Studies in Applied Philosophy,
Epistemology and Rational Ethics

SAPERE

Alan Chamberlain
Andy Crabtree *Editors*

Into the Wild: Beyond the Design Research Lab

Springer

Studies in Applied Philosophy, Epistemology and Rational Ethics

Volume 48

Studies in Applied Philosophy, Epistemology and Rational Ethics (SAPERE) publishes new developments and advances in all the fields of philosophy, epistemology, and ethics, bringing them together with a cluster of scientific disciplines and technological outcomes: ranging from computer science to life sciences, from economics, law, and education to engineering, logic, and mathematics, from medicine to physics, human sciences, and politics. The series aims at covering all the challenging philosophical and ethical themes of contemporary society, making them appropriately applicable to contemporary theoretical and practical problems, impasses, controversies, and conflicts. Our scientific and technological era has offered "new" topics to all areas of philosophy and ethics – for instance concerning scientific rationality, creativity, human and artificial intelligence, social and folk epistemology, ordinary reasoning, cognitive niches and cultural evolution, ecological crisis, ecologically situated rationality, consciousness, freedom and responsibility, human identity and uniqueness, cooperation, altruism, intersubjectivity and empathy, spirituality, violence. The impact of such topics has been mainly undermined by contemporary cultural settings, whereas they should increase the demand of interdisciplinary applied knowledge and fresh and original understanding. In turn, traditional philosophical and ethical themes have been profoundly affected and transformed as well: they should be further examined as embedded and applied within their scientific and technological environments so to update their received and often old-fashioned disciplinary treatment and appeal. Applying philosophy individuates therefore a new research commitment for the 21st century, focused on the main problems of recent methodological, logical, epistemological, and cognitive aspects of modeling activities employed both in intellectual and scientific discovery, and in technological innovation, including the computational tools intertwined with such practices, to understand them in a wide and integrated perspective.

Studies in Applied Philosophy, Epistemology and Rational Ethics means to demonstrate the contemporary practical relevance of this novel philosophical approach and thus to provide a home for monographs, lecture notes, selected contributions from specialized conferences and workshops as well as selected PhD theses. The series welcomes contributions from philosophers as well as from scientists, engineers, and intellectuals interested in showing how applying philosophy can increase knowledge about our current world. Initial proposals can be sent to the Editor-in-Chief, prof. Lorenzo Magnani, lmagnani@unipv.it:

- A short synopsis of the work or the introduction chapter
- The proposed Table of Contents
- The CV of the lead author(s)

For more information, please contact the Editor-in-Chief at lmagnani@unipv.it. Indexed by SCOPUS, ISI and Springerlink. The books of the series are submitted for indexing to Web of Science.

More information about this series at http://www.springer.com/series/10087

Alan Chamberlain · Andy Crabtree
Editors

Into the Wild: Beyond the Design Research Lab

Springer

Editors
Alan Chamberlain
School of Computer Science
University of Nottingham
Nottingham, UK

Andy Crabtree
School of Computer Science
University of Nottingham
Nottingham, UK

ISSN 2192-6255 ISSN 2192-6263 (electronic)
Studies in Applied Philosophy, Epistemology and Rational Ethics
ISBN 978-3-030-18018-8 ISBN 978-3-030-18020-1 (eBook)
https://doi.org/10.1007/978-3-030-18020-1

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

Contents

About the Editors

Alan Chamberlain is a Senior Research Fellow in the Mixed Reality Laboratory at the University of Nottingham. He has published numerous papers on varied aspects of human–computer interaction. He has a long-standing interest in the development of computational systems in real-world settings (research in the wild). His research interests relate to real-world problems as articulated by various communities of practice and relate to human–computer interaction, ethnography, action research, participatory design, rural aspects of computing and user engagement in order to develop networks of people that are able to involve themselves in the practices of innovation and design.

Andy Crabtree is Professor in the School of Computer Science at The University of Nottingham. His research focuses on the relationship between computing systems and social interaction. He has made substantive contributions to models of innovation and systems development, design and evaluation methodology, distributed systems, network infrastructure and e-Science. His work has informed systems development across a range of application domains, including library services, customer services, interactive exhibitions, mixed reality games, home networks and applications, e-social science, tourism and leisure, culture and heritage.

Research 'In the Wild'

Alan Chamberlain and Andy Crabtree

Over recent years the term 'in the wild' has increasingly appeared in publications within the field of Human Computer Interaction (HCI). The phrase has become synonymous with a range of approaches that focus upon carrying out research-based studies reporting on user behaviour in 'natural', 'situated' contexts, as distinct to lab-based studies. The objective of this book is to bring together a range of perspectives from a variety of researchers who have carried out studies in the wild. By bringing these together we aim to explore and demonstrate how such studies can support research in different fields and domains. In doing this we wish to help the broader research community understand some of the issues, reasoning, methods and practical matters that are involved in doing research in the wild. This edited collection is part of an ongoing and developing debate, and as such provides both a backdrop and platform that will promote further discussions in this emerging area.

1 The Turn to the Wild

Early works in this area of an influential nature were based within the field of Anthropology and Cognition, with researchers attempting to unravel and evolve theories of practice and cognition, showing through their studies the situated, distributed, and emergent nature of cognition in the real world (see for example Suchman 1987; Lave 1988; Hutchings 1995). In many respects this research went against accepted notions of the time and reshaped fundamental understandings of cognition and human practice and how it might impact the design and use of digital technologies. 'In the wild' studies are now routinely carried out to understand the everyday uses of emerg-

A. Chamberlain (✉) · A. Crabtree
University of Nottingham, Nottingham, UK
e-mail: Alan.Chamberlain@nottingham.ac.uk

A. Chamberlain and A. Crabtree (eds.), *Into the Wild: Beyond the Design Research Lab*, Studies in Applied Philosophy, Epistemology and Rational Ethics 48,
https://doi.org/10.1007/978-3-030-18020-1_1

ing technologies and shape the design of systems and applications to better fit the situations in which they are deployed and used.

Early HCI focused on the interface between the user and machine and design of the 'software control dialogue' (Grudin 1990). HCI researchers began to recognise, however, that digital technologies are ecologically situated, which necessitated an appreciation of wider socio-technical issues. Of particular note is the 'turn to the social' that occurred during the late 1980s and early 1990s and the development of CSCW (Computer Supported Cooperative Work), which prompted designers to look beyond the computer interface to the socially embedded nature of systems beyond the lab, as researchers have done more recently when comparing lab-based and 'in the wild' studies (Rogers et al. 2013). As Grudin (1990) wrote, "the location of the 'user interface' has been pushed farther and farther out from the computer itself, deeper into the user … environment." The need to understand and appreciate the socially embedded nature of technology required that researchers go out 'into the wild'. With the development of technologies that are mobile, ubiquitous and embedded in mundane objects or 'things' (the so-called Internet of Things) it becomes increasingly important to understand technology at an ecological rather than at a species level, which cannot be accomplished in a sterile lab-based setting.

It might be said then that a fundamental concern with ecological validity motivates the turn to the wild. The Glossary of HCI (Papantoniou et al. 2018) tells us that "*…ecological validity refers to an acknowledgment of the fact that human action is situated and highly contingent on contextual factors/variables. To obtain 'valid' results, humans should [therefore] be studied in the richness of their natural environment.*" This means that is important, if not imperative, to move out of the lab. It is only then that the real world, real time nature of human action and cognition can be apprehended, and systems be shaped around them. By taking technology out into the wild, we are better placed to understand the ecological factors that impact it and understand what needs to be done to make it fit into the settings in must inhabit.

