able to generate their own concepts:

3. CREATE GREEN CARDS: We've likely left out some words or phrases that you feel are important. Use the blank **green** cards to write-in new concepts that fit your understanding.

Fusing the structured and open-ended 3CM approaches together is a new technique in 3CM methodology. With an exploratory topic, the hybrid approach allowed researchers to maximize the range of perspectives that might exist while also providing participants, whom may possess no such mental model, some ideas and concepts to build from. After participants selected and generated cards they felt were relevant to their understanding of green citizenship, they were then asked to organize them into meaningful groups:

4. SORT CARDS INTO PILES: Sort the cards into meaningful piles that explain your understanding of the notion of green citizenship. The items in each pile should somehow be related to one another. Create as many or as few piles as you wish. Please, feel free to move the cards around, create new green cards, discard or reclaim blue cards throughout the process.

Organizing the concepts into meaningful groups occupies the most time, though participants naturally start this process while selecting concepts. As participants moved through this process, it was important to allow them to continue adding or removing concepts they felt were relevant to their understanding of green citizenship.

5. LABEL PILES WITH PURPLE CARDS: Assign a name to each pile that represents that grouping of items. Write the label on a separate **purple c**ard and place it on top of each pile. If you have created more than 12 different piles, please clip or band the remaining piles together and securely place them in the return envelope.

The final cognitive step in the 3CM process is naming the categories. Although it varies by 3CM, participants tend to generate roughly 3–7 categories (Kearney 2015). Since the structured list was larger than normal, we provided participants with additional category label cards. Finally, participants were asked to collect their piles, and prepare their packet to be returned:

6. COLLECT THE PILES: Finally, carefully collect the cards in each pile and place them into separate mini-envelopes and close them. Place all the mini-envelopes into the larger return envelope and mail them back at your earliest convenience.

Participants who returned their packets noted that the highly structured, color-coded instructions were helpful in ascertaining what was being asked of them. For in-person 3CMs, the facilitator can more easily address participants' questions or concerns regarding the process. An important theme throughout the 3CM instructions is to continue generating participant ownership. 3CM is a participant-driven methodology, which provides participants the opportunity to actively explore their own understanding. Some of our participants provided notes that they really enjoyed the process, and further provided diagrams detailing their conception of 'green citizenship' (Fig. 2).

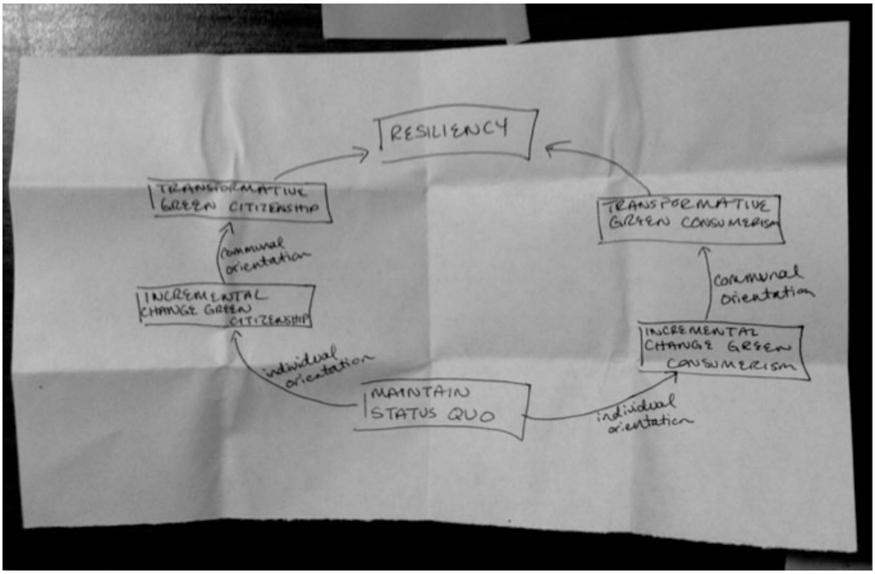


Fig. 2 Participant's drawing of their conceptualization of green citizenship

4.2 Analysis

Participants' 3CMs were analyzed at the group level. A hierarchical cluster analysis was performed using R. The resulting dendrogram (de Vrie and Ripley 2016) represents the relationship of similarity in concept groupings across the participants (Fig. 3). Generally, dendrograms are used to visualize how individuals' collectively understand and group concepts together with respect to a particular topic. The arrangement and proximity of the clusters provides an indication of which concepts are most similar or most often grouped together by participants. To interpret dendrograms, no threshold is qualitatively specified or statistically defined. Rather the threshold for determining which branching or cluster inclusions to follow is subjectively determined by the researcher.

In the present study, it was about striking a balance between meaningfulness or significance and cohesiveness. Larger group clusters risk losing cohesiveness, while smaller groups loose significance and/or meaning. In addition to the hierarchical analysis, frequency analysis was performed for the structured concepts, looking for the percent of participants who selected each term. Terms with complete endorsement (e.g., 'adopt new habits') and low overall endorsement (e.g., 'sacrifice' and 'maintain status quo') can provide insightful information as to what resonates with individuals' understanding of green citizenship, and what falls outside of their understanding. Importantly, analysis of individuals' maps can reveal how people differentially group concepts together despite containing the same concepts. For example, some participants in the green citizenship study interpreted

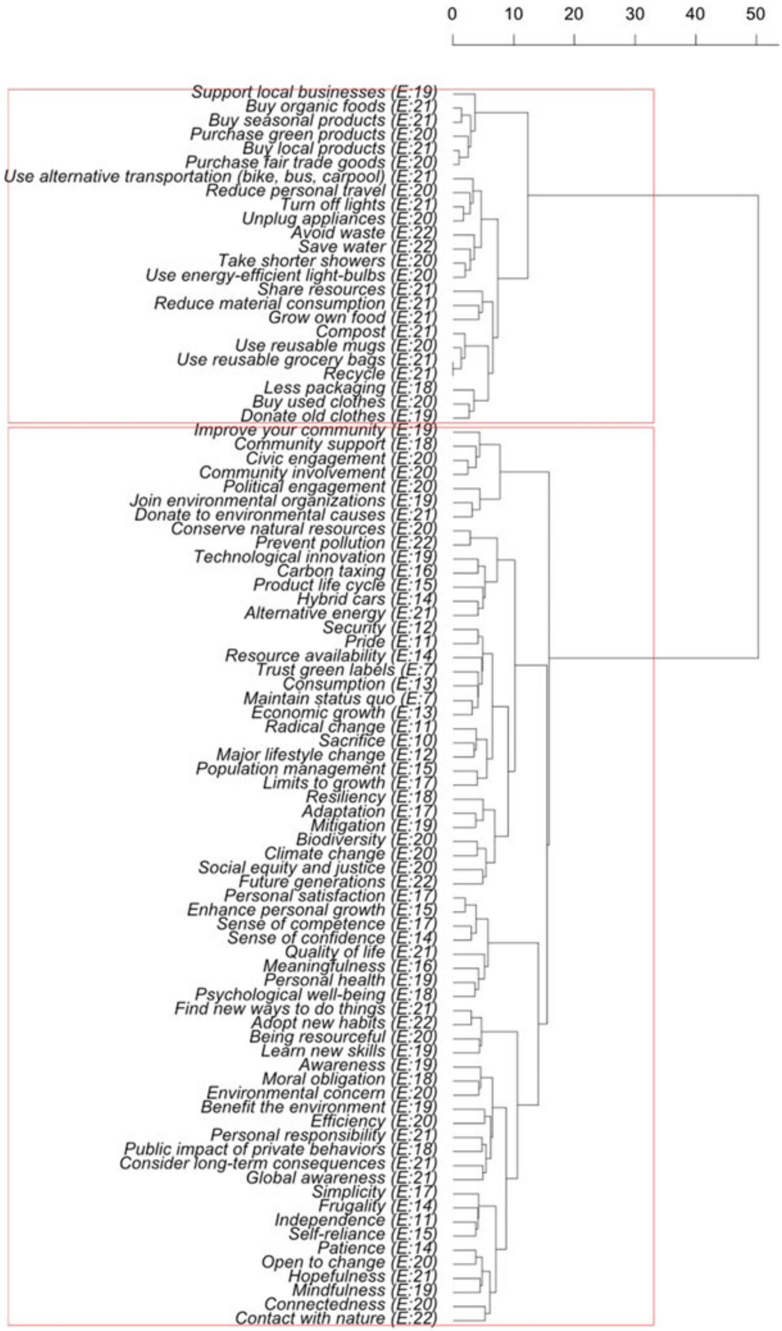


Fig. 3 Dendrogram for the green citizenship only 3CM sort. The numbers that appear next to each term are the frequency of selection by participants (n = 22)

'trust green labels' as a positive consumerist response, while others lumped the concept into more negatively charged categories. Although content analysis may reveal what concepts participants collectively deem relevant to their conceptualization of particular topics, perhaps more revealing is how participants categorize and label these concepts into distinct groups. Ultimately, the dendrogram should reveal similarities of categories across participants, as it did for the green citizenship study. For a full analysis of the results including discussion of the relevant takeaways and analysis of the dendrogram, see Hamilton et al. (2017).

5 Discussion

The study of mental models and the tools, like 3CM, used to elicit them, offers social scientists a unique and necessary framework to employ while exploring and solving the complexities of issues related to sustainability and the environment. One of the primary strengths of the 3CM method is its ability to provide researchers and participants alike with a broader understanding of the topic of interest. By capturing a picture of individuals' knowledge and understanding of particular topics, 3CM not only offers researchers a framework for overcoming their own preexisting expertise and biases, but also provides the basis for more effective communication and the exploration of previously unknown or unfamiliar topics (Kearney 2015). Furthermore, given the nature of the participant-driven card-sorting process, 3CM encourages greater participant ownership and overall engagement with the topic.

In the green citizenship study, participants were asked to think beyond the traditional green consumer paradigm and instead, actively explore and define a novel, alternative role for individuals. Through a structured and open-ended hybrid 3CM, participants were able to visually communicate their lived understanding of green citizenship by selecting, generating, and categorizing cards into networks of meaning that reflected their personal conceptualization of the topic. Participants' multiple perspectives offered an encouraging and foundational participant-driven conceptualization of green citizenship, one that endorsed broader pathways to everyday environmental engagement (Hamilton et al. 2017). Participants not only noted how captivated they were by the process, but also stressed how actively grouping and regrouping concepts into meaningful categories challenged their preconceived notion about how they viewed and made connections between certain concepts.

Although 3CM is not new, its participant-driven approach should serve as an invaluable addition to social scientists' methodological toolbox, particularly for those seeking to view topics in drastically different ways, explore the foundations of a novel concept, or work in collaborative settings. By blending qualitative and quantitative methods, 3CM results in simple, yet visually enriching representations of individuals' experienced knowledge content and structure. This type of methodology will be instrumental as researchers increasingly recognize the need for working across disciplines, drawing on local knowledge, and for collaborative management.

6 Conclusion

However compelling and potentially convenient the 3CM is to administer, one must exercise caution in its use (Kearney 2015). It is neither intended nor suitable to answer every question that may arise in social science research related to sustainability or environmental issues. Thus, it is important to understand what 3CM can do: offer a visual display of meaningful, interconnected concepts that represent an individual's unique, lived experience, and knowledge of a particular topic. It is also important to understand what 3CM cannot do: provide answers to what people's attitudes, beliefs, or values are regarding a particular topic (Kearney 2015). Determining whether 3CM is the appropriate technique to address your underlying question can be difficult, but likely the most important step in the research process.

When 3CM is used successfully, researchers can do more than just expound on theoretical discourse or identify invaluable place-based information. This participant-driven approach can significantly increase engagement and meaningful action among stakeholders. In working to further define and realize a participant-based understanding of green citizenship, a structured and open-ended 3CM hybrid offered a way to address and explore an uncommon, yet potentially robust concept. For social science researchers or practitioners seeking to understand an audience's assumptions and experiences regarding a particular topic, 3CM provides an intuitive framework for garnering greater perspective with respect to complex environmental issues.

References

Aldenderfer, M. S., & Blashfield, R. D. (1984). *Cluster analysis*. Sage University Paper Series on Quantitative Applications in Social Sciences, series no. 07–144. Beverly Hills, Sage Publications.

Amtmann, L. A. (1996) Stakeholder perspectives on wild and scenic rivers: A new cognitive tool for enhancing participation. Master's thesis. University of Michigan, School of Natural Resources and Environment.

Basu, A. & Kaplan, R. (2015). The reasonable person model: Introducing the framework and the chapters. In R. Kaplan and A. Basu (Eds.), *Fostering reasonablenesss: Supportive environments for bringing out our best*. Ann Arbor, MI: Michigan Publishing.

Brundtland, G.H. (1987). *Our Common Future*. World Commission on Environment and Development: Brussels, United Nations.

Byrch, C., Kearins, K., Milne, M., & Morgan, R. (2007). Sustainable "what"? A cognitive approach to understanding sustainable development. *Qualitative Research in Accounting & Management, 4*(1), 26–52.

Carlsson, L., & Berkes, F. (2005). Co-management: Concepts and methodological implications. *Journal of Environmental Management, 75*(1), 65–76.

Craik, K. J. W. (1943). *The nature of explanation*. Cambridge, UK: Cambridge University Press.
de Vries, A. and Ripley, B. D. (2016). ggdendro: Create dendrograms and tree diagrams using 'ggplot2'. R package version 0.1–18. http://CRAN.R-project.org/package=ggdendro.
Dobson, A. (2003). *Citizenship and the Environment*. OUP Oxford.
Elgin, D. (1993). *Voluntary simplicity: Toward a way of life that is outwardly simple, inwardly rich* (Vol. 25). New York: Quill.
Gilg, A., Barr, S., & Ford, N. (2005). Green consumption or sustainable lifestyles? Identifying the sustainable consumer. *Futures, 37*(6), 481–504.
Hamilton, E. M., Guckian, M. L. & De Young, R. (2017). Living well and living green: Participant conceptualizations of green citizenship. In *Handbook of Sustainability Science and Research*. Ann Arbor, MI.
Hudson, W. (2005). Playing your cards right: Getting the most from card sorting for navigation design. *Interactions, 12*(5), 56–58.
Jasanoff, S. (Ed.). (2004). *States of knowledge: The co-production of science and the social order*. Routledge.
Johnson-Laird, P. N. (1983). *Mental models*. Cambridge, UK: Cambridge University Press.
Jones, N. A., Ross, H., Lynam, T., Perez, P., & Leitch, A. (2011). Mental models: An interdisciplinary synthesis of theory and methods. *Ecology and Society, 16*(1), 46.
Kaplan, S. (1973). Cognitive maps in perception and thought. In R. M. Downs & D. Stea (Eds.), *Image and environment* (pp. 63–78). Chicago: Aldine.
Kaplan, R. (2015). The joys and struggles of building mental models. In R. Kaplan & A. Basu (Eds.), *Fostering reasonableness: Supportive environments for bringing out our best*. Ann Arbor, MI: Michigan Publishing.
Kaplan, S., & Kaplan, R. (1982). *Cognition and environment: Functioning in an uncertain world*. New York: Paeger. Republished by Ann Arbor, MI: Ulrichs Books, 1989.
Kearney, A. R. (1993). *Promoting ride sharing: The effect of information on knowledge structure —a cognitive perspective.* Un-published Master's thesis, University of Michigan, Ann Arbor.
Kearney, A. R. (2015). 3CM: A tool for knowing "where they're at". In R. Kaplan & A. Basu (Eds.), *Fostering reasonableness: Supportive environments for bringing out our best*. Ann Arbor, MI: Michigan Publishing.
Kearney, A. R., & Kaplan, S. (1997). Toward a methodology for the measurement of knowledge structures of ordinary people the conceptual content cognitive map (3CM). *Environment and Behavior, 29*(5), 579–617.
Kearney, A. R., Bradley, G., Kaplan, R., & Kaplan, S. (1995). Stakeholder perspectives on appropriate forest management in the Pacific Northwest. *Forest Science, 45*(1), 62–73.
Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8*(3), 239–260.
Kruskal, J. B., & Wish, M. (1978). *Multidimensional scaling* (Vol. 11). Sage.
Lehto, R. H. (2004). *Worry and cognitive representations of illness in cancer.*Unpublished Doctoral dissertation (Nursing), The University of Michigan, Ann Arbor.
Lynch, K. (1960). *The image of the city*. Cambridge, MA: M.I.T. Press.
Scheuer, C.W. (2007). *Adoption of residential green building practices: Understanding the role of familiarity*. Unpublished doctoral dissertation. University of Michigan, Ann Arbor.
Tilt, J. H., Kearney, A. R., & Bradley, G. (2007). Understanding rural character: Cognitive and visual perceptions. *Landscape and Urban Planning*, *81*(1), 14–26.
Wells, N. M. (2005). Our housing, our selves: A longitudinal investigation of low-income women's participatory housing experiences. *Journal of environmental psychology, 25*(2), 189–206.

The Impact of Status and Brainstorming in Participation in Small Group Deliberations

Sandra Rodegher

Abstract

Scenario planning first gained traction within corporations as an energy transition management tool, but recently gained popularity within sustainability. It is a process for exploring potential futures and thinking critically about complex decisions that involve high degrees of uncertainty. It is also effective in shifting mental models and engaging diverse stakeholders, making it ideal for complex sustainability problems. Scenario-planning insights are typically used in strategic planning, further aligning with sustainability's commitments to action-oriented solutions. However, as a participative process, success hinges on equitable participant engagement that is threatened by power imbalance.The current pilot study uses an experimental design to explore the impact of explicit acknowledgement of status differential and pre-event brainstorming on participation in a small group task. The task was selected based on its parallels to scenario-planning interactions. Twenty-four triads engaged in group deliberation while wearing devices that gather data to measure interactions. Afterward, participants completed a participation perception survey. Despite the popularity of brainstorming, results of the pilot study point to the utility of status concealment over individual-level brainstorming to bolster participation. Ultimately, this work contributes to a more nuanced understanding of participation in service of more robust, pluralistic sustainability decision-making.

S. Rodegher (✉)
Julie Ann Wrigley Global Institute of Sustainability, Arizona State University, Tempe, AZ, USA
e-mail: sandra.rodegher@asu.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*, World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_20

1 Introduction

Sustainability has gained momentum within the scientific and broader societal community. The term is at times used in broad ways (keeping the world going on forever) and also in narrow ways (recycling); this can add to confusion in communication and identifying strategies and actions. However, an ever-growing human population combined with a dependence on technology-based modifications to our environment and degradation of natural resources has put the human species in a precarious position. Thus, sustainability scientists, based on a normative desire to sustain human and environmental well-being, must continue to build knowledge and address problems despite lack of shared clarity. Furthermore, it's difficult to identify which threats are most pressing for society to adapt to. As Stewart contends, "uncertainty in prediction simply means that, given current knowledge, there are multiple possible future states of nature" (Stewart 2000, p. 41). Given this high degree of uncertainty, building adaptive capacity is critical for transitioning to a more sustainable state (Smit and Wandel 2006), even without exact knowledge of what society is adapting to. Furthermore, this should be accomplished in a just, equitable way so that all people share the benefit of such adaptations. Using groups to address complex sustainability problems, one can tap into a broader set of resources through group members' "experiences, expertise, and manpower… in the pursuit of a common goal" (Kurtzberg and Amabile 2000, p. 287). Additionally, decisions made through group deliberation have more buy-in, or commitment to the decision, from the group than top-down decisions (Lunenburg 2011).

Given society's need to prepare for and confront complex sustainability challenges in sophisticated ways, scenario planning becomes a powerful tool because it's designed to address uncertainty by engaging stakeholders in deliberation of multiple possible futures (Peterson et al. 2003). Scenario planning is not without flaws; indeed, its greatest strength may also be its greatest weakness. Specifically, it uses collective knowledge to build a stronger understanding of the future, but individuals, and the collective, are influenced by invisible or unrecognized sources of social influence. Without identification of the impact of social influence in deliberative processes, the value of incorporating diverse forms of knowledge can be undermined. As such, it's important that sustainability scientists and scholars continue to interrogate and refine scenario planning. Towards this, this study tests a source of undue influence, status without expertise, as well as a potential tool for bolstering individuals when faced with influence, individual brainstorming. Combining the framing of sustainability with the processes of future studies and the controlled, experimental method of social psychology, variables of interest can be isolated from the web of group interactions embedded in scenario planning for sustainability, allowing for a clearer understanding of how the variables operate.

1.1 Participation

Complex social dynamics present group processes like scenario planning with challenges, which may undercut the stated benefits. Woolley et al. (2010) found that, though neither satisfaction nor strength of bond had an impact on the collective intelligence of groups, equal participation did. Groups with more balanced participation demonstrated more collective intelligence than groups where a subset monopolized interactions. Though critical for success, participation is challenging to operationalize because individual characteristics and contextual factors impact what participation should look like. Finn et al. (1991) identified distraction or interrupting others as non-participation, however this work is focused on academic performance, From the framework of creativity, however, interjections or interruptions can be characterized as good participation, rather than disruptive (Niu and Sternberg 2002; Pentland 2010). Thus, the operationalization of participation is tied to a specific normative frame.

To address the complexity of participation, this study attempts to tap into various elements of participation via incorporating four distinct indicators: self-report, total amount of time spoken, ratio of successful interruptions to total interruption attempts, and finally, self-turns taken by participants. The first variable, self-report, addresses how participants felt about the group performance and their role in it. The next four variables are measures of interaction between participants, which denote interest and engagement (Caneel 2005). Total amount of time spoken measures and establishes total amount of contribution to the conversation. Average speaking segment length is a second measure of contribution to conversation. This measure accounts for different speaking types as someone may have a large total speaking time but short speaking segments, suggesting that their speaking time consisted of confirmatory remarks (e.g., "uh-huh"). The ratio of successful interruptions is used as a measure of engagement. Being able to interrupt others is important to participation so that, not only is the individual's voice heard, but also so that they can participate spontaneously as thoughts are generated. Finally, self-turns may indicate intellectual participation via thinking on the part of the individual and, perhaps more importantly, demonstrates receptiveness on the part of the group by way of a lack of "verbal pushing," an influence tactic where the influencer seeks to control the conversation by speaking quickly, allowing for no natural pauses (Pentland 2010). Ultimately, each variable addresses different elements of participation, particularly in light of the presence of status.

1.2 Status

Status and power are distinct phenomena, with status referring to social rank or prestige and power referring to the ability to control resources, but they are tightly linked. When interacting with others, "people are likely to use status as a (valid) indicator of power" (Lücken and Simon 2005, p. 411). Thus, this discussion follows the lead of researchers who join power and status under one heading (Hall et al. 2005; Mast and Hall 2004).

The functions of high and low status individuals remain fairly constant. Those with more status provide direction and control, whereas those with less status follow direction and attend to the needs of those with higher status (Fiske 2010; Mazur 1985). Status is also believed to play a critical role in the cultural transmission of ideas, whereby maintaining close proximity to an individual, viewed as successful, and closely observing their behavior allows others to emulate their successful behavior (Henrich and Gil-White 2001).

1.2.1 Impacts of Status on Social Cognition and Behavior

Status impacts how people feel and behave when interacting with others. Those with less status are more likely to experience negative emotion and attend upward, paying attention to those with more status as a means of protecting themselves from threats via behaviors such as self-censoring (Keltner et al. 2003). Low status participants from marginalized groups or communities may be particularly vulnerable when faced with high status individuals as a result of “stereotype threat”—which occurs when people perform poorly as a result of being reminded of a negative stereotype about the group they belong to (Cadinu et al. 2005; Steele and Aronson 1995). In fact, merely being in an environment that is seen as threatening in terms of the stereotype (such as women solving a math problem in the presence of men) still results in underperformance (Inzlicht and Ben-Zeev 2000).

Conversely, those with more status generally express themselves more freely (Keltner et al. 2003), are more able to focus on the specific objectives they are working on (Guinote 2007), and are more reward-focused (Anderson and Berdahl 2002). Those with more status speak more in interactions (Hall and Friedman 1999) and are perceived to be more dominant (Mast 2002)—this is particularly true if the high status individual is male and speaking with strangers (Cashdan 1998). Similarly, those with more status are more successful at interrupting others than their low status counterparts (Fiske 2010; Hall et al. 2005) and the types of interruptions are often non-supportive, such as changing the subject (as opposed to an interruption that asks a clarifying question; Menz and Al-Roubaie 2008).

1.2.2 The Overextension of Status

Leadership can, when employed correctly, increase satisfaction, motivation, and success (Halevy et al. 2011), however, many status cues impact perceptions though they not necessarily tied to one’s ability to lead. For example, people attribute more status to people who score high in gender normative behavior (such as a woman acting nurturing) (Cashdan 1998). Similarly, displays of expertise bring men more influence and status, whereas displays of expertise by women tend to result in lowered influence and status (Thomas-Hunt and Phillips 2004). Additionally, perceptions of participation may be mediated by ideas of status. Women are perceived to be more talkative than men, though studies consistently find that men generally speak more in interactions (Kimble and Musgrove 1988; Leaper and Ayres 2007).

As a whole, these findings point to systemic discrepancies in participation and knowledge sharing. It is important then to consider why expertise and speaking is more valued from a member of a group that is considered to have high status. Moore (1968) referred to the tendency of high status individuals to have undue influence, even when point of status is not linked to the type of expertise needed, as the "status generalization phenomenon." According to this theory, people use easily accessible cues such as gender, race, and information about job roles to assess the status of others, regardless of the utility of any of those characteristics on the task at hand (Webster and Driskell 1978). It is important to consider status in the context of scenario planning as it can have a number of critical effects on participation, particularly since people can accurately assess the status level of people within a group as well as individuals through visual cues alone (Mast and Hall 2004).

Though status may be fabricated, it still impacts group members' interactions and perceptions. Sachdev (1991) found that in a group task, those randomly assigned to "high status" were more likely to feel satisfied with their group membership and were also more likely to engage in discriminatory behavior against their low status group members, despite self-reported beliefs that they had engaged in more parity and less discrimination than the outgroup. In contrast, those randomly assigned to low status acknowledged their lower status, were less satisfied with their group membership, and more critical of the process. However, dissatisfaction may not be detected by the rest of the group since those with less status tend to show more positive or polite cues such as smiling more (Hall et al. 2005). Particularly important in the context of scenario planning events, groups with shorter tenure together are more likely to rely on these "diffuse" status cues, or broad status cues that seemingly point to general ability identified in the status generalization phenomenon, rather than specific cues that indicate targeted knowledge (Bunderson 2003).

1.3 Brainstorming

Brainstorming is a potential tool for addressing unequal participation. "Brainstorming," developed by Osborn (1963), is an idea generation tool in service of problem solving. This method—originally created for group usage—involves generating multiple potential answers to a question while temporarily suspending judgment of said answers. The effectiveness of this process is attributed to the stimulation of novel ideas as a result of earlier, less novel, ideas (Connolly et al. 1993). These ideas form as a result of social factors (e.g., building off of others' energy) and cognitive factors (e.g., priming) (Brown et al. 1998). Brainstorming has become widely adopted and is often identified as important for creative problem solving, but there is also a great deal of criticism on its effectiveness (Mullen et al. 1991; Paulus et al. 1995).

Brainstorming has since expanded to include individual brainstorming with more positive results. Paulus et al. (1995) found that when comparing groups of four, half of which brainstormed together and half of which brainstormed independently side-by-side (in "nominal groups"), despite the participants' beliefs that they brainstormed best in groups, those who brainstormed collaboratively produced half as many ideas as those who brainstormed alone. Specifically, individual brainstorming before group decision-making is believed to promote equality via limiting the effects of social influence (Delbecq et al. 1975). The shortcomings of group brainstorming are primarily a result of social dynamics, which tend to have largely negative impacts on the process (Brown et al. 1998; Mullen et al. 1991). If social factors could be removed, group brainstorming would be more effective than individual brainstorming (Brown et al. 1998). Since social dynamics can't be removed, this ultimately lends support to the use of individual-level brainstorming. One area of concern within brainstorming is that initial brainstorming may create a narrowing of focus, or a "lock-in," to initial ideas (Heath and Heath 2013). This has proven to be problematic in group brainstorming where all members of the group become fixated around an idea, but with nominal groups more ideas are still generated (Kohn and Smith 2011). Thus, in the case of individual-level brainstorming, that lock-in may be the mechanism by which participation is bolstered during the subsequent group process.

Further support is provided for the benefit of individual-level brainstorming as a solution to unequal status. Status differentials have a negative impact on participation and creativity in groups (Collaros and Anderson 1969). Davis et al. (2003) employed the use of a computerized group decision support system to examine how it impacted uptake of individual-level brainstorming. Sessions that used the tool came up with a broader diversity of ideas as compared to in-person sessions. Furthermore, when anonymity was maintained, ideas produced by male participants were less likely to be given priority by the group. Similarly, Stam et al. (2013) found that individual-level brainstorming allowed for more diverse perspectives to be incorporated in group discussions. These two studies support the hypothesis that brainstorming may improve participation and, specifically, bolster participation in light of unequal status. Though the mechanisms underpinning the effectiveness of individual brainstorming are unclear, what is apparent is — when compared to group brainstorming — nominal group brainstorming is more effective (Mullen et al. 1991; Ziegler et al. 2000).

1.4 Present Study

The present study used a 2x2 design to explore the impact of revealing or concealing status and pre-event individual-level brainstorming on participation within group deliberation processes. Same sex triads consisting of two undergraduate students and one graduate student engaged in a group task which asked them to rank items from most to least important for desert survival. Prior to beginning the task, participants were asked to either reveal or conceal their degree sought (undergraduate or graduate) and either instructed to brainstorm individually while ranking (e.g., "_____ is ranked a 3 for desert survival because it could serve the following purposes…") or rank individually without brainstorming ("This is ranked a 3”. It is hypothesized that, in conditions with revealed status, low status participants will participate less and be less satisfied than their high status counterparts. A second hypothesis is that pre-event, individual-level brainstorming will lead to more individual satisfaction and more participation. The third and final hypothesis is that the effect of explicit status difference will be reduced by individual brainstorming, relative to when individual brainstorming does not take place.

2 Method

2.1 Participants

Seventy-two students from Arizona State University participated in this study (39 female, 33 male). Participants consisted of 48 undergraduate and 24 graduate students between the age of 19 and 30 (M = 22.9, SD = 3.13). Of the participants, one identified as Black or African American, 7 as Asian, 8 as Hispanic, 50 as White, and 6 as Other. Only 16 students identified as first generation college students, while 56 participants reported that they were not. In terms of socioeconomic class, 81.9% of participants reported being in the “middle” (35) or “upper-middle” (24) income bracket, while two reported being in the “upper” bracket, ten “lower-middle”, and one “lower.”

Participants were recruited through the use of flyers placed around campus. Volunteers were offered a participation incentive of eight dollars. Additionally, undergraduate participants could opt to participate for extra credit rather than money.

2.2 Procedure

Same-sex triads were randomly created, each consisting of two undergraduate and one graduate student. Twenty-four total groups were formed. Upon arrival, each participant was invited to read and sign an informed consent form and provided a wearable sociometric badge. Participants were then seated around a small round table.

In all sessions, participants were asked to complete a “Desert Survival” scenario task (Cooke and Lafferty 2006), commonly used to measure group decision-making dynamics. Participants were allowed up to ten minutes for the individual ranking. They were then instructed to take turns introducing themselves to the other group members before engaging in the group ranking task. They were asked to complete the group ranking process in twenty minutes. Additionally, groups were randomly assigned to four conditions based on the manipulation of two variables:

1. **Status:** Groups were instructed to either reveal or conceal their status when introducing themselves to the group. In the concealed status condition

(abbreviated in figures and tables as "no status"), participants were instructed to introduce themselves by name and describe their interests, concealing their degree sought; in the revealed status condition (abbreviated as "status") they were explicitly asked to include more descriptive information, including their degree sought (i.e. whether they were a graduate or undergraduate student).

2. **Brainstorming:** Half of the groups were instructed to include an additional step of brainstorming the rationale for the placement of each item, and the item's potential uses, in their individual ranking task. Whereas the other half was asked to simply rank the items.

In the remainder of the paper, the conditions are abbreviated as follows: "No Brainstorming, Status" is NB/S, "Brainstorming, Status" is B/S, "No Brainstorming, No Status" is NB/NS, and "Brainstorning, No Status" is B/NS

After the group discussion and ranking of items, which lasted a maximum of 30 min, participants completed a brief questionnaire and were then debriefed verbally, allowed to ask questions, and reviewed the correct ranking.

2.3 Measures

Sociometric badges. Sociometric badges are wearable sensors, smaller and lighter than smart phones. The badges gather data on group interactions—triangulating of speech prosody, movement, and proximity—and then compiles them through badge-specific analytical software. This study focused on three measures related to participation: speaking time, cumulative amount of time speaking during group deliberations; average speaking segment, the average of each participants speaking turns; ratio of successful interruptions, as compared to total attempts; and self-turn taking, when individuals spoke, paused for more than half of a second but less than ten seconds, and then began speaking again.

Desert survival situation. Used by permission from Cooke and Lafferty (2006). The instructions ask participants to imagine that they are the only survivors of a plane crash, and then task them with prioritizing a list of 15 items salvaged from the wreckage as potential aids to survival. Participants rank the items first individually and then as a group. Many items listed are vague, however, there are correct answers established by survival experts.

Survey. Sixteen survey items were divided into two sections. The first section contained four questions around participants experience within their group. Participants were asked to rate the degree to which they agreed with the statements (e.g. "I felt comfortable sharing my opinion with the group") using a 7-point Likert scale (1 = "strongly disagree," 7 = "strongly agree"). The second section contained demographic questions, and a question regarding their potential survival expertise.

3 Analytical Plan

The nature of this study had participants acting within groups, as such Multilevel Modeling (MLM) was used due to the possibility that there was not independence of observations (Muthén and Muthén 1998–2012). In the case of this study, the triads are the subgroup within the experiment and function as "level-two" variables or "clusters." The individual participants function as "level-one" variables. Through MLM, brainstorming and status can be evaluated at the group level.

All variables were continuous variables, with the exception of the count variable of "self-turns." Given self-turns' relatively normal distribution and lack of an abundance of zero scores treating it as a continuous variable was justifiable.

Four models (0–3) were run for each dependent variable. Generally, statistical significance is used to determine whether or not the process of analysis and the next model, should be continued. As this was a pilot study, emphasis was placed not on statistical significance, but on describing variation and directionality. In Model 3, the focus of this study, the slope is allowed to vary by experimental condition and across clusters, providing slopes for each of the experimental conditions.

Grand mean centering was used for all five level-one variables (total speaking time, average speaking segment, perception of participation, self-turn taking, and successful interruption rate) to establish whether or not there was a dependency between groups.

4 Results

Descriptive analysis was conducted on the outcome variables (Tables 1 and 2). The four self-reported items, intended to measure individual perception of participation, had similar means and standard deviations, suggesting that they could be collapsed

Table 1 Means and standard deviations of self-rated group participation (7-point lickert scale)

	Mean	SD
I feel good about	5.89	1.069
I felt comfortable	6.44	0.948
I felt my opinion was considered	6.39	0.865
I felt my group worked well together	6.40	0.988
Composite	6.281	0.853

Table 2 Means, standard deviations, minimum, maximum values for sociometric measures of participation

	Mean	SD	Min.	Max.
Self-turns (cumulative count)	103.778	80.568	16	438
Successful interruptions (ratio of successful interruptions to total attempted interruptions)	0.476	0.093	0.27	0.69
Total speaking (in seconds)	438.5	153.929	179.5	789.5
Average speaking segment (in seconds)	2.737	1.085	1.065	5.160

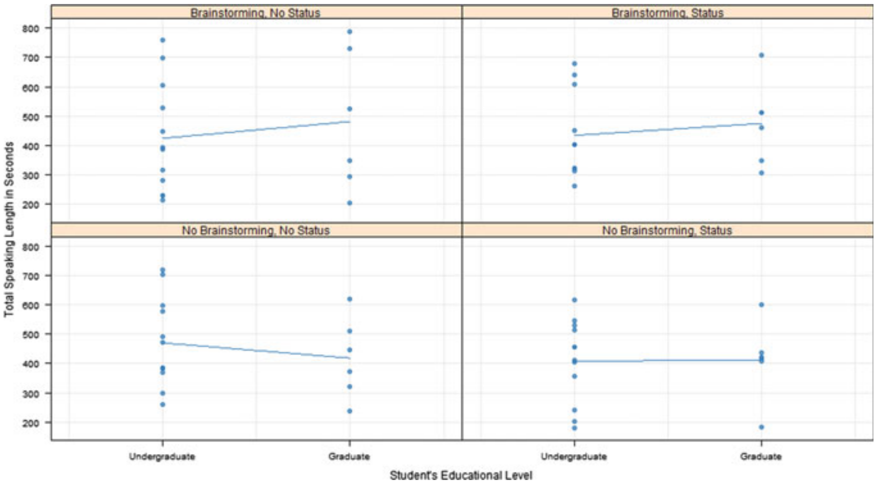


Fig. 1 Total Speaking Time in Seconds on Student's Degree Sought by Experimental Condition

Table 3 Group mean and slope by condition for total speaking time

	Mean	Slope
B/NS	443.682	56.741
B/S	448.355	41.468
NB/NS	452.39	−51.108
NB/S	409.347	2.332

into a single score. To support this, I conducted a Cronbach's alpha for the four items, which was found to be highly reliable ($\alpha = 0.902$), thus collapsing the items into a single measure was justified.

