Balancing Paradigms in Climate Change Communication Research to Support Climate Services

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1 Introduction

Crafting effective solutions to challenges posed by climate change requires evidence-based actions. Climate services is the arm of climate change science that deals precisely with using the results of science to inform practice. Climate services draws from state-of-the-art of climate science to customize knowledge products to meet the needs of specific stakeholders towards the goal of initiating and sustaining appropriate action versus climate change (AMS 2014; CSP 2014; WMO n.d.). Climate services are not limited to repackaging and popularizing science. Rather, climate services aim for increased capacity in interpreting and using scientific information in sectors or groups outside of climate scientists (Changnon and Kunkel 1999; Munang et al. 2010; Scott et al. 2011). Thus, climate services need to employ increasingly inter- and trans-disciplinary approaches to address these varied, changing audiences (Cooney 2010; Weaver et al. 2014). These approaches require iterative dialogue to give academic researchers and other stakeholders the opportunity to share expertise, identify solutions together, and adapt and adjust as needed through time (Dilling and Lemos 2011).

Active dialogue, however, requires a structure that is beyond the capacity and original intent of the Intergovernmental Panel on Climate Change (IPCC) assessments (Visbeck 2008). The IPCC has been criticized for its focus on the bench sciences, rather than consultation with a wide variety of stakeholders—a practice

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that contradicts the complexity of the climate change issue (Glover 2006). Global initiatives have since been established that help address this gap. For instance, the WMO established the Global Framework for Climate Services (GFCS) in 2009 with a framework that explicitly calls for continued interaction amongst physical and social science researchers, practitioners, and decision-makers (Asrar et al. 2012; WMO 2014). Future Earth: Research for Global Sustainability Initiative, established by the International Council for Science in 2012, recognizes that sustainability is possible only through wide systemic and behavioral changes (Reid et al. 2010), and espouses co-design and co-production towards that end (Future Earth 2014). It builds on the work of various international sustainability programs, including the Earth System Sciences Partnership (ESSP), which early on recognized the importance of continuous stakeholder dialogue (Leemans et al. 2009).

Both GFCS and Future Earth are relatively new endeavors, and we only starting to grapple with what the large scale operationalization of "dialogue" might entail in the long term. Multi-stakeholder dialogue, co-design, and co-production need to be based on sound climate science, but also defined and planned with a sound social sciences foundation (Weaver et al. 2014). Therefore, these concepts must be supported by a firm research base. Given these needs, communication research emerges as a crucial field of inquiry, with academics and researchers needing to confront the challenge of transdisciplinary work. How has communication research been conducted? Does the literature provide enough grounding to support activities related to co-production and co-design? How should researchers be trained or oriented to address the needs of climate services through communication research design? This paper reflects on the underlying paradigms employed in recent literature and proposes ways by which different paradigms can help diversify and balance climate change communication research, for current and future researchers and higher education institutions to consider. With a stronger theoretical base undergirding climate change communication research, climate change communication practice can be more focused, systematic, and organized.

2 Articulating Paradigms Used by Communication Research

Communication research, and the social sciences in general, need to be supported by a paradigm to inform and drive research into various aspects of climate services (Cooney 2010; Hackmann et al. 2014; Weaver et al. 2014). A research paradigm or worldview contains assumptions about the nature of reality and knowledge. Paradigms guide how research should be conducted, and how results can be interpreted (Guba and Lincoln 1994). To some extent, paradigms can also inform how research results can be applied (Trench 2008); in this case, paradigms can drive how climate change research is used in climate change communication activities.

Some basic worldviews are summarized below and explained in detail in the literature (including Guba and Lincoln 1994; Hatch 2002; Ponce de Leon and Gotangco 2013; Trench 2008). Note, however, that this is not an exhaustive list as different disciplines may have their specific worldviews.

Post-positivism assumes that the world is made up of objective, measurable patterns that can be approximated by careful research. Under such a worldview, research can take a quantitative, qualitative, or mixed methods approach. Post-positivism aims for generalizations that apply to large groups or cut across different audiences. For example, researchers could use large-scale surveys, aggregate findings, and use the findings to create educational materials. Post-positivism guides dissemination models of communication, which have been used in various climate change information campaigns in different countries (Chambliss and Lewenstein 2012; Krantz et al. 2013; Lyytimaki et al. 2013). Under a post-positivist worldview, researchers can use one-on-one interviews or group discussions, but they would still be in charge of determining the content to be disseminated.