An evolving body of 'in the wild' studies have emerged over recent years, for an introduction to this work (see Crabtree et al. 2013). In examining these studies, we start to see a marked difference between the situated use of technology in the real-world and its development, creation and use in research labs. This begs the question, is there more to research in the wild than merely studying technology that has already been developed in a lab, or do we need to leave the lab behind and start to appreciate the in situ nature of the setting where such technologies will be used as a premise for design? It's clear to see that lab-based studies may lead to situations where participants are over-controlled and that the activities and actions they are asked to engage in do not map onto, and are not reasoned about in the same ways, outside of such controlled environments. It is for reasons such as this that Davies (2005) argues that lab studies are not a substitute for deployment: "*it is impossible to understand ahead of time the impact of the environment on technology (or indeed, the impact of technology on the environment), and this is often critical to system design.*" Understanding the environment of use can engender better understanding of the context in which technology will actually be deployed and the heterogeneous factors at play in the real world beyond the laboratory doors.

This position is of course contestable and contested. Kjeldskov et al. (2004) launch a notable critique of research in the wild and beg question "is it worth the hassle?", for as Rogers et al. (2007) note carrying out research-in-the-wild is both labour intensive, financially expensive, and significant investment. We can already appreciate the difficulty of carrying out research in the wild, particularly in settings where groups and multiple actors are involved. As Grudin wrote nearly 30 years ago, "group processes are often variable and context-sensitive, and usually unfold over time and in different locations; organizational change that results from introducing technology may take even longer to observe; and generalizing from observation is difficult—each group's experience is governed by its constitution and the conditions under which technology is introduced (Grudin 1990)." Nonetheless, and as the articles in this book hopefully demonstrate, the returns on 'in the wild' research offer significant insights that offset its costs.

This is not to suggest that we abandon the lab and move entirely into the wild. The purpose of the research and the end-point of a project all have to be factored into the way that the research is carried out. Arguably developing technology to support paramedics responding to an emergency situation will inevitably need to go through multiple rounds of in the wild testing and evaluation based in different situations, whereas an educational game might require a different approach to understanding and evaluating its applied use. So, there may well be cases where lab-based studies are rightly prioritised over studies in the wild and vice versa, and research needs to consider this when developing its design approach. At root we need to ask, are carefully controlled experimental results required or do we need to explore and understand what the technology will look like in the wild? Ultimately, as the 'turn to the social' in HCI opened up a new vistas and research agendas, then turn to the wild further expands our field of vision and immerses design *in* the world.

2 Contributors and Contributions

This volume brings together a variety of perspectives on research in the wild. Without giving to much away, below we give the reader a flavour of the chapters that make up this work. We start in this chapter with Alan Dix's walk around Wales. In charting this Alan offers intriguing glimpses of the many issues that can affect research in the wild. Alan's is a journey of discovery that helps us to see what is involved in both doing a journey, understanding that journey, and bringing the understandings gained to bear on possible design solutions. As Alan puts it, "research in the wild is always methodologically challenging, dealing with unconstrained use, data collecting for the unexpected, creating transferable knowledge from particular incidents, and inevitably pushing the boundaries of professional objectivity."

Chapter "Step by Step Research", by Andy Crabtree, Peter Tolmie and Alan Chamberlain, provides a sociological orientation to the wild as an everyday and unremarkable place for those that inhabit it and the technologies situated within it. The authors make the case that the 'unremarkable' status of the everyday world is

consequential, as it means that the wild is a mundane place whose social features may easily be overlooked by design researchers. This chapter elaborates "a collection of in-the-wild approaches for conducting foundational research on socio-technical systems, moving the development of future systems out of the laboratory to engage directly with users at each turn in the development process."

Chapter ""Research in the Wild": Approaches to Understanding the Unremarkable as a Resource for Design", by Tomasso Columbino Jutta Willamowski and Antonietta Grasso takes a thought provoking look at what happens when organisations examine the approaches they use to carry out research and how research agendas are prioritised and controlled. Doing research in the wild and reflecting upon the roles and motivations of the actors involved allows the authors to uncover 'uncomfortable lessons' about corporate research. This chapter will be of particular interest to researchers that are interested in innovation in organisations and how research in the wild blurs the distinction between prototype and product, experiment and deployment.

Chapter "Deeper into the Wild: Technology Co-creation Across Corporate Boundaries", by Richard Harper, Siân Lindley, Richard Banks, Phil Gosset and Gavin Smyth questions the mechanisms that might be employed to carry out design research and the problematic nature of methodology. As Harper et al. emphasize, taking an enquiry-based approach can be difficult and can sometimes suffer from a lack of direction. Nonetheless, early stage research is key to design and development. In presenting and elaborating the evaluation of a new type of data store, the authors consider the role of researchers as early stage in the wild adopters and what this might mean for design. As the authors put it, "Our engagement with the technology is not, as it were, intended to let us figure out how to appropriate the technology; our research has entailed engaging with it so as to fathom our own imaginations made real through use of the technology."

Chapter "HCI in the Wild Mêlée of Office Life—Explorations in Breaching the PC Data Store" by Keith Cheverst Nick Taylor, and Trien Do moves the focus to a rural village in Lancashire. The authors address what is involved in doing community-based research and giving communities a voice in design. In an honest response to the fact that what is created and deployed can never respond to the needs of an entire community composed of people with differing needs and wants, Cheverst et al.'s work focuses upon the culture of the community and the ways in which that might be represented, shared and used by multiple stakeholders. As a final parting comment the chapter asks us to think about impact that research can have upon a community. This in itself is an ethical question that needs to be pondered upon.

Chapter "Supporting Shared Sense of History Within a Rural Village Community" by Jon Whittle, Maria Angela Ferrario and Will Simm also explores community-based research and picks up the ethical challenge. The authors explore egalitarian approaches to doing research in the wild that actively engage and involve people and share power. A particularly valuable part of the paper lies in the discussion of innovation and the concept of 'responsible innovation'. The interdisciplinary nature of research in the wild is also highlighted in a chapter that is not only timely, but key to developing research approaches in general.

Chapter "Community-University Research: A Warts and All Account" by Ewa Luger and Tom Rodden explores ethics as a constituent part of in the wild studies and examines the foundational nature of consent in research and design. Questions are asked about the nature and prediction of harm in 'in the wild' research and the consequences of carrying out research that may be taken out of the control of the researchers' hands. Luger and Rodden note, "new variables, such as third parties, can come into play creating a highly dynamic research environment that stymies the identification of right or wrong conduct through a host of unexpected temporal, social and other contextual factors". They ask, how do we design in situations where we might not know the actual context of the research? The notion of 'responsive consent' and the role of the 'participant as researcher' are considered in response.

Chapter "Ethics and Consent in the (Sociotechnical) Wild" by Nick Race, Dave Randall, Mark Rouncefield and Roger Slack explores the practical character of ethics and is food for thought. Using examples from their work the authors examine "relationship between researchers and subjects" and question amongst other matters notions of community and trust. Being able to gain insights based on real-world studies is valuable and this chapter serves to inform researchers both about the actual issues that occurred in specific 'in the wild' projects and to generalise findings in a palatable way that may enable the broader community to understand some of the difficulties of carrying out 'research in the wild" in diverse settings.

In Chapter "Practical Ethics", Peter Tolmie provides a thoughtful response to many issues relating to 'research in the wild' in a carefully constructed piece that makes the reader think about both the practicalities and the unpredictable nature of working in the wild. Tolmie writes, "I want to take this proposition seriously and examine what research orientations to 'the wild' actually look like and what the implications of those orientations might be." He crafts an intelligent argument based on a significant amount of literature in the field and his discussions throw the homogenous notion of 'in the wild' into sharp relief. We think that Peter's work is a perfect way to end this book.