4.1 Total Speaking Time

Total speaking time is a cumulative measure of how many seconds each participant spoke for over the duration of the ranking task. Beginning with NB/S or, in other words, the "normal" condition,[1] there is relatively little variability between graduate and undergraduate participants (slope = 2.332). With B/S, graduate student total speaking time is bolstered with a slope of 41.468 (an increase of 39.136). With B/NS, the divide grows even larger with a slope of 56.741 (an increase of 54.409 from the normal condition). In contrast, when NB/NS, the balance shifts with undergraduates speaking more in total than graduate students (slope = −51.108) (Fig. 1 and Table 3).

[1]In this instance, "normal" refers to the condition that is most likely to occur within typical societal interactions.

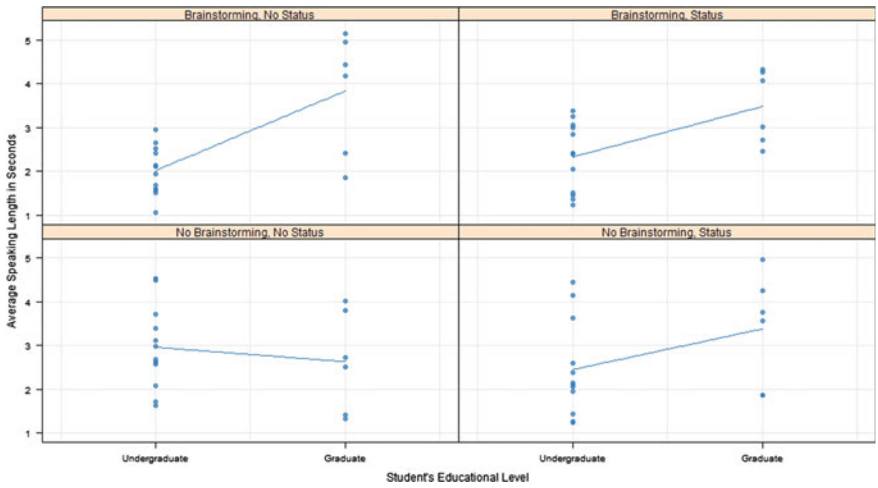


Fig. 2 Average Speaking Segment on Student's Degree Sought by Experimental Condition

Table 4 Group mean and slope by condition for average speaking segment

	Mean	Slope
B/NS	2.622	1.816
B/S	2.712	1.154
NB/NS	2.847	−0.332
NB/S	2.760	0.924

Ultimately, in the case of total speaking, it appears that refraining from brainstorming is more useful in terms of moderating the effect of status, with revealed status having more parity but concealed status leading to more bolstering of the lower status, undergraduate participants.

4.2 Average Speaking Segment

Average speaking segment is the average length of time each participant spoke for (Total speaking time/total speaking events). In the case of average speaking segment, with NB/S, graduate student participants speak for longer periods of time on average in comparison to their undergraduate counterparts (slope = 0.924 or just under one second longer per speaking segment). In the B/S condition, the undergraduate students once again speak for shorter durations than the graduate students with the difference becoming more pronounced (slope = 1.154). Following a similar pattern to the total speaking time variable, the gap grows even larger with B/NS, with an increase from the normal condition of 0.924 (slope = 1.816). In the final condition, NB/NS, there is a directional shift. In this case, undergraduate student participation is bolstered over graduate student participation (slope = −0.332) (Fig. 2 and Table 4).

Again, refraining from brainstorming appears to have the most benefit in reducing the effect of status. In this case, concealing status results in more bolstering of undergraduate participants and more equity in participation between the two groups.

4.3 Self-Rated Group Participation

Self-rated group participation is the average of all six perception-based survey questions. These questions were on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). In general perceptions around participation were quite high with a mean of 6.282. In looking at the data we see that satisfaction was highest in the no brainstorming conditions and, in this case, the concealed status condition both most favors undergraduate participants and also is the condition with the highest satisfaction. The revealed status condition somewhat less favors the undergraduate participants and is instead the condition with the most equity between groups (Fig. 3 and Table 5).

In the case of self-rated group participation, NB/S, unlike the previous variables, demonstrates a negative slope of −0.044, with undergraduate participants reporting higher evaluations of their group performance. With B/S, the slope shifts direction with graduate student participants now reporting higher evaluations (slope = 0.167). With B/NS, once again the slope becomes more pronounced (slope = 0.447). In the final condition, NB/NS, graduate students report lower evaluations than their undergraduate counterparts (slope = −0.165). This condition (concealed status with no brainstorming) once again displays the most bolstering of undergraduate participants as well as the most parity between the two groups.[2]

4.4 Self–Turn Taking

Self-turn taking is a cumulative count of the number of times participants spoke, paused, and then spoke again. In the case of self-turn taking metric, in NB/S there is a negative slope (slope = −35.934) meaning that undergraduate students took more pauses while speaking than the graduate students. With B/S, undergraduate students remain bolstered but to a lesser extent (slope = −29.696). With B/NS, self-turn taking in favor of the undergraduate participants is most pronounced (slope = −56.145). In NB/NS, the directionality shifts in favor of the graduate students (slope = 6.252). It is worth noting, however, that in spite of favoring graduate students, this is also the condition with the most parity (Fig. 4 and Table 6).

In considering the various conditions, at initial take it appears that refraining from brainstorming is of greater benefit to undergraduate participants (with a difference of 6.238), but in looking at the variation in scores (see Fig. 2), graduate

[2]For further explanation on the inclusion of the outlier data point and the potential ceiling effect, please see Rodegher (2015).

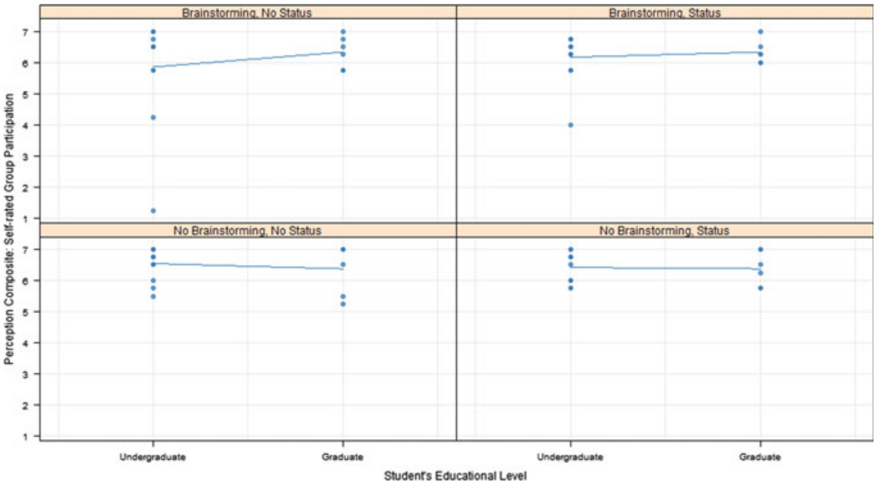


Fig. 3 Self-Rated Group Participation on Student's Degree Sought by Experimental Condition

Table 5 Group mean and slope by condition for self-rated group participation

	Mean	Slope
B/NS	6.013	0.477
B/S	6.22	0.167
NB/NS	6.483	−0.165
NB/S	6.404	−0.044

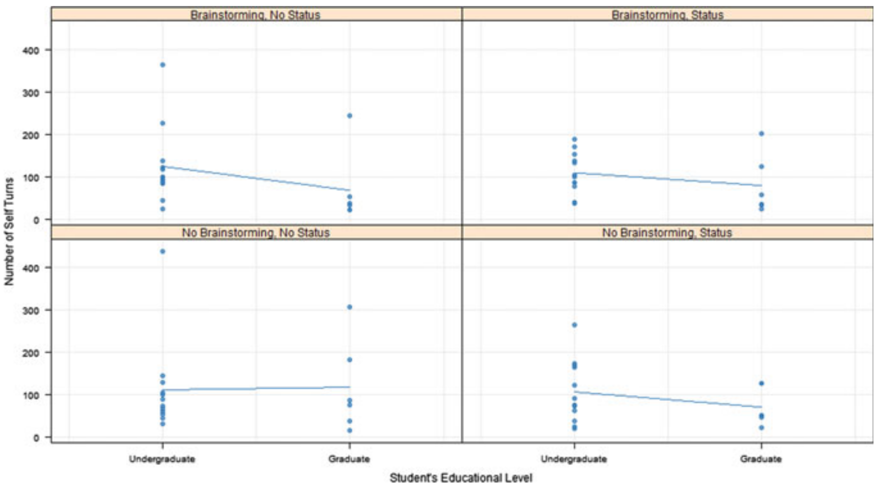


Fig. 4 Number of Self-Turns on Student's Degree Sought by Experimental Condition

Table 6 Group mean and slope by condition for self-turn taking

	Mean	Slope
B/NS	106.009	−56.145
B/S	99.715	−29.696
NB/NS	113.715	6.252
NB/S	95.275	−35.934

students show much less variation in this condition than in other conditions. This suggests that the presence of status without brainstorming may potentially result in the higher status participants engaging in verbal pushing.

4.5 Ratio of Successful Interruptions

The measure of ratio of successful interruptions is calculated by dividing successful attempts by total interruption attempts. A successful interruption occurs for person A, when person A and person B speak at the same time and person B stops but person A continues (conversely, this is recorded as an unsuccessful attempt for person B). The grand mean for the ratio of successful interruptions was 0.476 or, in other words when attempting to interrupt participants were successful 47.6% of the time (Fig. 5 and Table 7).

In the normal condition, NB/S, graduate participants demonstrate a higher interruption success rate (slope = 0.056 or graduate participants in this condition were on average 5.6% more effective at interrupting). With B/S, graduate students remain more successful at interrupting than their undergraduate student counterparts, though the advantage lessens (slope = 0.039). With B/NS, the imbalance

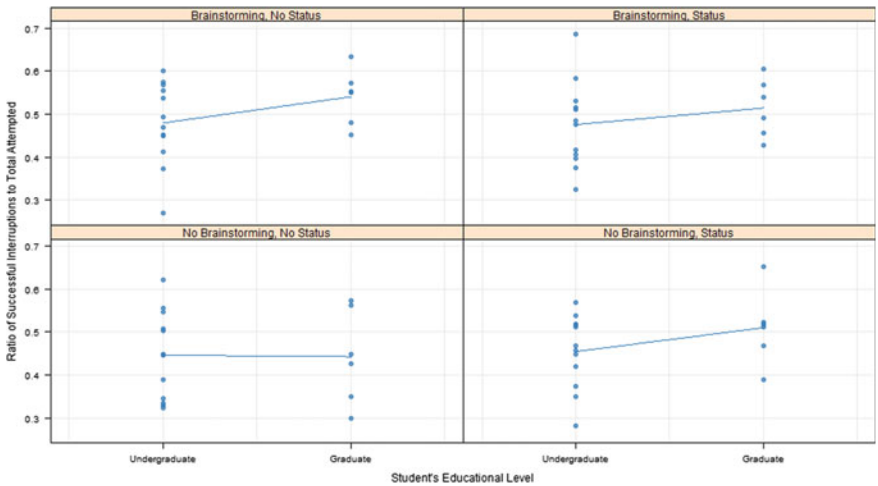


Fig. 5 Ratio of Successful Interruptions on Student's Degree Sought by Experimental Condition

Table 7 Group mean and slope by condition for ratio of successful Interruptions

	Mean	Slope
B/NS	0.499	0.061
B/S	0.488	0.039
NB/NS	0.444	−0.003
NB/S	0.473	0.056

grows more pronounced (slope = 0.061). With NB/NS, there is the most parity of all conditions (slope = −0.03). Furthermore, as the negative slope demonstrates, undergraduate participants are slightly favored in this condition.

Ultimately, in the case of successful interruptions, it appears that refraining from brainstorming is useful in situations in which status can be concealed. In cases where status must be revealed, however, brainstorming does hold some potential for decreasing the impacts of status.

5 Discussion

As previously outlined, there were three hypotheses being tested with the study to examine the impact of status and brainstorming on participation. These hypotheses and their findings are explored below.

H1: Explicit status differentials will lead to less satisfaction and less balance in participation.

The impact of concealing or revealing status varied across the different metrics of participation. Interestingly, there was more parity between graduate and undergraduate participants when status was revealed (in the no brainstorming condition) and this was also true in terms of self-ratings on group participation. However, if the objective is to bolster the participation of the lower power group then concealing status is more impactful as it demonstrated a negative slope demonstrating that undergraduates were speaking more than graduate students. Self turn-taking and ratio of successful interruptions most closely reflected the premises of the hypothesis with the concealed status leading to more equality between graduate and undergraduate students.

H2: Pre-event, individual-level brainstorming will lead to more balance in group participation

Brainstorming also had mixed outcomes in terms of potential for increasing parity in group participation. It seems that though brainstorming is believed to lead to lock-in (Heath and Heath 2013) that this may have been experienced in a detrimental way. Specifically, pre-event brainstorming led to less satisfaction among undergraduate participants. This drop in satisfaction is perhaps due to the ability to more readily and clearly compare individual observations with the decisions made by the group. This was more pronounced when status was concealed. This may be the result of experiencing power imbalances while having ambiguity in terms of whether or not that imbalance actually existed. Similarly, brainstorming was most detrimental to undergraduate self-turn taking and ratio of successful interruptions when status was concealed.

> *H3: Pre-event, individual-level brainstorming will increase participation and satisfaction in* groups where status difference is explicit.

On the first three dependent variables (total speaking time, average speaking segment, and self rating of group participation), brainstorming did not bolster participation when status was present as compared to when it was absent. However, on the final two dependent variables (ratio of successful interruptions and self-turn taking) there was an increase in parity when brainstorming was introduced as compared to when it was not. Though lower status participants spoke less, the findings suggest that their ability to take the floor (via interruption) was increased, as was their ability to think through an idea that they were presenting. If status was playing out in this dynamic, it did so via self-censoring.

In summation, the highest degree of parity or bolstering of low status participants occurred where status was obscured and in groups where no one brainstorms, since brainstorming appeared to bolster those with high status more than it did those with low status.

5.1 Limitations and Future Directions

One potential limitation within the study was the strength of the status manipulation. First, several of the graduate students referred to themselves as “first year students.” It is possible that, though they technically had higher status than the undergraduates, being new to the university of their program may have reduced their perceptions of status. Additionally, many of the undergraduates referred to themselves as “juniors” and “seniors” which suggests that while they may have lower status in terms of degree structure, that they may have more knowledge of the university and enjoy relatively higher and more secure status within their reference group at the university where the study took place.

A potential confound may be the result of the undergraduate participants recruitment from classes for Sustainability majors and many recognized other undergraduate study members from courses that they had together. As such there is a potential that the strength of the ingroup that was created was sufficient to usurp any status gained by the manipulation. This suggests that group membership could be explored as a way to bolster low status group members.

Finally, this study focused on one element within the scenario planning process, which is the ranking of potentially critical variables (though in the case of scenario planning this is system drivers rather than actual objects). Though this is an important first step, further studies should be conducted to examine other sub-processes that exist within scenario planning. For example, pre-event individual-level brainstorming may be more effective at enhancing participation for idea generation elements of scenario planning. Furthermore, as gender and group culture emerged as thematic findings in the case study, partial replications of this study should be conducted to understand how brainstorming might interact with those variables in terms of participation.

Acknowledgements Acknowledgements to David Lovis-McMahon and Camille Basilio for their support with the statistical analysis of this data.

References

Anderson, C., & Berdahl, J. L. (2002). The experience of power: Examining the effects of power on approach and inhibition tendencies. *Journal of Personality and Social Psychology, 83*(6), 1362–1377. doi:10.1037//0022-3514.83.6.1362.

Brown, V., Tumeo, M., Larey, T. S., & Paulus, P. B. (1998). Modeling cognitive interactions during group brainstorming. *Small Group Research, 29*(4), 495–526.

Bunderson, J. S. (2003). Recognizing and utilizing expertise in work groups: a status characteristics perspective. *Administrative Science Quarterly, 48*(557–591). doi:10.2307/3556637.

Cadinu, M., Maass, A., Rosabianca, A., & Kiesner, J. (2005). Why Do Women Underperform Under Stereotype Threat? Evidence for the Role of Negative Thinking. *Psychological Science, 16*(7), 572–578.

Caneel, R. (2005). *Social Signaling in Decision Making*. (M.Sc.), Swiss Federal Institute of Technology, Zurich.

Cashdan, E. (1998). Smiles, speech and body posture: how women and men display sociometric status and power. *Journal of Nonverbal Behavior, 22*(4), 209–228.

Collaros, P. A., & Anderson, L. R. (1969). Effect of perceived expertness upon creativity of members of brainstorming groups. *Journal of Applied Psychology, 53*(2), 159–163.

Connolly, T., Routhieaux, R. L., & Schneider, S. K. (1993). On the effectiveness of group brainstorming: Test of one underlying cognitive mechanism. *Small Group Research, 24*(4), 490–503.

Cooke, R. A., & Lafferty, J. C. (2006). *Desert survival situation*. Plymouth, MI: Human Synergistics.

Davis, J., Zaner, M., Farnham, S., Marcjan, C., & McCarthy, B. P. (2003). *Wireless brainstorming: overcoming status effects in small group decisions*. Paper presented at the System Sciences, 2003. Proceedings of the 36th Annual Hawaii International Conference on SystemSciences.

Delbecq, A. L., Van de Ven, A. H., & Gustafson, D. H. (1975). *Group techniques for program planning: A guide to nominal group and Delphi processes*. Glenview, IL: Scott, Foresman and Company.

Finn, J. D., Folger, J., & Cox, D. (1991). Measuring participation among elementary grade students. *Educational and Psychological Measurement, 51,* 393–402. doi:10.1177/0013164491512013.

Fiske, S. T. (2010). Interpersonal stratification: Status, power, and subordination. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *Handbook of Social Psychology* (Vol. 2). Hoboken, NJ: John Wiley & Sons Inc.

Guinote, A. (2007). Power affects basic cognition: Increased attentional inhibition and flexibility. *Journal of Experimental Social Psychology, 43*(5), 685–697. doi:10.1016/j.jesp.2006.06.008.

Halevy, N., Y. Chou, E., & D. Galinsky, A. (2011). A functional model of hierarchy: Why, how, and when vertical differentiation enhances group performance. *Organizational Psychology Review, 1*(1), 32–52. doi:10.1177/2041386610380991.

Hall, J. A., & Friedman, G. B. (1999). Status, gender, and nonverbal behavior: A study of structured interactions between employees of a company. *Personality and Social Psychology Bulletin, 25*(9), 1082–1091.

Hall, J. A., Coats, E. J., & LeBeau, L. S. (2005). Nonverbal behavior and the vertical dimension of social relations: A meta-analysis. *Psychological Bulletin, 131*(6), 898–924. doi:10.1037/0033-2909.131.6.898.

Heath, C., & Heath, D. (2013). *Decisive: How to make better choices in life and work*. New York: Random House.

Henrich, J., & Gil-White, F. J. (2001). The evolution of prestige: Freely conferred deference as a mechanism for enhancing the benefits of cultural transmission. *Evolution and Human Behavior, 22,* 165–196.

Inzlicht, M., & Ben-Zeev, T. (2000). A threatening intellectual environment: Why females are susceptible to experiencing problem-solving deficits in the presence of males. *Psychological Science, 11*(5), 365–371.

Keltner, D., Gruenfeld, D. H., & Anderson, C. (2003). Power, approach, and inhibition. *Psychological Review, 110*(2), 265–284. doi:10.1037/0033-295x.110.2.265.

Kimble, C. E., & Musgrove, J. I. (1988). Dominance in arguing mixed-sex dyads: Visual dominance patterns, talking time, and speech loudness. *Journal of Research in Personality, 22,* 1–16.

Kohn, N. W., & Smith, S. M. (2011). Collaborative fixation: Effects of others' ideas on brainstorming. *Applied Cognitive Psychology, 25*(3), 359–371. doi:10.1002/acp.1699.

Kurtzberg, T. R., & Amabile, T. M. (2000). From Guilford to creative synergy: Opening the black box of team-level creativity. *Creativity Research Journal, 13*(3 & 4), 285–294.

Leaper, C., & Ayres, M. M. (2007). A meta-analytic review of gender variations in adults' language use: talkativeness, affiliative speech, and assertive speech. *Pers Soc Psychol Rev, 11* (4), 328–363. doi:10.1177/1088868307302221.

Lücken, M., & Simon, B. (2005). Cognitive and affective experiences of minority and majority members: The role of group size, status, and power. *Journal of Experimental Social Psychology, 41*(4), 396–413. doi:10.1016/j.jesp.2004.08.006.

Lunenburg, F. C. (2011). Decision making in organizations. *International Journal of Management, Business, and Administration, 15*(1), 1–9.

Mast, M. S. (2002). Dominance as expressed and inferred through speaking time. *Human Communication Research, 28*(3), 420–450.

Mast, M. S., & Hall, J. A. (2004). Who is the boss and who is not? Accuracy of judging status. *Journal of Nonverbal Behavior, 28*(3), 145–165.

Mazur, A. (1985). A biosocial model of status in face-to-face primate groups. *Social Forces, 64*(2), 377–402.

Menz, F., & Al-Roubaie, A. (2008). Interruptions, status and gender in medical interviews: The harder you brake, the longer it takes. *Discourse & Society, 19*(5), 645–666.

Moore, J. C. (1968). Status and influence in small group interactions. *Sociometry, 31*(1), 47–63.

Mullen, B., Johnson, C., & Salas, E. (1991). Productivity loss in brainstorming groups: A meta-analytic integration. *Basic and Applied Social Psychology, 12*(1), 3–23. doi:10.1207/s15324834basp1201_1.

Muthén, L., & Muthén, B. BO 1998–2012. *Mplus user's guide, 7.*

Niu, W., & Sternberg, R. (2002). Contemporary studies on the concept of creativity: The East and the West. *Contemporary Studies, 36*(4), 269–288.

Osborn, A. F. (1963). *Applied Imagination; Principles and Procedures of Creative Problem-solving.* New York: Scribner.

Paulus, P. B., Larey, T. S., & Ortega, A. H. (1995). Performance and perceptions of brainstormers in an organizational setting. *Basic and Applied Social Psychology, 17*(1–2), 249–265. doi:10.1080/01973533.1995.9646143.

Pentland, A. S. (2010). *Honest signals*. Cambridge, MA: MIT press.

Peterson, G. D., Cumming, G. S., & Carpenter, S. R. (2003). Scenario planning: A tool for conservation in an uncertain world. *Conservation Biology, 17*(2), 358–366.

Rodegher, S. L. (2015). *Scenario planning for sustainability: Understanding and enhancing participation in group deliberations.* ARIZONA STATE UNIVERSITY.

Sachdev, I. (1991). Power and status differentials in minority and majority group relations. *European Journal of Social Psychology, 21,* 1–24.

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change, 16*(3), 282–292. doi:10.1016/j.gloenvcha.2006.03.008.

Stam, D., De Vet, A., Barkema, H. G., & De Dreu, C. K. W. (2013). Suspending group debate and developing concepts. *Journal of Product Innovation Management, 30*(S1), 48–61. doi:10.1111/jpim.12063.

Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology, 69*(5), 797–811.

Stewart, T. R. (2000). Uncertainty, judgment, and error in prediction. In D. Sarewitz, R. A. Pielke, & R. Byerly (Eds.), *Prediction: Science, decision making, and the future of nature*. Washington, DC: Island Press.

Thomas-Hunt, M. C., & Phillips, K. W. (2004). When what you know is not enough: Expertise and gender dynamics in task groups. *Personality and Social Psychology Bulletin, 30*(12), 1585–1598. doi:10.1177/0146167204271186.

Webster, M., & Driskell, J. E. (1978). Status generalization: A review and some new data. *American Sociological Review, 43*(2), 220–236.

Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., & Malone, T. W. (2010). Evidence for a collective intelligence factor in the performance of human groups. *Science, 330*(6004), 686–688. doi:10.1126/science.1193147.

Ziegler, R., Diehl, M., & Zijlsrta, G. (2000). Idea production in nominal and virtual groups: Does computer-mediated communication improve group brainstorming? *Group Processes & Intergroup Relations, 3*(2), 141–158.

Promoting Participation in a Culture of Sustainability Web Survey

Heather M. Schroeder, Andrew L. Hupp and Andrew D. Piskorowski

Abstract

The Sustainability Cultural Indicators Program (SCIP) at the University of Michigan is designed to measure and track the university's progress (Callewaert and Marans 2017) in moving the campus community towards a culture of sustainability. SCIP gathers this data using a web survey conducted annually. Web surveys generally attain lower response rates than other modes of data collection. Web surveys are also at risk of other forms of nonresponse, such as breakoffs, which happen less frequently in other modes. Breakoffs commonly occur very early in a web survey, often on informed consent screens required by Institutional Review Boards (IRBs), before respondents have a chance to get to the survey content. There are many methods used (prenotification, incentives, etc.) to try to increase participation and reduce breakoffs. This paper investigates the efficacy of two experiments designed to increase participation and reduce breakoffs in two SCIP surveys. The first experiment examines the effect of "celebrity endorsement". As part of the final email reminder, respondents were randomized to receive a reminder with a link to the survey or a reminder that also contained a link to a video of a head coach from the U-M Department of Athletics encouraging non-respondents to participate. The second experiment investigates informed consent screen design. One group was presented a screen appearing as a traditional informed consent form. The other group was presented a screen with the most important items visible and the rest of the information available via a series of accordion menus.

H.M. Schroeder (✉) · A.L. Hupp · A.D. Piskorowski
Survey Research Center, University of Michigan, Ann Arbor, MI, USA
e-mail: schroedh@umich.edu

A.L. Hupp
e-mail: ahupp@umich.edu

A.D. Piskorowski
e-mail: apiskoro@umich.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_21

Keywords
Email · Paradata · Sustainability survey · Consent screen design · Breakoff Celebrity endorsement

1 Introduction

Web surveys are an increasingly common form of data collection (Couper 2000, 2008; see also Callegaro et al. 2015) and are particularly attractive for studies that investigate attitudes on sustainability given their sustainable nature. Web survey data collection utilizes electronic resources including emails and web based survey instruments which once programmed can use virtually the same amount of resources to collect data from 1 to 10,000 people. Other modes of data collection such as telephone or face to face interviewing tend to have higher response rates compared to web surveys (Lozar Manfreda et al. 2008), but are less sustainable given their need for paper, pencils, and travel expenses including gas and the cost of interviewer time. Maximizing the efficiency of web surveys is therefore an important topic of study to increase the overall sustainability of attitudinal data collection.

One component of lower response rates in web surveys can be attributed to persons who start the survey and then do not complete it, commonly referred to as a breakoff. Peytchev (2009) reports on two meta-analyses that showed median breakoff rates in the 16–34% range. Breakoffs generally occur early in the survey, and Couper (2008) suggests that the early screens in a survey often do a poor job engaging the participant. These initial screens often contain informed consent information required by Institutional Review Boards (IRBs) and can appear arduous and often contain a large amount of information.

Over recent years the use of smaller platforms, such as smartphones and tablets, for accessing the internet has steadily increased (Pew 2015). Surveys designed for the web, which are often optimized for platforms such as desktop computers, may be poorly suited for viewing on increasingly popular smaller platforms. These smaller screens coupled with typical informed consent screen designs force users to scroll through pages of information that may not look as burdensome on a desktop or laptop, motivating a participant to breakoff. The rising popularity of smartphones and tablets requires the adaptation of web surveys to accommodate these smaller screen dimensions in an attempt to curb breakoffs and therefore boost response rates.

There are many strategies to increase participation in web surveys including, incentives (Bosjnak and Tuten 2003), multiple contact attempts (Cook et al. 2000) including prenotifications (Bosnjak et al. 2008; Crawford et al. 2004; Harmon et al. 2005; Holland et al. 2014; Kaplowitz et al. 2004), reminder emails (Harmon et al. 2005; Trouteaud 2004; Tuten 2005; Vehovar et al. 2002), and telephone reminder calling (Schonlau et al. 2003).

This work sought to determine strategies to increase platform specific web survey participation using surveys implemented in the 2014 and 2015 Sustainability Cultural Indicators Program (SCIP) web survey data collections at the University of Michigan. Two experiments were designed and implemented to deter breakoffs and encourage more reluctant sample members to participate.

The first involved randomizing participants to receive either a traditional consent screen design or a modified consent screen design that featured accordion menus (see Fig. 1). The accordion design displayed the six most relevant items followed by three menus that showed the major consent topic headings. The menus could be expanded to see the full set of items associated with the particular menu heading. The accordion design contained identical information as the traditional consent screen but required far less scrolling on smaller platforms. This experiment aimed to test the hypothesis that small platforms yield high breakoff rates due in part to the ardor of long consent screens that lead to a lot of scrolling.

Work by Dillman et al. (2014) regarding contacting respondents suggests that each communication with a potential respondent should have its own look and message. Changing the content of follow up email reminders to appeal to different people could sway reluctant persons into participating in the survey. With this in mind, the second strategy tested the hypothesis that a local celebrity endorsement increases survey participation. Each year a different head coach from the U-M Department of Athletics was asked to record a video highlighting the importance of participating in sustainability research and encouraging participation in the survey. An experiment was implemented in the final follow up email reminder. Those that had not responded before the final reminder were randomized into one of two groups—one that received links to the head coach video and web survey, and one that received a link to the web survey only.

2 Study Background

The Sustainability Cultural Indicators Program (SCIP) is a collaborative effort between the U-M Graham Sustainability Institute and the U-M Institute for Social Research designed to not only track sustainability culture and practices but also to inform educational programs on the University of Michigan campus. Sustainability culture is meant to reflect a set of attitudes, behaviors, level of understanding commitment, degrees of engagement, and dispositions among members of the campus community (see Callewaert and Marans 2017 for detail on SCIP).

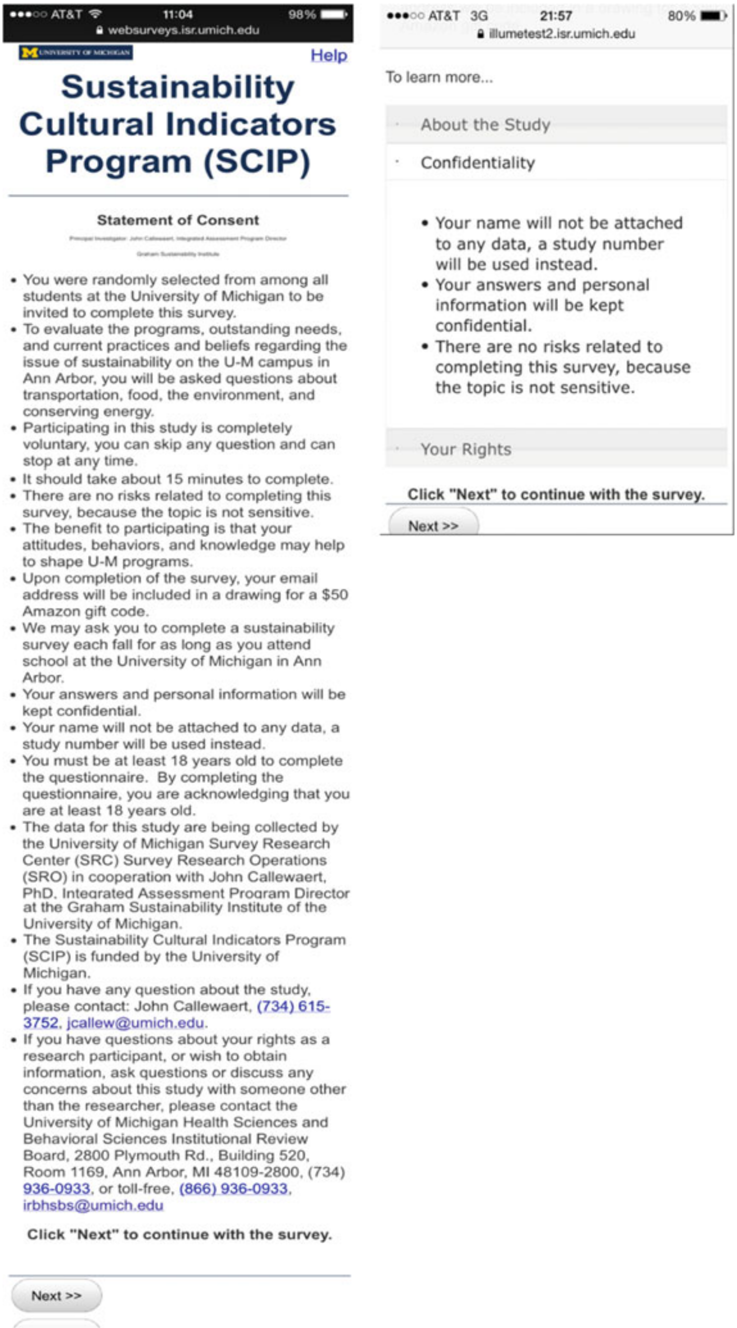


Fig. 1 Traditional consent design *left* accordion consent design *right* as viewed on a smartphone

SCIP began collecting data to access the campus sustainability culture in 2012 through an annual web survey conducted during the fall semester. A stratified cross-sectional sample of roughly 21,000 faculty, staff and students is selected each year as well as a rotating panel of roughly 3000 undergraduate students. This work focuses on the cross-sectional samples from 2014 and 2015. The survey is designed to take approximately 15 minutes and upon completing the survey respondents are entered into a lottery drawing for a $50 gift card. For further details see Chap. Use of Email Paradata in a Survey of Sustainability Culture this volume.

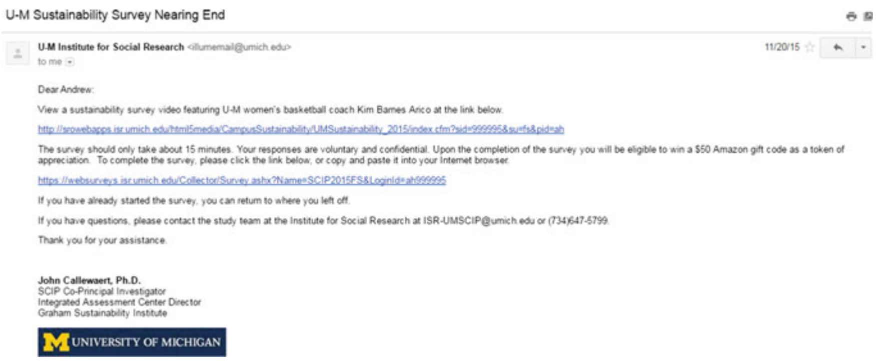
Data collection protocol begins with each sample member receiving a prenotification email from the president of the university giving background on the study and informing them that the following day they would receive an email invitation to complete the survey. The invitation was the first communication that contained a link for the survey. Those who had not started the survey after 4 days were sent the first email reminder, after 10 days of non-response they were sent the second email reminder, and after 16 days the third and final email reminder was sent. Half of the sample members were randomly assigned to receive an additional link for the local celebrity endorsement video as part of the last reminder. In 2014 the local celebrity featured in the endorsement video was the head women's softball coach and in 2015 the head women's basketball coach for the University of Michigan.

A previous wave of the SCIP study in 2012 featuring the head men's basketball coach in the endorsement video experimented with the optimal timing for including the video link. One group received the video link as part of the first reminder and the other group did not receive the video link until the final reminder. There was a modest improvement in response rate for those that saw the video at either time point. The most cooperative respondents are captured by the invitation and by the earlier reminders, while later reminders target less interested sample members. Therefore it was decided that future waves of SCIP data collection would utilize local celebrity endorsement videos in a later email reminder in an effort to increase participation. In 2013 the endorsement video featured the head U-M swimming and diving coach in an email that preceded the second reminder.

3 Methods

3.1 Experimental Assignments

In the 2014 and 2015 waves of data collection selected students, faculty, and staff members from the University of Michigan's Ann Arbor campus were invited to participate in the SCIP survey. Half of the sample was randomly assigned to receive the traditional consent screen design while the other half was assigned to receive the accordion style consent screen design. Likewise, sample members had a 50/50 chance to receive the celebrity endorsement video link as part of the final email reminder (see Fig. 2). Only those that did not complete the survey from the invitation or the first two reminder emails received the final email reminder, therefore



U-M Sustainability Survey Nearing End

U-M Institute for Social Research <illumemail@umich.edu> 11/20/15
to me

Dear Andrew:

View a sustainability survey video featuring U-M women's basketball coach Kim Barnes Arico at the link below.

http://srowebapps.isr.umich.edu/html5media/CampusSustainability/UMSustainability_2015/index.cfm?sid=999995&su=fs&pid=ah

The survey should only take about 15 minutes. Your responses are voluntary and confidential. Upon the completion of the survey you will be eligible to win a $50 Amazon gift code as a token of appreciation. To complete the survey, please click the link below, or copy and paste it into your Internet browser.

https://websurveys.isr.umich.edu/Collector/Survey.ashx?Name=SCIP2015FS&LoginId=ah999995

If you have already started the survey, you can return to where you left off.

If you have questions, please contact the study team at the Institute for Social Research at ISR-UMSCIP@umich.edu or (734)647-5799.

Thank you for your assistance.