A critical paradigm assumes that the world comprises measurable patterns, but while there are objective truths, researchers cannot measure them directly because centuries of history, culture, and socialization prevent researchers from being completely objective. Critical research is concerned with power issues and structures, which might exist among different stakeholders, or arise from the nature of media itself. Any critically-oriented research cannot aim for generalization, because each group, culture, and society is different. Critical research is characterized by depth and location-specific work and must be pursued using qualitative methods. The critical worldview can be used to create contextualized, community-based climate change communication materials and initiatives. This method is closest to the participatory approach. Questions that can be explored include "How does this group perceive its problems?" and "How can this group formulate its own solutions?"

Constructivism assumes that humans can never measure or report reality, and can only represent it through symbols, such as numbers, words, or images. No human being, therefore, will ever have a full view of the truth, approximate or otherwise. The truth is constructed in the moment of research. Like critical work, constructivist work is unique to a location and point in time and must be pursued using qualitative methods. Researchers have used this worldview to study how communities make meaning of climate change (Becken et al. 2013; Rudiak-Gould 2012). Both critical and constructivist studies allow climate change communication initiatives to see how climate change is perceived and understood at local levels, and how these perceptions and understandings can drive (or hinder) climate change mitigation and adaptation programs. Research under this paradigm can be built on questions like "What does climate change mean to this group?" and "How do these meanings lead to solutions to the problem?"

Post-modernism assumes that the truth is viewed differently by every single individual, and there are as many truths as there are people who view it, with all truths equally valid. Research in post-modernism does not seek generalizations, but

a reporting of all these truths. Post-modernist work is always qualitative, and stakeholders contribute equally to a final project. This is considered co-production, but can be difficult to carry out in culturally heterogeneous nations. Interesting questions can arise, such as "How do these different views reflect the cultural milieu and stakeholder group characteristics?"

No worldview or paradigm is better or worse than the other. Each worldview can be used to address different facets of climate services research (Ponce de Leon 2011; Trench 2008). The success of climate services efforts will rest on a good match among goals, audiences, resources, and context (Johnson 2012) as guided by a balanced application of research paradigms. Research paradigms should be articulated and applied from when a climate change communication problem is formulated, to the time the research is published and its findings are interpreted and utilized. This will ensure that findings are valid, and any conclusions made about the findings do not overreach the assumptions of the paradigm under which the research operates. Research in support of climate services should be cognizant of different worldviews and their advantages and limitations, especially since the field involves diverse stakeholders who must be heard and addressed (Carlton and Jacobson 2013). Each paradigm can lead to more interesting questions about various aspects of climate change communication. However, are all worldviews currently being used in a balanced way to structure climate change communication research, or are there dominant paradigms in recent publications? What have we learned from research guided by specific paradigms?

3 Paradigms in Recent Climate Change Communication Literature

To identify the paradigms employed in literature that have emerged since initiatives like the GFCS and Future Earth were launched, a quick scoping of peer-reviewed articles was performed. EBSCOHOST was used to search for research articles (including empirical articles, review articles, and commentaries) published between January 2010 and August 2014, using the key phrase "climate change communication". However, research articles from the fields of policy and politics, and education were excluded. The assessments and reflections in this paper are based on 145 unique articles, representing different fields of study. Major categories of studies focus on media use and content, context analysis, sociological studies, and psychological studies.

Studies on media use and content comprised articles that examined how climate change could be framed, how audiences understood these frames, and how these frames influenced their perceptions and behavior (for example: DiFrancesco and Young 2010; Dirikx and Gelders 2010; Eskjaer 2013; Nerlich et al. 2010; Pasquare and Oppizzi 2012). Other researchers examined the effects of mass media exposure over time on taking action versus climate change (Howell 2014). Research within

the time frame, for the greater part, was post-positivist. Most research used experimental set ups, followed by questionnaires, workshops, and/or interviews to evaluate how people perceived and acted on mass media messages regarding climate change (for example: Gifford and Comeau 2011; Jang 2013; Lieske et al. 2014; Maibach et al. 2010; Morton et al. 2011; Myers et al. 2012; Nisbet et al. 2013). A good number of articles carried out large-scale surveys on mass media use (for example: Feldman et al. 2014; Stoutenborough and Vedlitz 2014; Tam and McDaniels 2013; Williams 2011; Zhao et al. 2011). In some studies on the effects of mass media on climate change attitudes, researchers assumed that they can predict behavior and perception by looking at media messages alone. In general, researchers called for more studies on whether message framing can lead to actual behavior change, and more participatory programs to engage audiences above and beyond media exposure.