References

Crabtree, A., Chamberlain, A., Grinter, R. E., Jones, M., Rodden, T., & Rogers, Y. (2013). Introduction to the special issue of "The Turn to The Wild". In *ACM Transactions on Computer-Human Interaction* (TOCHI), *20*(3), 1–4.

Davies, N. (2005). Proof-of-concept demonstrators and other evils of application-led research. In *Proceedings of PerCom, Ubi App Workshop*, Munich. IEEE Press.

Grudin, J. (1990). The computer reaches out: The historical continuity of interface design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems—(CHI '90)* (pp. 261–268), New York, NY, USA. https://doi.org/10.1145/97243.97284.

Hutchins, E. (1995). *Cognition in the wild*. MIT Press.

Kjeldskov, J., Skov, M. B., Als, B. S., & Høegh, R. T. (2004). Is it worth the hassle? Exploring the added value of evaluating the usability of context-aware mobile systems in the field. In *Proceedings of Mobile HCI 2004* (pp. 61–73), Glasgow, Scotland. LNCS. Berlin: Springer-Verlag. https://doi.org/10.1007/978-3-540-28637-0_6.

Lave, J. (1988). *Cognition in practice*. Cambridge University Press.

Papantoniou, et al. (2018). *The glossary of human computer interaction*. Published by the Interaction Design Foundation. https://www.interaction-design.org/literature/book/the-glossary-of-human-computer-interaction/ecological-validity. Accessed 2018.

Rogers, Y., Connelly, K., Tedesco, L., Hazlewood, W., Kurtz, A., Hall, B., et al. (2007). Why it's worth the hassle: The value of in-situ studies when designing UbiComp. In J. Krumm et al. (Eds.), *UbiComp 2007* (Vol. 4717, pp. 336–353). Lecturer Notes in Computer Science. Berlin: Springer-Verlag. https://doi.org/10.1007/978-3-540-74853-3_20.

Rogers, Y., Yuill, N., & Marshall, P. (2013). Contrasting lab-based and in-the-wild studies for evaluating multi-user technologies. In *The SAGE Handbook of Digital Technology Research* (pp. 359–373).

Suchman, L. (1987). *Plans and situated actions: The problem of human–machine communication*. New York: Cambridge University Press.

Step by Step Research

Alan Dix

1 Introduction

When the term 'research in the wild' is used, it may refer to studies of novel technology in a museum, observing shoppers in a mall, or deploying a mobile app to observe real large-scale use. The settings may be outdoors, but are most often urban. They are open and contingent, but still relatively controlled.

This chapter is about a three and half month, one-thousand-mile walk around Wales undertaken as a research journey. In some ways this is still relatively 'tame', there are no large game animals, although the sight of thirty bullocks charging down a field towards one is not un-alarming. However, it is a mode of enquiry that is physically challenging, sometimes painful, and not infrequently uncomfortable.

Research in the wild is always methodologically challenging, dealing with unconstrained use, data collecting for the unexpected, creating transferable knowledge from particular incidents, and inevitably pushing the boundaries of professional objectivity. The Wales walk stretches this envelope further.

Parts of this chapter will read like a 'war story'; the practical problems simply to keep things working at the time often overshadowed deeper research goals. However, these practical problems as much as the methodological ones define the nature of Research in the Wild.

The next section provides background to the Wales Coast Path and the reasons behind this walk. It also reviews a selection of relevant walking related literature and technology. This is followed by a description of the execution challenges, the physical and practical problems associated with walking as research. We then look at some of the research outcomes and outputs, and use these to illustrate deeper methodological challenges.

A. Dix (✉)
Computational Foundry, Swansea University, Swansea, Wales, UK
e-mail: alan@hcibook.com

A. Chamberlain and A. Crabtree (eds.), *Into the Wild: Beyond the Design Research Lab*, Studies in Applied Philosophy, Epistemology and Rational Ethics 48,
https://doi.org/10.1007/978-3-030-18020-1_2

2 Just Walking

2.1 The Wales Coast Path, Perimeter, and Perimeteers

In 2012 the Wales Coast Path was formally opened. While there were various existing paths around portions of the coast, the Wales Coast Path links these into a single, complete, way-marked route around the entire coast of Wales, 870 miles in total. This makes Wales the only country in the world to have a complete coastal path.

The path was conceived in 2006, largely to attract tourism following on from the success of the Pembrokeshire Coast Path (now over 40 years old), Anglesey Coast Path and Ceredigion Coast Path (at that point still under development).

There is also a long-distance footpath, running up the border between Wales and England, following the route of Offa's Dyke, the 9th Century earthwork that separated Mercia (the English Kingdom) and the Welsh. This runs north–south, coast to coast, and so, together with the Wales Coast Path, enables a complete circumnavigation of Wales by foot, approximately 1050 miles (1700 km).

The first such 'perimeteer' was Arry Beresford-Webb, who ran the entire distance in 39 days, a marathon distance each day; her extreme achievement was timed to finish in Cardiff on the day of the opening in May 2012. Since then and this time there have been a number of nonstop walks of the Coast including one en-masse walk "Walk on Wales" in aid of a military veterans charity (WCP 2014). There have been fewer complete perimeter walks (or runs!); at the time of writing just nine in addition to my own.

2.2 Why Walk?

The majority of the full coastal walks have been in aid of charity. However, my walk was always a multi-faceted one. The initial impetus was personal, an overriding sense when I heard of the opening of the Wales Coast Path, that I had to walk it. However this was quickly followed by a realisation of the research potential, both for my own research areas and also for others. The borders and coast cut through both the major urban areas of Wales and remote rural locations; it thus acts as a form of socio-economic transect of a modern nation.

One of the issues that I was expecting was problems in connectivity, as much of the time I would be in remote rural areas. As well as poor mobile connectivity, I knew fixed internet would also be problematic. During a preparatory visit to St. Davids, a major town (or strictly tiny city) in the Pembrokeshire peninsula, I visited a supermarket to buy food. The checkout tills had recently been replaced with ones that connected to the bank via the internet. However, the connection was down and so the cashier had to look out old paper-based credit-card payment machines. I have had an interest in the ways mobile applications cope with poor connectivity since the mid 1990s (Dix 1995) and so one goal of the walk was to understand how this and

other IT issues affected the walker as a tourist and the communities through which the path passes.

Another issue of interest was maps, the way local mapping emphasises different aspects, compared with 'standard maps', and often uses different perspectives such as oblique hills-eye views, or even fish-eye views portraying a town centre at higher scale than the periphery. The availability of online mapping, especially Google maps, has made it easy to add maps to web sites, but always standard God's eye maps, potentially threatening more locally focused and individual mapping. As Barbara Bender said:

> Post-Renaissance maps cover the surface of the world with an homogeneous Cartesian grip. (Bender 1996, p. 41)

As well as these and other personal technological, social and philosophical interests, I offered myself as a 'living lab', taking note of specific concerns and carrying equipment for other researchers.

An example of the former was the issue of 'off path destinations', that is towns and villages nearby, but just off the main path. The Wales Coast Path was created largely for its tourism potential, but how far does its benefit spread from the route of the path itself? While I walked I kept a lookout for where off-path destinations were, or more often were not, signed or otherwise apparent.

An example of the latter was the bio-sensing devices I carried (EDA and ECG). These came about due to a pre-walk talk at Nottingham where one of the attendees put me in touch with a researcher there who studies this kind of data.