John Callewaert, Ph.D.
SCIP Co-Principal Investigator
Integrated Assessment Center Director
Graham Sustainability Institute

UNIVERSITY OF MICHIGAN

Fig. 2 Email reminder 3 with video link

analysis of the celebrity endorsement video experiment is subset to those that opened the final reminder. 75% of all sample members were sent a third email reminder, and of those 45% opened the email.

3.2 Measures

A complete survey is defined as completing 80% of the questionnaire and a breakoff is defined as starting the questionnaire but not completing at least 80% of the questions. Consent specific breakoff is the special case of breakoff where the last survey page the respondent visited before exiting the survey was the consent screen. AAPOR Response Rate 2 (AAPOR 2016) is calculated as complete and partial interviews divided by the number invited to take the survey excluding those considered non-sample. Breakoff rate and consent specific breakoff rate are calculated as the number of cases that breakoff divided by the number of cases that started the survey. Response and breakoff rates were calculated for each of the experimental groups described above. Pearson Chi-square tests were used to assess statistical significance.

Platform is defined as three distinct categories of devices—smartphones, tablets, and personal computers (laptops and desktops). Devices like an iPhone, Nexus 5 or Galaxy S6 are categorized as smartphones; while devices like an iPad, Nexus 10 or Galaxy Note are classified as tablets. Personal computers are a singular device. Information regarding the platform used to access the email and/or survey was obtained from the user-agent string. The user-agent string is a text string that contains information about the device being used to access a website (Callegaro 2010, 2013). That information is captured when a participant accesses the web survey and is parsed, categorized, and summarized into a specific platform: PC (desktop/laptop), smartphone, or tablet.

To capture information related to email engagement a web beacon was used (see Chap. Use of Email Paradata in a Survey of Sustainability Culture this volume).

Each email contains a graphic that points to a URL on a server. Each time an email is opened a receipt is registered. These types of data (e.g., platform, email engagement) are considered paradata. Paradata is data that is generated by the data collection process and is used to improve the survey process (Couper 1998).

After the 2012 survey, the U-M switched to Gmail from their internet message access protocol (IMAP) infrastructure. The U-M Health System did not make that switch. Paradata gathered from the web beacon showed that email engagement was low for sample members in this group. Their email client is likely either text-based (not html) or set to block images at the server level which disables the web beacon. This impacts the ability to determine if an email was opened for sample members in the health system, however these cases were retained in this work since it was a small proportion of the sample population.

4 Results

4.1 Study Results

Of the 36,540 U-M faculty, staff, and students selected for the 2014 and 2015 waves of SCIP data collection, (18,302 from 2014 and 18,238 from 2015), 9830 (5326 from 2014 and 4504 from 2015) completed the survey, Table 1. Thus the overall response rate of 24.7% in 2015 was lower than the 29.1% response rate achieved in 2014. Faculty and staff members were twice as likely to participate compared to students, 41.8% versus 21.3%, respectively. Table 1 also shows that the breakoff rate was higher in 2015 as compared with 2014, 15.0% and 13.5% respectively, and nearly twice as high for students (17.3%) compared with faculty/staff members (9.4%). 82.5% of those that started the survey did so from a PC, 16.3% from a smart phone and 1.2% from a tablet.

4.2 Consent Designs

Response and breakoff rates were also calculated within each consent experiment group. 27.5% of those in the traditional consent design group completed the survey while 26.3% completed from the shortened accordion style consent design group, Fig. 3 (Chi-square p-value = 0.006). The pattern of a slightly higher response rate in the traditional consent design compared to the accordion consent design holds across the two data collection years and across faculty/staff compared with students. The group that received the traditional consent design had an overall breakoff rate of 13.1%, while the accordion consent design group saw a higher (15.3%) overall breakoff rate (Chi-square p-value = 0.007). As seen in Table 2, this overall pattern of more breakoffs in the accordion design group held within each platform used to access the survey where there was a roughly 2 percentage point increase for those with the accordion consent design in each group. Breakoff rates were approximately

Table 1 Response and breakoff rates of 2014–2015 SCIP data collection at U-M

	2014			2015			Total		
	Faculty/Staff	Students	All	Faculty/Staff	Students	All	Faculty/Staff	Students	All
Sample	4965	13,337	18,302	4979	13,259	18,238	9944	26,596	36,540
Start survey	2358	3796	6154	2235	3063	5298	4593	6859	11,452
Complete	2145	3181	5326	2014	2490	4504	4159	5671	9830
Breakoff	213	615	828	221	573	794	434	1188	1622
Response rate	43.2%	23.9%	29.1%	40.4%	18.8%	24.7%	41.8%	21.3%	26.9%
Breakoff rate	9.0%	16.2%	13.5%	9.9%	18.7%	15.0%	9.4%	17.3%	14.2%

Fig. 3 Response rate by consent experiment group

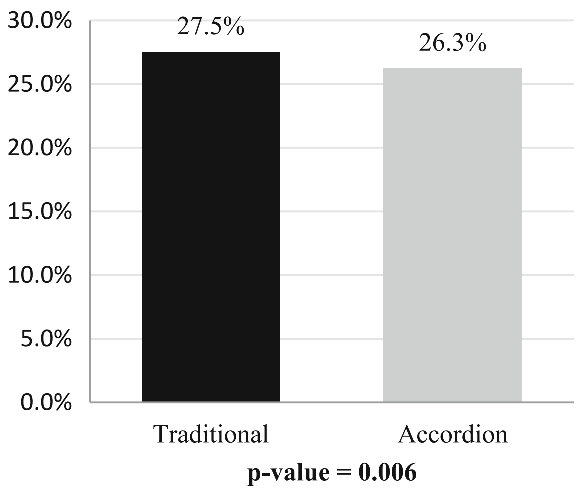


Table 2 Breakoff Rates by platform used to access SCIP survey

	PC/Tablet[a]			Smartphone			Overall		
Consent group	Trad	Accord	Overall	Trad	Accord	Overall	Trad	Accord	Overall
Start survey	4819	4761	9580	943	928	1871	5762	5689	11,451
Breakoff	553	646	1199	201	222	423	754	868	1622
Consent breakoff	141	172	313	48	38	86	189	210	399
Breakoff rate	11.5%	13.6%	12.5%	21.3%	23.9%	22.6%	13.1%	15.3%	14.2%
Consent breakoff rate	2.9%	3.6%	3.3%	5.1%	4.1%	4.6%	3.3%	3.7%	3.5%

[a]9443 cases use a PC and 137 cases used a tablet to access SCIP survey

ten percentage points higher among those using a smartphone compared with those using a PC or tablet.

When looking more closely at breakoffs that occur specifically at the time the respondent views the consent screen, there is a slightly higher consent specific breakoff rate in the accordion design group on PC/tablet, but within smartphone users there is a slight difference in the opposite direction; a lower consent specific breakoff rate in the accordion group. However, neither of these differences is statistically significant (PC/tablet Chi-square p-value = 0.096, smartphone Chi-square p-value = 0.304). Therefore, the accordion consent design had a slightly negative impact on response and breakoffs, and has the same effect on PCs and tablets as it does on a smartphone.

The median amount of time respondents spent on the consent page was 6 s overall with no observable differences between the consent experiment groups, study years or platforms used to access the survey. Faculty/staff spent a slightly

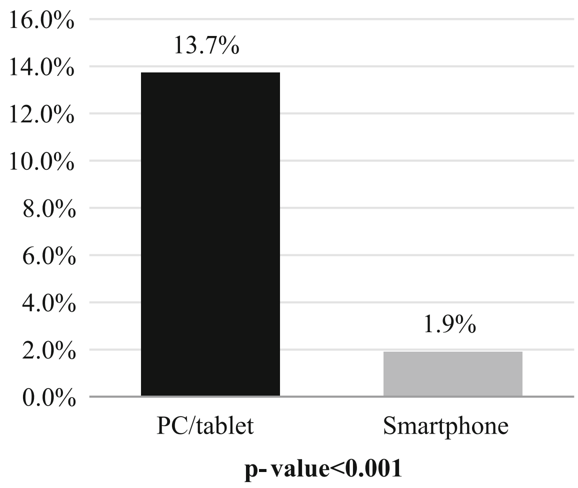


Fig. 4 Respondents expanding accordion menus by platform

longer time on the consent page with a median of 7 s while students had a median of 5.5 s; the distribution of amount of time on the consent page was similar in both consent screen experiment groups.

Further exploration showed that 11.7% of respondents who started the survey and were assigned to the accordion consent design expanded at least one of the accordion menus. As seen in Fig. 4, 13.7% of respondents using a PC/tablet expanded at least one accordion menu, while only 1.9% of respondents using a smartphone expanded any menus (Chi-square p-value < 0.001). There was no difference in accordion menu expansion between faculty/staff and students, but there was a decline in accordion menu expansion from 13.0% in 2014 compared with 10.3% in 2015 (Chi-square p-value = 0.002). These results suggest that few respondents are reading either style of the consent form in detail.

4.3 Video Endorsement

Figure 5 illustrates the difference in response and breakoff rates for the 12,395 sample members who opened the 3rd email reminder by video endorsement experiment group. Those in the group without a video endorsement link had a response rate twice as high as those with the endorsement video, 6.7% and 3.3% respectively (Chi-square p-value < 0.001). 68.3% of cases in the video group that started the survey did not complete compared to the 53.4% breakoff rate in the group without a video link (Chi-square p-value <= 0.001). The pattern was the same across study years, platforms used to access the survey and between faculty/staff and students. A logistic regression model of breakoff was used to assess the multivariate effect of both experiments simultaneously while controlling for device the respondent used to start the survey. An interaction term between the two experimental conditions was also tested, but the model failed to show a

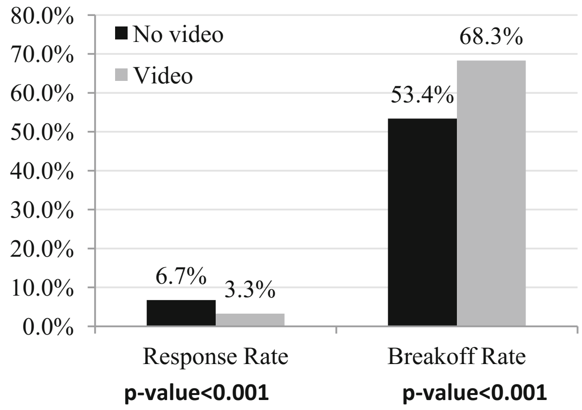


Fig. 5 Response and breakoff rate by local celebrity endorsement video experiment group

significant interaction between the two experimental treatments, and produced similar results as found with the bivariate analysis described above. It can therefore be concluded that inclusion of the video link in the last email reminder had a negative effect on participation.

5 Discussion

5.1 Consent Designs

The accordion consent design experiment was designed to study the effect of a shortened consent form on breakoffs since respondents need to be in the survey to view the consent screen. Overall the accordion style consent design performed slightly worse regarding response rate, breakoff rate, and consent specific breakoff rate compared to the traditional consent design. Platform used to access the survey has a significant impact on breakoffs, with breakoffs more common on a smartphone compared to a PC or tablet. However, the original hypothesis that the accordion consent design that required less scrolling would perform particularly well on a smaller screen was also negated since the pattern of higher breakoff in the accordion consent design held within smartphone users.

The results suggest that scrolling through a large amount of consent text does not impact completions or breakoffs. Smartphone users are certainly used to scrolling through long forms, as a growing number of apps, user profiles, etc. require long consent forms. The well-educated population studied here might be accustomed to quickly scrolling through consent or legal language and they are conditioned to accept this as a normal practice. The median time spent on the consent page was just six seconds which is not a plausible amount of time to read the information thoroughly. Respondents may also feel that the researchers are trying to hide or bury information in the accordion menus. They may find it comforting to see the length of the traditional consent design and assume that appropriate measures were taken to protect their privacy and best interests. It is also possible that one or more of the accordion menus (“About the Study”, “Confidentiality”, and “Your Rights”) cause respondents to think their rights or confidentiality are in question and lead them to decide against participating.

A closer look at how often respondents expand the accordion menus revealed a distinct difference between platform used to access the survey. Just 2% of those that used a smartphone expanded any accordion menu and a much higher proportion, 14%, expanded an accordion menu while using a PC or tablet. This difference, however, did not save them any time, since the distribution of time spent on the consent screen was similar across platforms. It is possible that those on a PC were more likely to expand an accordion menu because it is easier to access an accordion menu by clicking with a mouse than tapping with your finger. As people move toward using smaller devices to access the internet and therefore web based surveys, one should consider using the traditional consent design since it yielded higher response and fewer breakoffs.

5.2 Video Endorsement

The original hypothesis that including a celebrity endorsement video link in the final reminder would encourage sample members to participate was again not upheld by these analyses. Including a video link in the final reminder had a negative impact on both the response rate and the breakoff rate. When narrowing down to those that opened the final reminder, email breakoff rates were twice as high and the response rate was almost fifteen percentage points lower for those with a video link.

It is possible that sample members may inherently mistrust an email that contains multiple URL links. Those in the endorsement video group saw two links in the final reminder (see Fig. 2), one for the video and one for the survey. With many phishing attempts and spam emails in circulation it may cause a general mistrust of emails with multiple links and cause users simply to delete an email with multiple links. The video link may have distracted respondents from the survey task itself by directing them away from the email and the link to the survey. Future studies might embed the video directly in the email rather than including an additional link so the screen capture of the video can be seen directly from the email. This may not be possible with all email providers, but the U-M uses Gmail which makes this a possibility in future waves of SCIP data collection.

It is also possible that the celebrities used in the 2014 and 2015 videos might not have been salient enough for the target population to have a positive impact on response. The head women’s softball coach and head women’s basketball coach may not be recognizable and therefore not influential enough to encourage participation to a large portion of the sample. A possible future direction might be to use a higher profile local celebrity such as the president of the university (see Chap. Use of Email Paradata in a Survey of Sustainability Culture this volume for an example related to email opening rates by different senders) or to use tailored videos that target subgroups of the sample that have greater recognition. For example; use a doctor or other health care professional endorsement for those that work in the university's health care system and use the dean of each college to target students in that specific college. However, care should be taken to keep the endorser removed enough from individuals being targeted so the endorsement is not perceived as coercion.

In summary the experiments from the 2014–2015 SCIP data collections did not produce the positive effects on response that were anticipated. The local celebrity endorsement video seemed to have a slightly negative effect on response and breakoff, and the accordion informed consent screen design failed to decrease breakoffs within smartphone and tablet users. Further research in these areas could focus on different types of local celebrities who are more salient to the population of interest, or go one step further and tailor the local celebrity specifically to different subgroups of the target population. More experimentation with different consent screen design options is necessary to continue the search for an optimal design that conveys the necessary information while not discouraging participation.

Acknowledgements The authors thank the Office of the Provost at the University of Michigan for funding the SCIP. Thanks to John Callewaert and Robert Marans for allowing the research to be conducted on the SCIP and to the reviewers for their useful suggestions.

References

Bosnjak, M., & Tuten, T. L. (2003). Prepaid and promised incentives in web surveys: An experiment. *Social Science Computing Review, 21*(2), 208–217.

Bosnjak, M., Neubarth, W., Couper, M. P., Bandilla, W., & Kaczmirek, L. (2008). Prenotification in web surveys: The influence of mobile text messaging versus e-mail on response rates and sample composition. *Social Science Computing Review, 26*(2), 213–223.

Callegaro, M. (2010). Do you know which device your respondent has used to take your online survey? *Survey Practice*, *3*(6), 1–12.

Callegaro, M. (2013). Paradata in web surveys. *Improving Surveys with Paradata*, 259–279.

Callegaro, M., Manfreda, K. L., & Vehovar, V. (2015). *Web survey methodology*. Thousand Oaks: Sage.

Callewaert, J., & Marans, R. W. (2017). Measuring progress over time: The sustainability cultural indicators program at the University of Michigan. In W. Leal (ed.). *Handbook of theory and practice of sustainable development in higher education* (Vol. 2). New York: Springer.

Cook, C., Heath, F., & Thompson, R. L. (2000). A meta-analysis of response rates in web-or internet-based surveys. *Educational and Psychological Measurement*, *60*(6), 821–836.

Couper, M. P. (1998). Measuring survey quality in a CASIC environment. *Proceedings of the survey research methods section, ASA,* pp. 41–49.

Couper, M. P. (2000). Review: Web surveys: A review of issues and approaches. *Public Opinion Quarterly, 64*(4), 464–494.

Couper, M. P. (2008). *Designing effective web surveys*. New York: Cambridge University Press.

Crawford, S. D., McCabe, S. E., Saltz, B., Boyd, C. J., Freisthler, B., & Paschall, M. J. (2004). Gaining respondent cooperation in college web-based alcohol surveys: Findings from experiments at two universities. Paper presented at the 59th annual conference of the American Association for Public Opinion Research, Phoenix, AZ, May.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys*. Hoboken: Wiley.

Harmon, M. A., Westin, E. C., & Levin, K. Y. (2005). Does type of pre-notification affect web survey response rates? Paper presented at the 60th annual conference of the American Association for Public Opinion Research, Miami Beach, FL, May.

Holland, L., Couper, M. P., & Schroeder, H. (2014), Pre-notification strategies for mixed-mode data collection. Paper presented at the 69th annual conference of the American Association for Public Opinion Research, Anaheim, CA, May.

Kaplowitz, M. D., Hadlock, T. D., & Levine, R. (2004). A comparison of web and mail survey response rates. *Public Opinion Quarterly, 68*(1), 94–101.

Lozar Manfreda, K., Bosnjak, M., Berzelak, J., Haas, I., & Vehovar, V. (2008). Web surveys versus other survey modes: A meta-analysis comparing response rates. *International Journal of Market Research, 50*(1), 79–104.

Pew Research Center. (April, 2015). The smartphone difference. http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/.

Peytchev, A. (2009). Survey breakoff. *Public Opinion Quarterly, 73*(1), 74–97.

Schonlau, M., Asch, B. J., & Du, C. (2003). Web surveys as part of a mixed-mode strategy for populations that cannot be contacted by e-mail. *Social Science Computer Review, 21*(2), 218–222.

The American Association for Public Opinion Research. (2016). Standard definitions: Final dispositions of case codes and outcome rates for surveys. 9th edition. AAPOR.

Trouteaud, A. R. (2004). How you ask counts: A test of internet-related components of response rates to a web-based survey. *Social Science Computer Review, 22*(3), 385–392.

Tuten, T. L. (2005). Do reminders encourage response by affect response behaviors? reminders in web-based surveys. Paper presented at the ESF workshop on internet survey methodology, Dubrovnik, Croatia, September.

Vehovar, V., Batagelj, Z., Lozar Manfreda, K., & Zaletel, M. (2002). Nonresponse in web surveys. In R. M. Groves, D. A. Dillman, J. L. Eltinge, & R. J. A. Little (Eds.), *Survey Nonresponse* (pp. 229–242). New York: Wiley.

Author Biographies

Heather M. Schroeder is a Research Associate in the Survey Research Center at the University of Michigan. She received an MS in Biostatistics from the University of Michigan and a BS in Mathematics/Statistics from Ohio Northern University. Her current research interests include data visualization, dashboard creation, and the analysis of paradata to optimize data collection processes.

Andrew L. Hupp is a Survey Specialist Senior in the Survey Research Center at the University of Michigan. He received an MSc in Geographic Information Systems (GIS) from the University of Leeds and a BA in Geography from the University of Northern Iowa. His current research interests include the web survey process and their related paradata, data collection with mobile devices, technology design and implementation in surveys, and geographic information systems.

Andrew D. Piskorowski is a Data Manager in the Survey Research Center at the University of Michigan. He received a BS in Economics and Statistics from the University of Michigan. His current research interests are the web survey process, including respondent survey progression, the related methods for survey data and paradata collection, and data storage and optimization for processing and analysis.

Use of Email Paradata in a Survey of Sustainability Culture

Andrew L. Hupp, Heather M. Schroeder and Andrew D. Piskorowski

Abstract

Survey data collection is often utilized to study/gage public perceptions of sustainability, and can use considerable resources to carry out. It seems natural that collecting data about sustainability and the culture of sustainability should be done in a sustainable way, optimizing the use of available resources. This paper strives to investigate and understand respondent engagement with web survey email invitations. This is important because often less sustainable contact methods are used in follow-up to raise response rates. This paper uses data from the Sustainability Cultural Indicators Program (SCIP) survey at the University of Michigan (U-M). During the 2014 and 2015 data collections, email paradata was utilized to understand sample members' engagement with emails sent asking them to complete a survey. Engagement is determined by using email paradata combined with paradata from the survey about access and completion. Low engagement may mean not receiving (e.g. spam, bad email address, etc.) or never opening the email. High engagement with low survey access (and completion) may mean there are other attributes (e.g. survey length, survey topic, incentive, how the data will be used, etc.) of the design affecting the decision to participate that researchers may need to address. The data also provide insight as to when emails are opened. This has the potential for the survey practitioners to focus on optimal times to attempt contact to try to gain cooperation. Three engagement analyses were conducted. The first analysis looks at the open rate for each email type (prenotification, invitation, reminder 1,

A.L. Hupp (✉) · H.M. Schroeder · A.D. Piskorowski
Survey Research Center, University of Michigan, Ann Arbor, MI, USA
e-mail: ahupp@umich.edu

H.M. Schroeder
e-mail: schroedh@umich.edu

A.D. Piskorowski
e-mail: apiskoro@umich.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_22

etc.). The second analysis looks at the elapsed time (lag) between sending and opening of each email type. The final analysis looks at the optimal day to send an email invitation to elicit response. This information can be used to inform future survey design decisions and provide insight into non-response.

Keywords
Email · Paradata · Sustainability culture · Web survey

1 Introduction

There is a critical need for accurate, reliable information about sustainability, and more specifically, the culture of sustainability. A key tool used to measure people's awareness and behaviors about sustainability is a survey asking about these topics. The goal of any survey is to be efficient, and gather high quality data given available resources. It seems natural that a survey that addresses attitudes and behaviors related to sustainability should have a survey design that is also sustainable and maximizes the use of available resources.

The most sustainable and environmentally friendly method of data collection is a web survey. Web surveys are low cost in nature, (Couper 2000) and utilize primarily electronic resources rather than the additional resources, such as gas for shipping or travel, needed for other types of data collection (e.g. mail or face-to-face interviewing). However, web surveys tend to see lower response rates than other data collection modes (Couper and Miller 2008; Lozar Manfreda et al. 2008). If a web survey does not meet response rate requirements other less sustainable methods of contact, such as mailing paper letter reminders, can be used to encourage response. Optimizing the execution of a web survey could eliminate the need for additional less-sustainable follow up methods, making the survey design more sustainable.

Respondents are typically invited to a web survey through email. Much research has been done with regard to optimizing the content of an invitation email (Couper 2008). A less studied area is how participants interact, or engage with email invitations and reminders. This interaction can include whether the email was opened, if opened how long after the email was sent was it opened, and what platform (PC, smartphone, tablet) was used to access the email. Studying this interaction could help diagnose whether non-response is attributable to possible delivery problems, or some other factor of the survey design. A better understanding of this interaction can be used to optimize not only invitation content but also timing and frequency of the email communications, in an effort to maximize response rates.

This paper examines email paradata collected from two waves of an annual sustainability survey conducted at the University of Michigan. It describes how a sample of university students, staff, and faculty engage (open) with emails sent to them. Lag time between sending and opening of an email is studied along with which day of the week an email is sent produces the best results. Understanding these nuances will inform future survey designs to use study resources in the most efficient and sustainable way possible.

2 Sustainability Cultural Indicators Program

2.1 Sample

Since 2012, the University of Michigan (U-M) has a program that conducts an annual survey on the culture of sustainability, the Sustainability Cultural Indicators Program (SCIP). SCIP is a collaboration between the U-M's Graham Sustainability Institute and the Institute for Social Research (ISR). The study is designed to track sustainability culture and inform educational programs and operations on the U-M's Ann Arbor campus (Callewaert and Marans 2017). A key component of the SCIP is an annual web survey. A sample of approximately 21,000 faculty, staff and students at the U-M's Ann Arbor campus are invited to participate each year.

2.2 Administration of the Survey

The survey is a self-administered web survey that takes approximately 15 min to complete. Respondents are entered into a drawing to win one of several Amazon gift codes, as a token of appreciation for time spent completing the survey. Each person is sent a prenotification and invitation via email. If no response is received, up to three additional email reminders are sent. No further contact was made once a survey was completed, unless they contacted the study team or were notified as a winner of a gift code. All email communications were sent during business hours (9:00 am–5:00 pm).

3 Methodology

3.1 Motivation

The 2013 survey saw a considerable decline in response rate, from 40.6% in 2012, to 22.1% in 2013. While no changes were made to the content of the emails, feedback from some suggested there might have been an issue with delivery of email invitations after having received the prenotification email. U-M replaced their internet message access protocol (IMAP) infrastructure for sending and receiving emails with Gmail between the 2012 and 2013 data collections. More information was needed to help diagnose whether items in the email design (frequency, content) were possibly causing the email invitations to be filtered to spam or if they were received and ignored due to some other factor of the survey design (e.g. length of survey, survey topic, incentive, how the data will be used, etc.). Beginning in 2014 a web beacon was implemented to capture paradata to provide information to investigate.

3.2 Web Beacons

Web beacons are designed to monitor engagement on a web page or within an email and are known as pixel tags, clear gifs, 1 × 1, etc. Web beacons are one class of data magnets (Rezgui et al. 2003) that can be implemented in an email as a graphic, often a small (1 × 1 pixel) transparent graphic. Many email delivery and management providers offer this type of functionality (e.g. Constant Contact, MailChimp, SendGrid, etc.).

When a graphic is added to an outgoing html-based email, the image points to a URL on a server. When the email is opened, the image is requested from the server, and that registers as an "open". This is akin to a "read" receipt in some email clients, although no assumptions can be made about whether the message was actually read. There are several limitations associated with web beacon use including:

- No data is captured if a user (inbox) or their email system (server) has images disabled.
- No data is captured if the email client is text based.
- Data capture may be limited. Some email clients cache the image and an open receipt is only received once, the first time a message is opened, regardless of how many times it is opened. An indication of imperfect web beacon data in SCIP was found when completed interviews were captured with no record that an email was ever opened.

3.3 Survey and Email Design

Modifications were made to the 2014 and 2015 waves of data collection. Modifications to the email design, specifically gathered more information to help determine if reduction in response rate was due to a technical issue or some other factor of the survey design. The following enhancements were made to the project design beginning with the 2014 data collection (see Fig. 1 for items 1–5).

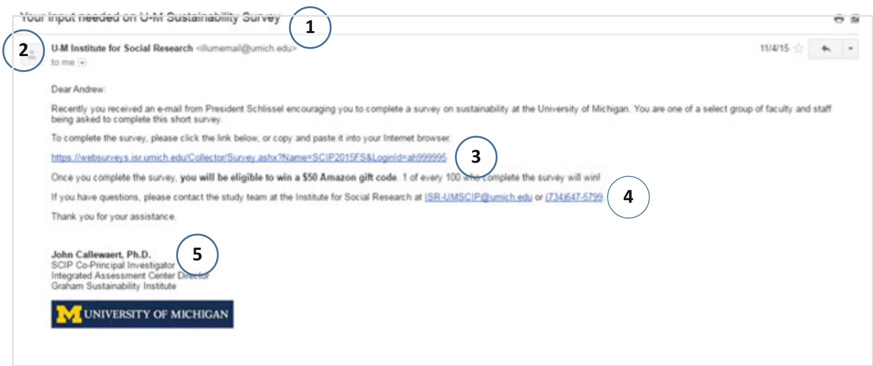


Fig. 1 2014/2015 Email design enhancements

1. The subject line was updated to better inform the sample member of what was being requested of them.
2. The friendly name was updated to include “U-M”. Sample members may not have been familiar with ISR or its association with U-M.
3. The survey URL was exposed. Exposing the URL allows sample members to see the survey was hosted on U-M servers and was not an attempt at phishing.
4. The study team contact information (phone number and email) was added. This allowed sample members with questions to easily communicate with the study team and look up information in the university directory to ensure legitimacy.
5. The researcher’s signature and university wordmark were added. This allowed sample members to see it was a legitimate request from a researcher at the university.
6. A longer delay ($\sim$24 h) between the invitation and reminder was instituted. In 2012 and 2013, the prenotification and invitation emails occurred the same day a few hours apart. This has the possibility of flagging an email as spam when multiple messages are sent in volume from the same sender (email address and domain) to the same recipient.
7. Cases were divided into replicates and released over a two-week period. If spam was a problem, releasing cases over a longer period may reduce the chances that a message is flagged as spam.
8. Email paradata capture was added. Web beacons allowed the researchers to gather more information around sample members’ engagement with email communications.
9. The survey was optimized for smaller platform (smartphone and tablet) displays.
10. A consent design experiment was implemented (see Chap. 21 this volume for more detail).
11. A celebrity endorsement experiment (see Chap. 21 this volume for more detail) was also implemented.

3.4 Paradata

A benefit of conducting a web survey is the ability to capture other data about the data collection process, called paradata (Couper 1998). An edited volume (Kreuter 2013) details the wide and varied uses of paradata in improving the survey process. Paradata is generated at the respondent level in one of two ways, server-side or client-side (Heerwegh 2003, 2011). Server-side paradata is generated when the respondent interacts with a server (e.g., timestamps related to page submissions). Client-side paradata is data generated on the respondents (users) end (e.g. key-strokes, mouse clicks, response changes, etc.) with JavaScript. SCIP captured paradata around the survey process, both server-side and client-side including:

- Date(s)/time(s) survey is accessed (includes break-offs and completes)—server-side
- Date(s)/time(s) survey is completed—server-side
- Platform(s) used to access the survey (smartphone, tablet, PC)—client-side

Platform for each respondent is ascertained by the user-agent string which contains information about the device being used to access a website (Callegaro 2010, 2013), in our case a web survey. The device was determined by parsing the agent string into an analyzable format and then summarizing devices into one of three platforms: personal computer (PC) (e.g., desktop/laptop), smartphone, or tablet.

Email paradata is captured server-side and includes:

- Date(s)/time(s) e-mail sent—server-side
- Type of email sent (e.g., prenotification, invitation, reminder 1, etc.)—server-side
- Date(s)/time(s) e-mail opened—client-side
- Type of email opened—server-side

The date/time an email was sent, and the type of email are recorded server-side by the survey software. The date/time an email was opened and type of email are recorded on the server-side from the web beacon broadcast. Survey and email paradata can be combined into one succinct dataset that details when emails were sent, opened, and when the survey was started and/or completed for each sample member.

4 Results

4.1 Email Delivery

Table 1 shows that almost 90% of sample members both years opened at least one email, and approximately 80% viewed at least one of the emails that contained a link to the survey. This high engagement rate of the emails being opened suggests that respondents are successfully receiving the email in their inboxes and the emails are not being filtered to spam.

Over 70% of the 37,478 prenotification emails sent both years were opened, while around 60% of the 37,478 invitation emails sent the following day were opened. From there the engagement rates decline 2–5% for each subsequent reminder.

Emails were most often opened from the PC platform. Faculty and staff opened 75% of their emails on a PC compared to 65% of the students. Therefore, students are more often using smaller devices (smartphones and tablets) to open their email.

4.2 Time to Open an Email

Emails were opened relatively quickly with the median time between an email being sent and opened being less than 60 min in 2014, and 90 min in 2015. As seen in Fig. 2, the median time between sending and opening increased between 2014 and 2015 for each email type.

Each year follows a similar pattern, with longer times between sending and opening the invitation and the first reminder. The second and third reminder lag times were shorter than for the invitations and first reminder in 2014, while tending to be longer in 2015. There are no significant differences in opening lag time between sample groups (faculty, staff and students) for any of the email types.

In 2014, the median lag time was 40 min from sending to opening of the prenotification email and increased to 44 min in 2015. There is a wide range of

Table 1 Email open rate

	Year	
	2014	2015
Cases	18,685	18,793
Any email	90%	88%
Prenotification	78%	72%
Any email with link	81%	80%
Invitation	61%	59%
Reminder 1	57%	55%
Reminder 2	52%	52%
Reminder 3	48%	50%

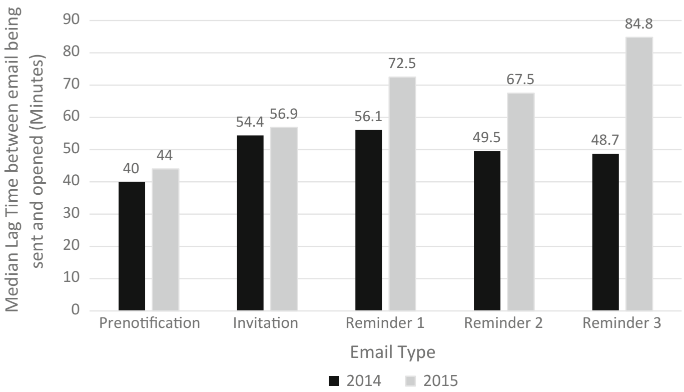


Fig. 2 Median email open lag time

prenotification lag times observed, from being opened within five seconds to being opened almost one year later. Looking at opening lag time by platform, emails first viewed on PCs and smartphones were opened more quickly (median of 40 min for PCs, and 43 min for smartphones), while emails first viewed on tablets took much longer (median of 101 min) to be opened.

4.3 Optimal Timing to Send

Email prenotifications were sent Monday—Thursday so email invitations could be sent Tuesday—Friday. Figure 3 shows the percent of cases that completed the survey between receiving the invitation and prior to sending the first reminder. No statistically significant difference was observed in completion rates between the different days the invitation was sent.

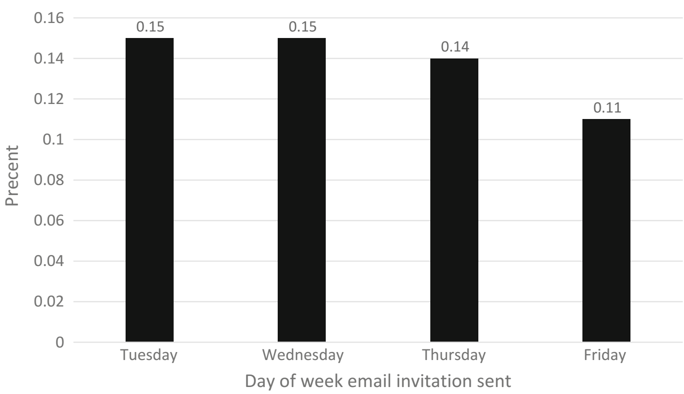


Fig. 3 Percent of cases completed before the first reminder by the day of week the invitation was sent

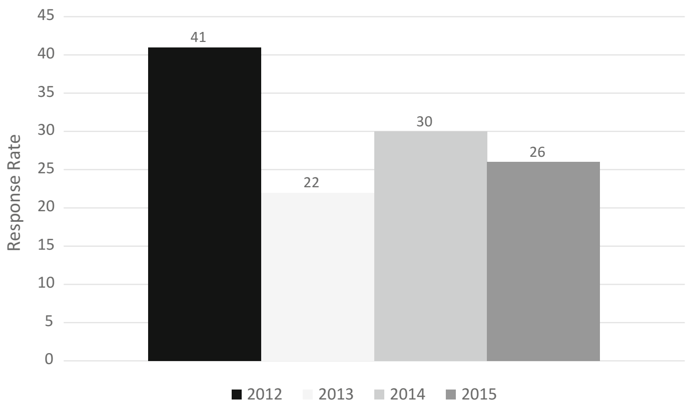


Fig. 4 SCIP response rates 2012–2015

There is evidence that the modifications to the email design increased response rates in the 2014 survey with gains seen over 2013 (see Fig. 4). However, some of the gains were lost in the 2015 survey.

5 Conclusions

5.1 Email Delivery

The email paradata, including the data generated by the web beacon provided rich detail about engagement. 90% of sample members opened at least one email sent to them. The high rates of opening an email were encouraging given the rates are likely biased low given the limitations of the web beacon. This shows that those invited have a high-level of engagement with survey requests that are sent via email. This seems to indicate that any technical issues (e.g. spam), was limited to the 2013 survey data collection.

The prenotification email from the president, arguably the highest profile person on campus, was opened at a higher rate (above 70%) than the invitation sent the following day. The prenotification email specifically informed sample members they would be receiving an email invitation soon. Three possible explanations for the difference in open rates are (1) the profile of the sender has an effect, or (2) the sample member made their decision to participate based on the prenotification email, or (3) sample members are accustomed to deleting emails that do not look as if they are from a person (i.e., are from an organization). Given the difference in engagement rates for emails sent a day apart suggests that a link to the survey should be included in the prenotification email during the next data collection wave since they are engaged with at a higher rate.

Roughly, 80% of sample members opened an email containing a link to the survey. The survey completion rate was not as high. This suggests there is something in the study design that is influencing the decision (lack of interest, time commitment, token of appreciation, etc.) since the email engagement rate is high.

The rate at which each subsequent email is viewed declines. This decline seems reasonable as the more cooperative sample members complete the survey leaving the harder to convince non-responding cases.

The high email engagement rates in the 2014 and 2015 surveys coupled with lagging response rates in comparison to the first survey conducted in 2012, suggest that there are other factors affecting survey completion. There is no single reason for lower interest, but likely several contributing factors. Leverage-salience theory, the theory that persons receiving a survey request place different importance on different features of the request (Groves et al. 2000), is likely at play. Some may not find the offer of a token of appreciation of enough value for their time, while others may not be interested in the topic or understand the value of their contribution. There may be a myriad of reasons, not all of which can be addressed. Some modification of the survey materials and design may be warranted to try to increase the saliency of the survey for a broader group.