Research on interactions between context and communication comprised articles that examined climate change from the audience's perspective, and then cross-checked these perspectives against both environmental and social records. Research published under this classification from 2010 to 2014 was also generally post-positivist, as it sought out large scale patterns to examine how environmental and economic contexts could affect people's perceptions about climate change (for example: Akerlof et al. 2012; Brulle et al. 2012; Howe and Leiserowitz 2013; Safi et al. 2012; Scruggs and Benegal 2012; Ungar 2014). However, some researchers did use in-depth, qualitative studies of specific locations to examine different environmental contexts and their effects on climate change, and even engaged participants in bottom-up approaches to design community-based, localized materials to help communities deal with climate change (Gentle and Maraseni 2012; Khan et al. 2012; Leonard et al. 2013; Schweizer et al. 2013). Recommendations included conducting more research in indigenous knowledge, as well as multidisciplinary studies (Scott et al. 2011), framing climate change as a local problem, and using more specific, concrete information to enable adaptation at local levels.

Sociology-based articles comprised research focused on group dynamics, behavior, and perceptions regarding climate change. Studies published from 2010 to 2014 were mostly post-positivist and based on surveys. Surveys were conducted at the country level (for example: Barnes et al. 2013; Hamilton et al. 2012; Hine et al. 2013; Marshall et al. 2013; Milfont 2012; Zia and Todd 2010) and across country boundaries (Bostrom et al. 2012; Crona et al. 2013). Some researchers chose qualitative methods instead of surveys to gather data on cultural understandings and beliefs. These included interviews and focus group discussions to examine various aspects of climate change perceptions from a sociological standpoint (for example: Becken et al. 2013; Buys et al. 2012; Nursey-Bray et al. 2012; Poortinga et al. 2011; Rudiak-Gould 2014; Sjogersten et al. 2013; Wibeck 2014a). Researchers found that various cultural communities varied in their understanding of climate change due to deeply-ingrained values and worldviews.

Psychology-based studies comprised articles on the cognitive aspects of climate change communication. Research into the psychological aspects of climate change communication focused on the public perceptions of climate change, risk, and the

mass media. Most research into the psychology of climate change communication was based on surveys, which provided a broad-based, post-positivist look at how people from varying backgrounds perceived climate change (for example: Beard and Thompson 2012; Binder 2010; Carlton and Jacobson 2013; Hedlund-De Witt et al. 2014; Spence et al. 2012; Van der Linden 2014; Wendling et al. 2013). In general, research found that people interpret risk in different ways, but awareness of an issue does not necessarily lead to action. In general, researchers in psychology-based studies in climate services recommended more research on local worldviews and understandings of climate change. In terms of practice, these researchers recommended creating communication messages that are localized, and engaging in participatory projects to foster engagement among small communities.

All these research articles support the needs of climate services initiatives; however, based on this initial review, there seems to be over-reliance on post-positivism as a guiding research paradigm. Research in climate change communication published from 2010 to 2014 was largely post-positivist, seeking large-scale patterns to make generalizations. Researchers also called for more localized work, and some studies took on the challenge. These localized studies were critical or constructivist in nature, and documented local understanding and meaning-making regarding climate change.

Some post-positivist research, especially those that dealt with content analysis and media use, assumed that simply changing the message can lead to attitude and behavior change. However, this assumption is based on one-way dissemination models of science communication, where science alone holds the knowledge, and where knowledge flows to a lay public that will willingly change its behavior (Burns et al. 2003; Gregory and Miller 1998). However, research shows that awareness is not enough to take action, and that climate change knowledge does not translate immediately to environmentally-sustainable behavior (Jang 2013; Lieske et al. 2014; Morton et al. 2011; Whitmarsh et al. 2013). Dialogue cannot be gained through a one-way model of disseminating communication. The one-way model might not engender trust that would otherwise be gained through engagement with science and scientists (Cooper 2011; Whitmarsh et al. 2013; Wibeck 2014b). In the same manner, scientists might be able to catch a deeper glimpse of the complexity of social, economic, institutional, political, and cultural contexts of non-science stakeholders through dialogue, which can also help inform future research in climate change (Burns et al. 2003; Hackmann et al. 2014; Sharma and Gosain 2010).