2.3 Walking Technology

There are many research and commercial applications focused on the act of walking. The most obvious examples are mobile tourist guides, which date back many years (Cheverst et al. 2000). More recently this notion has been inverted by Hobbit (Posti et al. 2014), which deliberately highlights routes that are infrequently walked or away from other users; this reflects the idea that those walking in woods and other rural locations do so deliberately to seek solitude, again inverting the focus on social networking and hyper-connectivity.

Hobbit is also unusual in its rural focus; the majority of mobile application research has been targeted at urban areas, largely because this is where universities are situated. However, there is also an active industry in the production of devices (e.g. Garmin,[1] SPOT[2]) and mobile phone applications (e.g. ViewRanger[3]) that help navigate or

[1] http://www.garmin.com.

[2] http://www.findmespot.eu/en/.

[3] http://www.viewranger.com/.

capture experiences in the wild. While many are effectively standalone, others enable connections with social media and other information sources (e.g. Social Hiking[4]).

Similarly, there is a rapidly growing market in devices and applications to track and share sporting or health and fitness related activities. Some, such as Nike + FuelBand, can be used independently, but actively encourage sharing of activity data in order to encourage competition:

> Sync with your device, see your progress and compete against your friends. (Nike website, 31/7/2014, http://www.nike.com/gb/en_gb/c/nikeplus-fuelband)

However, detailed user studies have shown that, while social elements are appreciated, it is intrinsic motivation and individual goals, that are the main determinants of behaviour (Spillers and Asimakopoulos 2014).

The mobile-phone-based research application HeartLink takes this a stage further enabling a live two-way interaction (Curmi et al. 2013). HeartLink connects to a commercial chest-strap heart sensor and transmits live heart rate information to friends and supporters. In turn they can 'cheer' the wearer, which is conveyed by vibrating the phone.

2.4 Walking as Research

Within the humanities there has been a long history of using walking as a means of creative stimulus, notably Wordsworth walked not just outdoors, but continually paced his study whilst composing. The nature of walking and more widely the journey has also been both a topic in itself (Odyssey, Marco Polo) and also the thread that ties together otherwise disparate stories from Australian Aboriginal dream time to city ghost walks.

The relation between walking, paths, narrative and lifelines has been a topic of more philosophical inquiry, for example, the rich writings of Solnit (2001, 2006) or Ingold's focus on the importance of the line as opposed to the Cartesian privileging of the point (Ingold 2007). These philosophical strands connect to psychogeography, which uses walking extensively to understand the felt nature of environments (Coverley 2010). While psychogeography is predominantly urban-focused, there are some, such as the Macfarlane Wild Places trilogy, with a more rural and wilderness perspective (Macfarlane 2008, 2010, 2013).

At a more pragmatic level, field walking is an important part of archaeologists' practice allowing them to get a sense of the land, complementing information from remote sensing such as aerial photographs, and written records (Connolly 2007). In addition, being on the ground offers the potential to collect surface artefacts (for example, those revealed through ploughing), and also to get a feel for the potential of past human habitation, where they may have chosen to live, to farm, and not least, to walk.

[4] http://www.shareyouradventure.com/.

Within the socio-technical literature walking has been predominantly the object of study, rather than used as the means of study. For example, space syntax theorists have compared actual walking patterns with those predicted by their methods (Kostakos et al. 2010); ubicomp and mobile HCI researchers have used movement patterns as part of the design of context-sensitive user interfaces and services (Cheverst 2000; Pribeanu et al. 2001; Dix et al. 2000); walking may be an integral part of an activity being studied, as was the case with Bidwell et al.'s (2013) work with solar charging in rural Africa; and health and well-being researchers have combined environmental and bio-sensors into many mobile applications. In general when mobile interfaces, such as those discussed in the previous section, are designed to be used while walking, these are, quite reasonably, evaluated while walking, but where the walkers are test users not researchers.

The subjective nature of walking has also been the subject of various applications and studies. Several of the applications we have discussed (e.g. Hobbit and HeartLink), have this as a principal function. Other researchers have simply used the evocative nature of walking, particularly of a familiar area, as a research instrument, for example, Stanton Fraser et al. (2013) used mobile blogging (moblogging) in order to reveal perceptions of urban spaces while Bidwell and Browning (2006) used egocentric videos taken during walking to help elicit the 'sense of being in' a place at a local natural landmark in tropical Queensland, Australia.

Since my Wales walk, the volume of research within HCI focused on outdoor activity has increased markedly, including work on running (Curmi et al. 2013; Spillers and Asimakopoulos 2014) and walking (Posti et al. 2014; Eslambolchilar et al. 2016). The level of interest has been sufficient for a number of workshops and workshop series to emerge with slightly different foci including NatureCHI (Häkkilä et al. 2016), CHI Outdoors (Jones et al. 2017), UbiMount (Daiber et al. 2017) and Technology on the Trail (Virginia Tech 2017; McCrickard et al. 2018)

3 Execution Challenges

There are clearly challenges performing research in any context, from repetitive strain injury while typing an article, to obtaining sufficient participants when performing a laboratory experiment. Research in the wild has many of the same problems as desktop or lab-based research, but adds many more due to the uncontrolled nature of the physical environment and human interactions in it.

However, even 'Research in the Wild' often means simply studying the use of an innovative application in a museum foyer or mobile app in an urban street, and typically for relatively short periods. Three and half months walking in all weathers creates new challenges on top of those of more civilised research in the 'wild'.

3.1 Physical—Time, Pain and Damp

Walking one thousand miles is demanding physically on the body, not helped by the fact that I had not walked seriously since I was eighteen. Happily, I suffered no serious injuries, but did have a variety of musculoskeletal aches and pains, including some form of strain or tendonitis in one foot, which left it swollen for several weeks, and long term pain in both foot pads that took several months to clear up after the walk was over.

Despite the occasional encounter with a herd of charging bullocks or steep cliff-side paths, the coast of Wales is far less hazardous than, say, a trip to the International Space Station, but the level of discomfort and danger does pose some ethical problems. Self-experimentation has a long history especially in medicine (Gandevia 2005), but is still the subject of active ethical debate (Annas 2010; Cunningham 2004). More problematic is when the experimenter is a research student or employed research assistant. For example, Ellie Harmon a doctoral student at University of California, Irvine has walked the 2650 miles of the Pacific Crest Trail as part of her studies on 'dis-connection in its multiple forms'[5] and volcanology researchers, by the nature of the subject, spend time close to active volcano vents. Even if the subject fully understands the risks, what level of discomfort or risk is acceptable?

The process of walking also takes considerable time. This creates an opportunity cost: is the extensive time justified compared with, for example, spending three and half months writing, or three and half months creating experimental software? In many ways the time taken was an essential part of the method, this is effectively slow research, and the slow pace of walking means that I was forced to spend time going through parts of the coast (for example, the post-industrial towns of north east Wales) that I might otherwise have rushed past and so missed some of the insights described later in this chapter.

However, I also underestimated the time taken to walk the distance with consequent threats to some of the goals of the expedition, and also skipping rest and writing days, adding to the physical and psychological stresses.

Weather was also an issue, both in terms of physical discomfort, whether getting soaking wet or suffering sunburn, but also in its impact on equipment. Cameras suffered particularly as they cannot be sheltered completely, there are some gaps in the record where conditions were too bad, and two cameras were effectively worn-out during the trip. Other equipment had to be well protected, with heavy-duty waterproof bags, adding to carrying weight.