5.2 Time to Open and Email

Emails are opened relatively quickly after being sent. The median time to open the prenotification and invitation is less than an hour after being sent. The time to open an email was more than twice as long for those viewing their email on a tablet computer. This could be because tablets are use specific and likely are less accessible during work or class.

The time to open increased between 2014 and 2015. This trend corresponds with a small decline in response rate between those years. Of the emails opened, 90% of them are opened the same day they were sent.

The time at which an email is opened is respondent dependent and outside of the researcher's control. There are a variety of factors that contribute to when an email is opened. Some jobs require employees to be at a computer and they likely have their email open all day allowing them to see the email immediately after being sent. Staff in service positions may not check their email as frequently given their particular job responsibilities and students may prefer other methods of communicating such as texting, and check their email less frequently. The volume of email and the time of day the email is received may have an effect on when it is opened. Those viewing email on their smartphone may be checking things quickly while on the go and not in a position to dedicate even a small amount of time to the survey request.

5.3 Optimal Timing to Send

It was anticipated that Friday might be a good day to send invitations given that the target population tends to have more time available on Fridays (e.g. fewer classes) to read email and therefore participate, but the data suggest otherwise. Invitations sent on a Friday were less likely to result in a completed interview before the first reminder was sent for this population. One possible explanation may be that if there are fewer classes, people are doing other things (taking the day off, studying, catching up, etc.) than checking their email.

Data can be captured at different levels and a researcher needs to think through what detail they want. The examples in this paper were about engagement in general. Enough data were captured to provide detail about particular email types. Longitudinal studies with a web component may have accumulated various email addresses over the past data collections. A similar design to the one discussed in this paper could be implemented to determine which email addresses continue to be valid and which are out-of-date. One would need to capture additional information by email address to make this determination.

The analysis results suggest that there is more that can be done before trying more costly, less sustainable methods of follow-up. Further work is needed to address the contributing factors of non-response and raise the response rate.

5.4 Limitations

The analysis and findings in this paper are based on observational data. It should be noted that 4765 cases from the U-M Health System are excluded from all analyses except those in Sect. 4.3. The U-M Health System did not switch to Gmail with the rest of the university. Due to low open email data from the Health System, their email client may be set to block images at the server level and not an option of individual users. The beacon was useful to help identify this issue. According to our paradata over half (53%) of all respondents from the Health System that completed the survey never opened an email. This made it clear that the web beacon was not working as designed for this subgroup of the sample, as it is impossible to complete the survey without opening an email to access the survey link. 2.5% of those not in the Health System completed the survey without opening the email, which points to individual email preference selections by sample members as opposed to an email system wide issue.

While email paradata is useful, there are several limitations one should be aware of when working with this data. For example, if a sample member has email forwarding to another account, the paradata does not provide that level of detail. Open data may be generated for the email address originally used even though it was opened via a different email account. This may not be an issue depending on the type of analysis one is doing. The fact that it was opened may be enough detail.

Acknowledgements The authors thank the Office of the Provost at the University of Michigan for funding the SCIP. Thanks also go to John Callewaert and Robert Marans for allowing the research to be conducted on the SCIP and to the reviewers for their useful suggestions.

References

Callegaro, M. (2010). Do you know which device your respondent has used to take your online survey? *Survey Practice 3*(6), 1–12.

Callegaro, M. (2013). Paradata in web surveys. In F. Kreuter (Ed.), *Improving surveys with paradata: Analytic uses of process information Improving Surveys with Paradata* (pp. 259–279). Hoboken: Wiley.

Callewaert, J., and Marans, R. W. (2017). Measuring progress over time: The sustainability cultural indicators program at the University of Michigan. In W. Leal (ed.). *Handbook of theory and practice of sustainable development in higher education* (Vol. 2). New York: Springer (in press).

Couper, M. P. (1998). Measuring Survey Quality in a CASIC Environment. *Proceedings of the Survey Research Methods Section, ASA,* pp. 41–49.

Couper, M. P. (2000). Review: Web surveys: A review of issues and approaches. *The Public Opinion Quarterly, 64*(4), 464–494.

Couper, M. P. (2008). *Designing effective web surveys*. New York: Cambridge University Press.

Couper, M. P., & Miller, P. V. (2008). Web survey methods public. *Opinion Quarterly, 72*(5), 831–835.

Groves, R. M., Singer, E., & Corning, A. (2000). Leverage-salience theory of survey participation: Description and illustration. *Public Opinion Quarterly, 64*(3), 299–308.

Heerwegh, D. (2003). Explaining response latencies and changing answers using client-side paradata from a web survey. *Social Science Computing Review, 21*(3), 360–373.

Heerwegh, D. (2011). Internet survey paradata. In M. Das, P. Ester, & L. Kaczmirek (Eds.), *Social and behavioral research and the internet. Advances in applied methods and research strategies* (pp. 325–348). New York: Taylor and Francis.

Kreuter, F. (Ed.). (2013). *Improving surveys with paradata: Analytic uses of process information*. Hoboken: Wiley.

Lozar Manfreda, K., Bosnjak, M., Berzelak, J., Haas, I., & Vehovar, V. (2008). Web surveys versus other survey modes: A meta-analysis comparing response rates. *International Journal of Market Research, 50*(1), 79–104.

Rezgui, A., Bouguettaya, A., & Eltoweissy, M. Y. (2003). Privacy on the web: facts, challenges, and solutions. *IEEE Security and Privacy, 1*(6), 40–49.

Author Biographies

Andrew L. Hupp is a Survey Specialist Senior in the Survey Research Center at the University of Michigan. He received an MSc in Geographic Information Systems (GIS) from the University of Leeds and a BA in Geography from the University of Northern Iowa. His current research interests include the web survey process and their related paradata, data collection with mobile devices, technology design and implementation in surveys, and geographic information systems.

Heather M. Schroeder is a Research Associate in the Survey Research Center at the University of Michigan. She received an MS in Biostatistics from the University of Michigan and a BS in Mathematics/Statistics from Ohio Northern University. Her current research interests include data

visualization, dashboard creation, and the analysis of paradata to optimize data collection processes.

Andrew D. Piskorowski is a Data Manager in the Survey Research Center at the University of Michigan. He received a BS in Economics and Statistics from the University of Michigan. His current research interests are the web survey process, including respondent survey progression, the related methods for survey data and paradata collection, and data storage and optimization for processing and analysis.

Innovative Instructional Module Uses Evaluation to Enhance Quality

Martha C. Monroe, Annie Oxarart, Tracey Ritchie and Christine Jie Li

Abstract

The instructional module, *Southeastern Forests and Climate Change*, is an example of innovation in sustainability education. The module was designed for high school science teachers and developed as part of a research project on southern pine productivity in a changing climate. As a result, it combines climate science with pine ecophysiology and economic productivity. It also encourages classroom debate and role playing activities to explore relevant ethical issues. It deftly brings together science education and education for sustainability. The process of developing the instructional module utilized a needs assessment, experimentation, and evaluation which improved program quality. The summative evaluation provided insights about the success of the program. This tight coupling of evaluation and program development created a high quality product that educators are requesting and using.

Keywords

Climate change · Curriculum development · STEM · Education for sustainable development · Environmental education

M.C. Monroe (✉) · A. Oxarart · T. Ritchie
School of Forest Resources and Conservation, University of Florida, 110410, Gainesville, FL 32611, USA
e-mail: mcmonroe@ufl.edu

A. Oxarart
e-mail: oxarart@ufl.edu

T. Ritchie
e-mail: tracey.ritchie@ufl.edu

C.J. Li
School of Natural Resources, University of Missouri, Columbia, MO, USA
e-mail: lij1@missouri.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*, World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_23

1 Introduction

There is a striking similarity between instructional materials that help learners understand the nuances required for sustainability to become reality and environmental education (EE) materials (Disinger 2001; Eilam and Trop 2010; Jickling and Wals 2012; Kopnina 2012; McKeown and Hopkins 2003; Monroe 2012; Sauvé and Berryman 2005). While there can be differences between these two forms of education, such as education for sustainable development (ESD) activities that limit their focus to economic growth or EE programs that only teach about nature, there can also be significant overlap. In cases where the topic of study is an environmental issue and students are learning about it through various lenses, including economics and social justice, the content is clearly situated in both camps. One of the first manuals of EE activities, for example, organized exercises into five concepts that cover all sustainability components: ecosystems, population, economics and technology, environmental decisions, and environmental ethics (Stapp and Cox 1974). For education to adequately prepare learners to imagine and work toward sustainable solutions to environmental problems, it is essential that they appreciate and understand the potential conflicts and synergies within the three pillars of environment, economy, and society. Educators must aim to build students' skills and agency in critical thinking, systems thinking, and action taking. To fulfill these goals, instructional materials should also be interdisciplinary.

Interdisciplinary education has been discussed and debated with a variety of assumptions and definitions (Klein 1990). The process of integrating different subject areas can result in a *multi-disciplinary* approach that provides students with a series of perspectives and expects the student to link them together, an *interdisciplinary* program that coalesces various perspectives and may involve team teaching around a common theme, or a *transdisciplinary* approach to education that may restructure the curriculum into a kaleidoscope of possibilities (Klein 2006).

Not only is there a good match in content between ESD, EE, and interdisciplinary education, there is also similar pedagogy. Klein (2006) suggests that teachers use innovative approaches in interdisciplinary education to "promote dialogue and community, problem-posing and problem-solving, and critical thinking" (p. 15). Echoing the emphasis Dewey and Piaget placed on projects that use real challenges, interdisciplinary teaching also uses inquiry, constructivist, and student-centered approaches (Ellis and Stuen 1998). These strategies have long been a hallmark of quality environmental education.

It may seem obvious that solutions to environmental challenges are best approached from multiple perspectives, but the reality in the United States is that schools, courses, textbooks, and teachers are organized around disciplines: biology, chemistry, history, economics, etc. Even though environmental themes such as energy could be the basis for interdisciplinary instructional materials, teachers tend to select those portions that best fit their discipline-based course (Ireland and Monroe 2015) and continue their disciplinary tradition, teaching about the biology or economics of using wood for energy, for example, but rarely linking the two. To create materials that are implemented in an interdisciplinary fashion might require a topic that is not easy to subdivide, individual concepts that have roots in multiple disciplines, or exercises that do not require expertise to facilitate and encourage teachers with any disciplinary background to engage.

An additional challenge to interdisciplinary sustainability education in the U.S. is the current emphasis on STEM education, emphasizing science, technology, engineering, and mathematics, in part because of the lure of future jobs in a technological world. While somewhat interdisciplinary, STEM education favors themes such as robotics, genetics, and computers more often than environmental challenges such as energy, agriculture, or climate change. But solutions to these environmental issues will also involve technology and mathematics, and they are appropriate STEM topics as well (Holdren et al. 2013).

Science education materials in U.S. schools often miss the opportunity to link science principles to current issues and build skills that will enhance stewardship and sustainability. In some communities current and controversial issues are avoided, even though they can motivate students to become more engaged in civic practice (Klosterman and Sadler 2010). Our background in environmental education, rather than science education, provided a framework for addressing skills that lead to both student and community outcomes. In addition, the constraints of the U. S. education system guided us to develop this material to reflect the science objectives that teachers are required to meet.

The opportunity to create a novel instructional package brings a responsibility to use evaluation strategies throughout the program development process to assure that the material will meet needs and function as intended. In addition to providing an orientation to the innovations associated with this instructional module, this chapter reports the results of the evaluation process, conducted in four phases: needs assessment, quasi experiment, formative evaluation, and summative evaluation.

2 The Opportunity

In 2011 the authors joined a team to begin a six-year, grant-funded project that focused on managing pine plantations in the southeastern United States in a changing climate. The project, PINEMAP (Pine Integrative Network: Education, Mitigation, and Adaptation Project), was funded through the USDA National Institute of Food and Agriculture. As an integrated project, it included biological, ecological, and policy research; education; and outreach to stakeholders. One of the education activities was the development of an instructional module for middle and high school science teachers, *Southeastern Forests and Climate Change*.

The instructional module was closely based on the framework and objectives that defined PINEMAP's research activities in tree physiology, genetics, soil carbon, forest management and landowner preferences, and life cycle analysis. Those objectives were derived from the overall goal of the project: to create, synthesize, and disseminate knowledge that enables southern private forest landowners to

- Manage forests to increase carbon sequestration,
- Increase the efficiency of nitrogen and other fertilizer inputs, and
- Adapt forest management approaches and plant improved tree varieties to increase forest resilience and sustainability under variable climates.

These goals specify the forest management and biology research goals, but their implementation required a number of other research activities, which are articulated in the outcomes for the project:

- Increased carbon (C) sequestration from silviculture and genetic enhancement of productivity and efficiency of fertilizer use, and resilience to climate variability and disturbance;
- Engaged and literate public with the capacity to make informed, practical decisions related to climate, forest ecosystems, and forest management;
- Public policy that supports sustainable management of planted pine under future climate scenarios;
- Enhanced capacity for regional, interdisciplinary collaboration among climate and forest scientists and Extension and education professionals;
- Enhanced connections between corporate and non-corporate forest landowners and forestry and climate researchers and education and outreach professionals; and
- A more robust and resilient forest-based economy in the Southeast U.S.

The instructional module was developed to achieve the outcome of building an engaged and climate literate public, and does so by helping students understand carbon sequestration, genetic enhancement of trees, climate impacts on forests, forest impacts on climate, and the role of consumers in selecting products that mitigate climate change. Because our focus is on the links between forests and climate, the module does not venture into energy efficiency and reduction of fossil fuel combustion. Although most students will not become forest landowners or forest managers, they may travel through the southeastern region, appreciate forested landscapes, and purchase wood products. We used these assumptions to keep the module content relevant to learners in the southeastern U.S. In keeping with our commitment and orientation to environmental education and education for sustainability, the module goals also reference skills and attitudes that are important for the development of learners who will help move their communities toward sustainability:

- Understand how climate change could impact forests in the southeastern U.S.;
- Understand how forests can be managed to address changing climate conditions and to reduce greenhouse gas emissions;

- Enhance decision making skills to make informed choices as consumers to mitigate climate change;
- Develop systems thinking skills to understand connections between climate change forests, and people;
- Recognize that individual and community actions can help mitigate and adapt to climate change; and
- Become part of future community conversations about climate change and potential solutions.

The module scaffolded concepts so that basic information oriented learners to the principles (such as the carbon cycle) before applying forest specific information (such as measuring carbon storage in trees). Similarly, in order to understand the impact that consumers can have on carbon emissions, it was necessary to introduce life cycle analysis and externalities. Linking together carbon sequestration and product life cycles, a culminating activity explores sequestered carbon in forests and wood products, as well as carbon that is "saved" through wood substitution. Additional activities introduce students to the history of climate science, evidence of climate change, climate models, genetic variation in loblolly pine, and forest management strategies to improve forest resilience. Similar themes were organized together into sections, and section introductions provided background information for teachers that was common to each of the activities in that section (Table 1).

To enhance the dissemination of the material and give it a long-term home for future adaptations, we partnered with Project Learning Tree (PLT). This U.S.-based environmental education program develops instructional materials and manages state coordinators who train workshop facilitators to deliver professional development to educators. PLT offers issue-specific modules for secondary teachers (teaching 13–18 year-old students) but did not yet have a module on climate change. PLT staff and coordinators were part of the development process from the beginning of the project and provided suggestions to improve activities and evaluations.

3 Innovatively Addressing Sustainability, Interdisciplinarity, and STEM Goals

The topic of private forest management in a changing climate sits squarely between the economic and environmental aspects of sustainability. Several of the 14 activities incorporated discussion or worksheet questions to help learners focus on these elements. In addition, some discussion questions focused on aspects of social justice. For example, the activity of measuring carbon stored in a tree is extended by comparing the carbon emitted by a state's population to that sequestered in the state's landscapes with discussion questions about whether other states should be responsible for sequestering "our" carbon or if cities should pay rural communities to sequester their carbon waste. In another activity, students roleplay members of a

Table 1 Southeastern forests and climate change activities by theme

Section	Theme	Activity
1. Climate Change and Forests	Three activities introduce the module theme by conveying how scientists currently understand observed changes in weather and climate that are impacting forest ecosystems.	**1. Stepping through Climate Science**—Students walk along a timeline of climate science and policy initiatives and then explore connections between forests and climate. **2. Clearing the Air**—After an introduction to the evidence of climate change, students explore common confusions and role-play a community discussion with the goal to reach consensus on strategies to reduce greenhouse gas emissions. **3. Atlas of Change**—Students are introduced to climate modeling to understand past changes and project future possibilities, and then use Web resources to consider how forest ecosystems might change over the next 100 years.
2. Forest Management and Adaptation	Climate changes are projected to affect surface temperature, precipitation patterns, and frequency of storm events. As scientists study how forests might change as a result, forest managers can be encouraged to alter management practices to help create resilient forests that will survive these challenges.	**4. The Changing Forests**—Students review how scientists are monitoring forest changes and exploring adaptive strategies to keep forests healthy. **5. Managing Forests for Change**—Students develop and use a systems diagram to model a forest so they can advise a forest landowner how to manage a pine plantation in light of climate projections. **6. Mapping Seed Sources**—Across the native range of loblolly pine, variations in genotype create trees that may do better under new climatic conditions. This activity helps students analyze data from three trials to determine the origin of the seeds.
3. Carbon Sequestration	Sequestering carbon in trees, soil, and wood products keeps it out of the atmosphere. Scientists are exploring if we can sequester more carbon in these carbon pools.	**7. Carbon on the Move**—Students become familiar with the carbon cycle and pathways that increase and decrease atmospheric carbon. **8. Counting Carbon**—Students measure trees near their schools and calculate the amount of carbon stored in individual trees. Students then compare the carbon

(continued)

Table 1 (continued)

Section	Theme	Activity
		sequestration potential for land-use types in their state, compare this to the estimated amount of carbon released by human activities, and discuss forests' ability to sequester atmospheric carbon.
4. Life Cycle Assessment	Consumer choices can play a role in reducing and preventing greenhouse gas emissions. These activities introduce the concept of externalities to consider the environmental problems that can occur from the production, shipping, and disposal of various products. Greenhouse gas emissions are one of the many criteria that students can use to assess products as they develop their own personal code for deciding what to purchase.	**9. The Real Cost**—Through a simulated shopping activity, students learn about the impact, or externalities, of consumer choices on the environment. **10. Adventures in Life Cycle Assessment**—Students investigate life cycle assessment data for three types of outdoor dining furniture to determine which type would generate the lowest amount of greenhouse gases. This detailed analysis of inputs and outputs is another tool for systems thinking. **11. Life Cycle Assessment Debate**—Students debate four pairs of similar products to develop their own sets of questions about product life cycles that can help guide consumer choices.
5. Solutions for Change	Three activities that help teachers summarize the concepts in this module. These can be adapted to reflect the activities that teachers selected. Students can be empowered with the knowledge and hope that all of us can help work toward healthy, sustainable forests and communities.	**12. The Carbon Puzzle**—Students use a series of facts to realize how forest plantations, wood products, and wood substitution can reduce atmospheric carbon, and then interpret a graph published by the researchers who explored this concept. **13. Future of Our Forests**—Student teams review information from the module and share their knowledge with an appropriate audience. **14. Starting a Climate Service-Learning Project**—Students select and complete an action project to mitigate climate change or help their communities adapt to projected changes.

community committee assigned to develop recommendations to reduce potential impacts of climate change. Roles for committee members represent a diversity of opinions about the causes and importance of climate change that reflect the range of opinions of the public. This leads students to consider strategies that seek agreement on actions rather than causes, and debate the trade-offs associated with economic and environmental benefits. A series of activities lead students to understand externalities and life-cycle assessments, and then debate the impacts of product pairs: e-book and paperback book, paper cups and drinking glasses, plastic bottles and aluminum cans, or paper and plastic bags. A written assignment asks students to develop their own criteria for making purchasing decisions and explain which would be more important to them.

While the module was designed for science teachers, the activities incorporate concepts from social studies and skills from language arts and mathematics (Table 2). Recognizing that teachers may not have the background to feel comfortable with concepts outside their disciplinary training, the module and accompanying website includes: (1) significant background information for teachers, (2) discussion questions for each activity, as well as appropriate responses, (3) worksheet answer keys, (4) lists of common misconceptions and clarifying corrections about each major concept, (5) slide presentations with teacher notes to help explain the activities, (6) short videos of PINEMAP research professors and graduate students providing additional background, and (7) links and references to additional resources and materials. Climate policies are introduced in three activities, and the economics of forest management and wood products are featured prominently in four, supporting the social studies component. Students are asked to explain beliefs and assumptions, debate products, and design posters in activities that address language arts objectives.

Many of the activities in this module also address the objectives of STEM education. Strong science themes, such as evidence for climate change, the carbon cycle, and genetic variation within a population, form the backbone of the module. Technology and engineering concepts are introduced through a detailed comparison of the life cycles of plastic, aluminum, and wood picnic tables and the function of

Table 2 Subject correlation by activity

SUBJECT	ACTIVITY													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Agriculture (including forestry)	X	X	X	X	X	X	X	X				X	X	X
Biology	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Chemistry		X					X							
Earth Science	X	X					X							
Environmental Science	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Language Arts			X	X					X	X	X		X	
Mathematics	X					X		X		X		X		
Social Studies (including economics, government)	X	X							X	X	X			X

models to explain and predict phenomena. Technology is also alluded to in potential solutions to climate mitigation and adaptation and the management options to create more resilient forests. Mathematics skills are taught and practiced, such as creating and interpreting graphs, calculating carbon-equivalent emissions, and using trigonometry to calculate tree height (Table 3).

Table 3 STEM connections to each activity

	Activity	STEM Connection
1	Stepping through Climate Science	• Understand the progression of science findings over time • Create a graph of atmospheric carbon over time • Make observations about the relationship between science and policy
2	Clearing the Air	• Explore scientific evidence of climate change • Understand the causes of climate change • Develop a chart of criteria for making an informed decision
3	Atlas of Change	• Learn about computer models • Use a computer model to understand the impact of climate change on forests • Use data from a computer model to create a poster
4	The Changing Forests	• Explore five scientific studies that scientists are currently doing
5	Managing Forests for Change	• Use a systems diagram to convey forest ecology • Consider management strategies that can help a forest adapt to climatic changes
6	Mapping Seed Sources	• Analyze data and explain hypothesis about heredity • Graph data and interpret results
7	Carbon on the Move	• Explain carbon cycling and the ways in which carbon can be removed from and added to the atmosphere • Illustrate the carbon cycle, including carbon pools and fluxes
8	Counting Carbon	• Collect data • Practice using field tools to measure trees • Compute comparisons of carbon sequestration and emissions • Apply concepts to determine whether a state could be carbon neutral
9	The Real Cost	• Understand how technology affects the environmental impacts caused by a product
10	Adventures in Life Cycle Assessment	• Understand how products are engineered • Calculate the emissions of three products at each step of their life cycle
11	Life Cycle Assessment Debate	• Assess environmental impacts of common products • Draw conclusions based on information assessed
12	The Carbon Puzzle	• Interpret a graph • Understand how carbon moves through three pools
13	Future of Our Forests	• Synthesize climate and forest science
14	Starting a Climate Service-Learning Project	• Develop problem solving skills as they 0plan and implement a project

Finally, content is not the only avenue for addressing sustainability and STEM goals. Pedagogy can also be used that cultivates attitudes, empowers learners, reinforces skills, and builds capacity for change. Several of the most commonly used pedagogies in EE and ESD were employed in this module: experiential learning and reflection, small group discussions, jigsaw discussions, group projects, and community action projects. Other engaging techniques, such as theatre, debate, and solving a mystery were used to stimulate learning.

4 Methods

Evaluation was an integral aspect of this program's development to answer questions about the design of the program and to assess the quality of the product (Ernst et al. 2009; Patton 1997). We used a combination of a needs assessment, a quasi-experiment, formative evaluation, and summative evaluation to collect data from secondary educators and students.

4.1 Needs Assessment

Needs assessments are typically conducted at the beginning of a project to help frame the program. In our case, however, the proposal and the research activities narrowed the realm of possibilities regarding the topic, audience, and purpose. Within those limitations, we began to design the objectives of the activities, which led us to a series of questions that teachers could answer to provide guidance. Our first assessment of our audience, therefore, involved questions for programmatic guidance rather than traditional needs.

To collect data for the needs assessment, we conducted an online survey of science teachers in the southeastern U.S. (Monroe et al. 2013). Survey questions were developed, reviewed by an Advisory Board of 24 educators, and pilot tested with practicing teachers. The survey contained 28 questions regarding current and future preferences for including climate change in secondary science courses, knowledge and comfort for teaching about climate change, usefulness of instructional materials, educational goals, and demographics. The survey invitation and three reminders were sent through state science coordinators, environmental education coordinators, and environmental education associations, and recipients were encouraged to share the link with colleagues. As we did not have access to the email lists, we do not know the overall population size, nor could we assess non-response bias. We assume that respondents likely represent those educators most interested in teaching about climate change in the region, and therefore most likely to use supplemental module on climate change.

4.2 Quasi-Experiment

Reactions of conservative adults when conversations turn to climate change range from polite indifference to physical movement away from the speaker. If some students feel strongly about climate change, they are not likely to engage in learning. As we designed some of our lessons we had a choice about whether to reveal the climate connection at the end of the lesson, or at the beginning. We wondered which would lead to increased knowledge. Our second data collection opportunity was a quasi-experiment to explore this important question.

We designed a quasi-experiment with two equivalent groups of youth (ages 15–17) during a summer science camp (Monroe et al. 2016). After a pre-test of carbon knowledge, one group was introduced to the connections between carbon, climate change, and forests. This group learned that adding fossilized carbon to the atmosphere is one important cause of climate change and that trees can sequester carbon and thus be a potential solution for removing carbon from the atmosphere. The other group was introduced to carbon as a ubiquitous element and learned about the carbon cycle with trees as one carbon pool. Both groups completed an activity reinforcing the carbon cycle and measured carbon in nearby pine trees. A post-test was conducted with the second group before continuing the discussion about human-generated carbon dioxide emissions and the carbon sequestration potential of ecosystems across the state.

4.3 Formative Evaluation

Additional opportunities to interact with educators and students followed the more traditional expectations for formative evaluation–gathering input on the structure of the activities, areas of confusion, practicality of the materials, time requirements, and to collect teachers' ideas for adaptations. In particular, advisors and reviewers suggested that our draft materials were most appropriate for Environmental Science and Advanced Placement classes that are typically taken by students 16–18 years old. We were uncertain about whether the activities could be meaningful to younger students and what adaptations might be necessary for the activities to be successful.

We conducted the formative evaluation during fall 2013 and spring 2014 to answer the following questions:

1. What are teachers' perceptions of the secondary teaching module?
2. To what degree did students meet the activity objectives?
3. To what extent did these activities change students' knowledge, skills, and attitudes?
4. How can these activities be improved?

Survey items were pilot tested with students, teachers, and advisors, and refined several times. Data were collected from 28 middle school teachers who used two activities of their choice with students, ages 11–15 years, and made any adaptations they wished (Li and Monroe 2015). Teachers completed an online survey that captured their perceptions about the value of the activities, whether or not the students met the activity objectives, and the ways they revised them.

4.4 Summative Evaluation

Our summative evaluation assessed student learning and enabled us to discover if the core assumption of this program–that science teachers could convey information outside their discipline that relates to a current interdisciplinary issue–was met. To collect student data, 32 teachers located in 10 southeastern states used 5 module activities with their 9–12th grade students and conducted pre and post student surveys. The survey used some of the formative evaluation questions; new items were pilot tested. Items measured knowledge, attitudes, skills, and demographics.

A final evaluation tool, an online survey, was sent to teachers who received the module, either through an educator workshop, the module website, or by request. The survey invitation and three reminders were emailed approximately 6 months after the person received the module and contained questions regarding if and how the activities had been used and their perceptions of student outcomes and reactions. The survey contained three tracks for different types of educators: classroom teachers, youth non-formal educators, adult non-formal educators.

5 Results

Evaluation results were key to guiding all major decisions about the development of this module. In addition to helping us design the materials, the results allowed us to

- better meet the needs and expectations of the teachers most likely to use the materials,
- use teachers' needs to help market the materials,
- ask and answer questions about the structure and value of the activities,
- add teacher comments about the materials to the website and final printed version as testimonials and implementation tips, and
- provide our funder with details on the ways the materials were being used.

This section will describe the results of our evaluations by questions that were answered.

5.1 Needs Assessment: Will Teachers Use a Unit on Forests and Climate? How Should It Be Structured?

The needs assessment survey was completed by 746 respondents, who were mostly female (67%), taught in public schools (87%), and located in Florida (49%), Virginia (14%), or North Carolina (10%). The results provided important insights into educator preferences and priorities (Monroe et al. 2013). For example, we wondered if science teachers would use activities on product life cycle assessments and learned that they are motivated to provide strategies students can use to mitigate climate change. In that context, 85% of the respondents were willing to include information about product life cycles and make the link to carbon sequestration. We also wondered whether and how teachers currently taught about climate change and learned that teachers tended to use informal discussions in agriculture, chemistry, and physical science courses. Environmental science and ecology courses covered climate change with planned lessons for more than one week. Biology and earth science teachers tended to spend less than one week on the topic with planned lessons. Most of the respondents already covered climate in some context (77%) and 82% intended to do so in the future. We learned that the following were among the highest priority goals for these respondents:

- Connect science to students' lives (98%)
- Emphasize critical thinking skills (98%)
- Develop data analysis skills (94%)
- Emphasize choices that affect sustainability (92%)
- Emphasize systems thinking skills (92%)

5.2 Quasi-Experiment: Will Students Learn if the Lesson Is Introduced in the Context of Climate Change?

The two groups' pre-test scores were not significantly different, but the post-test scores from the group introduced to climate change were significantly higher than the control group, suggesting they learned more about carbon (Monroe et al. 2016). Follow-up interviews with all students suggested that linking the two concepts, carbon and climate, was critical; some students remembered learning about both in school, but did not realize the two concepts were connected. Other students said the climate context made learning about trees more interesting and relevant.

5.3 Formative Evaluation: How Could Middle School Educators Use Lessons that Are Designed for Older Students?

Twenty-two middle school teachers implemented activities and completed the online survey. We learned that some activities were appropriate for younger students as written, though fewer middle school teachers than high school teachers agreed that their students were able to meet the stated objectives (mean = 3.91 vs

4.27 on a scale of 1–5). We gained a variety of suggestions for strategies to simplify or emphasize key concepts for the more complicated exercises. For example, one of the middle school teachers suggested that rather than dividing students into small groups as instructed in one activity, teachers could keep the class together and facilitate a discussion with the entire class. In addition, the feedback from middle school teachers resulted in a new introductory activity to connect forests and climate. The formative evaluation enabled us to revise draft activities and to include a Modification section for each activity with teacher's suggestions about alternative formats for conducting the activity.

5.4 Summative Evaluation: Do Learners Gain Interdisciplinary Knowledge and Skills After Being Exposed to These Activities?

Table 4 indicates that students in both the biology and environmental science classes increased knowledge of several concepts, even those typically included in social science classes such as life cycle analysis. The environmental science

Table 4 High school students' knowledge scores before and after instruction with five activities from summative evaluation

Concept	Pre score	Post score	Difference	T value	P value	% students who answered more correctly
Students from biology classes (n = 168)						
Forest management (6 items)[a]	2.04	2.71	0.67	4.40	<0.001	54.8%
Carbon (3 items)	1.29	1.56	0.27	3.07	<0.002	39.3%
Climate (2 items)	0.91	1.07	0.15	1.91	<0.06	35.7%
Life cycle (1 item)	0.65	0.72	0.07	1.29	<0.2	21.4%
Students from environmental science classes (n = 627)						
Systems (7 items)	4.01	4.45	0.44	5.45	<0.001	49.0%
Carbon (2 items)	1.05	1.15	0.10	3.20	<0.005	21.7%
Climate (5 items)	2.77	3.23	0.46	6.96	<0.001	47.7%
Life cycle (3 items)	1.32	1.93	0.61	11.46	<0.001	52%

[a]refers to the number of multiple-choice items that tested this concept

students demonstrated a greater increase in knowledge, perhaps because 71% of the biology students were in 9th grade as compared to 15% that were 9th graders in the environmental science classes.

5.5 Summative Evaluation: How Was the Material Received, Who Used It, and Was It Useful?

Of the 379 respondents who completed the follow-up online survey, 54% used the materials with learners within the first year. Of these respondents, 55% are classroom teachers who have used an average of 2 activities, mostly with 9th to 12th grade students. While most teachers used the materials in science classes, others used them in social studies, mathematics, and language arts courses (Table 5). The teachers felt these activities supported them in meeting a number of objectives, including helping students practice systems thinking skills, engaging students with discussions of ethics or environmental quality, discussing solutions to climate change challenges, connecting science with current policy, and connecting consumer choices to sustainability (3.52, 3.52, 3.46, 3.44, 3.39 respectively, on a scale of 1–4 where 4 equals Very Supportive). One teacher that used the activities in Earth Space and Geography classes commented that the students "*understood the relationship between policy and science*" after completing the activities. Another teacher who used one of the life cycle activities in science courses, reported that the students "*asked many more questions about where products we buy come from and what impacts they have on the environment*."

Table 5 Subjects in which classroom teachers used module activities (n = 101)

Subjects	Count	%
Environmental Science	53	29.3
Biology	38	21
General Science	28	15.5
Earth/Space Science	19	10.5
Interdisciplinary and sustainability courses (geography, gifted, STEM, EE, etc.)	16	8.8
Agriculture/Forestry/Natural Resources	14	7.7
Social Studies	5	2.8
Mathematics	4	2.2
Chemistry	2	1.1
Language Arts	2	1.1
Total Subjects Taught	**181**	**100**

6 Summary

Instructional materials that engage learners in thoughtful approaches to solutions to a complex environmental issue will likely combine environmental education and sustainability goals while at the same time peering through a variety of disciplinary lenses. This is good, appropriate, and necessary education (Orr 2004). Students who are committed to environmental or justice goals might disregard or undermine the need for economic livelihood or development, for example, and so they must first become knowledgeable about the value and consequences of neglecting this leg of sustainability. Creating successful learning experiences requires that both educators and learners have enough background to appreciate and understand the issue and the multiple perspectives needed to think through solutions (Newell 1992). An interdisciplinary approach to sustainability must provide a background in each discipline and build an understanding so that each concept is well grounded (Miller et al. 2008).

Our module scaffolds each key concept so that teachers and students gain new information at a comfortable rate. The online survey suggests we successfully provided sufficient background for the various disciplines, since teachers used the materials in a variety of classes. It might be, however, that teachers selected a few activities that they were most comfortable teaching. The increase in student knowledge scores from the summative evaluation suggests that environmental science teachers were more successful at using activities that deviated from traditional science concepts than the biology teachers.

The process of development of instructional materials requires a team effort. In this case, experts in each discipline were consulted to confirm that information was presented accurately and in sufficient detail for understanding. Educators were tapped for advisory boards and formative testing; the activities and materials were in a constant state of revision for three years. The power of a dissemination network was supported with small grants to state coordinators who oversaw additional teacher workshops. Sufficient time and resources to support development, evaluation, and research are essential for the production of quality and innovative educational resources that are both educative and interdisciplinary. A variety of evaluation tools and techniques helped make this program useful while being innovative.

Acknowledgements We thank the graduate students, teachers, and advisors who helped develop this instructional resource, particularly Stephanie Hall, Kristen Kunkle, and Richard Plate. We also thank our colleagues in the PINEMAP project, especially the PI, Tim Martin. This work was supported by the Pine Integrated Network: Education, Mitigation, and Adaptation project which is a Coordinated Agricultural Project funded by the USDA National Institute of Food and Agriculture, Award #2011-68002-30185.

References

Disinger, J. (2001). K-12 education and the environment: Perspectives, expectations, and practice. *The Journal of Environmental Education, 33*(1), 4–11.

Eilam, E., & Trop, T. (2010). ESD pedagogy: A guide for the perplexed. *The Journal of Environmental Education, 42*(1), 43–64.

Ellis, A. K., & Stuen, C. J. (1998). *The interdisciplinary curriculum*. Larchmont, NY: Eye on Education.

Ernst, J. A., Monroe, M. C., & Simmons, B. (2009). *evaluating your environmental education programs: A workbook for practitioners*. Washington DC: North American Association for Environmental Education.

Holdren, J., Marrett, C., Suresh, S. (2013). Federal science, technology, engineering, and mathematics (STEM) education 5-year strategic plan. National Science and Technology Council: Committee on STEM Education. http://www.whitehouse.gov/sites/default/files/microsites/ostp/stem_stratplan_2013.pdf. Accessed 27 Sept 2016.

Ireland, J., & Monroe, M. C. (2015). Should we use wood for energy? An education for sustainable development case study. *Applied Environmental Education & Communication, 14*(2), 82–89.

Jickling, B., & Wals, A. E. J. (2012). Debating education for sustainable development 20 years after Rio. *Journal of Education for Sustainable Development, 6*(1), 49–57.

Klein, J. T. (1990). *Interdisciplinarity: History, theory, and practice*. Detroit, MI: Wayne State University Press.