Thus, dialogue entails more than "bringing down the science"; it should encourage contributions from all sides of research and practice to transform cross-disciplinal and multi-sectoral work into a coherent whole (Podesta et al. 2013). Research shows that the public has its own valid form of lay knowledge, which might be based on personal experience or beliefs (Weiler et al. 2012), but which is not necessarily wrong or subordinate to scientific knowledge (Brace and Geoghegan 2010; Etkin and Ho 2007; Howe and Leiserowitz 2013; Moser 2010; Naustdalslid 2011; Weber 2010; Weber and Stern 2011). For instance, indigenous knowledge can inform how people understand climate change, and researchers might need to understand how indigenous knowledge can help scientists understand

climate at local levels (Brace and Geoghegan 2010; Leonard et al. 2013; Whitmarsh et al. 2013).

Dialogue should therefore engage non-scientists, with a focus on critical thinking (Cooper 2011) instead of simply filling people with the type of knowledge that scientists believe they should have. This is where more critical and constructivist research paradigms can fill in the gap: meaningful dialogue begins with understanding of local contexts (Cooper 2011). Granted, such research takes time to implement, and even longer to publish, which may be a disincentive to the research and academic world. But such research is valuable to climate services because it meets the insistent call for localizing messages and framing them in terms of values and issues pertinent to specific populations and groups. Qualitative, in-depth studies can unearth these values and issues, and future research should address this need.

4 Concluding Remarks: Reflections on Balancing Communication Research for Climate Services

Climate services require support from the field of climate change communication to effectively promote the dialogue and collaboration necessary for co-production and co-design. This paper reviewed climate change communication research published from 2010 to 2014, and found that most research used a post-positivist worldview, with very few research articles guided by critical or constructivist paradigms. This limits the dialogue needed by climate services. Climate change communication research must take a step forward by considering what approaches would value and use stakeholders' differing perspectives of the issue toward co-designing and implementing long-term solutions.

The drive toward more dialogue-driven climate services needs to be supported by collaboration among the many different stakeholders involved, which calls for researchers to adapt a more transdisciplinary approach. Climate change communication research is not meant to problematize and then seek to harmonize diverse perspectives, but rather to channel those voices toward developing more robust dialogue and co-production strategies. However, climate change communication must not only change on its own, but must be supported by infrastructure that lends importance to dialogue, from the moment that research problems are framed, to the time that research results are used to benefit a public that contributed to that research. To this end, research and higher education institutions can play an important role in directing and forming current and future change communication work, with the aim to:

- Examine how various cultures are unique in their understanding of climate change, and how these understandings might either hamper future action or actually encourage action versus climate change, even if the understandings do not completely match those of scientists. Research can involve close contact and iterative interactions with various groups.

- Engage the public in dialogue at all stages of the research, from inception to long-term implementation, including monitoring and evaluation. The public will need assistance in understanding the science of climate change; but scientists, too, need assistance in understanding how non-scientists view the phenomenon.
- Keep using research findings to inform further work. There is no end to the many understandings and perceptions about climate change. As the audience keeps changing, so will their communication needs. Researchers are dealing with moving targets, and they must be grounded in good research philosophy before they can proceed.
- Consider using constructivist and critical worldviews to push research forward. Interesting questions might include: How might indigenous knowledge enrich bench-sciences-derived knowledge? How can this knowledge be used in climate services? What meaning do people make of the climate change issue?

These recommendations are based on an initial review of the recent academic literature; however, the current review is limited. Future reviews should include books, use other databases, expand the time frame, and assess constructivist or critical research in detail. Furthermore, projects and initiatives utilizing the constructivist or critical or post-modern worldviews may currently be conducted in other arenas (e.g. by practitioners, civil groups, non-government or aid organizations) but are not sufficiently reflected in peer-reviewed academic literature. This assessment focuses specifically on work implemented by the research and academic sector.

Inter- and transdisciplinary initiatives such as the GFCS and Future Earth require more research to support the need for salient climate services and meaningful co-production and co-design. By exploring other worldviews, climate change communication research can truly support climate services, which, in turn, can better engage the diverse publics that must be served. The researchers hope that this paper can help institutions involved in climate services and/or in training current and future generations of researchers to understand the information needs and unique contexts of various groups and cultures; and, in so doing, address the climate change issue by facilitating the development of useful and actionable climate services.

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