This is particularly an issue for bespoke equipment. For just over half the trip I carried a box designed by researchers at the dot.rural research centre in Aberdeen. This included a GPS, temperature sensor and GSM module to transmit data. This of course suffered from the general lack of mobile signal, limiting its utility, but in addition, the physical form posed problems. The box was light but was a comparatively bulky rectangular box, meaning it was hard to pack without a corner sticking through the rucksack into one's back. Furthermore, the on-off switch was a rocker,

[5] http://ellieharmon.com/.

so that after a day bouncing in the rucksack it would typically have been knocked off by the end of the day. Both these problems were solved by wrapping the box in light clothing, but ultimately the rechargeable battery stopped working, presumably the effect of continual movement, and the occasional jarring fall. Lab experiments typically involve static equipment in indoor conditions; designing equipment that can withstand long term use in adverse conditions is a non-trivial engineering challenge.

3.2 Personality—Waving Banners

In laboratory settings one takes considerable effort to ensure that the researcher's personal character does not affect the experiment. Qualitative research often involves face-to-face interviews, and so interpersonal skills are critical; however, even here the artificial situation creates a legitimacy to ask questions and a staged role as 'interviewer'.

Some 'in the wild' research is in this respect more like a laboratory experiment acting as external observer to normal behaviour or behaviour in the presence of intervention technology. However, the walk was not like that, by its nature the majority of contacts were accidental and often in semi-social situations, people met on the path, in bed and breakfast accommodation, cafes or pubs. The ability to collect data is therefore intimately tied to one's personal skills and character.

While I am reasonably good at talking with people, I (in common with many computer scientists!) find it very hard to initiate conversations. In order to help this I took leaflets and cards explaining the walk and also had a banner on the back of my rucksack. Between them, these helped establish a role as 'the Wales walker', which helped set the tone of conversations. Furthermore, the banner meant that people often approached me and asked questions.

This is an example of *personality prosthesis*. A lever, block and tackle, or fork-lift truck acts as a physical prosthesis allowing the operator to lift more than they could by muscle power alone. An electronic calculator, or address book similarly extends cognitive abilities acting as prostheses for mental arithmetic or memory. The banner in a corresponding way acted as a prosthesis allowing me to perform interpersonal tasks that I would have otherwise have found difficult or impossible.

3.3 Practical—Tending Technology … No Army of RAs

Although not entirely wired up, I was carrying a fair amount of digital technology: two phones (on different carriers to maximise connectivity), iPad, Garmin GPS, SPOT satellite emergency GPS, dot.rural data box, USB battery, digital camera, voice recorder, wrist-worn EDA, and ECG. Much of this needed charging each evening and often some sort of periodic download of data. A high-power four-output USB

charger made this simpler, but even simply charging this number of devices was a major task.

However, the downloading of data onto laptop (and making frequent backups) was more time consuming. Unfortunately, this is rarely a matter of simply plugging in and leaving devices, but typically involved a complex rota of tasks, some time critical. Some were easier: the camera would literally upload its photos to the laptop when plugged in, and copying text from iPad to laptop was relatively simple through iTunes.

Most complex was the ECG sensor, which connected onto a special reader device, which then connected to a laptop via USB. Unfortunately there were only device drivers for Windows 7 meaning a special laptop had to be carried especially for this task. Once on the Windows device it was transferred via USB stick to the main laptop (a Mac Air) where Dropbox would share it (when next WiFi connected). The software to read the device involved several stages of reading, saving and reinitialising, all of which took considerable time, and some of which would time out leaving the device in an inconsistent state if not watched continually.

In nights when I was staying at a bed-and-breakfast and having a taxi carry the bags of computers from place to place, all of this had, in addition, to be unpacked and packed each day.

All in all this simple housekeeping or 'tending technology' took at least an hour a day … before I could start the, on average, two hours of writing and reporting for the past day.

In addition to this daily or near daily housekeeping, there were periodic tasks, especially in the rare opportunities with efficient WiFi. For photographs, this included running processes to reduce their size, uploading them to Flick and moving the full-size versions onto a separate hard disk (19,000 photos are too large for a laptop disk). For blogging this involved copying and formatting the text, finding suitable photographs to illustrate the day and then updating status on Twitter and Facebook on both personal and 'alanwalkswales' accounts.

Normally, when research in the wild involves some form of novel technology or sensing technology, it is both for a short period and is heavily supported; often multiple research assistants hang over laptop screens for the entire duration of the study. If this had been a shorter expedition I would undoubtedly have one or more people to act as a support team; they would have taken over the mundane tasks leaving more time for writing and rest. When planning a more long-term and solo expedition it is easy to neglect the time and effort needed for basic digital housekeeping.

While this is a lesson for research in the wild, it is also a distillation of a more general issue with digital technology. Devices are often marketed in terms of their utility, and sometimes timesaving, whilst in use. However, installation and charging can take a disproportionate amount of time, not to mention a plethora of leads, and in ubiquitous computing charging has been a constant and unresolved problem. Yet, despite this, the topping and tailing of once-off installation and configuration, and on-going daily housekeeping are rarely included in scenarios of use.

4 Outputs and Outcomes

The aim of this chapter is to explore the methodological challenges of the walk, but in order to exemplify these some of the research outputs and outcomes are described here. In the next section these will be used to exemplify different methodological challenges raised by each.

4.1 Technology and Connectivity

One of the aims of the walk was to explore the technological needs of the walker and of the communities along the path. A key issue was expected to be levels of connectivity following from a long-term personal research interest in connectivity issues for mobile user interfaces dating back to the early 1990s (Dix 1995) and more generally time in the user interface dating back more than 25 years (Dix 1987, 1992; Dix et al. 1998).

One of the practical limitations to this exploration was that the levels of connectivity around the coast were far worse than had been expected, even after living on an island with minimal mobile connectivity. Typically the best mobile signal in a day was 2 bars of GSM, with 2G signal very rare, and 3G almost non-existent. While mobile reception maps appear to show relatively good coastal connectivity, this is primarily focused out to sea as yachts-folk are more affluent than those living in rural communities on the land—signal follows money.

The paucity of raw connectivity was exacerbated by poor software design. Prominent examples were Twitter mobile apps, which failed entirely in areas of even moderate reception despite being based on 140 character messages. The reasons for this appeared to be:

(i) Each 140 character Tweet is wrapped in about 4–7 K of XML in the API.
(ii) To reduce server load a single large request (typically 50 items) is made to populate the feed.
(iii) The interface is synchronous at initialisation loading the whole feed before allowing a status to be set.

These are a combination of poor software engineering and poor interface design. Together they mean that nearly a quarter of a megabyte has to be downloaded before it is possible to send a Tweet. Other apps had similar behaviour, with the exception of email, which was designed in the 1970s and hence has protocols designed for intermittent and low-bandwidth connectivity. These observations suggest a need for clear guidance and appropriate user interface architectures so that interaction degrades gracefully in areas of poor connectivity.

4.2 Supporting Technology and Activity

Although poor connectivity reduced app usage while walking, in fact there was considerable technology in use surrounding the act itself:

- Data collection technology recording the route taken (GPS) and biological measures (ECG and EDA)
- Technology carried while walking, for use in emergencies (phone on battery pack in the rucksack and 'SPOT' emergency SOS device)
- Technology used while stopped during a day's walk (iPad for writing)
- Technology used before the walk started (principally for planning transport and accommodation)
- Technology used in evenings or rest days, particularly when connectivity was available (more planning, blogging, uploading photos)
- Technology used after the walk (more blogging, sorting photos, reporting).

In many ways this reinforces the normal HCI and socio-technological design advice to take note of the big picture. However, it is easy to focus on technology during an act rather than the broader activity (see Fig. 1).