Klein, J. T. (2006). A Platform for a shared discourse of interdisciplinary education. *Journal of Social Science Education, 5*(2), 10–18.

Kopnina, H. (2012). Education for sustainable development (ESD): The turn away from 'environment' in environmental education? *Environmental Education Research, 18*(5), 699–717.

Klosterman, M. L., & Sadler, T. D. (2010). Multi-level assessment of scientific content knowledge gains associated with socioscientific issues-based instruction. *International Journal of Science Education, 32*(8), 1017–1043.

Li, C., Monroe, M. C. (2015). Measuring the effectiveness of materials on climate change and forests. PINEMAP Research Summary. Gainesville, FL: University of Florida. http://www.pinemap.org/publications/research-summaries/education/formative%20eva%20summary_final.pdf. Accessed 22 Aug 2016.

McKeown, R., & Hopkins, C. (2003). EE does not equal ESD: Defusing the worry. *Environmental Education Research, 9*(1), 117–128.

Miller, T. R., Baird, T. D., Littlefield, C. M., Kofinas, G., Chapin, F. S., Redman, C.L. (2008). Epistemological pluralism: Reorganizing interdisciplinary research. *Ecology and Society, 13*(2), 46. http://www.ecologyandsociety.org/vol13/iss2/art46/. Accessed 27 Sept 2016.

Monroe, M. C. (2012). The co-evolution of ESD and EE. *Journal of Education for Sustainable Development, 6*(1), 43–47.

Monroe, M. C., Oxarart, A., & Plate, R. (2013). A role for environmental education in climate change for secondary science educators. *Applied Environmental Education & Communication, 12*(1), 4–18.

Monroe, M. C., Hall, S., & Li, C. J. (2016). Can climate change enhance biology lessons? A quasi-experiment. *Applied Environmental Education & Communication, 15*(2), 125–137.

Newell, W. H. (1992). Academic Disciplines and Undergraduate Interdisciplinary Education: Lessons from the School of Interdisciplinary Studies at Miami University, Ohio. *European Journal of Education, 27*(3), 211–221.

Orr, D. W. (2004). *Earth in mind: on education, environment, and the human prospect*. Washington DC: Island Press.

Patton, M. Q. (1997). *Utilization-focused evaluation* (3rd ed.). Thousand Oaks, CA: Sage.

Sauvé, L., & Berryman, T. (2005). Challenging a "closing circle": Alternative research agendas for the ESD decade. *Applied Environmental Education & Communication, 4*(3), 229–232.

Stapp, W. B., & Cox, D. A. (1974). *Environmental education activities manual*. Dexter, MI: Thomson-Shore.

Author Biographies

Professor Martha C. Monroe completed a PhD at the University of Michigan (1991) and is currently a Professor and Extension Specialist at the University of Florida in the School of Forest Resources and Conservation. Her work explores strategies to enhance knowledge and skills to engage the public in sustainable practices.

Annie Oxarart completed a master's degree from the University of Florida (2008) and worked for several years coordinating Extension and education programs at the School of Forest Resources and Conservation, University of Florida. She is currently the Administrative Director for the Association for Fire Ecology.

Tracey Ritchie recently completed her PhD at the University of Florida working on teaching skills and measuring the quality of systems thinking. She completed a master's degree from Florida Atlantic University in 2008.

Christine Jie Li completed a PhD at the University of Florida and is currently an Assistant Professor at the University of Missouri. Her dissertation work on measuring and enhancing hopefulness was a key dimension of the instructional material described here. She earned her master's degree from the University of Minnesota-Duluth in 2012.

From Sustainable Cities to Sustainable People—Changing Behavior Towards Sustainability with the Five A Planning Approach

Petra Stieninger Hurtado

Abstract

The discussion about sustainable cities mainly focuses on technical solutions such as public transportation systems, resource-efficient buildings, and renewable energy generation. However, most cities don't take into consideration that the main factors that make a city sustainable are the people who live in the city. Sustainability is not just about using new technologies that make cities and their systems more sustainable by addressing the technical cause of inefficiencies. Sustainability is about changing behavior. The installation of public transportation systems alone doesn't guarantee that people will actually use them and drive less. Therefore, to create a sustainable city, the factors that make people choose the sustainable option over the unsustainable one need to be addressed in a planning process. Extensive research in European and American cities resulted in five factors that can make a change towards sustainable behavior possible: the accessibility, the affordability, the attractiveness, and the availability of sustainable options and people's awareness of their existence (the five A's). This paper explains how these five factors must be incorporated in urban sustainability strategies and how they can create truly sustainable cities by enabling long-term behavior change.

Keywords

Sustainable cities · Climate action · Behavior change · Urban planning

---

P. Stieninger Hurtado (✉)
Urban Breezes, Apt. 304, 4715 N. Racine Ave, Chicago, IL 60640, USA
e-mail: petra.hurtado@urbanbreezes.com

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_24

1 Introduction

According to the United Nations, the "world is undergoing the largest wave of urban growth in history. More than half of the world's population now lives in towns and cities, and by 2030 this number will swell to about 5 billion" (United Nations). At the same time, cities are one of the main contributors to climate change, "consuming two thirds of the world's energy and creating over 70% of global CO2 emissions" (C40). The problems that evolve from urban growth and related effects on climate change, environmental pollution, and scarcity of resources are challenges that have been recognized by city governments in their daily agendas, as they affect the entire society.

For years and decades, cities have incorporated climate action agendas and sustainability strategies, trying to combat environmental pollution and its effects on climate change. In 1994, with the Aalborg-Charter, the Charter of European Cities and Towns Towards Sustainability, thousands of cities and towns in Europe agreed on the implementation of sustainability strategies. Since then, cities around the globe, from Los Angeles to New York, Vancouver to Bogotá, Dubai, Cape Town, Melbourne, and Singapore have developed extensive sustainability agendas.

The objectives of the sustainability strategies of these cities are following more or less the same ideas. To reduce transportation-related greenhouse gas emissions, cities build public transportation systems, bike lanes, and walkable neighborhoods. To make buildings more resource-efficient, local governments require stricter building codes. Additionally, the use of sustainability rating systems for buildings and neighborhoods such as LEED—Leadership in Energy and Environmental Design (U.S. Green Building Council), BREEAM—Building Research Establishment Environmental Assessment Methodology (Building Research Establishment), or the Living Building Challenge (Living Future Institute) are gaining more and more attention. For more sustainable energy generation, renewable energy systems such as solar panels, wind turbines, or district heating and cooling have been installed. Furthermore, for sustainable waste management, cities require recycling and use waste for energy generation.

Not every city has been successful, though, and plans don't always work out the way they were designed on paper. The technical solution alone doesn't necessarily solve the problem, and what looks good on paper doesn't always work out in reality.

In this paper, it is argued that in current planning approaches, urban planners focus too much on the technical problem and its technical solutions, ignoring the factor that can make sustainability projects successful—the people who live, work, and play in the city. It will be explained why some projects in the urban sustainability field are successful and some are not, and what planners, architects, engineers, and other urban stakeholders can do to create truly sustainable cities by focusing on people instead of only technologies. Furthermore, this paper will outline five factors that can influence people's behavior toward sustainability and how they have to be applied.

2 Methodology

Between 2009 and 2013, extensive research on energy efficiency in European and North American cities (Europe: Vienna, Linz, Stockholm, Madrid, Hamburg; North America: Chicago, New York, Los Angeles, San Francisco, Phoenix, Seattle, Vancouver, Montreal) was conducted, including field investigations and expert interviews with city planners, planning consultants, and university professors. These investigations and interviews, as well as the analysis of statistical data on energy consumption, mode share, and other predefined factors for energy efficiency in cities (focusing on the transportation and residential sectors) resulted in five factors that are crucial for the success of energy efficiency strategies: the availability, attractiveness, accessibility, affordability, and awareness of energy-efficient options. The results were published in a monograph (Stieninger 2013). It describes a new planning approach that incorporates these five factors in order to create new energy efficiency strategies by focusing on people's behavior (the Five A Planning Approach).

This approach has been further elaborated and discussed with experts from the urban planning and sustainability fields through various presentations and panel discussions at conferences hosted by the Chicago Architecture Foundation (2014), the U.S. Green Building Council (2015), and the American Planning Association (2016). In addition, input from further literature review and new findings from field investigations in the Colombian cities Medellin, Cartagena, and Bogotá have been analyzed, and the five factors previously defined for energy efficiency have been applied to the broader sustainability topic (resource efficiency and urban climate action in general). For this paper, the five factors were applied to select sustainability projects and climate actions (successful and unsuccessful ones), using metrics such as mode share, average distance to transit stops, energy consumption per capita, etc. to determine their success. The results clearly show if all five factors had been applied to a project (knowingly or unknowingly), it was more likely to succeed.

3 The Problem of Unsuccessful Urban Sustainability Projects

Today, most cities around the globe are developing sustainability strategies, and even though they are pursuing the same objectives and are following similar strategies, for some of them, the implementation works out successful, and for others, it fails. As Janice E. Perlman (Founder and President of the Mega-Cities Project) put it during her presentation at the Eco-City World Summit in Montreal in 2011: "To plan is human, to implement divine."

What is it that makes some sustainability projects work out so well and others not? Why does over 70% of the population in Vienna take public transportation, ride their bikes, or walk to work every day (City of Vienna 2015), while in the Chicago metropolitan region more than 70% drive to work (CMAP 2015), even though Chicago has the second largest public transportation system in the United States (Chicago Transit Authority) and was rated the most bike-friendly city in the country (Chicago Tribune 2016)? Why do certain buildings that were designed and calculated to achieve energy savings equivalent to a LEED Gold certification turn out to use more energy than conventional buildings (Turner and Frankel 2008)?

Obviously, building public transportation systems and bike lanes doesn't guarantee that people will use them and drive less. Designing an energy-efficient building doesn't guarantee that the occupants will use less energy than in any other building. In the following, two examples of urban sustainability projects will be described that looked good on paper (one of them even won several sustainability awards), but in reality, they are not as successful as planned.

In 2008, Phoenix inaugurated its Valley Metro Rail, a light rail going from the northwest to the southeast of the Phoenix metro area. It was originally built with the intention to spur urban development along its over 20-mile long corridor. Additionally, a bike lane and a pedestrian path were built in parallel to the rail tracks, nicely designed with landscaping features for shading. However, field investigations that were conducted three years later in 2011 showed that very few people were using the metro rail, even during rush hour, and the bike lane and pedestrian path were empty during the entire 3-day period of the investigation (Figs. 1 and 2). A local urban planner explained in an interview "that due to the housing market crisis the expected urban development along the light rail corridor hadn't happened and now the metro light rail was passing through empty neighborhoods. In addition, driving was still too attractive in Phoenix and no one saw an advantage in taking the train" (Hurtado 2016). Obviously, a project that had been well designed did not change people's behavior from driving to taking public transportation, riding bikes, or walking.

Fig. 1 Empty platforms of the Valley Metro Rail in Phoenix, AZ (2011). (*Source* author)

Fig. 2 Empty bike lane and pedestrian path in Phoenix, AZ (2011). (*Source* author)

The construction of the award-winning solarCity, a mixed-use urban development project south of the city of Linz, Austria, started in the late 1990s (City of Linz). It was meant to be a showcase for sustainable urban development, featuring energy-efficient building design, numerous solar panels for renewable energy generation, district heating, and public transportation connecting the solarCity with the city center of Linz. Even though all the implemented technical solutions justified the awards that had been won for this energy-efficient urban development, a post-occupancy evaluation by the Johannes Kepler Universität Linz in the year 2009 showed that not everything about the project was as sustainable as it looked on paper (Lins 2009). Post-occupancy evaluations deal with social and behavioral aspects of the occupants of a building and how they are using it, unlike a post-construction evaluation that deals with the technical aspects of the building itself (Wener 1989). The evaluation showed that less than 15% of the participants of the study were using public transportation for their daily commutes to work, and only three percent were walking or riding their bikes (Lins 2009). The rest (over 80%) still drove to work every day; which, on average, was a 20-minute drive due to the remote location. In addition, it was evaluated that a lot of occupants did not know how to properly use the heating and ventilation systems in their apartments, which resulted in inefficient use (open windows all day despite the air ventilation system) and an unnecessary waste of energy where it could have been saved. Obviously, the existence of public transportation didn't guarantee that the dwellers of the solarCity really used it, and the energy-efficient building systems didn't guarantee that the occupants knew how to use them to save energy.

The reason why these two projects didn't work out as successfully as they could have, is because the success of an urban sustainability project doesn't only depend on its technical design and its technical feasibility, it mainly depends on the preferences, needs, and behavior of its users. In both examples, the users preferred driving to work despite the new public transportation systems. The occupants of the solarCity preferred opening their windows all day despite the resulting inefficiencies of the ventilation system.

4 What Can Make a Sustainability Project Work Out Successfully?

The two examples show there seems to be a disconnect between plans and reality. In the following, it will be explained what planners do wrong and how this disconnect can be avoided.

1. **Cities focus too much on the technical problem and its technical solution.**

Looking at examples of urban sustainability projects, it seems that urban planners focus on technical solutions for technical problems. "In trying to solve the terrifying problems that face us in the world today, we naturally turn to the things we do best. We play from strength, and our strength is science and technology" (Skinner 1971, p. 3). However, the most important "component" of a city and the factor that can make a city more sustainable are the people who live, work, and play in it. If they don't act according to how the planner, engineer, or architect envisioned it, the project can't be successful. In the end, the people decide if they will take the train or drive to work. They decide if they want to turn on the air conditioning or if they prefer to open the window.

Community engagement has gained more and more importance in the last decades (especially in Europe and North America), and in some cases it is even required by law. However, it usually starts at the point where a technical problem had already been determined and one of many options of technical solutions has to be selected. For example, to reduce congestion on the roads between town A and town B, the technical solutions would be to either build a highway or a transit line. No one looks at the problem from a different angle, asking the question: What is missing in A that makes people drive to B?

Traffic simulations for Phoenix and Linz might have predicted a decrease in people driving to work based on the assumption that building a light rail line would automatically change traffic behavior. Energy calculations for the solar City might have predicted a decrease in energy consumption based on the assumption that people would automatically use the energy-efficient building systems the way they were supposed to be used. These calculations were made without taking into account the people that really live there, their preferences, and their needs.

Therefore, when planning and designing urban sustainability projects and strategies, not only the technical solution, but a solution that understands the needs of the people has to be implemented to make a change from unsustainable behavior to sustainable behavior. As described in Corral-Verdugo et al. (2003, p. 247):

"Solutions for this challenge have to be found by combining technological and socio-behavioral strategies […]". The questions are therefore: How can the technological and the socio-behavioral strategies be combined? What are the factors that can change people's behavior towards choosing the sustainable options over the unsustainable ones? And, how can these factors be incorporated in urban sustainability strategies?

2. **Sustainability is about changing behavior of ordinary people who are living their ordinary lives.**

People don't behave unsustainably just to behave unsustainably. "People don't consume energy just because they want to consume energy. Furthermore, nobody would waste energy just to waste it" (Stieninger 2013, p. 24). Dealing with cities means dealing with "ordinary people doing ordinary things, rather than villainous or greedy people doing especially nasty things" (Gardner and Stern 2002, p. 26).

At the same time, we can't expect people to behave sustainably just to behave sustainably. Only a few people that are especially environmentally conscious live sustainable lifestyles for the sake of being sustainable. Barr (2007) argues that values towards environment and nature are the core factor that can make people more aware and willing to choose for sustainable options. However, environmental knowledge doesn't correlate with environmental action. Even though people know they should recycle, use less water, and turn off the light when leaving the house, they don't do it. Therefore, Barr (2007) added two more factors to the equation that influence the choice of sustainable behavior: personal situational variables such as sociodemographic, individual knowledge and experience (enablers or disablers for sustainable behavior) and psychological factors such as personality characteristics and perception toward environmental actions (motivators and barriers for sustainable behavior).

People don't drive from A to B just to drive. All they want is to satisfy their needs (e. g. getting something in B that doesn't exist in A). "Each individual […] is self-interested, that is, behaves mainly so as to advance his or her own interest" (Gardner and Stern 2002, p. 23). When developing sustainability strategies, planners have to consider that as long as driving from A to B seems the better solution in people's self-interest, considering their personal situational variables and psychological factors, people will keep doing it, independent from their personal environmental knowledge. Geller (1989, p. 20) even says it is more effective "to apply intervention strategies directly to environmentally relevant behaviors instead of attempting to modify environmental attitudes and values first and hoping for subsequent indirect influence on behaviors."

On the other hand, Praschl et al. (1994) argue that people don't just act out of rationality. The emotional evaluation of a situation weighs much heavier in a decision process. In addition, people are creatures of habits and do things in a way just because they have always done it that way. However, the unwillingness to change oftentimes results from a lack of feedback or, as Skinner (1971) put it, the lack of “consequences”. If there is no negative consequence, they will keep doing what they have always been doing.

Therefore, urban sustainability strategies have to focus on the needs and the self-interest of people, considering their personal situational variables and psychological factors, while defining clear and direct consequences of unsustainable behavior, to make the sustainable option the best solution in their self-interest to satisfy their needs.

3. **Urban planning should be about creating an environment that allows and motivates sustainable behavior.**

Urban planning is not just about designing buildings and infrastructure. “[…] housing is a matter not only of buildings and cities but of how people live” (Skinner 1971, p. 4). According to Hoch (2011), “Planning serves as a tool for translating political purposes into specific policies, programs, and projects […]” (Hoch 2011, p. 111). Furthermore, planners compose “plans that will meet the needs and solve the problems of many different groups of citizens” (Hoch 2011, p. 111). Therefore, when translating the political objective of creating more sustainable cities into their plans and strategies, planners have to focus on the people who live in their cities, creating an environment that invites sustainable behavior and lifestyles.

Decisions are shaped by the environment people live in. The built environment, the design of a city, and the urban fabric shape people’s decisions in their everyday lives. (Stieninger 2013). “[…] people have multiple subconscious tendencies and behaviors that govern their responses to built environments” (Sussman and Hollander 2015, p. 3). Hence, it is the urban planner’s task to create an environment, a city, that allows people to make sustainable decisions in their self-interest. Creating a city that allows people to choose sustainable options over the unsustainable ones will enable long-term behavior change, the only way cities can be truly sustainable. “[…]: the environment can be manipulated. […] man’s genetic endowment can be changed only very slowly, but changes in the environment of the individual have quick and dramatic effects” (Skinner 1971, p. 18 f.)

5 Five Factors of Behavior Change

Research on energy efficiency in European and American cities resulted in five factors that have to be incorporated in urban sustainability strategies and planning procedures for sustainability projects to allow the focus on people, to understand their self-interests and needs, to capture their personal situational variables and psychological factors, and to create cities that invite people to behave sustainably and discourage them from behaving unsustainably.

It is essential that sustainable options are (1) <u>available</u>, (2) <u>accessible</u>, (3) <u>affordable</u>, and (4) <u>attractive</u>, and people have to be (5) <u>aware</u> of them—<u>the five A Planning Approach</u> (Stieninger 2013). In addition, it must be obvious that the benefits of the sustainable options exceed those of the unsustainable options. According to Skinner (1987), people are more likely to change their behavior if there is an obvious consequence for choosing the unsustainable option. The consequence must therefore be an obvious disadvantage for choosing the unsustainable option over the sustainable one. The unsustainable options should be less attractive and more expensive than the sustainable options, with limited availability and accessibility, and people should be aware of these disadvantages (Fig. 3).

In the following, the five A's will be explained in more detail, giving examples from cities around the world.

1. **Availability**

First of all, sustainable options have to be available. If people shall use sustainable transportation options, the appropriate infrastructure systems have to be available; not just where people live, but also where they work, study, and play. Americans have been blamed for their love affair with their cars. However, many Americans don't have a choice. The majority of U.S. cities and suburbs have been designed around the car, which is why, for most Americans, the car is the only option they have to get to work or school (Stieninger 2013). It is crucial to provide people with the option to choose sustainable alternatives in order to change their behavior (Grohmann 2006).

In addition, the availability of unsustainable options must be limited. As long as the infrastructure that is needed for driving is still available, people may not see the benefit of changing their habits. Providing sustainable alternatives without changing what is already there, may not be enough incentive for change. "What must be changed are the contingencies" (Skinner 1971, p. 118). If unsustainable options are

The Five A's	Definition	Examples
Availability	Sustainable options must be available. The availability of unsustainable options has to be limited.	Walkable distance (500m) to at least one bus or train station from any point in the city; limited parking throughout the city; etc.
Accessibility	Sustainable options must be physically and legally accessible. The accessibility of unsustainable options must be limited.	Public transit accessibility of any point in the city; growth boundaries regulated by law to minimize sprawl & optimize transit use; etc.
Attractiveness	Sustainable options must be attractive in terms of beauty, comfort, safety, and quality. Unsustainable options must be less attractive than sustainable options.	Bus/train frequencies <5 min. during the day; lighting in stations and pedestrian areas for safety; pedestrian areas and shared streets; traffic lights in favor of busses; etc.
Affordability	Sustainable options must be affordable and less expensive than unsustainable options.	Road pricing in cities and on highways; attractive transit passes; free transit or incorporation of price in property tax; etc.
Awareness	People must be aware of the availability, the accessibility, the attractiveness, and the affordability of sustainable options as well as the benefits of choosing them over the unsustainable options.	Create awareness of benefits of sustainable options by obvious design (e.g. visible subway stations), laws and regulations, information and education (e.g. car-free day).

Fig. 3 The Five A's. (*Source* author)

no longer available or very limited, people are more likely to use the sustainable options.

The Phoenix example showed that building a transit line alone and keeping everything else the way it has been, doesn't lead to success. The Valley Metro Rail and its adjacent bike lane and pedestrian path were beautifully designed, they were using the newest train technology, offering air conditioning and spacious vehicles, but due to the fact that infrastructure for driving was still available and as attractive as it had always been, people didn't consider changing their behavior.

On the other hand, Vienna offers an extensive network of public transportation including busses, tramways, subways, and regional trains; an attractive network of bike lanes; and numerous pedestrian zones and walkable neighborhoods. Over 70% of its population takes public transportation, rides their bikes, or walks to work (City of Vienna). However, people who live in Vienna don't just take public transportation because of its availability, but also because parking is not available. The space for parking is very limited (especially within the beltway (Gürtel), where parking is mostly allowed for residents only). People choose the sustainable option not just because the sustainable infrastructure is available, but also because the unsustainable option is not available.

2. **Accessibility**

Sustainable options have to be physically and legally accessible. Urban design and technology can restrict or allow physical access. Laws and regulations can make access legal or illegal. Urban design, laws, and regulations have to favor the sustainable option over the unsustainable one. For instance, current zoning plans allow legal access to land outside the city for the development of unsustainable suburban sprawl. Highways enable people to physically access those unsustainable developments. As long as people are legally allowed to build single-family houses on the green field and highways are built to physically access them, people won't change towards more sustainable behavior. "Behavior is shaped and maintained by its consequences" (Skinner 1971, p. 18). To change people's behavior towards more sustainable options, there have to be consequences when choosing the unsustainable option. A change in policies and a rethinking of transportation networks has to make the physical and legal accessibility of sustainable options possible and limit the accessibility of unsustainable options.

Solar City, for example, was designed to become a showcase for sustainable urban development. However, its location outside the city and the unattractive service of the light rail train (20-min intervals) make more than 80% of its dwellers drive to work every day (Lins 2009), wasting all the energy on the road that could have been saved by energy-efficient building design. "The bad accessibility made the Solar City a residential ghetto that doesn't use much energy for its operation but uses a lot of energy for its accessibility" (Stieninger 2013, p. 135).

In comparison, the city of Vienna extended its U2 subway line to the urban development area in Seestadt Aspern before developers actually started to build there. The City understood that this could only be a sustainable urban development, if it was accessible by sustainable means of transportation.

3. **Attractiveness**

Sustainable options have to be more attractive than unsustainable options. Attractiveness refers to beauty, service quality, safety, and comfort. "Design has a strong influence on how people feel and perceive things. Furthermore, it has an influence on how people use things and how they behave" (Stieninger 2013, p. 139). According to Gibson's concept of affordance, oftentimes, there is a disconnect "between the initial intentions or objectives of the design with how the artifact is actually used […]" (Maier et al. 2009, p. 394). The initial intention of sustainable options is that people favor them over the unsustainable options. Hence the design of the sustainable options has to encourage this behavior change. Attractiveness in terms of beauty can result in the perception of safety and comfort. Daniel Burnham, a famous architect in Chicago in the late 1800s, was convinced that "beauty could reform society and conjure new virtue from citizens" (Montgomery 2013, p. 25).

However, if taking public transportation means waiting for a long time in a dirty and unsafe station, being squeezed into a vehicle packed with commuters, and arriving late at the destination, people will end up driving. For instance, many subway train stations in Chicago are completely run down and in very bad conditions (see example Fig. 4). With over 70% of the population driving to work (CMAP 2015), the City understood that changes had to be made in order to get people to use public transportation. Most of the stations along the red line are currently being renovated.

Fig. 4 Red Line stop Clark & Division in Chicago (2013). (*Source* author)

Stockholm turned its subway stations into an art gallery, decorating them with paintings, sculptures, and reliefs by over 150 artists. Waiting for the train in those stations is much more enjoyable than being stuck in traffic on a gray and boring highway.

4. **Affordability**

For a behavior change towards sustainability, sustainable options have to be affordable and less expensive than unsustainable options. This is not always the case though. For example, the sustainable apartment in the dense city, served by public transportation and within walking distance from everyday needs, is more expensive than the unsustainable, car-dependent single-family house in the middle of nowhere. Obviously, this is a problem of supply and demand and just one example of unsustainable developments that were created by markets, but can't be solved by markets (Hoch 2011); also called market failure. In order to make a behavior change towards sustainability possible, the affordability of sustainable and unsustainable options has to be better regulated in line with the overall sustainability objectives. This can only be done by public intervention, as most markets and private entities would most likely not volunteer to change. "Professional planners […] take on problems that private organizations not only avoid, but tend to aggravate or cause. These collective problems, such as congestion, pollution, land use conflict […], defy simple and unilateral treatment by a single agency" (Hoch 2011, p. 8).

This doesn't mean that unsustainable options shall be affordable only for rich people. It means that externalities of unsustainable options shall be incorporated in their price and that the advantage of sustainable alternatives should increase their value in people's minds; or as Enrique Peñalosa, mayor of Bogotá, put it in many of his speeches: "A good city is not a city where poor people drive cars. A good city is a city where rich people take public transportation." When he was elected mayor in 1998, he immediately increased the "gas taxes and banned drivers from commuting by car more than three times a week" (Montgomery 2013, p. 7). At the same time, he built the TransMilenio bus rapid transit system, offering an affordable alternative.

Many other examples around the world show that a policy change towards sustainable markets is possible. In Austria, for example, people have to pay to use highways (not just select tollways, but any highway in the country), while the national railway company ÖBB offers attractive half-price passes for their customers. In London, people have to pay to enter the city by car. All that is needed is political will and decision makers that understand the importance of the right price perception when it comes to sustainability issues and that provide attractive sustainable alternatives. In the U.S., the federal gas tax has been the same for over 20 years, while transit prices have been increasing almost every year.

5. **Awareness**

Environmental knowledge doesn't correlate with environmental action. Therefore, simply making people aware of environmental pollution and climate change won't change their behavior. People have to be aware of the available sustainable options and that they are more attractive, more affordable, and more accessible than the unsustainable ones. The awareness of the advantages of choosing the sustainable option ("positive reinforcers"), and the disadvantages of the unsustainable option ("negative reinforcers") can make a change in behavior happen (Skinner 1971).

In the sustainability sector, there are a lot of prejudices and wrong perceptions that result in ideas that influence decisions towards unsustainable choices. "When we think we do not just think: we think with ideas" (Schumacher 1973, p. 86 f.). For instance, affordability is an important aspect in a decision making process. However, what is even more important is the awareness of affordability (Praschl et al. 1994). In many instances, sustainable options are less expensive than unsustainable ones (e.g. driving is more expensive than taking public transportation). However, people are not aware of how much money they could save by choosing the sustainable option because the real prices are not obvious to them. Green buildings are perceived as much more expensive than conventional buildings, even though the operating costs are much lower (when operated correctly) and can pay off the capital costs after a few years. A study by the U.S. Green Building Council (2014) said that the capital costs of green buildings are on average only two percent higher than those of conventional buildings. In addition, green design is often perceived as ugly and limited in style. "Designers care about image, and the green movement […] has a reputation for being all substance and no style. […] As a result, many consider *great design* and *green design* to be separate pursuits […]" (Hosey 2012, p. 1).

In 2000, Enrique Peñalosa started an experiment with his citizens, trying out a car-free day in Bogotá. People realized that walking or riding their bikes through the city was much more enjoyable than driving (Montgomery 2013). That day changed people's awareness of alternative means of transportation, and together with the construction of numerous bike lanes and the TransMilenio bus rapid transit service, people in Bogotá started changing their behavior towards the more sustainable options.

Wrong perceptions regarding availability, affordability, attractiveness, and accessibility of sustainable options have to be eliminated.

6 Conclusion

To create truly sustainable cities, planners have to focus more on people than on technologies, as only their decisions and behavior can make a sustainability strategy or project work out successfully. People's decisions are based on their preferences, self-interest, and needs. Urban planning must create environments that invite and motivate people to make decisions that favor the sustainable options and change their behavior accordingly. People tend to be creatures of habits and base actions on behaviors from the past (Skinner 1987). Therefore, the consequences of unsustainable behavior and the benefits of sustainable behavior must be obvious and clear.

The five A factors can influence decisions and can therefore result in a behavior change towards sustainability. Sustainable options have to be available, accessible, attractive, and accessible and everyone has to be aware of them. Unsustainable options should not be available, accessible, attractive, or accessible, or at least, less than the sustainable ones. And everyone should be aware of the advantages of choosing the sustainable options over the unsustainable ones.

Changing the environment and the contingencies can be a challenging large-scale task that requires political will and commitment of the decision makers. Acceptance from all stakeholders is crucial for a project's success, but not always easy to be achieved depending on the political and cultural systems. In Europe, for example, sustainability is much more regulated than in the U.S., including stricter laws for issues such as energy consumption, CO_2 emissions, or road pricing. However, these regulations are widely accepted in Europe due to the awareness of attractive sustainable alternatives, existing consequences of unsustainable actions, and a more community-oriented mindset in general (Stieninger 2013). On the other hand, the American Dream mindset, focusing on the individual's business advantage, makes large-scale changes more difficult in the U.S. However, integrating all five A's in the planning process and using them as motivators for sustainable choices and discouragement of unsustainable actions will result in a higher acceptance of the projects, as the environment and the contingencies will be changed without impairing the quality of life or the purpose of people's self-interest.

It is important that all five A's are applied though. The Phoenix example showed that the availability alone wasn't inviting enough for people to change from driving to taking public transportation. Additionally, when applying the five A's, measurable goals for each A have to be pre-defined; for instance, in the transportation sector: for availability, thresholds for walkable distances to transit stops; for attractiveness, minimum intervals of trains and busses; etc. (see examples in Fig. 3). Furthermore, the interrelations between the five A's must be considered. Factors such as affordability of attractiveness, awareness of affordability, and accessibility of availability are as important as the factors themselves.

References

Barr, S. (2007). Factors Influencing Environmental Attitudes and Behaviors. A UK Case Study of Household Waste Management. *Environment and Behavior, 39*(4), 435–473.

Building Research Establishment: BREEAM. http://www.breeam.com/. Last Accessed 25 Jan 2017.

C40. http://www.c40.org/ending-climate-change-begins-in-the-city. Last Accessed 25 Jan 2017.

Chicago Transit Authority. http://www.transitchicago.com/about/overview.aspx. Last Accessed 25 Jan 2017.

City of Linz: solarCity. http://www.linz.at/solarCity. Last Accessed 12 Jan 2017.
City of Vienna. (2015). Wienerinnen und Wiener gehen gerne zu Fuß—Studie „Zu Fuß gehen in Wien". Stadt Wien.
Chicago Tribune. (2016). Chicago tops NYC as most bike-friendly city in U.S. *Chicago, 2016*(9).
CMAP. (2015). Transportation mode share in the CMAP region. http://www.cmap.illinois.gov/about/updates/policy/-/asset_publisher/U9jFxa68cnNA/content/transportation-mode-share-in-the-cmap-region. Last Accessed 25 Jan 2017.
Corral-Verdugo, V., Bechtel, R. B., & Fraijo-Sing, B. (2003). Environmental beliefs and water conservation: An empirical study. *Journal of Environmental Psychology, 23*(3), 247–257.
Gardner, G. T., & Stern, P. C. (2002). *Environmental Problems and Human Behavior* (2nd ed.). New York: Pearson Custom Publishing.
Geller, E. S. (1989). Applied Behavior Analysis and Social Marketing: An Integration for Environmental Preservation. *Journal of Social Issues, 45*(1), 17–36.
Grohmann, P. (2006). *Angebotsänderungen im öffentlichen Personennahverkehr (ÖPNV) und Auswirkungen auf die Nachfrage*. Vienna: Österreichischer Kunst- und Kulturverlag.
Hoch, C. (2011). *What planners do: Power, Politics, and Persuasion*. San Francisco: APA Planners Press.
Hosey, L. (2012). *The shape of green: Aesthetics, Ecology, and Design* (2nd ed.). Washington: Island Press.
Hurtado, P. (2016). Smart Cities – Behavior Change towards Sustainability. http://smartcities-infosystem.eu/newsroom/blog/smart-cities-%E2%80%93-behavior-change-towards-sustainability. Last Accessed 25 Jan 2017.
Lins, J. (2009). *Sozialwissenschaftliche Evaluierung der solarCity Pichling*. Universität Linz: Johannes Kepler.
Living Future Institute: Living building challenge. https://living-future.org/lbc/. Last Accessed 12 Jan 2017.
Maier, J. R. A., Fadel, G. M., & Battisto, D. G. (2009). An affordance-based approach to architectural theory, design, and practice. *Design Studies, 30,* 393–414.
Montgomery, C. (2013). *Happy City, transforming our lives through urban design*. New York: Farrar, Straus and Giroux.
Praschl, M., Scholl-Kuhn, C., & Risser, R. (1994). *Gute Vorsätze und Realität: Die Diskrepanz zwischen Wissen und Handeln am Beispiel Verkehrsmittelwahl*. Vienna: Bundesministerium für Umwelt, Jugend u. Familie.
Schumacher, E. F. (1973). *Small is beautiful, Economics as if people mattered*. New York: Harper Perennial.
Skinner, B. F. (1971). *Beyond freedom & dignity*. Indianapolis: Hackett Publishing Company.
Skinner, B. F. (1987). *Upon further reflection*. Englewood Cliffs: Prentice-Hall Inc.
Stieninger, P. (2013). *Changing human behavior towards energy-saving through urban planning*. Chicago: LAP LAMBERT Academic Publishing.
Sussman, A., & Hollander, J. B. (2015). *Cognitive architecture. Designing for how we respond to the built environment*. New York: Routledge.
Turner C, Frankel M. (2008). Energy performance of LEED for new construction buildings. New Buildings Institute.
United Nations: Urbanization. http://www.unfpa.org/urbanization. Last Accessed 15 Jan 2017.
U.S. Green Building Council. (2014). *LEED® Core Concepts Guide. An Introduction to LEED and Green Building* (3rd ed.). Washington: Green Building Council.
Wener, R. E. (1989). Advances in evaluation of the built environment. In E. H. Zube & G. T. Moore (Eds.), *Advances in environment, behavior, and design* (Vol. 2, pp. 287–313).

Author Biography

Petra Hurtado (formerly Stieninger) has a Ph.D. in urban planning from the Vienna University of Technology. She has been working as an advisor and researcher in the global urban sustainability arena for over 10 years. Her areas of expertise and publications include global urban developments, sustainable urban planning, smart cities, energy efficiency, behavior change and environmental psychology, sustainable infrastructure systems, and related policy issues. In 2013, she published the book "Changing Human Behavior towards Energy Saving through Urban Planning". Petra is the founder of the research collaborative Urban Breezes, a platform for collaboration between researchers, planners, and local governments to drive urban action towards sustainability.

Sustainability Knowledge and Attitudes—Assessing Latent Constructs

Adam Zwickle and Keith Jones

Abstract

The majority of sustainability related social science research conducted to date has primarily focused on individual level behaviors occurring within the environmental domain. In order to achieve the advancements needed to move towards a truly sustainable society, this interdisciplinary field must grow to not only include the social and economic domains, but also expand in scope to study groups and institutions. Sustainability research has paused at the brink of this needed growth and expansion because it has failed, thus far, to build new theories specifically tailored to the three domain model of sustainability. The purpose of this chapter is to encourage scientists to begin identifying and measuring sustainability latent constructs in order to do just that, and to submit two such measures to the academic community. This chapter introduces a revised Assessment of Sustainability Knowledge (ASK) and the Sustainability Attitudes Scale (SAS), and discusses when and how to use them for applied and theoretical purposes. Building theoretical models using these (and other) latent constructs will allow social scientists to test a new and diverse set of hypotheses and push the field to create cutting edge, sustainability-tailored theories.