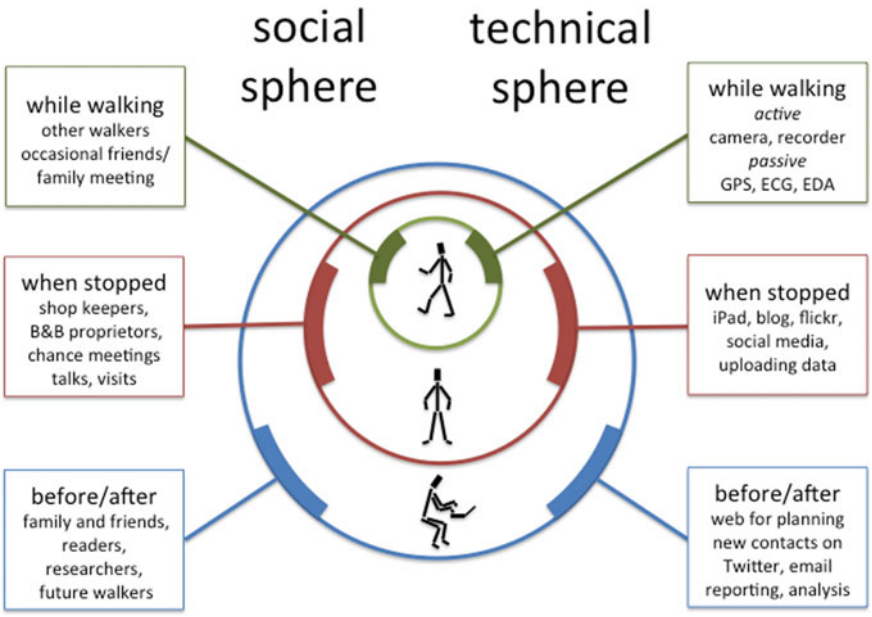

Fig. 1 Onion-layers of experience: social and technical interactions around the act of walking (from Asimakopoulos and Dix 2017)

4.3 Heart of Community

Travelling from east to west along the North Wales coast, one travels through some of the most deprived areas of Wales.

The single most deprived area is West Rhyl. This has a simple explanation. In common with many Victorian seaside towns it is suffering general decay due to the growth in overseas sun-seeking holidays. This then leads to cheap bed and breakfast accommodation, which is used as overspill for those on housing lists from neighbouring cities. In the case of Rhyl, it is effectively the dumping ground for Liverpool with hard-to-place individuals and families sent there.

However, there are another set of villages and small towns where past industrial activity has been lost, leading to widespread unemployment. Towards the east, villages such as Connah's Quay and Flint are visibly depressed, in Connah's Quay even the pubs are all closed down. Yet further west there are villages where industry and employment have equally been lost and yet there remains a heart to the community. Is this random or are there systematic factors that make it more likely that one community will survive and retain its internal strength and another die from within?

This is really a human geography question raised by the journey. It seems the sort of question that ought to be in the heart of psychogeography, except the psychogeographers have a more urban bias and appear to be more interested in vivid description and romance than intervention.

There is clearly an east-west trend, and yet all set within a close area. There are things that feel as though they could be making the difference:

- *Estuary versus open sea*—While the mudflats of estuaries have a barren beauty and are havens for wildlife, they can also be depressing.
- *Urban influence*—While it is mainly Rhyl that has become overspill for Liverpool, there may be other urban influences, perhaps creating an external focus, neglecting inner resources.
- *Community churn*—Connected to the urban effect, Flint has been an immigrant town for at least 150 years, with the part north of the railway called 'Irish Town' in the 19th century and today with a very large Polish community. While bringing fresh influences, does this also weaken the sense of heritage?
- *Industries of the land*—The villages and towns of the east were mainly 'brought in' industry: chemical works, and factories, often originally related to local conditions, but in recent memory about raw materials that are shipped in. In contrast the villages of the west are based around quarrying. Does this connection to the land encourage a sense of community roots?

These are open questions, but these physically close and yet very different communities seem a good proving ground for understanding the causes of community decay, and maybe understanding how to prevent or even reverse it.

4.4 Interstitial Communities and Transhumance

At the edge of Monmouth is a small caravan park. It at first appears to be mainly a touring site as the caravans are all small, not the vast static caravans that are planted liberally around much of the coast. However, you then notice that each caravan is surrounded by a small garden, each different: some with small ankle-high picket fences, some with tubs of plants—the majority of the caravans are clearly there for the season, indeed season after season. Many of the owners are semi-retired and are here for four or five days a week, some are here virtually permanently going 'home' every two or three weeks to do the washing, but otherwise living permanently on the site during the season. There is a whole seasonal community here.

In Anglesey I discover that many of the residents of the static caravan sites are retired and live there all year except the month around New Year when the site closes to fulfil planning permission. They typically have another house, but the caravan is their more permanent domicile, the word 'home' becomes problematic.

Traditionally many rural communities had winter and summer homes, moving up into the mountains as cattle and sheep grazed higher pastures. In Georgian times and through to the early 20th century, it was common for upper and upper-middle class families to have a second home at the spa, by the sea, or abroad, even the Queen holds court at Sandringham over Christmas.

While it has become common not to know your neighbour, here are real communities forming that slip between the gaps. For these caravan sites, the majority of (semi)residents are retired or semi-retired, however amongst the working population various factors including negative equity, fluid employment, professional couples with jobs in different cities, countries or continents have created substantial numbers of people living in multiple places, where the notion of 'home' is problematic.

4.5 Low-Level Quantitative Data: Location and Biosensing

I carried a number of sensors that gave low-level data about the walk.

- *Location (GPS)*—A Garmin dedicated GPS unit and a phone app Viewranger created GPX traces of the journey. These were sometimes incomplete if I forgot to turn on the devices or if batteries ran out during the day. They also contain occasional sporadic readings way off track due to glitches in GPS location and periods of rapid movement if I forgot to turn off the devices before getting on a bus to go back to a campsite.
- *Heart (ECG)*—I wore a medical-grade twin-electrode ECG recorder. Typically this stored 2 days and a night of data. It is, to my knowledge, the largest long-term trace of ECG activity in the public domain. The daytime recordings offer the potential to correlate heart activity with the terrain, weather, etc. The overnight readings allow long-term analysis, especially interesting given my fitness level changed dramatically during the walk.

- *Skin (EDA and temperature)*—I wore an Affectiv Q sensor,[6] rather like a wristwatch, which measured electro-dermal activity (EDA), effectively skin moisture as used in lie detectors and also skin temperature.
- *Movement (accelerometers)*—Both the ECG and EDA devices included three-axis accelerometers, allowing the calculation of movement levels, and potentially to act as a post hoc pedometer.

4.6 Analysis of Blogs—Lostness and Social Relationships

As well as quantitative data there is an abundance of qualitative data, 19,000 photographs, audio blogs and more than 150,000 words of daily text blogs. There are two main research activities around these:

- *Meta data and Semantic mark-up*— Meta data has been prepared to enable easy connections between the qualitative and quantitative data. In particular everything is time-stamped making it possible, for example, to notice an unusual incident in the heart-rate or accelerometer data, and then drill into any photographs or audio blogs at that time. In addition, semantic mark-up is being added to the blog entries, including all names and places.
- *Qualitative analysis*—The data is all available freely to view online or download for third party use, but in addition a collaborator has been analysing the blog entries using inductive analysis techniques. The original focus was on issues of wayfinding and lostness, but one of the core categories that emerged was social engagement.