A. Zwickle (✉)
Michigan State University, 502 Baker Hall, 655 Auditorium Road,
East Lansing, MI 48823, USA
e-mail: zwicklea@msu.edu

K. Jones
Central College, 812 University St, Pella, IA 50219, USA
e-mail: joneskt@central.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_25

1 Introduction

Understanding what motivates people to behave sustainably is a necessary step towards making the societal changes needed in order to avoid the environmental, social, and economic catastrophes associated with natural resource depletion and climate change. This needed societal shift also presents a fertile ground for research in the fields of psychology, sociology, economics, and political science (among others), yet this interdisciplinary field of “sustainability research” remains underdeveloped and disjointed. Given that sustainability issues are multidimensional and interest a wide range of people, it is no surprise that scholars from a variety of backgrounds have conducted sustainability research from a variety of vantage points, stemming from their own theoretical and methodological backgrounds. Sustainability research, then, stands to gain much from the diversity of these research traditions.

Other fields of inquiry have developed and benefited from a similar situation. Gerontology, for example, became and remains a multidisciplinary field because scholars from different disciplines (e.g. psychology, medicine, sociology, social work) collaborated on a common interest. Kenyon (1988) noted that his vibrant field had a variety of perspectives, yet each discipline studying aging was limited due to its particular framework, history, and methodology. Nonetheless, each discipline contributed valuable knowledge to understanding the aging process albeit less organized and comprehensive than desired (Kenyon 1988). Gerontology’s vibrancy and value have only increased in the past decades as the field has expanded its research, improved cross-disciplinary work, and shown its applicability to real-world problems. Sustainability research finds itself facing the same challenges and opportunities. This example illustrates the rationale behind this chapter; that by utilizing and coordinating the strengths of the disciplines contributing to sustainability research, the field will be strengthened and legitimized as an area of scientific inquiry and practice. This chapter serves as a call to encourage more cross-disciplinary collaborations aimed towards building new theory that encompasses the environmental, economic and social domains and can be applied at the individual, group, and societal level.

1.1 Perceived Lack of Agreement Over Definitions of Sustainability

One reason for this lack of focus and direction in sustainability research is the perceived lack of agreement on how to actually define “sustainability” (Toman 2006; Vos 2007). This perceived failure to come to a consensus has impeded budding research from moving much beyond the starting gate. Although a variety of definitions have been put forth and are being used, the definitions arguably are speaking of the same thing. First mentioned in the 1990’s was the economic centered idea of the “triple bottom line” (Elkington 1997). The three bottom lines that successful businesses should be focusing on were also referred to the as the three P's: people, planet, and profit. These P's have also been referred to as E's: Environment, economic, equity/ethical. While different terms are commonly used, it is clear that there is general agreement that sustainability consists of three overlapping domains which focus on environmental, economic, and social factors, and that any effort towards sustainability must address each of these domains.

The first and best attempt at an overarching definition of sustainability came in the Brundtland Report on environment and development. Sustainable development was defined as "…development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The World Commission on Environment and Development 1989, p. 43). The Brundtland definition provided a long-term temporal focus that the other, more common, uses do not explicitly state. For something to be truly sustainable it is necessary that it sustain indefinitely. The only way to ensure that an effort, policy, or society sustains over time, is to ensure that it does not negatively impact the environment, the economy, or the social well-being of those involved. The authors encourage the academic (and larger) community to accept the broad and encompassing Brundtland definition of sustainability, recognize that it contains these three separate, but intertwined, dimensions, and move forward. An agreed upon understanding on what comprises sustainability is not only necessary for the creation of future social science research, but such a consensus arguably has already been reached.

1.2 Current State of Sustainability Research

To date, much of the sustainability research conducted has been heavily focused on either observable behaviors or limited to the environmental domain. This is understandable, as observable actions are easiest to measure, and the environmental domain is most closely linked to climate change and resource depletion. If "sustainability research" can be thought of as an emerging paradigm (Kuhn 2012), then these initial areas of focus can be analogous to early studies in other past developing fields. Straightforward, inductive studies that may be primarily exploratory in nature describing observed phenomena. Thought of in this light, what is needed next in order to expand our knowledge beyond the individual and beyond the environmental domain is to begin building and testing theory. These theoretical advancements will require a better understanding of the latent forces influencing individual and group decisions and behavior. Disciplines that study other aspects of behavior offer methods and insight that will complement existing research on overt sustainability behaviors.

1.2.1 Lack of Research in Economic and Social Domains

The vast majority of sustainability research has focused on environmental domain, largely failing to address the economic and social domains. Two reasons for this unbalanced level of research is that the environmental dimensions is both easier to understand and easier to observe. Environmental sustainability is a relatively straight forward concept when compared to economic and social sustainability. In terms of natural resources, sustainable use consists of withdrawing the resource at a rate equal to or less than the rate of replacement. In regards to ecosystem health, sustainability may simply mean the continuation of the structure and function of the landscape in its current or native state. Coming to a consensus on what is economically or socially sustainable, however, will be a contentious process.

Positive and negative examples of economic and socially sustainability will likely vary based on an individual's ideological values. Some may believe that a smaller publicly funded social safety net and a greater reliance on capitalism are keys to maintaining a healthy society, while others may believe a more egalitarian society achieved thru greater wealth redistribution (taxation) are hallmarks of social and economic sustainability. Identifying successful models of social and economic sustainability will be difficult, perhaps impossible, to separate from political ideology, but it is likely that the argument over what is sustainable, in itself, will be a productive step. Such a discussion could identify the salient values playing a role in an individual's or group's idea of sustainability. The identification of these values in turn could help guide public discourse beyond acceptance of the problem (i.e., the climate "debate") and on to debate over desired solutions.

In these two domains questions of scope also become a complicating factor, as what is sustainable at the community level is not necessarily sustainable at the state or global level. Where this boundary is drawn will influence the outcome of any kind of assessment effort. Is a wealthy suburb socially sustainable because of its well-funded and high performing schools? Or is it unsustainable because of its lack of socioeconomic diversity and high property values?

If establishing a definition for these two overlooked dimensions of sustainability is even possible, both the process and the outcome will be controversial. This controversy, however, needs to be had and can be quite beneficial. By going through this intellectual and ideological struggle, the research community may identify societal features which may facilitate, or impeded, sustainable develop at any scope or scale. Perhaps some ideological issues which are often culturally or politically considered to be taboo (e.g., alternatives to capitalism) may be questioned as to if they are truly good for long term state or global health.

1.2.2 Focus on Individual Behaviors

The majority of the research focused on environmental behaviors has been at the individual level, even though major motivational factors often come from a larger social group. Robert Cialdini's groundbreaking and extensive research into social norms and their influence on pro-environmental behavior is the primary example in this category. Cialdini's initial work in this field used recycling as the dependent variable as an avenue for understanding the different effects of both injunctive and descriptive social norms had on individual's behavior (Cialdini et al. 1990). Much later research suggested specific ways to use those different social norms effectively in a study focused on reducing household energy consumption (Schultz et al. 2007). But, while these individually focused studies may be useful for understanding the motivations behind a person's behavior, they arguably lack the efficacy of addressing society scale problems. Cialdini's studies focused on personal behavioral change and were conducted at the neighborhood level. Would they work at the state or national level? More importantly, what are the barriers to implementing such a program at such a scale, and how can they be overcome?

Some research has extended the implications of Cialdini's (and others) theoretical advancements one step beyond the individual, testing whether the same effects of social norms apply to group behaviors (for a meta-analysis of the breadth of interventions tested, see Osbaldiston and Schott 2012). These studies have primarily focused on the use of messaging, feedback and group competitions to encourage a specific environmental behavior. While this approach of harnessing the power of descriptive and injunctive norms to encourage change is useful in the short term, there is consistent evidence that unless a prolonged intervention is made, participants typically fall back into old habits once the attention and incentive is removed (Allcott and Rogers 2014). This line of research, however, arguably suffers from the same limited efficacy of the earlier studies it is built upon. While it is true that if an entire society transformed their behavior in a similar manner to that achieved through these interventions the results would be at a meaningful scale; it may also be true that to achieve such a societal change would require an entirely different methodological and theoretical approach. In the words of Thomas A. Heberlein, there is no cognitive fix for an unsustainable society (Heberlein 2012).

1.2.3 Lack of Latent Assessment

With a couple very notable exceptions, the majority of social science sustainability research has failed to move beyond the measurement of observable behaviors in an effort to map and understand important latent constructs such as attitudes, values, beliefs, motivations, etc., that may play a role in an individual or societal shift towards a more sustainable future. The clear quantification of observed behaviors makes them an ideal dependent variable to test the effects of other, unobservable latent constructs. Definitions of latent constructs vary partly due to the mathematical models from which they arose (Bollen 2002). Consistent with Bollen (2002), the authors agree that the best definitions are those that are useful in understanding the phenomenon at hand. Furthermore, at this point of sustainability research using a simplified definition is most likely the best to allow more researchers to collaborate on common sustainability phenomena. Therefore, for our purposes latent constructs are defined simply as variables that are not directly observable. Knowledge of these unseen influences is important, as it provides a foundation for theoretical advancements which would otherwise not be possible.

Arguably the most important area of research which has looked into sustainability related latent constructs is Riley Dunlap's New Ecological Paradigm (Catton and Dunlap 1978; Riley E Dunlap 2008; R. E. Dunlap et al. 2000). Over time Dunlap and colleagues research has looked into a slow societal shift away from the "dominant social paradigm" (Pirages and Ehrlich 1974) and adopting beliefs, to some extent, about limits to growth and living "in harmony with nature" (R. E. Dunlap et al. 2000). While some of the facets of the NEP can be thought of as measuring sustainability, it is important to note that the NEP was neither designed nor intended to be used to measure anything other than one's subscription to an ecological worldview. It has, however, been used to measure environmental concern, environmental values, and environmental attitudes. Increasingly, and appropriately, it is used to measure environmental beliefs (Riley E Dunlap 2008).

The NEP's ability to measure a person's worldview, a directly unobservable latent construct, has been a boon for environmental social science. Being able to quantify one's environmental beliefs and use that data to conduct statistical analyses enables researchers to test new hypotheses and put forward new theory. One example of this is the creation of the Value-Belief-Norm theory (Stern et al. 1999), which used the NEP, among other latent constructs, to produce a social-psychological map of the primary motivating factors necessary for an individual (and society) to support a social movement. Like the NEP, the VBN theory has since been applied to many different contexts, some of them directly related to sustainability, such as sustainability efforts in multi-national corporations (Andersson et al. 2005), sustainable behaviors among college students (Whitley et al. 2016), and educating for transformative sustainable action (Frisk and Larson 2011).

Both the NEP and VBN theory pinpoint cognitive, emotional, and attitudinal factors that influence behavior. In doing so they also illustrate why defining and measuring latent constructs is important; enabling greater comprehension beyond simply whether one does, or does not behave a certain way, to begin to explain why. Gaining in-depth knowledge of relevant latent constructs within sustainability research will have two immediate effects. First, researchers can expand our knowledge by including more factors in conjunction with studying directly observable behaviors. When looking to explain why people engage (or fail to engage) in sustainable behaviors, including sustainability attitudes, values, or motivations will allow researchers to account for greater variability in the dependent variable of interest. For example, when explaining recycling behavior, researchers typically examine external factors such as promotion of a recycling program, the availability of recycling bins, and ease of recycling (e.g. comingled recycling). Yet, if results did not reveal the expected impact of these external factors, the next logical explanation points to within-group variance; individual differences. Studying latent constructs would explore this within-group variance, as beliefs, knowledge, and emotions related to recycling vary between people. Given the range of multivariate data analytic techniques available, researchers can discern the individual and combined contributions of each variable. Thus, by including these latent constructs in research efforts, scientists can better understand why recycling rates are what they are.

Second, latent constructs would broaden social scientific investigations of sustainability overall. Given the science's cyclical nature of idea creation and exploration, an increase in the diversity of sustainability related inquiry opens up the field for more scientists to conduct cutting edge research. Advances in methodology arguably lead to theoretical development as well. Gerontology, again, offers an example of this progress. As new ideas, research questions, and methodologies developed with advancing data analytic techniques, theory developed as well (Schaie 1988). The same could occur in sustainability research because studying latent constructs would broaden the range of testable questions researchers can ask. Our call echoes Dunlap (2008), who notes that the NEP was useful in the advancement of other, perhaps unexpected theories of risk perception, predicting willingness to pay, and the reasonable developmental differences in sustainability thoughts and concepts between children of different ages.

Including latent structures in research does increase the complexity of conducting research because latent structures are more difficult to study than directly observable, overt behaviors. Nonetheless, other areas of research (e.g. cognition) have succeeded in developing valid and reliable means for defining and studying latent phenomena. The task before us, then, is to create measures and methods to do the same within sustainability research. A task that the authors believe is necessary and attainable.

2 Measuring Sustainability Knowledge and Attitudes

Motivated by these possibilities, the authors endeavored to measure two important latent constructs with a specific focus on sustainability. The resulting Assessment of Sustainability Knowledge (ASK) and Sustainability Attitudes Scale (SAS) were created and tested with the help and expertise of many colleagues. These scales are humbly put forward to be used, criticized (with hope, constructively!), debated and improved. The authors do not pretend that these measurements are without flaws, but do believe they represent a strong step forward towards building social science theory that equally incorporates the three domains of sustainability. Each scale was developed, treating sustainability as a single underlying construct comprised of three factors, pre-tested, and tested independently across different institutions to best assess their validity. A brief description of the development of the two scales, what precisely each is and is not measuring, and how to best use them for research and evaluation is presented below.

2.1 Assessment of Sustainability Knowledge (ASK)

The ASK was first developed in 2014 with input from a large pool of subject experts (Zwickle et al. 2014). This original 16 question measure has been used for variety of purposes and in a range of academic settings. In the following years the question pool was expanded to 28 as a result of fruitful collaboration with colleagues at the University of Maryland. Where the original ASK had intentionally focused on domain specific knowledge items (questions that were strictly focused on environmental, economic, or social concepts), researchers at the University of Maryland had taken the opposite approach. The items created for their knowledge assessment focused on concepts that blended two and sometimes all three domains together. As the broader subject of sustainability contains some concepts that may be specific to a single domain and others that integrate multiple systems, combining some of each question increased the construct validity of the ASK.

This expanded question set was then tested, shortened, and retested in multiple waves of surveys administered to undergraduate students *(publication forthcoming)*. Decisions to remove questions from the pool were based on both their content as well as confirmatory factor analysis and item response theory, following the same procedure used in Zwickle et al. (2014). The final result is a 12 item scale with a blend of questions of varying difficulty covering the environmental, economic, and social domains (Table 1). Obviously many important concepts will be left out of a knowledge assessment containing only a dozen questions. However, the concepts that are covered in the ASK have been found to be correlated with a greater amount of sustainability knowledge overall. Just as the National Science Foundation has been measuring the public's understanding of science for years with only nine true or false questions (Natinoal Science Board 2016; Miller 1998, 2004), not every concept needs to be directly assessed in order to accurately measure the extent of one's knowledge. Identifying those concepts which serve as an indicator, or keystone, for numerous others makes it possible to use fewer items to return the essentially the same score. Finally, the ASK has demonstrated strong convergent validity, with students majoring in sustainability related areas averaging higher scores than other students, seniors averaging higher scores than freshmen, and ASK scores significantly correlated with measures of environmental concern and attitudes (Zwickle et al., *forthcoming)*.

Table 1 Revised 12 question assessment of sustainability knowledge (ASK; Zwickle, Koontz, Hamm, *forthcoming*). *correct answers in bold, a "Don't know" option was also given*

1. What is the most common cause of pollution of streams and rivers?
a. Dumping of garbage by cities **b. Surface water running off yards, city streets, paved lots, and farm fields** c. Litter near streams and rivers d. Waste dumped by factories
2. Ozone forms a protective layer in the earth's upper atmosphere. What does ozone protect us from?
a. Acid rain b. Climate change c. Sudden changes in temperature **d. Harmful UV rays**
3. Which of the following is an example of sustainable forest management?
a. Setting aside forests to be off limits to the public **b. Never harvesting more than what the forest produces in new growth** c. Producing lumber for nearby communities to build affordable housing d. Putting the local communities in charge of forest resources

(continued)

Table 1 (continued)

4. Of the following, which would be considered living in the most environmentally sustainable way?
a. Recycling all recyclable packaging **b. Reducing consumption of all products** c. Buying products labeled "eco" or "green" d. Buying the newest products available
5. Which of the following is the most commonly used definition of sustainable development?
a. Creating a government welfare system that ensures universal access to education, health care, and social services b. Setting aside resources for preservation, never to be used **c. Meeting the needs of the present without compromising the ability of future generations to meet their own needs** d. Building a neighborhood that is both socio-demographically and economically diverse
6. Over the past 3 decades, what has happened to the difference between the wealth of the richest and poorest Americans?
a. The difference has increased b. The difference has stayed about the same c. The difference has decreased
7. Many economists argue that electricity prices in the U.S. are too low because…
a. They do not reflect the costs of pollution from generating the electricity b. Too many suppliers go out of business c. Electric companies have a monopoly in their service area d. Consumers spend only a small part of their income on energy
8. Which of the following is the most commonly used definition of economic sustainability?
a. Maximizing the share price of a company's stock **b. Long term profitability** c. When costs equal revenue d. Continually expanding market share
9. Which of the following countries passed the U.S. to become the largest emitter of the greenhouse gas carbon dioxide?
a. China b. Sweden c. Brazil d. Japan
10. Which of the following is a leading cause of the depletion of fish stocks in the Atlantic Ocean?
a. Fishermen seeking to maximize their catch b. Reduced fish fertility due to genetic hybridization c. Ocean pollution d. Global climate change

(continued)

Table 1 (continued)

11. Which of the following is the best example of environmental justice?
a. Urban citizens win a bill to have toxic wastes taken to rural communities b. The government dams a river, flooding Native American tribal lands to create hydro-power for large cities **c. All stakeholders from an indigenous community are involved in setting a quota for the amount of wood they can take form a protected forest next to their village** d. Multi-national corporations build factories in developing countries where environmental laws are less strict.
12. Put the following list in order of the activities with the largest environmental impact to those with the smallest environmental impact:
A. Keeping a cell phone charger plugged into an electrical outlet for 12 h B. Producing one McDonald's quarter-pound hamburger C. Producing one McDonald's chicken sandwich D. Flying in a commercial airplane from Washington D.C. to China
a. A, C, B, D b. D, A, B, C c. D, C, B, A **d. D, B, C, A**

2.1.1 Using the ASK

It is important to remember that by design the ASK only measures knowledge. It does not measure anything related to one's behavior, nor their capacity for bringing about behavioral change. Keeping this strict focus in mind is imperative when deciding when to administer the ASK. The most logical and practical use is to evaluate the effectiveness of an educational program through either a pre and post-test, or by comparing a treatment group to a control. For example, if a new sustainability-focused major or minor is being created, the ASK can be given to students prior to its implementation and again after students complete the program. Alternatively, if a student's major is known, comparisons can be made between programs to assess their relative effectiveness at teaching the core concepts of sustainability knowledge (see Zwickle et al. 2014 for example analyses).

The limitations of using each approach should be well understood, to avoid making unjustified claims based upon the data. Unless the targeted population is both well-known and homogenous, knowledge gains measured via pre-post tests may not be solely attributable to the academic program of interest. In other words, if students in a sustainability major commonly take outside elective courses that also are oriented towards sustainability, it is possible that students learned those core concepts elsewhere. This limitation can be addressed by either controlling for courses taken outside the major (if the sample size is sufficiently small), obtaining a large enough sample (if possible) to introduce more random variance, or selecting a related group of students to compare knowledge gain to (Did students in the sustainability major show greater gains in sustainability knowledge than students in, say, environmental science?).

The importance of finding a appropriate comparison group highlights the primary limitation of comparing a sustainability major or minor to another academic program: the fact that students who choose a sustainability major likely have higher levels of sustainability knowledge than the general population prior to entering the classroom. Therefore the entire difference in knowledge scores between sustainability majors and non-majors cannot be attributed to classroom instruction alone. The exact magnitude of this bias can be easily measured however, by comparing scores of incoming students (who have chosen the sustainability major but not yet taken a class) to their peers in other fields. This value may be subtracted from the overall score of students who have completed the program for a more accurate evaluation of a sustainability curriculum when comparing to peers in other majors.

More related to our previous discussion, the ASK's exclusive focus on knowledge enables social scientists to test the effect that sustainability knowledge has in theoretical models. If a single measure were to address multiple constructs (e.g., knowledge, mindset, behavioral intention), the individual effect of each variable cannot be parsed out analytically. In order to test the influence of each of these on a dependent variable, each one must be measured individually and entered as a separate independent variables in a regression model.

This analytical approach was used to test the "information deficit model," which suggests that if students only knew more about sustainability they would adopt more sustainable behaviors. This model of behavioral change has been found to be ineffective by risk communication (and other) scholars, though some researchers have concluded that adding sustainability related learning goals into the curriculum will lead to more sustainable behaviors among students. This assumption was empirically tested by measuring knowledge in conjunction with other latent constructs in a single study. Heeren et al. (2016) conducted a survey of university undergraduate students using the theory of planned behavior (TPB) to predict one's willingness to engage in various pro-environmental behaviors. The ASK was included in addition to the TPB to measure to the extent that knowledge played a role in a student's behavior after taking into account attitudes, norms, and perceived behavioral control. As past research had predicted, knowledge was found to have very little influence in students' behavior. By using the ASK to test existing theory in this new context, it was shown that one cannot simply expect students to change their behavior after receiving sustainability oriented curricula.

2.2 Sustainability Attitudes Scale (SAS)

The development of the SAS began in 2010 with an interest to measure the three-domain model of sustainability presented by Brundtland et al. in 1987. The initial aim was to measure both the independent domains (ecological, economic, and social) as well as the intersections of those domains. An initial pool of 74 items was created at Central College by consulting experts in the three domains with the intent to reduce the number items in the scale. The first wave of participants (college students) completed the measure in 2011 in an exploratory examination of potential structures within the SAS. Schutte and Jones (2012) reported three structures across 26 items that did not conceptually align exactly with the theoretical model. Although the three structures (social justice, social-economic, self-entitlement/privilege) were consistent within a larger sustainability framework and showed good convergent validity with other measures (Schutte and Jones 2012), the relatively small sample size in this study necessitated subsequent studies with larger samples to improve reliability and validity of the measure.

A follow-up study using a sample of roughly 400 first-year college students helped address the sample size issue, but it revealed different structures from the 74-item pool (Campbell and Jones 2015). In fact, exploratory factor analysis revealed factors that had multiple plausible conceptual interpretations. Testing the larger pool of SAS items in pre/post-test within-group comparison of a smaller sample of these 400 students after they had graduated revealed a different set of sustainability factors. At this point, the SAS was a potentially beneficial measure of sustainability attitudes but it did not align with the three domain model. Developing the SAS, however, had two needs: obtaining a more representative sample and expanding the statistical analyses for item reduction.

In 2016, the full pool of SAS questions was tested with roughly 1,000 undergraduates at Michigan State University. These data were analyzed using confirmatory factor analysis (confining the data to three environmental, social, economic factors) and Item Response Theory (IRT, used to select better discerning items with a range of difficulty). Thus, the authors were able to address both issues from the previous data sets. These analyses revealed that 11 items could measure the three factors consistent with the three domain model of sustainability with good internal reliability (with Cronbach alpha levels ranging from 0.74 to 0.78) (Jones and Zwickle, *forthcoming*; Table 2). To further test the SAS's validity, a follow-up study of 1,895 undergraduates compared the SAS's predictive ability against the typical measure of sustainability attitudes, the New Ecological Paradigm (NEP). Participants completed the SAS, NEP, and a range of questions pertaining to sustainability behaviors and beliefs (e.g. How actively do you look for ways to reduce electricity use? My university should aspire to carbon neutrality.) This study revealed that while the NEP significantly predicted these behavior and beliefs, the SAS did so with greater correlation coefficients (when controlling for variables such as political party, and social and economic ideology) (Jones and Zwickle 2016). Combined, these two studies show the 11-item Sustainability Attitudes Scale has established both internal reliability, construct and content validity, as well as predictive power that aligns with a view of sustainability that is comprised of ecological, economic, and social domains.

Table 2 Sustainability attitudes scale (SAS; Jones & Zwickle, *forthcoming*)

1. Equal rights for all people strengthens a community
2. Community cooperation is necessary to solve social problems
3. Generally speaking consumerism is not sustainable
4. Access to clean water is a universal human right
5. I am willing to put forth a little more effort in my daily life to reduce my environmental impact
6. An unsustainable economy values personal wealth at the costs of others
7. I believe that many people can work together to solve global problems
8. Clean air is part of a good life
9. Our present consumption of natural resources will result in serious environmental challenges for future generations
10. The well-being of others affects me
11. Biological diversity in itself is good

All items set to a 1—Strongly Disagree, to 6—Strongly Agree, scale
Scoring note: Overall measure of sustainability attitude: Calculate mean of all 11 items
Ecological Sustainability Subscale: Calculate mean for Items 4, 8, 9, and 11
Social Sustainability Subscale: Calculate mean for items 1, 2, 7, and 10
Economic Sustainability Subscale: Calculate mean for items 3, 5, and 6

2.2.1 Using the SAS

One of the benefits of the SAS is its combined precision and scope. Like the ASK, the SAS measures a single construct, sustainability attitudes, enabling statistical analysis and hypothesis testing. The contents of the SAS have high construct validity for the commonly accepted definition of sustainability, so it provides a wider, multidimensional scope than other measures. The relatively few number of items also allows for efficient, yet reliable, insight to people's views towards sustainability.

The SAS also would be applicable in both narrow and wide efforts to understand sustainability attitudes. The measure is suitable for detecting individual dispositions and more general population perspectives. Thus, the SAS is appropriate for one-time assessment of individuals and groups, but it also is useful for detecting development or change over time in situations evaluating the effectiveness of pro-sustainability efforts (e.g. curricula, institutional programming).

The practical usability of the measure is complimented by its theoretical basis. The three domain conceptualization of sustainability has shown to be, well, sustainable. The stability of this conceptualization is reflected in the SAS, as the SAS shows that the three domains are cognitively linked among individuals. Thus, an individual's score for the three separate domains, or a combined score, can be used to predict related sustainability outcomes. In fact, as new theoretical models of sustainability develop the SAS can be used as one method of assessing their validity.

2.3 Limitations and Constraints

While the sustainability knowledge and attitudes measures submitted here have been shown to be valid and reliable enough to be used for relevant theory testing, they are not without flaws. Two of the ASK items (#6 and #9) are bounded in time, as they reference somewhat current events. This is simply a limitation in question making ability, as the pool of experts were unable to craft questions addressing income disparity and global emissions that were as context neutral as the other items. Similarly, it is possible that the environmental impacts associated with the activities listed in #12 may change over time. The primary constraint associated with the SAS is the effect that social desirability bias may have on respondents. Currently the extent to which this influences responses is not known, but it is possible that respondents may feel that answering more favorably to the items will be perceived in a more positive light.

3 Conclusion

The current state of sustainability focused social science research has undoubtedly benefited from the diverse pool of disciplinary fields it has drawn from. The interdisciplinary research conducted by scientists from various backgrounds has successfully laid a solid foundation of literature largely focused on exploratory and inductive studies. One negative, yet understandable, by-product of this academic diversity is that the sustainability "wheel" has been redesigned a number of times as research published in various disciplinary journals has pursued similar goals, with similar methods, yielding similar results (see the numerous studies on campus energy competitions as one example). It is on this plateau that the field now rests; elevated by this initial research but lacking the theoretical foundation to climb much higher.

Substantial, quality sustainability research certainly is being conducted, research that brings existing and relevant theories to test in the sustainability domain in order to paint a fuller picture of individual behavior. The work of Shahzeen Attari and colleagues, for example, have used numeracy and the NEP to explain inaccurate perceptions in water and energy use (Attari 2014; Attari et al. 2010) and framed behavioral barriers in terms of existing theory (Lute et al. 2015). The authors hope to add this number with the ASK and SAS presented in this chapter. The ASK has already been used to challenge the assumption that sustainability education will result in behavioral change (Heeren et al. 2016), echoing past findings in communication research. Moving forward, the SAS provides an attitudinal measure specifically targeted to the three domain definition of sustainability. This focus increases its construct validity compared to past studies which have used the NEP as a proxy measure for sustainability attitudes. Looking forward, as the number of new sustainability focused academic journals continues to grow, the authors are optimistic that the amount of theoretically focused research will increase as well.

Testing existing theory is an effective way to learn how the current extent of our knowledge does, or does not, translate to the realm of sustainability. But when these theories perform differently than expected, it signals that new theory is needed. For example, using the NEP as proxy measure for sustainability attitudes is not theoretically valid, and doing so would impede future research. As the NEP can effectively measure environmental beliefs, perhaps the differences between the SAS and the NEP can shed light on what it means to be socially and economically sustainable. Developing measures for other latent constructs unique to sustainability (such as values, beliefs, perceptions, etc.) will help us discern the extent that this field is different than others. As these boundaries are delineated it will become clearer what is, and what is not, sustainable.

Therefore the authors contend that it is time for sustainability research to take a bold step forward. As a research community, let us accept the Brundtland definition of sustainability and recognize that in order for a society to be sustainable it needs to meet today's environmental, economic, and social needs without comprising the ability of future generations to do the same. Uniting behind this definition may be a mere formality at this point, but doing so will hopefully free some researchers to pursue the more difficult (and basic) questions like: What is social sustainability? The authors call on a thick-skinned sociologist or political scientist to make an initial attempt at a definition (and call on the rest of the field to be kind in their criticism!). Likewise for economic sustainability: the time is ripe for a brave economist to put forth suggested guidelines for a sustainable economy. This work will require moving beyond basic interdisciplinary research towards a transdisciplinary approach (Kumar Giri 2002; Max-Neef 2005) in order to fully incorporate the accumulated knowledge of each of our academic traditions. By doing so we, as a community of scholars, can begin to work towards some form of consilience; a necessary first step in the overall goal of achieving a truly sustainable society.

References

Allcott, H., & Rogers, T. (2014). The short-run and long-run effects of behavioral interventions: Experimental evidence from energy conservation. *The American Economic Review, 104*(10), 3003–3037.

Andersson, L., Shivarajan, S., & Blau, G. (2005). Enacting ecological sustainability in the MNC: A test of an adapted value-belief-norm framework. *Journal of Business Ethics, 59*(3), 295–305.

Attari, S. Z. (2014). Perceptions of water use. *Proceedings of the National Academy of Sciences, 111*(14), 5129–5134.

Attari, S. Z., DeKay, M. L., Davidson, C. I., & Bruin, W. B. De. (2010). Public perceptions of energy consumption and savings. *Proceedings of the National Academy of Sciences, 107*(37), 16054–16059.

Bollen, K. A. (2002). Latent variables in psychology and the social sciences. *Annual Review of Psychology, 53*(1), 605–634.

Campbell, B., & Jones, K. (2015). *Assessing Sustainability Attitudes: A New Multi-Dimensional Measure*. Paper presented at the Association for the Advancement of Sustainability in Higher Education, Minneapolis, MN.

Catton, W. R., & Dunlap, R. E. (1978). Paradigms, theories, and the primacy of the HEP-NEP distinction. *The American Sociologist*, 256–259.

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology, 58*(6), 1015–1026.

Dunlap, R. E. (2008). The new environmental paradigm scale: From marginality to worldwide use. *The Journal of Environmental Education, 40*(1), 3–18.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). New trends in measuring environmental attitudes: Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues, 56*(3), 425–442.

Elkington, J. (1997). *Cannibals with forks: Triple bottom line of 21st century business* (p. 424). Oxford: Capstone Publishing Ltd.

Frisk, E., & Larson, K. L. (2011). Educating for sustainability: Competencies & practices for transformative action. *Journal of Sustainability Education, 2*(March), 1–20.

Heberlein, T. A. (2012). Navigating environmental attitudes. *Conservation Biology, 26*(4), 583–585.

Heeren, A. J., Singh, A. S., Zwickle, A., Koontz, T. M., Slagle, K. M., & McCreery, A. C. (2016). Is sustainability knowledge half the battle? An examination of sustainability knowledge, attitudes, norms, and efficacy to understand sustainable behaviours. *International Journal of Sustainability in Higher Education, 17*(5), 613–632.

Jones, K., & Zwickle, A. (2016). *Measuring Sustainability Culture and Attitudes among the Student Body: Why you Should Care*. Paper presented at the Association for the Advancement of Sustainability in Higher Education, Baltimore, MD.

Kenyon, G. M. (1988). Basic assumptions in theories of human aging. *Emergent theories of aging*, 3–18.

Kuhn, T. S. (2012). *The structure of scientific revolutions* (p. 216). Chicago: University of Chicago press.

Kumar Giri, A. (2002). The calling of a creative transdisciplinarity. *Futures, 34*(1), 103–115.

Lute, M. L., Attari, S. Z., & Sherman, S. J. (2015). Don't rush to flush. *Journal of Environmental Psychology, 43,* 105–111.

Max-Neef, M. A. (2005). Foundations of transdisciplinarity. *Ecological Economics, 53*(1), 5–16.

Miller, J. D. (1998). The measurement of civic scientific literacy. *Public Understanding of Science, 7*(3), 203–223.

Miller, J. D. (2004). Public understanding of, and attitudes toward, scientific research: What we know and what we need to know. *Public Understanding of Science, 13*(3), 273–294.

National Science Board. (2016). Chapter 7, Science and technology: Public attitudes and public understanding. *Science and Engineering Indicators*. Retrieved from: http://www.nsf.gov/statistics/2016/nsb20161/#/.

Osbaldiston, R., & Schott, J. P. (2012). Environmental sustainability and behavioral science: Meta-Analysis of proenvironmental behavior experiments. *Environment and Behavior, 44*(2), 257–299.

Pirages, D. C., & Ehrlich, P. R. (1974). *Ark II: social response to environmental imperatives* (p. 344). New York: Viking Press.

Schaie, K. (1988). The impact of research methodology on theory building in the developmental sciences. In J. E. Birren & V. L. Bengtson (Eds.), *Emergent theories of aging: Psychological and social perspectives on time, self and society* (pp. 41–58). New York: Springer Publishing Co.

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2007). The constructive, destructive, and reconstructive power of social norms. *Psychological Science, 18*(5), 429–434.

Schutte, A., & Jones, K. (2012). Measuring sustainability attitudes: The development of a new scale. paper presented at the annual meeting of the midwestern psychological association, Chicago, IL

Stern, P. C., Dietz, T., Abel, T. D., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human ecology review, 6*(2), 81–97.

The World Commission on Environment and Development. (1989). *Our common future*. Oxford: Oxford University Press.

Toman, M. A. (2006). *The difficulty in defining sustainability. The RFF reader in environmental and resource policy* (pp. 247–253). Washington: RFF Press.

Vos, R. O. (2007). Defining sustainability: A conceptual orientation. *Journal of Chemical Technology and Biotechnology, 82*(4), 334–339.

Whitley, C. T., Takahashi, B., Zwickle, A., Besley, J. C., & Lertpratchya, A. P. (2016). Sustainability behaviors among college students: An application of the VBN theory. *Environmental Education Research*, 1–18.

Zwickle, A., Koontz, T., Slagle, K., & Bruskotter, J. (2014). Assessing sustainability knowledge of a student population. *International Journal of Sustainability in Higher Education, 15*(4), 375–389.

Sustainability Literacy and Cultural Assessments

John Callewaert

Abstract

As campus sustainability initiatives have expanded over the past decade, related efforts to assess the progress and impact of those initiatives have also developed. These assessments generally fall into two distinct categories, those focused on the assessment of student learning regarding sustainability and those focused on the assessment of campus culture—the sustainability values, behaviors, and awareness of students, faculty and staff. This paper provides an overview of leading examples of these two types of assessments—the Assessment of Student Knowledge (ASK) and the Sustainability Cultural Indicators Program (SCIP). Next, using self-reported assessment data from the Sustainability Tracking, Assessment & Rating System (STARS—a program of the Association for the Advancement of Sustainability in Higher Education) an analysis is provided on the number of institutions which are using such assessments. Results indicate that very few institutions are using these assessments and only a very small number are claiming the full STARS credit for this work. Finally, recommendations are provided on strategies for developing assessments and disseminating results which can best drive progress towards advancing campus sustainability.

Keywords

Campus sustainability · Literacy · Cultural assessment

J. Callewaert (✉)
Graham Sustainability Institute, University of Michigan, 625 E. Liberty, Suite 300,
Ann Arbor, MI 48104, USA
e-mail: jcallew@umich.edu

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_26

1 Introduction

Given the environment, social and economic challenges facing the global community, institutions of higher education can and should be at the forefront of fostering sustainability through collective actions and through cultivating future sustainability leaders. The works of Bartlett and Chase (2004, 2013) provide some of the best summaries of institutional sustainability transformation efforts over the past two decades. To date, however, most campus sustainability efforts stop either at "greening" or at the level of institutional commitments to eco-efficiency, climate action, waste mitigation, and expanding environmental education opportunities. Though calls for institutional and cultural transformation are increasing, rarely do institutions address the deeper change necessary to transform into organizations which empower citizens with a sustainability perspective. Instead, the focus is often on implementing many individual projects, isolated initiatives, or broad commitments (Sharp 2002, 2009). This is partly attributable to the lack of guidance for institutions attempting to follow this more uncertain and uncomfortable path towards sustainability literacy or more broadly a culture of sustainability. Zwickle et al. (2014) notes that tools to make such assessments are either nonexistent or their measures of knowledge rely on self-reported knowledge rather than more objective indicators.