In some ways the latter was unexpected as the walk was essentially solitary, albeit with the intention of making community contacts along the way. In response to this personal reflection led to a list of nearly twenty different categories of social contacts, from other walkers to academic collaborators.

5 Methodology Challenges

In the previous section we looked at the following research outputs/outcomes:

(a) Limitations of technology and mobile and broadband connectivity
(b) Supporting technology in the broader activities around walking
(c) Understanding how a post-industrial community retains its heart
(d) The issue of interstitial communities and modern-day transhumance
(e) Low-level quantitative data: location and bio-sensing

[6]The Affectiv Q is no longer available, but the MIT group that initially produced it has designed an improved wrist worn sensor to be built by a new company Empatica. http://affect.media.mit.edu/projectpages/iCalm/iCalm-2-Q.html.

(f) Semantic mark-up of blog text
(g) Qualitative analysis of blogs—lostness and social relationships.

We will now look in more detail at the methodological challenges raised by these.

5.1 Technical Questions

The issues of connectivity (outcome a) raised during the walk certainly contribute to wider public policy discussions about rural broadband and mobile connectivity raised elsewhere (Townsend et al. 2013) and indeed have already been used in this context (Morgan et al. 2014). Arguably, for this purpose, it would probably have been better to simply drive from community to community and systematically sample connectivity using standardised measures. However, there is also something about the subjective experience of attempting (and often failing) to perform real tasks that goes beyond the bare numbers.

In particular, public reports typically quote broadband speed as the key metric, for example, the Royal Society of Edinburgh's report 'Digital Scotland' makes a strong case for bringing fibre to every area of 2000 people:

> Any circle drawn on the map of Scotland to include a settled population of at least 2000 people, should also include a hub. Key Recommendations (RSE 2010, p. 4)

This is certainly important, but, both from my walking experience and also day-to-day life living on an island, I know it is the intermittency and unreliability that is more crippling. Based on this it would be possible to create some form of metric and measuring application that, for example, periodically probed the connection, and reported the frequency of incidents when connectivity dropped to below 10% of normal speed, or where end-to-end delay exceeded 1 s.

That is the subjective experience does two things:

- Helps to probe the implications of technical issues for real life
- Poses questions that are amenable to systematic quantitative analysis.

In addition to these infrastructure issues, much of the subjective angst was due to the inability of software to deal with limited connectivity. This then led to a putative technical deconstruction of the reasons why the software was failing, for example, the combination of factors that led to Twitter's poor performance. This can then be used to propose architectural design practices that avoid the worst of the problems.

That is:

- Subjective experience 'in the wild' raises critical software issues
- This then leads to technical analysis and potential design solutions.

5.2 Externalisation Through Reporting

The analysis of the way technology supports the broader activities around walking (outcome b) did not arise directly from the experience of walking. Indeed the opposite was the case, while walking I felt I was not using technology as much as I should given the goals of the expedition. It was only when I was writing and preparing talks about the walk that I noticed the incongruity between, on the one hand, the volume of data collected and, on the other hand, the time 'tending technology' and my assertion that in the end I used little technology.

Once the realisation dawned, it was easy to list numerous ways in which technology was used in the broader activity of walking, and it seemed almost perverse that someone who had taught about looking at the wide socio-technical picture for many years, could be so blind when applied to their own actions. Except that this is precisely the standard problem of expert knowledge, it is hardest to see when closest to it.

So, I had both the knowledge that broader activities are important, and that there was lots of technology being used, but both were tacit. As is so often the case (Dix and Gongora 2011), it was the process of writing and preparing talks that externalised that tacit knowledge, and acted as a creative impetus.

5.3 Qualitative Questions

The issues regarding post-industrial and interstitial communities (outcomes c & d) were ones that emerged naturally from observations made during walking.

In some ways the former is closest to psychogeography, an appreciation of the overall emotional feel of places, elicited largely through, effectively voyeuristic, and slow, walking—the *flâneur*. A frequent critique of psychogeography is that it is strong on method, but weak on results. This would be arguably true here too, although there is at least the posing of a problem, and some inkling of reasons.

The prolonged nature of the walk is helpful. Macfarlane (2005) suggests placing a glass on a map, drawing around it, and then walking the resulting circle; however, the assumption is that this would be a day's walk through urban streets. The border and coast of Wales is effectively a huge glass circle, cutting not arbitrarily through villages and cities, but certainly drawing one through a wide variety of physical and social landscapes. The slow movement over multiple days makes it easier to spot slow changes and trends, and to see details alongside the immediate emotional impact.

The issues of interstitial and modern day transhumance arose less from this slow movement, and more from reflection on individual events, experiences and conversations. In some ways this is closer to the technique of the social anthropologist, although certainly not of the disinterested observer variety. Being a walker, a wanderer, a vagrant, puts one in a liminal position thrown bodily into situations and yet also the outsider, the visitor—light of foot and soon to leave.

In this case, it is easy to see that the issue, once noted, is a general one; caravan site communities are clearly common around the whole country. Whilst in US culture the trailer park community is a frequent motif, for some reason this is not a notion in the British imagination beyond the traveller camp. There are exceptions such as Lydia Holly's caravan in South Riding (Holtby 1936) or the 1970s situation comedy 'Romany Jones',[7] set in a caravan site for the down at heel, but in general the media image of the caravan site is mostly the setting for semi-ludicrous summer holidays.

While gypsy communities have been the subject of extensive ethnographies, social studies, and books celebrating heritage and lifestyle, the seasonal semi-retired fall between the cracks of academic perception. The demographic shift in the UK and other developed countries has been towards a growing proportion of older people. There has been extensive discussion of the way this will lead to higher needs for later-stage care, especially related to dementia. However, there will also be an increasing number of 'fit elderly', so it is likely these liminal semi-retired communities will grow in importance.

Methodologically, in both these cases, the pace of the walk helped identify a specific and local issue, which, on reflection, is seen to be something that will recur widely. In neither case are we seeing systematic study or deep analysis, the walk served to raise issues. Having identified these issues, there is still the need:

- to corroborate extent (from impressions to evidence)
- to address the problem, and/or study the issue in detail? (may not be me).

5.4 Third Party Analysis to Personal Reflection

A qualitative analysis of the blog entries was carried out by a collaborator, Stavros Asimakopoulos. Although the reporting of this analysis has been a joint activity (Asimakopoulos and Dix 2017), the initial grounded theory analysis was deliberately performed independently by Asimakopoulos, with this author acting effectively as the data subject. In some ways this is just a form of single person study, with the same advantages of depth and disadvantages of breadth inherent in the technique (Razak 2008). As a diarist of the walk I was explicitly aware of the research potential of my writing, but so also are most subjects recruited for diary-based studies. So in many ways this part of the analysis is closest to traditional techniques, with Asimakopoulos taking the role of external researcher and me taking the role of (helpful) subject.

However, while the initial analysis was independent, the subsequent reflection on the categories has been a joint activity, informed by my subjective understanding as well as Stavros' external view. Perhaps most interesting from this point of view is the emergence of social relationships as a key element.

Rather like my initial assessment of technology use, if asked, I would have said the walk was largely solitary, and that I was worried that I was not having as much time

[7] http://en.wikipedia.org/wiki/Romany_Jones.

as I'd intended to engage with local communities. Yet the story that emerged from the writing was very different. Having been prompted by this inductive analysis, I then reflected more not just on the number of people with whom I interacted or communicated, but also different categories of relationship and types of social interaction. While many of these appeared in the blogs, the final list goes beyond those that emerged purely from the external analysis; the reflection of the author as participant researcher was essential. Rather like the technology issues, this is effectively a form of externalisation, but this time driven by third party analysis.