Institutions of higher education must play an important role in addressing the more difficult yet powerful part of the sustainability transition. That role is in creating and maintaining a culture of sustainability among members of a university community. For this discussion, a culture of sustainability is defined as "a culture in which individuals are aware of major environmental (and social/economic) challenges, are behaving in sustainable ways, and are committed to a sustainable lifestyle for both the present and future" (Marans et al. 2014; Marans et al. 2010). Sustainability literacy grows from a related effort to support curricular initiatives emphasizing the integration of sustainability concepts across majors, fields of study and courses (Hopkinson and James 2010; Lidgren et al. 2006; Benn and Dunphy 2009). This has also led to the discussion of identifying core sustainability competencies for academic programs (Cotgrave and Kokkarinen 2011; Glasser and Hirsh 2016; Missimer and Connell 2012; Rieckmann 2012; Svanström et al. 2008; Wiek et al. 2011).

The Association for the Advancement of Sustainability in Higher Education (AASHE) is doing much to support these efforts through their Sustainability Tracking, Rating & Assessment System (STARS) which is used by hundreds of institutions. Previously version 2.0 of STARS (AASHE 2016a) gave institutions credit for sustainability related assessments under one subcategory. Version 2.1 version of STARS asks institutions to report on both their sustainability literacy assessment efforts and assessing a culture of sustainability (AASHE 2016b). What has not been provided to date is an analysis of these efforts. Who is using what? How widespread are such efforts? What can be said about impact?

This paper provides an overview of leading examples of these two types of assessments—the Assessment of Student Knowledge (ASK) and the Sustainability Cultural Indicators Program (SCIP). Next, using self-reported assessment data from the Sustainability Tracking, Assessment & Rating System (a program of the Association for the Advancement of Sustainability in Higher Education) an analysis is provided on the number of institutions which are using such assessments and how results are being utilized. Finally, recommendations are provided on strategies for developing assessments and disseminating results which can best drive progress towards advancing campus sustainability.

2 Assessments

2.1 Assessment of Student Knowledge

Developed by researchers and staff at The Ohio State University, the Assessment of Student Knowledge (ASK) is a relatively short questionnaire of 12-30 questions depending on the version used. The aim of ASK to quantify knowledge of broad and abstract concepts of sustainability within three domains—environment, social, and economic—for an undergraduate population. As an assessment of learning objectives, ASK can be administered via a campus survey or within a course to gauge current levels of literacy and track changes over time. The instrument was developed through examining existing questions, gathering input from experts, focus group testing, and pilot testing. In addition, Item Response Theory was used to select the most discriminating questions (Zwickle et al. 2014; Environmental and Social Sustainability Lab 2016).

The ASK tool was recently distributed to a large student sample at Ohio State as part of a larger sustainability focused survey emailed to a randomly selected group of 10,000 undergraduate students from a total undergraduate population of more than 40,000. An initial invitation message was sent by a university vice president with two reminders. Over 1300 student completed the survey generating a 13.3% response rate. Additional administration details, analysis, and a list of the questions included on the survey can be found in Zwickle et al. (2014).

ASK developers are continuing to refine the tool and hope to establish a broad baseline of data for comparisons across other student populations. Key to this work is determining the degree to which sustainability concepts are context-specific particularly when comparisons might be made across different countries especially if questions about items like wealth inequality were developed within the US context (Zwickle et al. 2014).

2.2 Sustainability Cultural Indicators Program

The Sustainability Cultural Indicators Program (SCIP) is a multi-year project designed to measure and track the culture of sustainability at the University of Michigan—Ann Arbor (U-M). It is intended to inform U-M administrators and others responsible for day-to-day operations of the University including its academic programs. Furthermore, it is intended to serve as a model demonstrating how behavioral research can be used to address critical environmental issues within universities generally and in other organizational settings (Callewaert and Marans 2016; Sustainability Cultural Indicators Program 2016).

SCIP was developed following a comprehensive campus sustainability initiative at the University of Michigan (University of Michigan 2011). Completed in 2011, this initiative identified specific institutional goals for climate action, waste prevention, healthy environments, and a broader area of community awareness aiming to campus wide ethic of sustainability. To create SCIP, a small group closely involved with the campus sustainability initiative met for over a year examining the institutional goals, reviewing related literature, consulting with key national leaders working on similar efforts, conducting focus groups with students and staff to determine current understandings of sustainability, and analyzing more than thirty existing campus surveys from numerous institutions about topics such as recycling, transportation, etc.

One of the most useful resources for this work was the North American Association for Environmental Education's report "Developing a Framework for Assessing Environmental Literacy" (Hollweg et al. 2011). It provided a very useful frame for developing questions under three categories; knowledge, dispositions, and behavior. This went beyond many of the existing campus surveys which focused primarily on sustainability literacy or environmental literacy, or which focused exclusively on operational outcomes.

Two SCIP questionnaires were developed — one for staff and faculty, and one for students. In addition to these cross sections, there is also a version of the student questionnaire which is administered to a student panel. If a first year student completes the questionnaire they are then invited to repeat the survey in the future to more closely examine changes over time. The SCIP questionnaires include more than 200 questions but through effective survey design and utilizing Illume for online completion via desktop or mobile device most respondents complete the questionnaire in about 15 minutes. The questionnaires have been administered every fall between 2012 and 2015. Each year approximately 6000 members of the campus community complete the questionnaire with annual response rates at around 25% (Hupp 2016). A set of 15 key indicators have been developed which align with campus sustainability goals to demonstrate findings and changes over time. Copies of the survey instrument, annual reports and other materials are all available online (Sustainability Cultural Indicators Program 2016).

While some sustainability literacy content is included on the SCIP questionnaires, most of the questions focus on sustainability awareness, behavior and dispositions. A key difference from ASK is that the questionnaires were developed for students, faculty and staff as a primary objective is to work with the entire campus community in advancing campus sustainability. Results are shared broadly with the campus community and several courses utilize SCIP data for generating ideas for new programming or examining existing efforts. Over the 4 years which SCIP has been in place, respondents report greater awareness of sustainability topics but behavior has been slow to change except with respect to targeted programs with significant institutional support—such as alternative transportation, energy conservation, and sustainability food initiatives. More than 150 requests have been received for copies of the survey instruments from other institutions (Callewaert and Marans 2016; Marans et al. 2016).

2.3 Other Initiatives

Other efforts which should be mentioned include the Sulitest (2016) and the Sustainability Education questionnaire used by consortium members through the National Survey of Student Engagement (NSSE) (2016). Sulitest (Sustainability Literacy Test) aims to improve and measure sustainability literacy worldwide by providing citizens and organizations with internationally recognized and locally relevant assessment tools; by promoting and advocating for of education on sustainability development. It is a membership/fee based program which has been used by 445 universities and companies in 51 countries (only a few US institutions)—with more than 40,000 tests taken (Sulitest 2016). A new version of Sulitest was released in September 2016.

In 2011, eight institutions formed the sustainability education consortium are part of the NSSE to assess engagement in sustainability education across the curriculum. The consortium added questions to the core NSSE survey in order to develop a user-friendly assessment system for sustainability education. Through this it was hoped that institutions could acquire a cross-institution data set on students' engagement with aspects of sustainability, assess institutional strengths and weaknesses with respect to sustainability education compared to peers, and provide one source of assessment data for the AASHE education initiative (National Survey of Student Engagement 2016). As part of STARS 2.1, AASHE does not allow the NSSE Sustainability Education consortium questionnaire to be used for the sustainability literacy credit (AASHE 2016b) but may be reported as a STARS Exemplary Practice in Innovation & Leadership. Depending on institutional objectives, both Sulitest and the NSSE Sustainability Education consortium questionnaire should be considered.

3 Methodology

The AASHE STARS reporting system (2016a) as of July 2016 (version 2.0) offers the best opportunity to examine the extent to which institutions are using sustainability literacy or cultural assessments as part of their overall sustainability efforts given the number of participating institutions and the online availability of institutional reports. More than 750 institutions have registered to use the STARS reporting tool. STARS uses a comprehensive system for the self-report of sustainability related activities from each participating institution covering academics, engagement, operations, and planning and administration. There are multiple subcategories within each category. Each category can generate anywhere from 1–14 points based on the established criteria. Out of approximately 200 points (some categories provide a range of possible points), the following scores (Table 1) are available on the AASHE (2016c) website. Of the total registered intuitions, over 250 have ratings based on the following system.

In STARS 2.0, there is only one subcategory under academics for which institutions can earn points for sustainability related assessments. Institutions earn the maximum of 4 points available for this credit by assessing the sustainability literacy of 90 percent or more of the institution's students (directly or by representative sample) and conducting a follow-up assessment of the same cohort(s) using the same instrument. Incremental points are available based on the percentage of the total student population assessed and whether or not follow-up assessment(s) are conducted (AASHE 2016a).

For this analysis only Gold and Platinum rated institutions using the 4-point version 2.0 (n = 88) were examined for if and how they are assessing their work in this space. Very few other rated institutions reported on activity for this subcategory. From that subgroup, further examination was completed for the 10 institutions which received the full 4 points possible. Some institutions were still reporting based on a previous STARS system that provided fewer than 4 points for this subcategory—these institutions were not included in the following analysis.

Table 1 STARS Scores

Rating Level	Minimum Score Required	Number of Institutions
Platinum	85	1
Gold	65	129
Silver	45	97
Bronze	25	41
Reporter	For institutions that wish to use STARS and submit data publicly but are not pursuing a rating	16
Expired	-	96
No Score	-	374

4 Results and Analysis

Despite the fact that more than 750 institutions have registered to use the STARS reporting tool, very few institutions are fully pursing the sustainability literacy category of STARS 2.0. As noted above only 10 institutions claimed the 4 points (maximum) and as noted in Table 2 below, most institutions claim only partial or no points through this category despite their platinum and gold ratings.

One of the key challenges of the STARS reporting system is that it relies primarily on self-reported data. While there is a great deal of transparency by having the full institutional reports posted online and AASHE states that reports are reviewed (AASHE 2016a), it is not clear how much review is done to check these reports and the supporting data. For example, upon further analysis, several questions can be raised regarding the information provided by the 10 institutions which claimed the full 4 points are meeting the stated criteria. Table 3 provides the results of this analysis. Based on a review of the materials provided in these self-reports, only 4 institutions are meeting the stated criteria for claiming the full points; that the survey is administered to more than 90% of the student body or is sent to a representative sample, and that a follow up is conducted so that changes can be tracked over time. Three of these institutions may be meeting the criteria but is not clear if their approach matches the process outlined by AASHE. Another 3 institutions may not be meeting the criteria based on their self-reported process. Finally, from this subset of 10 institutions, most are focusing on literacy assessments.

Table 2 STARS 2.0 Sustainability Literacy Assessment Results (Platinum and Gold rated institutions only)

STARS Assessment results	Number (and percentage) of institutions (n=88)	The percentage of students assessed for sustainability literacy (directly or by representative sample) and for whom a follow-up assessment is conducted
Institutions receiving 4 out 4 points for sustainability literacy assessment efforts	10 (11%)	100%
Institutions receiving less than 4 but more than 1 point for sustainability literacy assessment efforts	18 (21%)	0–78.5%
Institutions receiving less than 1 but more than 0 points for sustainability literacy assessment efforts	25 (28%)	0–16%
Institutions not pursuing sustainability literacy assessment efforts	35 (40%)	0%

Table 3 Institutions Claiming Full Credit for STARS 2.0 Sustainability Literacy Assessment

Institution	Overview	Meets criteria: reaching 90% of students / representative sample; follow up	Type of Assessment
Colorado State University	Survey administered annually to a representative sample of students	Yes	Literacy with some questions about support for types of behavior
Kankakee Community College	Survey Monkey literacy assessment sent to all students in April each year, changes over time are tracked	Yes	Literacy and some engagement
University of Michigan – Ann Arbor	SCIP (described above)	Yes	Culture and limited number of literacy questions
University of Ontario Institute of Technology	Assessment and follow-up assessment sent via Survey Monkey, circulated to a representative sample of students	Yes	Literacy and awareness
Sterling College	Sustainability literacy is assessed as part of an essay students write in a required course for graduation	Maybe (unclear if approach matches STARS criteria)	Literacy
The Ohio State University	Early version of ASK (described above) sent electronically to a representative sample of students	Maybe (unclear if follow up is conducted)	Literacy
University of Wisconsin-Stevens Point	All current students sent assessment via email	Maybe (follow up rates were much lower than initial data collection)	Literacy
George Washington University	Sustainability Literacy Pre/Post Test through sustainability course taken by a broad range of students	No (unclear if representative sample is achieved and if any follow up takes place)	Literacy
Thompson Rivers University	Assessments administered through online surveys, surveys at student orientations and focus group interviews	No (unclear if representative sample is achieved and if any follow up takes place)	Literacy and behavior
Wartburg College	Students asked to complete the ASK survey through Survey Monkey	No (unclear if representative sample is achieved and if any follow up takes place)	Literacy

While there is the potential for disagreement in these results based on methodological approaches and the amount of detail included in the reports it is clear that there is a great deal of variability in how institutions conduct these assessments. An argument can be made that each institution should develop assessment tools and approaches which match their sustainability objectives, however, there is potentially great value in using some degree of a common approach so that more comparisons can be done across and over time. Furthermore, conducting these assessments can be labor intensive and expensive. Establishing common assessment tools and administration protocols that are flexible and easy to replicate will help expand this work to other institutions.

5 Conclusion

For the next iteration of STARS (2.1) institutions can still claim up to 4 points for sustainability literacy assessment but may also claim an additional 1 point for sustainability culture assessment. As with the previous version of STARS (2.0) institutions can only claim full credit if they administer the literacy assessment to the entire student body or a representative sample with follow up (pre and post assessments). For the cultural assessment (value, behaviors and beliefs) institutions may claim a maximum of 1 point is the assessment is administered to the entire campus community (students, staff and faculty) and if there is a follow up with the same cohort or a representative sample (AASHE 2016b).

While it is encouraging that institutions may claim credit for both efforts, the rationale for the assignment of points for these efforts is not clear. If the objective is to promote sustainability at institutions of higher education what is the rationale for giving greater weight to student literacy assessments? Of course, these are future leaders in many areas and disciplines including sustainability but why should those efforts be of more importance for advancing institutional sustainability than cultural efforts which seek to include all members of a campus community (students, staff and faculty) and address a potentially greater challenge—behavior change. A sustainably literate community is certainly a foundation for these efforts but if literacy is not connected to behavior change, what is the point? At the University of Michigan—Ann Arbor, the plan moving forward is to continue with SCIP and to add in ASK so that a full range of literacy and cultural items can be measured and tracked over time to inform a wide range of educational and operational objectives.

STARS offers a powerful tool for examining sustainability efforts at the institutional levels and across programs. While cultural change has been identified as a key component of sustainability efforts, the examination of such efforts (literacy and culture) at institutions using the STARS reporting tool (2.0) indicates that very few institutions are fully committed to these efforts. In fact very few are following the proscribed activities.

Moving forward institutions committed to sustainability such as AASHE should do more to guide these efforts. Not just the processes for conducting literacy and cultural assessment but also for determining the content of the assessments. This formative phase of campus sustainability assessment efforts has similar characteristics to efforts to develop common standards and practices for environmental education and service—learning (Simmons 1995; Eyler and Dwight 1999). While the NSSE Sustainability Education consortium questionnaire may not offer sufficient content to fulfill the STARS 2.1 criteria for sustainability literacy or a sustainability cultural assessment, this type of effort demonstrates the potential for powerful analyses within institutions by utilizing other questions such as demographic information of respondents and for cross institutional comparisons. Below are several recommendations for guiding this effort:

- *Develop a concise set of sustainability culture questions which can be used across institutions like ASK for sustainability literacy.*
- *Develop simple, cost effective and powerful protocols for guiding institutions to complete these assessments in ways that are representative and organized for longitudinal analysis.*
- *Develop common reporting frameworks and indicators which communicate key findings and changes over time.*
- *Work with other sectors (K-12, government, industry, etc.) to share strategies and learnings.*

As noted in the introduction to this paper, the importance of creating, examining, and fostering an institutions culture of sustainability is critical to moving beyond basic "greening the campus" efforts of sustainability. While some institutions are committed to this work much more can and should be done.

Acknowledgments Many thanks to Drake Johnson and Niyati Kellenberg Callewaert for their assistance in reviewing the institutional STARS data and in reviewing assessment instruments.

References

Association for the Advancement of Sustainability in Higher Education (AASHE) (2016a) Sustainability tracking, assessment & rating system (STARS) 2.0 technical manual. https://stars.aashe.org/pages/about/stars-20-technical-manual.html. Last Accessed 27 Sept 2016.

Association for the Advancement of Sustainability in Higher Education (AASHE). (2016b). Sustainability tracking, assessment & rating system (STARS) 2.1 technical manual. https://stars.aashe.org/pages/about/technical-manual.html. Last Accessed 19 Mar 2016.

Association for the Advancement of Sustainability in Higher Education (AASHE). (2016c). Sustainability tracking, assessment & rating system (STARS) STARS Participants & Reports. https://stars.aashe.org/institutions/participants-and-reports/. Last Accessed 27 Sept 2016.

Bartlett, P. F., & Chase, G. W. (2004). *Sustainability on campus: stories and strategies for change* (p. 337). Cambridge: MIT Press.

Bartlett, P. F., & Chase, G. W. (2013). *Sustainability in higher education: stories and strategies for transformation* (p. 316). Cambridge: MIT Press.

Benn, S., & Dunphy, D. (2009). Action research as an approach to integrating sustainability in MBA programs: An exploratory study. *Journal of Management Education, 33*(3), 276–295.

Callewaert, J., & Marans, R. W. (2016). Measuring progress over time: The sustainability cultural indicators program at the university of michigan. In W. Leal (Ed.), *Handbook of theory and practice of sustainable development in higher education* (Vol. 2). Berlin: Springer.

Cotgrave, A., & Kokkarinen, N. (2011). Promoting sustainability literacy in construction students Implementation and testing of a curriculum design model. *Structural Survey, 29*(1), 97–212.

Eyler, J., & Dwight, E. G. (1999). *Where's the learning in service-learning? Jossey-Bass Higher and Adult Education Series*. San Francisco: Jossey-Bass.

Environmental and Social Sustainability Lab. (2016). Assessment of sustainability knowledge (ASK). http://ess.osu.edu/research/assessment-sustainability-knowledge-ask. Last Accessed 27 Sept 2016.

Glasser, H., & Hirsh, J. (2016). Toward the development of robust learning for sustainability core Competencies. *Sustainability: The Journal of Record, 9*(3), 121–134.

Hollweg, K. S., Taylor, J. R., Bybee, R. W., Marcinkowski, T. J., McBeth, W. C., Zoido, P. (2011). Developing a framework for assessing environmental literacy. http://www.naaee.net. Last Accessed 14 Jan 2016.

Hopkinson, P., & James, P. (2010). Practical pedagogy for embedding ESD in science, technology, engineering and mathematics curricula. *International Journal of Sustainability in Higher Education, 11*(4), 365–379.

Hupp, A. (2016). Sustainability cultural indicators program web survey of University of Michigan students, staff, and faculty: Methodology report. http://graham.umich.edu/campus/scip/materials. Last Accessed 21 Mar 2016.

Lidgren, A., Hakan, R., & Huisingh, D. (2006). A systematic approach to incorporate sustainability into university courses and curricula. *Journal of Cleaner Production, 12*(9–11), 797–809.

Marans, R. W., Callewaert, J., & Shriberg, M. (2014). Enhancing and monitoring sustainability culture at the University of Michigan. In W. Leal Filho (Ed.), *Implementing campus greening initiatives: approaches, methods and perspectives* (pp. 165–181). Frankfurt: Peter Lang.

Marans, R. W., Levy, B., Bridges, B., Keeler, K., Avrahami, T., Bennett, J., Davidson, K., Goodman, L., Holdstein, B., Smith, R. (2010). Campus sustainability integrated assessment: culture team phase I report. http://www.graham.umich.edu/pdf/culture-phase1.pdf. Last Accessed 14 Jan 2016.

Marans, R. W., Callewaert, J., Webster, N. (2016). Sustainability cultural indicators program: Fourth Year Report. http://graham.umich.edu/campus/scip/materials. Last Accessed 27 Sept 2016.

Missimer, M., & Connell, T. (2012). Pedagogical approaches and design aspects to enable leadership for sustainable development. *Sustainability: The Journal of Record, 5,* 172–181.

National Survey of Student Engagement. (2016). Sustainability Education Consortium. http://www.nsse.indiana.edu/html/consortia.cfm. Last Accessed 27 Sept 2016.

Rieckmann, M. (2012). Future-oriented higher education: Which key competencies should be fostered through university teaching and learning? *Futures, 44,* 127–135.

Sharp, L. (2002). Green campuses: The road from little victories to systemic transformation. *International Journal of Sustainability in Higher Education, 3,* 128–145.

Sharp, L. (2009). Higher education: the quest for a sustainable campus. Sustainability: Science. *Practice and Policy, 5,* 1–8.

Simmons, D. (1995). *The NAAEE Standards Project: Papers on the development of environmental education standards*. Ohio: North American Association for Environmental Education Troy.

Sulitest. (2016). Building a sustainable future together. http://www.sulitest.org/en/. Last Accessed 27 Sept 2016.

Sustainability Cultural Indicators Program. (2016). http://graham.umich.edu/campus/scip. Last Access 27 Sept 2016.

Svanström, Lozano-García F. J., & Rowe, D. (2008). Learning outcomes for sustainable development in higher education. *International Journal of Sustainability in Higher Education, 9,* 339–351.

University of Michigan. (2011). Campus sustainability integrated assessment final report. http://graham.umich.edu/media/files/CampusIA-FinalReport.pdf. Last Accessed 27 Sept 2016.

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: a reference framework for academic program development. *Sustainability Science, 6,* 203. doi:10.1007/s11625-011-0132-6.

Zwickle, A, Koontz T. M, Slagle, K. M, Bruskotter, J. T. (2014). Assessing sustainability knowledge of a student population. *International Journal of Sustainability in Higher Education, 15*(4), 375–389. http://www.emeraldinsight.com/doi/full/10.1108/IJSHE-01-2013-0008.

Author Biography

John Callewaert Ph.D. is the Emerging Opportunities Program Director at the Graham Sustainability Institute and a Lecturer in the College of Literature, Science, and the Arts at the University of Michigan. As Emerging Opportunities Program Director at the Graham Institute, John is responsible for designing, implementing, and overseeing a wide range of activities which support translational knowledge efforts involving subject matter experts, decision-makers, and key stakeholders in outlining viable pathways toward sustainability solutions. Dr. Callewaert came to the Graham Institute in 2009 after serving for two years as the Director of the University of Michigan-Flint Office of Research. From 2000–2007, Callewaert was the founding director of the Institute for Community and Environment at Colby-Sawyer College and an Associate Professor of Social Sciences and Education. Between 1984 and 1987 he served as an agricultural volunteer with Peace Corps Nepal working on improving seed supplies in remote hill villages. Dr. Callewaert serves as an associate editor for the Journal of Environmental Studies and Sciences, as an advisory council member with the Association for the Advancement of Sustainability in Higher Education, and as an advisory board member for The Integrated Assessment Society.

A Conceptual Framework for Designing, Embedding and Monitoring a University Sustainability Culture

Richard Adams, Stephen Martin and Katy Boom

Abstract

Universities across the globe are giving increasing priority to the challenges of sustainability, encouraged by a variety of drivers including international and national policy, student and societal pressures. Many extant initiatives focus on a narrow set of activities including curriculum design and operational efficiency, and overlook the importance of cultural change in embedding sustainability. Drawing and building upon previous studies in the cultural change and sustainability literature, the purpose of this article is to propose a conceptual framework for designing interventions and measuring and monitoring progress in building and embedding a university sustainability culture. Our efforts are contextualised in the case of a UK university.

Keywords

University sustainability · Organizational culture · Environmental accountability Wicked problem

R. Adams (✉)
CODE, Business School, Surrey University, Guildford, UK
e-mail: r.adams@surrey.ac.uk

S. Martin
University of Worcester, Worcester, UK
e-mail: esm@esmartin.demon.co.uk

S. Martin · K. Boom
University of the West of England, Worcester, UK
e-mail: k.boom@worc.ac.uk

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2_27

1 Introduction

Universities have been amongst the earliest signatories to sustainability declarations, beginning in 1972 with the Stockholm Declaration on the Human Environment and later the Talloires Declaration, the first statement by university administrators of a commitment to sustainability in higher education (Wright 2002). As of January 2016, the Declaration had been signed by 499 university presidents and chancellors at institutions in 54 countries.[1] More recently, the Higher Education Sustainability Initiative (HESI) was created as a partnership of United Nations entities in the run-up to the UN's Conference on Sustainable Development (Rio + 20). With a global membership of almost 300 universities, HESI accounts for more than one-third of all the voluntary commitments that came out of Rio +20. The American College and University Presidents Climate Commitment run by Second Nature[2] and the Association for the Advancement of Sustainability and Higher Education (AASHE) has over 750 members, mostly from North America making a strong commitment by leaders in the Higher Education sector.

The role that universities have to play in the transformation toward a more sustainable society is increasingly recognised in both the scholarly and practitioner literature (Ramos et al. 2015). In recent decades, then, many universities have aligned themselves to the principles of sustainability. Further, a number of these have sought to advance the cause of sustainability through academic, operational and wider stakeholder outreach activities (Luna and Maxey 2013; Shiel et al. 2016).

Notwithstanding these efforts, progress has been criticised for being: piecemeal and limited to isolated pockets within universities (Cotton and Alcock 2013), technologically opportunistic, unresponsive to the social dimension and lacking overall coordination, leadership and coherence (Ramos et al. 2015; ISCN Secretariat 2014; Butt et al. 2014; Martin et al. 2013), leaving some of the bigger questions relating to sustainability unaddressed.

The purpose of this article is to propose a conceptual framework to guide developing, monitoring and embedding a university culture for sustainability reflecting diverse stakeholder communities, including: students, staff (academic), staff (non-academic) and, stakeholder businesses in the local community. We begin by briefly locating the challenge of sustainable culture as a 'wicked problem' (Churchman 1967) and contextualising our work in the case of University of Worcester's sustainability journey. Following that, we review and integrate two streams of literature, organizational culture and sustainable transformation, to propose a conceptual framework to inform the design, implementation and monitoring of initiatives to accelerate the embedding of a culture for sustainability. The article concludes with a discussion of next steps and reflections on implications for theory and practice.

[1]Source: Association of University Leaders for a Sustainable Future http://www.ulsf.org/programs_talloires_signatories.html#UK, June 2016.
[2]http://secondnature.org/.

2 Background

The whole notion of sustainability is inherently complex, made so through the integration of three high level considerations—people, planet, profit (Elkington 1997) – long time horizons with hard to quantify impacts (Epstein and Roy 2001). The journey towards sustainability is mired in this complexity and so characteristically a 'wicked problem'—wicked in the sense of cutting across boundaries, being highly resistant to resolution, often ill-formulated, constituted by multiple agents and decision makers with conflicting values, and with ramifications for the whole system (Churchman 1967). Consequently, a problem challenging in terms of communicating and controlling its characteristic values, behaviours and attributes to guide actor and institutional behaviour (Martin and Murray 2011).

On these grounds, there are several reasons why a university's journey to sustainability can be thought of as a wicked problem. First, as Hoover and Harder (2014) note, universities' transition to sustainability involves all areas of activity—learning and teaching, operations, external engagement and research and involves not only what is done but also how it is done, cutting across boundaries and involving multiple agents many of whom are accustomed to high levels of autonomy. Second, the cost-benefit calculations are highly complex: for example, how can an organization's impact on living and non-living natural systems and on social systems be measured, and over what time frame? Third, piecemeal initiatives, whilst lengthening the glide path (e.g. squeezing more from limited resources) are insufficient solutions, and more systemic approaches are required (Adams et al. 2016). Fourth, what is the 'system' and what is a university's place within that system? Should the university take a leadership role as an organization, as a player within the local community or within the community of universities or, should they simply comply with prevailing regulatory requirements? Finally, can consensus be expected in a context where there remains some (though diminishing) contestation over the evidence base (Whitmarsh 2011).

Typically, solutions to these problems in the university context have been sought in technological innovation such as designing smart buildings, curriculum change and strategic direction setting (e.g. McGibbon et al. 2015). With both Leadership in Energy and Environmental Design (LEED)[3] and BREEAM[4]certifications widespread in universities. Although scholarship acknowledges the contribution technological advances have contributed to helping move toward a sustainable world (Bocken et al. 2014), technical solutions alone are not enough, and alongside these, behaviour and systems level change are needed (Adams et al. 2016; Ramos et al. 2015). OECD (2009), too, emphasise the need to move beyond the technical to issues of behaviour and culture, implying that the sustainable organization will remain elusive until, at least, sustainability becomes embedded within the culture of the organization. Therefore, to continue the journey toward sustainability organizations, universities included, need to 'undergo significant cultural change and transformation' (Linnenluecke and Griffiths 2010, p. 357) which implies a change

[3]http://www.usgbc.org/leed.
[4]http://www.breeam.com/.

of attitude and developing a new set of values and behaviours: in short, an organizational culture for sustainability.

There are, though, challenges associated in developing sustainability cultures in a university.

For example, Marans et al. (2015) have reported successfully making operational and technical changes but failing to embed a culture of sustainability.

Further, there are dangers of recidivism – a return to business-as-usual – particularly as initiatives end or financial support expires (Verhulst and Lambrechts 2014). However, chief among the challenges is having a clear conceptualisation of what a culture for sustainability in the university sector actually means, how to implement it and how to monitor its development (Verhulst and Lambrechts 2014).

As noted earlier, a number of universities have already committed themselves to the sustainability journey. The idea of the sustainable campus has taken hold in universities across the globe and is reflected in a range of initiatives that include the International Sustainable Campus Network,[5] University of Maryland's Smart and Sustainable Campus Conference[6] and the Sustainable Campus International Competition[7] and the Association for the Advancement of Sustainability and Higher Education.[8] These initiatives have been successful in raising the challenge across a global audience, acting as living laboratories to design and test innovative technologies and approaches, and in providing a virtuous circle connecting teaching, research and practice.

Further, a number of universities publicly declared their intent by signing up to such things as the Talloires Declaration, committing university leaders to mobilise internal and external resources toward the objective (Wright 2002). However, different and supplementary approaches are also evident. Levy and Marans (2012) led an interdisciplinary team that developed recommendations grounded in education, assessment and monitoring among students, faculty and staff for building a culture of environmental sustainability on the campus at the University of Michigan. At the University of Guelph in Canada, Brinkhurst et al. (2011) explored the role of leadership for environmental sustainability. In particular they focused on leadership roles of the institutional "middle", faculty and staff, finding intrapreneurial behaviour within this cohort significantly contributing to reaching sustainability objectives, but under-celebrated and under-acknowledged.

Beringer (2007) benchmarked Lüneburg University's Sustainable University Project against six categories of practice:

- Governance and administration
- Curriculum and student opportunities
- Research and scholarship
- Operations
- Community outreach and service
- Faculty and staff professional development opportunities

[5] http://www.international-sustainable-campus-network.org/.
[6] http://sustainability.umd.edu/content/community/SSCC.php.
[7] http://sustainablecampusic.com/.
[8] http://www.aashe.org/.

and in doing so indicates the operationalization of the *sustainable university* phenomenon with respect to its dynamic, evolutionary nature. Finally, a number of largely descriptive case studies have been published telling how sustainability-oriented curricula have been developed as a response to market demand. Lozano et al. (2015) identify five main approaches for incorporating sustainable development (SD) into higher education curricula:

- Coverage of some environmental issues and material in an existing course or courses
- A specific SD course
- SD intertwined as a concept in regular disciplinary courses, tailored to the nature of each specific course
- SD as a possibility for specialisation within the framework of each faculty
- SD as an undergraduate or post-graduate program

It is clear that these approaches range from the relatively simple to those more demanding of resources, institutional commitment, expertise and cross-disciplinary working in short, embedding sustainability thinking more deeply into the university's structures, processes and practices.

According to the recent *Best Practice in Campus Sustainability* (ISCN Secretariat 2014) report, and Bartlett and Chase (2004 and 2013) activities toward the sustainable transformation of universities has, then, focused in three principal domains:

- Technological solutions to sustainability challenges
- Integrating sustainability as a core strategic principle across the campus
- Integrating sustainability subject matters across the curriculum

Building on previous studies relating to embedding sustainability thinking into the curriculum and implementing technological innovations of the sort that Bocken et al. (2014) might describe as maximising material and energy efficiency, the agenda has moved forward to consider the university more holistically in terms of organizational transformation and, its place in a wider social and organizational ecosystem as influencer, agent of change and driver of innovation: the formal and informal culture of the university. Both are important, the former to establish that the university 'walks the talk' and second, if it is embedded informally into culture we can be reasonably certain that it will be carried into the community to affect systems transformation.

The purpose of this paper is to begin to address this gap. The context for our work is the continuing transformation of the University of Worcester (UW) whose strategic aims include 'promoting the principles of sustainability through teaching, research and knowledge exchange activities…and to promote sustainable communities, services and businesses and foster a culture that values sustainability in arts and culture, and to promote social enterprise in the region'. UW has made progress in delivering on this agenda since its Sustainability Policy was adopted in

2007, rising from 93rd in the People and Planet League 2007 to 2nd by 2015.[9] Yet, questions remain about 'where next?' How can the progress achieved thus far be maintained and more deeply embedded in the DNA of the university? For example, in a recent evaluation of UW's participation in the Green Academy organizational change programme (launched in 2011 by the UK's Higher Education Academy), alongside its achievements it was recommended that UW "needed to take a more radical and holistic institutional approach" (McCoshan and Martin 2012, p. 26). It could be argued that both student interest and senior leadership are both driving this agenda. The former evidenced by longitudinal research undertaken by the Higher Education Academy and the National Union of Students[10] since 2010 research consistently finds that 80 per cent of UK students want their institution to actively incorporate and promote sustainable development, and that over 60 per cent want to learn about it. The later, university senior administrators identify UW as having four key areas of distinction within the Strategic Plan 2013–2018; one being sustainability.

In this article, we draw on literatures on (university) culture and organizational and (university) sustainability, bringing together these two broad streams into a conceptual framework to guide UW's sustainability culture transformation. Specifically, UW is looking to map key stakeholders' perceptions of its status as and progress toward becoming a sustainable university. It is anticipated that the framework's usefulness will be in underpinning new initiatives as well as data collection strategies to understand how key stakeholder groups perceive UW's sustainability culture, identify similarities and differences between these perceptions and, so, opportunities for continued improvement and cross-group cohesion. In doing so, this paper addresses amongst the most pressing of challenges in the transformation toward sustainable universities, and that is integrating sustainability holistically into their systems (Ramos et al. 2015).

3 Conceptualising a University Culture of Sustainability

3.1 Sustainability

Organizational sustainability is a recently emergent concept that integrates a diversity of intellectual and pragmatic influences. Some scholars have traced its roots back to the socially-informed practices of religiously-minded industrial dynasties most famously, at least in the UK, including the Bourneville and Cadbury families (Lamming et al. 1999; Smith 2003), and, in the USA, to include the likes of Henry Ford (Diamond 2005). More recent influences include Osborn's (1948) *Our Plundered Planet,* Carson's (1962) *Silent Spring,* The World Commission on

[9]See http://peopleandplanet.org/university-league/2015/tables, accessed 24 June, 2016.
[10]https://www.nus.org.uk/en/greener-projects/greener-research/attitudes-and-skills-for-sustainable-development/.

Environment and Development's *Our Common Future* (WCED 1987) as well as studies of anthropogenic influence purported to threaten the stability of planetary boundaries (Rockström et al. 2009) that support the ecosystem services on which we depend to survive and thrive (Costanza et al. 1997) and on persistent social injustice and inequality (Raworth 2012). There are multiple definitions of sustainability, but the idea of sustainable development as defined in the Brundtland report (WCED 1987)—"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"—(and variations of it) is commonly adopted as is Elkington's (1997) conceptualisation of the *Triple Bottom Line* in which organizations are exhorted to adopt a responsible approach and give equivalence to environmental, social and economic dimensions in decision-making.

Many scholars have argued that becoming and being a sustainable organization is not a singular 'before and after' event, rather it is a process of transformation that takes place over time and, frequently, the journey metaphor has been invoked to describe this (Mohrman and Worley 2010). For organizations that want to become and be sustainable, a dynamic model is required, one that portrays change taking place over time. For example, Verhulst and Lambrechts (2014) describe the integration of sustainable development at KHLeuven as happening in four stages, starting with a bottom-up approach characterised by local micro-initiatives, gradually becoming more prominent and inclusive through the university and moving toward embedding SD vision, strategy and behaviour throughout the university.

This is reflected in a number of models presented in the literature (see Kolk and Mauser (2002) for a review), from Hunt and Auster's (1990) five stages of environmental management (Beginner; Firefighter; Concerned Citizen; Pragmatist; Pro-activist) to, most recently, Adams et al. (2016) transformatory model of three contexts of the sustainability journey (Operational Optimization; Organizational Transformation; Systems Building), the latter resulting from the synthetic processes of systematic review (Table 1).

In this study, therefore, sustainability is conceived as a journey recognisable as a set of transformatory stages in which the behaviour and attitudes of groups of people within an organization become increasingly aligned around and consistent with the principles embodied in and implied by the Brundtland report's definition of sustainable development.

3.2 Organizational Culture

Organizational culture is a well-established, influential and, sometimes, controversial concept in management research and practice. The notion of 'culture' as applied to organizations originates in the fields of anthropology and sociology, where there exist various interpretations of its meaning as there do in management and organization studies (Smircich 1983; Tierney 1988). Although variously conceptualised, culture is generally taken to reflect the idea that groups of people—in assemblages of different size—share, in common, a specific set of ideas, norms,

Table 1 Three contexts of the sustainability journey

Operational Optimization: an internally oriented perspective on sustainability, referring to guiding a set of values described as a 'doing the same things but better' approach in which there is a focus on efficiency and compliance with regulation. Typically, technical solutions applied incrementally and in isolation, are the favoured solution to sustainability challenges
Organizational Transformation: represents a fundamental shift in mind-set in the organization, a shift in values from 'doing less harm' to creating shared value and delivering wider benefits for society by 'doing good by doing new things'. The context is characterized by a redefinition of internal and external relationships that increasingly are conceived in terms of environmental and social impacts. Typically, activities are more people oriented in that they engage with behaviours and attitudes, more deeply integrate sustainability within the organization and are less insular. It remains largely internally oriented, suffusing and diffusing sustainability throughout the organization, but extends to immediate stakeholders too. Sustainability moves beyond compliance and efficiency-motivated initiatives to become embedded in organizational DNA
Systems Building: extends the notion of sustainability beyond the boundaries of the organization and reflects a radical shift in philosophy and values to thinking beyond the firm and reframing the purpose of organization in society, as 'doing good by doing new things with others'. A key feature is that sustainability cannot logically be thought of as an attribute of a single organization, but can only properly be applied at the systems level which puts external linkages at its core. The context is characterized by a shift toward networks of relations in which sustainability value is created collaboratively rather than individually and firms shift from existing in isolation and in competition to integrated collaborations, with the potential to bring systems-shaping change In terms of sustainability, it can be seen as the 'set of actions that shift a system—a city, a sector, an economy—onto a more sustainable path'

values, beliefs and understandings and that these become manifest in and are reinforced by routines, practices, symbols, stories and so forth. These manifestations are more or less observable at different 'layers' of the organization and, importantly, govern the way in which people and the organization work. Organizational cultures provide a sense of identity, 'who we are', and are also a representation of behaviour and practice 'how things get done around here'. The link between behaviour and culture appears to be reciprocal, each reinforcing and shaping the other (Schneider and Barbera 2014; Bertels et al. 2010).

Schein (1985, p. 9) defines organizational culture as "a pattern of basic assumptions—invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration—that has worked well enough to be considered … the correct way to perceive, think, and feel in relation to those problems." In other words, organizational culture is a collection of values and norms that are shared by people and groups in an organization and it governs members' behaviours and actions in pursuit of organizational goals. It is clear then, with behaviours and actions on the one hand and values on the other, that the notion of culture challenges the researcher to consider tangible, overt as well as less visible instantiations of the phenomenon.

3.2.1 Visible and Invisible Culture

Indeed, Schein (1997) described three levels of culture: artefacts; espoused values; and, assumptions. These range from overt outward manifestations to deep underlying taken-for-granted, invisible elements that drive organizational action. Schein is not unique in decomposing culture into the visible and invisible, but many scholars favour a simple dichotomy.

For example, Kotter and Heskett (2011) recognise two levels which differ in their visibility and proclivity to change, as does Wilson (2001). The visible level of culture includes group behaviours and actions, which are more observable and easier to change. The invisible level is made up of shared values that tend to persist over time and are less amenable to change. The latter are the result of the continuing enactment of the former. Consequently, the process of changing the deeply-seated, implicit beliefs and assumptions that govern action takes place slowly and through the manipulation of visible factors: for example, changing a mission statement or reward structures. Both levels of culture are relevant to conceptions of sustainability culture. Organizations looking to build sustainability values into their culture embark on what can be a slow process of ideological transformation in which the underlying assumptions of behaviour are recalibrated through changes to what describe as 'the observable culture', (the visible organizational structure, processes and behaviours (Kagan 2014; Crittenden et al. 2011)). That is, over time, change in the visible layer can lead to change in the invisible layer (Kotter and Heskett 2011). The more visible the culture the easier it is to change and the less visible the culture the more resistant the culture is to change, but it is in the less visible aspects that culture is truly embedded.

3.2.2 Single and Multiple Cultures

In addition to visible and invisible elements, some researchers have argued that within a single organization multiple sub-cultures can co-exist (e.g. Linnenluecke et al. 2009; Schein 1985). These may be occupationally-, geographically-, hierarchically- or functionally-based. Clark (1983), for example, proposed three levels of culture in higher education: the culture of the discipline, the culture of the enterprise (i.e., organizational culture), and the culture of the academic profession and/or national system. Our focus is at the organizational level within which some researchers are divided as to whether or not multiple sub-cultures aggregate into a coherent, single culture. Schein (1985) argues that if the organization has a significant shared history, then it will have an overall culture. Conversely, and in a study specifically of the university sector, Silver (2003), echoing Cohen et al. (1972) notion of 'organized anarchy', argues that universities do not have 'a' culture but are better characterised by conflict and lack of coherence.

On this basis, we anticipate that multiple sub-cultures co-exist within UW each potentially holding different attitudes and orientations toward sustainability which are distinct from those of other sub-cultures. Within universities (Tierney 1988) cultural influences occur at many levels, within departments, across categories of employee, between staff and students. We will focus on student, academic, non-academic and external partner sub-cultures. Our multiple stakeholder approach, in contrast to previous studies that have focused on academic disciplines (Clark 1983), or tribes (Becher and Trowler 2001), recognises students, academic staff, non-academic staff and external organizational partners as important stakeholders. In recognising the possibility of sub-cultures with potentially different attitudes to and perceptions of sustainability at UW this positioning paper is located in the 'differentiation' stream of culture research (Martin 2015; Martin et al. 2006).

The visible/invisible dichotomy in instantiations of cultural phenomena is reflected in a related debate about whether or not *culture* is something that organizations ***are*** or ***have***. Previous scholarship has differentiated and separated these perspectives, and the roots of the separation lie in the distinct disciplinary ontologies relating to culture: the anthropological perspective (organizations ***are*** cultures) and a sociological perspective (organizations ***have*** cultures) (Cameron and Quinn 2011).

Both the ***visible/invisible*** and the ***are/have*** dichotomies have significant implications for issues of methodology. The advantage of quantitative approaches is that they make a fuzzy field more accessible on a range or pre-determined salient dimensions and for promoting generalizability —the ***have***. However, such methods have been criticised for failing to uncover and elaborate those deeper, underlying, hidden aspects of culture that may be idiosyncratic to organizations (the ***has***) and for which qualitative approaches and their resultant *thick descriptions* (Geertz 1973) are more apposite (Smircich 1983; Cooke and Szumal 1993). As Kwan and Walker (2004, p. 22) note:

> From the ***is*** (***are***) perspective, each organizational culture is unique and only qualitative methods can fully account for this uniqueness […] the *has* (***have***) perspective considers culture as an organizational variable and that it can influence or be influenced by other variables within organizations.

By integrating the ***are*** and ***have*** perspectives it is possible to interrogate the different layers of organizational culture and to begin to map the trickle-down that initiatives at the visible and influenceable *artefact* layer have at the more opaque and less accessible *basic assumptions* level. Consequently, our approach combines both quantitative and qualitative methods, the former to focus on the artefacts of culture—the 'visible products' of the organization (Schein 1997) examples of which can include products, formal policies, office arrangements, architecture, documentation, language, technology employed, activities and so forth. The latter looks at *Basic Assumptions,* root metaphors, stories, symbols and rituals that are implicit and unconsciously guide individual and collective behaviour. This has implications for monitoring the progress for embedding a sustainability culture, suggesting an approach, like organizational culture itself, and working at two levels: a quantitative (survey) approach to tap into the observable aspects of culture and a qualitative (observational/ethnographic) approach to tap into subconscious aspects.

Culture is, in short, the aggregate of people's beliefs, values, customs and norms to the extent that it regulates their behaviour in an organization: to paraphrase Bob Diamond,[11] it is how you behave when no-one is looking. Based on the previous discussion, an organizational culture of sustainability can be conceived as one in which organizational members hold in common a set of assumptions, beliefs and values and behave in a way reflecting a commitment to operate in a manner consistent with the sustainability principles of balancing economic efficiency, social equity and environmental accountability (after Bertels et al. 2010; Bartell 2003): sustainability culture is based upon the supportive integration of the organization's mission, values, goals and strategy (Galpin et al. 2015) and expressed in more or less visible ways. Organizations not built with sustainability values can transform their core ideology and change their organizational culture over time through the manipulation of cultural artefacts so as to incorporate sustainability into the company ethos (Crittenden et al. 2011). An example of 'scaffolding' organisational culture at UW is their Learning for Sustainable Futures[12] program. Small grants are awarded to teams for collaborative projects working across the organisation and the community to connect sustainability thinking and practice. Students are co-creators on all projects.

Based on the previous we conceive of transformation to sustainability as a journey…

- … requiring change in culture across diverse groups…
- … composed of visible and invisible elements…
- …in which the visible elements are manageable and accessible via quantitative research methods…
- …and invisible elements less amenable to management intervention, change slowly over time in response to changes at the visible level and observable only through rich insights derived from a qualitative approach (see Fig. 1).

[11]Former Chief Executive of Barclays, see http://news.bbc.co.uk/today/hi/today/newsid_9630000/9630673.stm, accessed July 14, 2015.
[12]http://www.worcester.ac.uk/discover/education-for-sustainable-development.html.

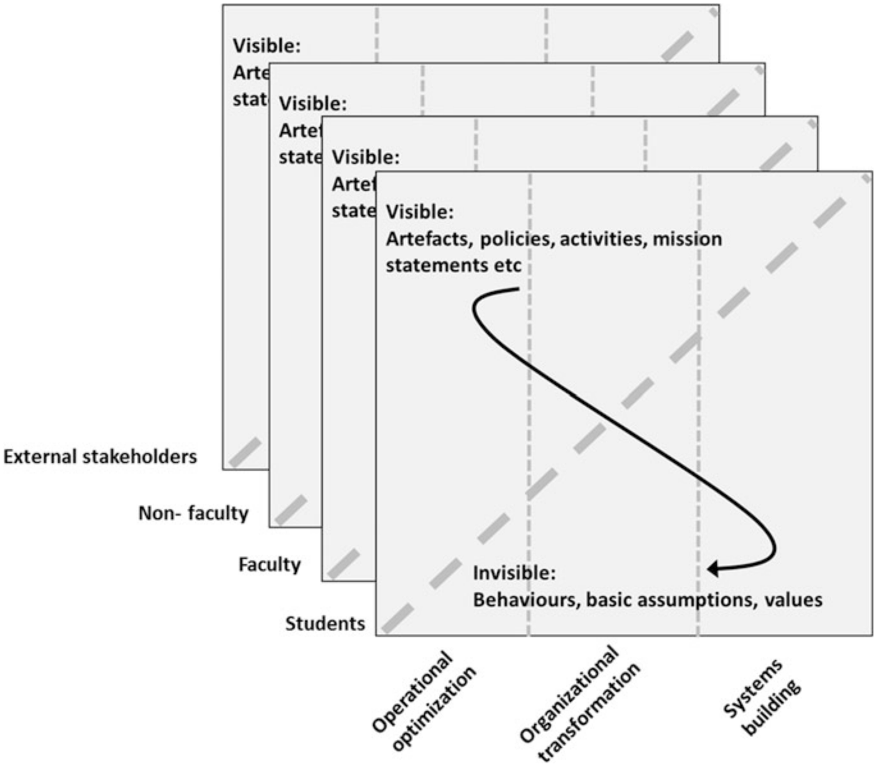


Fig. 1 Sustainability culture conceptual framework

4 Discussion

The primary purpose of this paper has been to develop a conceptual framework to inform the design, implementation and monitoring of initiatives to accelerate the embedding of a culture for sustainability at UW. As such, this work will have implications of significance to university faculty, managers, students and wider stakeholder groups as well as scholars invested in the sustainability agenda.

Tierney (1988) was amongst the first to apply the notion of culture to the university sector and outlines a set of *essential concepts* that would constitute a framework of organizational culture in a university: environment, mission, socialisation, information, strategy and, leadership. Since then, culture has been operationalised in a range of aspects of university activity such as, for example, management approaches (Sporn 1996), leadership (Asmawi et al. 2013) and internationalisation (Bartell 2003). The concept has, too, been applied to provide insight into the sustainability journeys of universities (Disterheft et al. 2015; Ferrer-Balas et al. 2009; Isaksson et al. 2013; Lozano 2006).

To the best of our knowledge, the framework presented here is the first of its kind to integrate contemporary thinking on the systemic dimension of sustainability with important factors drawn from cultural change theory. Consequently, our contribution is in providing a conceptualisation of university sustainability culture that integrates findings from both the sustainability and cultural change literatures and describes in more fine-grained detail than previously, more aspects of the transformation journey. The benefits of the conceptual framework reside in helping researchers and stakeholders move beyond the technical and piecemeal approaches that have been identified as limitations of previous efforts. Further, in its operationalization it directly addresses at least two of the limitations recently noted by Shiel et al. (2016), building capacities across communities and the development of relevant measures for evaluation and programme planning.

The presented framework has been developed with application in the context of UW in mind. This may limit its generalizability to other contexts. However, its grounding in the previous literature may offer some mitigation. In any case, future research should explore and test the conceptual framework described in Fig. 1. Following Churchill's (1979) prescriptions for the better measurement of constructs, we have specified our domain of interest and developed a conceptual framework. The next stage of this research will be to develop a set of indicators applicable at different levels of interest—students, faculty, non-faculty and external stakeholders. This requires that we address questions such as, what are the key indicators of successful change and what evidence is there indicating that a shift is taking place and, if so, in what direction and by how much.

To do this, there is the opportunity to draw from existing items from established frames including (AASHE 2014; Levy and Marans 2012; Roorda et al. 2009; Tierney and Tweddell 2013; Linnenluecke and Griffiths 2010; Linnenluecke et al. 2009), refining measures and testing for validity and reliability. In the case of UW, our observations will inevitably be looking at "manifestations" of that culture and how they have changed in respect of the sustainability priorities that the university has committed to. One example is the ongoing *Energise Worcester* project in which students are trained as advocates for adopting pro-environmental behaviour in off-campus accommodation through the cascading effects of peer-to-peer support (Jacobs 2002). Early evaluation indicates some positive progress but also that many students who believe they are energy efficient do not actually behave accordingly (Braconnier et al. 2016).

Such results direct attention toward the less quantifiable indicators of cultural change, and more subjectively understood, like emotional, psychological, and social transformations. In 2012, for example, UW opened The Hive,[13] the first joint public and university library in Europe. It is an exemplar of systemic reach in cultural transformation because of its outstanding environmental performance and for its social engagement with the wider local community and community groups.

[13]http://www.thehiveworcester.org/.

Evaluating the impact of such initiatives requires the investigator tries to become a "native" (Cameron and Quinn 2011) and collect data through observation of and participation in cultural and social processes, as well as in-depth interviews (Schensul 2009). UW's rollout includes assessing staff and local businesses with support of a Fulbright scholarship and partnership with University of Michigan to develop and validate a survey instrument to collect data on the salient dimensions of such a culture. Recommendations going forward for UW include aligning survey instruments to more closely mapped to UM's SCIP program. Furthermore there is a great deal of interest at UW to work on sustainability culture with stakeholders in the local business community. Given UW's close integration with the local community through award winning efforts such as The Hive, this approach has many benefits such as expanded learning opportunities for students, research opportunities for staff, and more competitive funding proposals. A stronger local business community has many advantages for UW and shared sustainability objectives provide benefits for all partners.

5 Conclusion

We have argued that an organizational culture of sustainability develops over time as a consequence of actions applied in the 'visible' layer and is likely manifest in different forms within sub-cultures. We have further argued that to fully understand an organizational culture a mixed-methods research approach is required that combines quantitative elements to access its visible artefacts and a qualitative approach to unearth and track change in the underpinning basic assumptions and values. As noted in the UN's recent *Shaping the future we want* report (Buckler and Creech 2014), the tendency to date has been to measure inputs (e.g. technologies, changes in curricula and policy etc) into the sustainable transformation process and it has been difficult to assess whether or not these have led to significant attainments in learning or behaviour change within institutions, communities or at the macro level. The concept of culture provides a lens through which this knowledge gap can be explored. The conceptual framework we have outlined here is a first step towards progress in this direction. It remains very much a work in progress with much still to be done. Nevertheless our hope and expectation is to refine the framework and measures and apply them over the coming years. The process and progress of this initiative will be closely monitored with findings contributing to the development of further in-depth cases of transformation to HEI Sustainability as called for by Hoover and Harder (2014) and develop better understanding of how organizational cultures and climates are shaped and reshaped as members of the organization address sustainability issues (Cotton et al. 2009; Howard-Grenville et al. 2014).

References

AASHE. (2014). STARS Technical manual: version 2.0. Association for the Advancement of Sustainability in Higher Education.

Adams, R. J., Jeanrenaud, S., Bessant, J., Denyer, D., & Overy, P. (2016). Sustainability-oriented innovation: a systematic review. *International Journal of Management Reviews, 18*(2), 180–205. doi:10.1111/ijmr.12068.

Asmawi, A., Zakaria, S., & Wei, C. C. (2013). Understanding transformational leadership and R&D culture in Malaysian universities. *Innovation: Management, Policy & Practice,* 15(3): 287–304. doi:10.5172/impp.2013.15.3.287.

Bartell, M. (2003). Internationalization of universities: A university culture-based framework. *Higher Education, 45*(1), 43–70.

Bartlett, P. F., & Chase, G. W. (2004). *Sustainability on campus: stories and strategies for change* (p. 337). Cambridge: MIT Press.

Bartlett, P. F., & Chase, G. W. (2013). *Sustainability in higher education: Stories and strategies for transformation* (p. 316). Cambridge: MIT Press.

Becher, T., & Trowler, P. (2001). *Academic tribes and territories: Intellectual enquiry and the culture of disciplines*. New York: McGraw-Hill Education.

Beringer, A. (2007). The Lüneburg sustainable university project in international comparison: An assessment against North American peers. *International Journal of Sustainability in Higher Education, 8*(4), 446–461.

Bertels, S., Papania, L., & Papania, D. (2010). Embedding sustainability in organizational culture. A systematic review of the body of knowledge. *Network for Business Sustainability*.

Bocken, N. M. P., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production, 65,* 42–56. doi:10.1016/j.jclepro.2013.11.039.

Braconnier, D., Goddard, K., Puckett, S., & Ruiz-Cadalso, D. (2016). Energize Worcester phase II. Analysis of consumer energy behavior in homes of multiple occupancy near the University of Worcester. BSc, Worcester Polytechnic Institute, Massachusetts.

Brinkhurst, M., Rose, P., Maurice, G., & Ackerman, J. D. (2011). Achieving campus sustainability: top-down, bottom-up, or neither? *International Journal of Sustainability in Higher Education, 12*(4), 338–354.

Buckler, C., & Creech, H. (2014). *Shaping the future we want: UN Decade of Education for Sustainable Development; final report*: UNESCO.

Butt, L., More, E., & Avery, G. C. (2014). The myth of the 'green student': student involvement in Australian university sustainability programmes. *Studies in Higher Education, 39*(5), 786–804. doi:10.1080/03075079.2012.754861.

Cameron, K. S., & Quinn, R. E. (2011). *Diagnosing and changing organizational culture: Based on the competing values framework*. New York: Wiley.

Carson, R. (1962). *Silent spring*. Boston: Houghton Mifflin.

Churchill, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research, 16*(1), 64–73.

Churchman, C. W. (1967). Guest editorial: Wicked problems. *Management Science, 14*(4), B141–B142.

Clark, B. R. (1983). *The higher education system: Academic organization in cross-national perspective*. Berkeley: University of California Press.

Cohen, M. D., March, J. G., & Olsen, J. P. (1972). A garbage can model of organizational choice. *Administrative Science Quarterly, 17*(1), 1–25.

Cooke, R. A., & Szumal, J. L. (1993). Measuring normative beliefs and shared behavioral expectations in organizations: The reliability and validity of the Organizational Culture Inventory. *Psychological Reports, 72*(3c), 1299–1330.

Costanza, R., d'Arge, R., Groot, R. de, Farber, S., Grasso, M., Hannon, B., et al. (1997). The value of the world's ecosystem services and natural capital. *Nature, 387*(6630), 253–260.

Cotton, D., Bailey, I., Warren, M., & Bissell, S. (2009). Revolutions and second-best solutions: education for sustainable development in higher education. *Studies in Higher Education, 34*(7), 719–733. doi:10.1080/03075070802641552.

Cotton, D. R. E., & Alcock, I. (2013). Commitment to environmental sustainability in the UK student population. *Studies in Higher Education, 38*(10), 1457–1471. doi:10.1080/03075079.2011.627423.

Crittenden, V., Crittenden, W., Ferrell, L., Ferrell, O., & Pinney, C. (2011). Market-oriented sustainability: a conceptual framework and propositions. *Journal of the Academy of Marketing Science, 39*(1), 71–85. doi:10.1007/s11747-010-0217-2.

Diamond, J. (2005). *Collapse: How societies choose to fail or succeed*. London: Viking.

Disterheft, A., Caeiro, S., Azeiteiro, U. M., & Filho, W. L. (2015). Sustainable universities – a study of critical success factors for participatory approaches. *Journal of Cleaner Production, 106,* 11–21. doi:10.1016/j.jclepro.2014.01.030.

Elkington, J. (1997). *Cannibals with forks*. Oxford: Capstone.

Epstein, M. J., & Roy, M. (2001). Sustainability in action: Identifying and measuring the key performance drivers. *Long Range Planning, 34*(5), 585–604.

Ferrer-Balas, D., Buckland, H., & Mingo, M. de. (2009). Explorations on the University's role in society for sustainable development through a systems transition approach. Case-study of the Technical University of Catalonia (UPC). *Journal of Cleaner Production, 17*(12), 1075–1085.

Galpin, T., Whitttington, J. L., Bell, G., Kakabadse, N. & Fleur, M. (2015). "Is your sustainability strategy sustainable? Creating a culture of sustainability." *Corporate Governance: The International Journal of Business in Society, 15*(1).

Geertz, C. (1973). Thick description: Toward in interpretive theory of culture. In C. Geertz (Ed.), *The interpretation of cultures: Selected essays* (pp. 3–30). New York: Basic Books.

Hoover, E., & Harder, M. K. (2014). "What lies beneath the surface? The hidden complexities of organizational change for sustainability in higher education." Review of yes. *Journal of Cleaner Production*. 10.1016/j.jclepro.2014.01.081.

Howard-Grenville, J., Bertels, S., & Lahneman, B. (2014). "Sustainability: How it shapes organizational culture and climate.". In B. Schneider & K. M. Barbera (Eds.), *The oxford handbook of organizational climate and culture* (pp. 257–275). New York: Oxford University Press.

Hunt, C. B., & Auster, E. R. (1990). Proactive environmental management: Avoiding the toxic trap. *Sloan Management Review, 31*(2), 7–18.

Isaksson, R., Johnson, M. W., & Garvare, R. (2013). "Towards a Model for Measuring University Sustainability." *Proceedings of the International Conference on Intellectual Capital, Knowledge Management & Organizational Learning*. 213–221.

ISCN Secretariat. (2014). Best practice in campus sustainability – Latest examples from ISCN and GULF Schools. Boston: International Sustainable Campus Network (ISCN).

Jacobs, R. L. (2002). "Institutionalizing organizational change through cascade training." *Journal of European Industrial Training, 26*(2–4), 177–182. 10.1108/03090590210422058.

Kagan, S. (2014). *Art and sustainability: Connecting patterns for a culture of complexity* (Vol. 25). Bielefeld: Transcript Verlag. (2nd emended edition 2013).

Kolk, A., & Mauser, A. (2002). The evolution of environmental management: From stage models to performance evaluation. *Business Strategy and the Environment*, *11*, 14–31.

Kotter, J. P., & Heskett, J. L. (2011). *Corporate culture and performance*. New York: Free Press.

Kwan, P., & Walker, A. (2004). Validating the competing values model as a representation of organizational culture through inter-institutional comparisons. *Organizational Analysis, 12*(1), 21–37.

Lamming, R., Faruk, A., & Cousins, P. (1999). Environmental soundness: a pragmatic alternative to expectations of sustainable development in business strategy. *Business Strategy and the Environment, 8*(3), 177–188.

Levy, B. L. M., & Marans, R. W. (2012). Towards a campus culture of environmental sustainability. *International Journal of Sustainability in Higher Education, 13*(4), 365–377. doi:10.1108/14676371211262317.

Linnenluecke, M. K., & Griffiths, A. (2010). Corporate sustainability and organizational culture. *Journal of World Business, 45*(4), 357–366. doi:10.1016/j.jwb.2009.08.006.

Linnenluecke, M. K., Russell, S. V., & Griffiths, A. (2009). Subcultures and sustainability practices: The impact on understanding corporate sustainability. *Business Strategy and the Environment, 18*(7), 432–452.

Lozano, R. (2006). Incorporation and institutionalization of SD into universities: breaking through barriers to change. *Journal of Cleaner Production, 14*(9), 787–796.

Lozano, R., Ceulemans, K., & Scarff Seatter, C. (2015). Teaching organisational change management for sustainability: designing and delivering a course at the University of Leeds to better prepare future sustainability change agents. *Journal of Cleaner Production, 106,* 205–215. doi:10.1016/j.jclepro.2014.03.031.

Luna, H., & Maxey, L. (2013). Towards a green academy. In S. Sterling, L. Maxey, & H. Luna (Eds.), *The sustainable university: Progress and prospects* (pp. 281–303). Oxon: Earthscan from Routledge.

Marans, R. W., Callewaert, J., & Shriberg, M. (2015). "Enhancing and monitoring sustainability culture at the University of Michigan.". In W. L. Filho (Ed.), *Transformative approaches to sustainable development at universities* (pp. 165–179). Hamburg: Springer.

Martin, J. (2015). *"Organizational culture." In Wiley Encyclopedia of Management*. New York: Wiley.

Martin, J., Frost, P. J., & O'Neill, O. A. (2006). Organizational culture: Beyond struggles for intellectual dominance. In S. Clegg, C. Hardy, W. R. Nord, & T. Lawrence (Eds.), *The handbook of organization studies* (pp. 725–753). London: Sage.

Martin, S., Dillon, J., Higgins, P., Peters, C., & Scott, W. (2013). Divergent evolution in education for sustainable development policy in the United Kingdom: Current status, best practice, and opportunities for the future. *Sustainability, 5*(4), 1522–1544.

Martin, S., & Murray, P. (2011). The role of wicked problems: Values in personal and organisational change. *Learning and Teaching in Higher Education (LATHE), 5,* 163–169.

McCoshan, A., & Martin, S. (2012). *Evaluation of the impact of the Green Academy programme and Case Studies*. The Higher Education Academy, York: The Higher Education Academy.

McGibbon, C., Ophoff, J., & Belle, J-P. Van. (2015). "Our building is smarter than your building: The use of competitive rivalry to reduce energy consumption and linked carbon footprint." *Knowledge Management & E-Learning: An International Journal (KM&EL), 6*(4):464–471.

Mohrman, S. A., & Worley, C. G. (2010). The organizational sustainability journey: Introduction to the special issue. *Organizational Dynamics, 39*(4), 289–294.

OECD. (2009). Sustainable manufacturing and eco-innovation: Towards a green economy.

Osborn, F. (1948). *Our plundered planet*. London: Faber and Faber.

Ramos, T. B., Caeiro, S., Hoof, B van., Lozano, R., Huisingh, D & Ceulemans, K. (2015). "Experiences from the implementation of sustainable development in higher education institutions: Environmental management for sustainable universities." Review of yes. *Journal of Cleaner Production* (0). doi:http://dx.doi.org/10.1016/j.jclepro.2015.05.110.

Raworth, K. (2012). A safe and just space for humanity: Can we live within the doughnut? http://www.oxfam.org/sites/www.oxfam.org/files/dp-a-safe-and-just-space-for-humanity-130212-en.pdf. Oxfam International Discussion Paper.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F., Lambin, E., et al. (2009). A safe operating space for humanity. *Nature, 461*(7263), 472–475.

Roorda, N., Rammel, C., Waara, S., & Paleo, U Fra. (2009). Assessment instrument for sustainability in higher education. http://www.dho21.nl/documents/AISHEBook1.5.pdf: Edition.

Schein, E. H. (1985). "Defining organizational culture." In *Classics of organization theory*, *3,* 490–502.

Schein, E. H. (1997). *Organizational culture and leadership* (2nd ed.). San Francisco: Jossey Bass.

Schensul, J. J. (2009). Community, culture and sustainability in multilevel dynamic systems intervention science. *American Journal of Community Psychology, 43*(3–4), 241–256.

Schneider, B., & Barbera, K.M. (2014). *The oxford handbook of organizational climate and culture*. New York: Oxford University Press.

Shiel, C., Filho, W. L.,do Paço, A. & Brandli, L. (2016). "Evaluating the engagement of universities in capacity building for sustainable development in local communities." *Evaluation and Program Planning,* 54, 123–134. doi:http://dx.doi.org/10.1016/j.evalprogplan.2015.07.006.

Silver, H. (2003). Does a university have a culture? *Studies in Higher Education, 28*(2), 157–169. doi:10.1080/0307507032000058118.

Smircich, L. (1983). Concepts of culture and organizational analysis. *Administrative Science Quarterly, 28,* 339–358.

Smith, N. Craig. (2003). Corporate social responsibility: Whether or how? *California Management Review, 45*(4), 52–76.

Sporn, B. (1996). Managing university culture: An analysis of the relationship between institutional culture and management approaches. *Higher Education, 32*(1), 41–61. doi:10.2307/3447895.

Tierney, A., & Tweddell, H. (2013). ESD Mapping Tool. http://www.bristol.ac.uk/environment/esd/. University of Bristol.

Tierney, W. G. (1988). "Organizational culture in higher education: Defining the essentials." *The Journal of Higher Education,* 59(1), 2–21.

Verhulst, E., & Lambrechts, W. (2014). "Fostering the incorporation of sustainable development in higher education. Lessons learned from a change management perspective." Review of yes. *Journal of Cleaner Production, 2014,* 1–16.

WCED. (1987). Our Common Future. In World Commission (Ed.), *on Environment and Development*. Oxford: Oxford University Press.

Whitmarsh, L. (2011). Scepticism and uncertainty about climate change: dimensions, determinants and change over time. *Global Environmental Change, 21*(2), 690–700.

Wilson, A. M. (2001). Understanding organisational culture and the implications for corporate marketing. *European Journal of Marketing, 35*(3–4), 267–353.

Wright, T. S. A. (2002). Definitions and frameworks for environmental sustainability in higher education. *International Journal of Sustainability in Higher Education, 3*(3), 203–220. doi:10.1108/14676370210434679.

Epilogue

Over a three day period in mid-May 2017, more than 70 researchers, professors, and graduate students gathered in Ann Arbor Michigan to share their ideas and research about sustainability and the social sciences. Among symposium participants who described themselves as social scientists, the majority were psychologists with a smattering of sociologists, anthropologists, economists, political scientists and geographers in attendance. Other attendees were drawn from applied fields including natural resources, architecture, urban planning, landscape architecture, graphic design, business, public policy, and education. Most papers presented empirical work involving populations in settings ranging from individual buildings and neighborhoods to college campuses. Others addressed theoretical issues associated with environmental sustainability. Still others considered links between social sustainability and the physical environment.

Sustainability topics ranged from climate change responses (Manning et al, Ch. 8) and the use of residential graywater in arid zones (Bell, Ch. 9) to stakeholder engagement in addressing a ban on plastic bags (Venkatesan, Ch. 14). Others examined levels of engagement in and understanding of energy efficiency initiatives (Hewitt, Ch. 10; Mills, Ch. 12; Schelhas et. al, Ch. 17)

Methodologically, wide ranging social research tools were employed in the presentations. These including sample surveys, in-depth interviews, collecting and analyzing secondary data, card sorting approaches, observations, and participatory/scenario planning exercises.

Although the symposium drew a diverse group of presenters and observers, some social scientists were underrepresented. These included political scientists and economists whose applied work addresses environmental policy and planning issues. Furthermore, the symposium would have benefited from the insights of individuals from outside academia including operational personnel from institutional, corporate, and governmental settings. Such individuals often serve in policy making roles, would likely be the recipients of social research findings, and consequently would be able to articulate their ideas and informational requirements. Finally, the interplay of and complementarity between social and natural scientists could point to the collaborative efforts needed to address the wicked problems associated with sustainability, climate change, and more generally, protecting the natural environment.

W. Leal Filho et al. (eds.), *Handbook of Sustainability and Social Science Research*,
World Sustainability Series, https://doi.org/10.1007/978-3-319-67122-2

While the explicit aims of the symposium dealt with information sharing and networking among participants (see Preface), an implicit objective was to develop ideas about future sustainability research involving the social sciences. Throughout the symposium and in a brief post-event survey, suggestions were made toward this aim. Several deal with the communication of findings from social science research to relevant audiences such as policy makers. In one plenary session, Maki (Ch. 2) suggested that meta-analysis of existing research covering specific thematic areas related to sustainability could be an effective way of summarizing and communicating key findings to policy makers. Others talked about communication approaches drawn for the design professions including visual design and the need for researchers to think about alternative means (beyond statistical tables and graphs) of presenting their findings, (Emans and Murdoch-Kitt, Ch. 5). The need to determine the most effective mode of communicating both information and research findings about specific sustainability topics (i.e. climate change) to different populations was also suggested as a direction for improving sustainability education (Li et al., Ch. 3). Indeed, the role of human behavior, social norms, social policy, culture, and the contributions of the social sciences was viewed as crucial to curriculum development in educational programs about sustainability. This should occur at all levels of education from elementary and high schools to universities and adult-education programs.

As suggested, contributions from behavioral economics, political science, and organizational psychology were lacking in the symposium and offer opportunities for future research. For example, there is need for modeling efforts involving the costs and benefits to individuals and organizations of engaging (or not engaging in) various pro-environment behaviors. Additional research is also needed to better understand the participatory processes in organizations and in sustainability movements. Furthermore, the degree to which political candidates and elected officials prioritize and use environmental issues in their campaigning and decision making in warranted. Similarly, the links between political contributions to pro-environment candidates for elected office and other pro-environmental behaviors among citizens is worthy of exploration.

Another area of research omitted during the symposium is the link between the social sciences and health sciences as it relates to the environment and specifically, climate change. While there has been research demonstrating the effects of extreme temperatures on physical health, there is a need to consider the impact of extreme temperature changes and various forms natural disasters (draught, flooding) on mental health (stress, anxiety, subjective well-being).

Few presentations discussed behavioral change over time (see Callewaert, Ch. 26: Schroeder et al. Ch. 21) although opportunities are apparent for such research in a number of the presented papers (Cole, Ch. 6: Johnson et al. Ch. 1). Clearly there is a need for more longitudinal studies that examine behavioral and attitudinal change of populations as well as individuals (panels) within different types of settings. These settings could include work environments as well as residential communities (buildings, neighborhoods, cities) that are subject slow-changing or rapidly changing environmental conditions. Changing environmental conditions could vary and include both those that are naturally occurring or unplanned (severe storms, flooding) and those conditions that are intentionally imposed (temperature control in buildings, legislative waste collection procedures). Such studies would be helpful in better understanding responses to environmental change among different populations and address the more perplexing topics of adaptation and resilience which could contribute to more informed policy and planning.

Longitudinal studies create opportunities to experiment or test different types of interventions in small-scale settings before adapting them system-wide. For instance, evaluation research techniques designed to test a program intended to promote composting in one neighborhood of a city could determine its relative success or failure among different types of neighborhood residents. Research findings would then be used to inform operational personnel and policy makers whether and where the program should be adapted in other city neighborhoods as well as determine how to might be modified.

Whether in longitudinal studies or those conducted at one point in time, consideration should be given to measuring contextual or environmental conditions as well as people's responses to those conditions. In longitudinal studies, opportunities exist for developing statistical models that establish causality between environmental change and behavioral change. However, in a single study, it would still be important to determine if there is an association between the two types of measures within the same unit of analysis. That unit of analysis may be an individual, a household, or an organizational unit made up of individuals such as a neighborhood, work group, or building.

Finally, consideration should be given to examining issues of sustainability among populations in different cultural settings including countries. Most of the empirical studies reported in this handbook reflect a Western perspective typically found in the United States and in other developed countries. However, the impact of climate change on countries in Africa, Latin America, and parts of Asia suggest that we have much to learn about modes of adaption and other forms of behavior within these cultural settings. Clearly, opportunities for comparative research and mutual learning abound.

There are no doubt other disciplinary gaps and future research directions involving the social sciences as they relate to sustainability that can be put forth by symposium participants as well as social scientists generally. We believe that opportunities to expand upon what was accomplished through this handbook will become more apparent as additional symposia take place in the years ahead.

The Editors
Walter Leal Filho
Robert W. Marans
John Callewaert