Just like the use technology, the level of social interaction at the moment of walking was low, but as soon as one considered the wider activities surrounding the actual act of walking the range and number of social interactions increased. That is, we have an onion-ring view of experience from the core experience through various layers which are more peripheral temporally, and yet essential socially and technologically (see Fig. 1).

5.5 Pure Data

Finally, we consider the raw quantitative data (outcome e) and semantic mark-up and cross linking of datasets (outcome f).

The pure bio-sensor data is perhaps methodologically simplest, it is just measurements, no subjectivity, no pollution of subject as researcher. However, part of the value of this 'objective' data is that it can be connected to the qualitative accounts (text blogs, audio blogs and photos), to enable rich interpretation. A substantial amount of analysis can be performed on the objective data alone: bio-sensors + GPS track + terrain + historic weather data. However, if there is an unusual peak in, say, heart rate, that is not explained by terrain or weather, then it is useful to be able to consult the qualitative data: maybe an encounter with a bull or fellow traveller. For example, a student at the University of Konstanz was using the data as part of a Bachelors project (Kolb 2015; Dix and Ellis 2015) and noticed a sudden heart rate peak at 8 a.m. one morning; it turned out to be a point when I had been writing and suddenly realised I'd be late to meet someone who was walking with me that day.

I tried to be as honest as possible in the blogs, and so the periods during the middle of the walk where I was at a low ebb are there as well as the high points. With photos and audio blogs I was also very aware of creating a record, and so would take photos as the terrain changed, or occasionally record a note concerning an event, for example, just after taking a tumble on Offa's Dyke, which I assumed would show up on accelerometers and EDA, but which also I realised followed a period when blood sugar levels were low. That is, this is a record that was knowingly created and crafted, with both advantages in terms of additional potential for analysis, but also all the layers of self-presentation of any such account. Even the photographs,

while attempting to be candid, are often framed to include some features and exclude others; rhetoric, narrative and data are mixed.

The purpose of collecting this data was not so much for my own research, but to be available for others (e.g. Kolb 2015 and Niu 2017, see Fig. 2), and, as noted above, this coloured the accounts I created. However, this creates a number of new personal academic challenges.

To be useful the data has to be documented and made available in ways that allow a future researcher to use it independently of me. While I have previously advocated the importance of data gathering as a separate activity within a rigorous discipline (Dix 2010), I have not previously attempted to either prepare or document data for others. One of the problems with open data is that making data available, even in standard formats, does not make it usable; while the automated analysis of big data and the policy implications of open data are major research areas, these issues of meaningful documentation are very much a second cousin, rather like computer system documentation.

I have also realised that while I have extensive experience in publishing and promoting the interpretation of results of research, I have no experience whatsoever in publishing and promoting the underlying data. The web was initially created to help spread the data of large-scale physics, and natural science journals are increasingly demanding original data be published alongside articles; yet there are only a few areas of computer science (e.g. computer vision, information retrieval, natural language processing) with coherent data sharing policies. Furthermore there are potential uses well beyond my own natural communities, for example, in sports or health studies. While I often have worked in cross-disciplinary settings, I have no experience of this deliberate 'marketing' to other disciplines.

Despite the substantial challenges, I believe that the creation of data sets is crucial to the development of my discipline; I encourage Ph.D. students to share their data (where anonymity allows) and have suggested that we should have some form of HCI & design data journal, where data (qualitative and quantitative) is published with accompanying documentation based on three criteria:

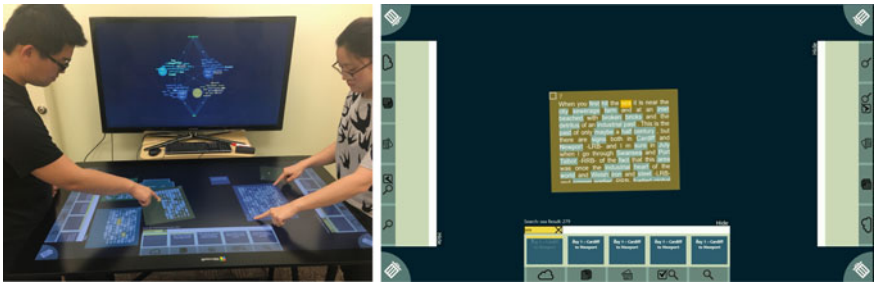

Fig. 2 AwareSpace (Niu 2017) a touch-based system for exploring textual material developed using Alan Walks Wales blog data (*photo credit* S. Niu)

- Some a priori reason to believe the data will be useful—you don't just randomly collect data. Of course this a priori reason may well not be how it eventually gets used.
- A systematic description of the collection methodology, so that other researchers can understand the context and reliability of the data.
- Clear documentation of the data itself including formats, structure, and meaning of fields, so that other researchers can use it independently.

One of the reasons for thinking about a data *journal*, is that the academic value system is driven by publication, hence it is hard to convince researchers to put effort into making data available. That is, there needs to be a substantial shift in our perception of the value of data production as research activity.

The Research Excellence Framework, the UK 5-yearly assessment of university research, explicitly recognises a 'database' as a research output in the humanities, but does *not* do so for science-based subjects (REF 2012). In computer science, dataset creation is effectively considered as valuable but not meritorious. The Leverhulme Trust, which prides itself on funding trans-disciplinary work, is, if anything, even less encouraging in its guidelines for project grants:

> The Trust will not fund applications in which the balance between assembling a data bank or database and the related subsequent research is heavily inclined to the former. (Leverhulme 2014)

The barriers to the effective creation, sharing and reuse of data are high.

6 Conclusions

It is hard to summarise the lessons of a thousand miles. The most obvious methodological concern is perhaps the subjective and inevitably unrepeatable nature of the experience. However, this is not an uncommon issue. Researchers are often engaged personally and emotionally with their subjects, whether as anthropologists embedded in an alien community, or single-person researchers becoming friends with their subject. Similarly in forms of cooperative inquiry or where participants are recruited as co-researchers, the participants are not merely subjects of study, but actively engaged in the study (Boylorn 2008).

Indeed it is rare for a researcher not to have some element of personal commitment, otherwise there would be no passion, neither are their subjects ignorant of being studied. Arguably the level of immersion is somewhat extreme in this case, but certainly no more so than the medical researcher working with small children, or those working in technology for development contexts.

The subjective immersion clearly also has benefits in terms of depth of understanding and richness of interpretation. The key is certainly to be aware of the potential for partial or biased observations, and then to factor this into the academic interpretation.

Generalising from a unique experience is arguably an oxymoron, and yet that is the essence of all learning. The mode of generalisation is not statistical, there is no completeness of sampling, neither is it controlled, but more like abduction, moving from a single instance or small number of instances through reasoning. This is common in both experience- and technology-driven research.

A good example of this was in the Savanna experimental mobile game, part of the Equator project (Facer et al. 2004). In this outside game, children took the role of predators and needed to be in the same area in order to 'hunt', but in one case a group became frustrated as they struggled to see the prey at the same time even though they had gathered round someone who had spotted prey. The reason was partly because children would stop as soon as they saw prey and hence were at the extreme edge of an active zone, partly because GPS units were held in back-packs, and partly about the uncertainty of GPS readings. However, having spotted this single instance, it was clear that there were lessons here in common with very different kinds of experience such as museums.

Within my research, the issues of interstitial communities and modern transhumance, or the way technology is used more in the broader supporting aspects of walking, are both examples where an issue once spotted was clearly seen to have wider ramifications. The full evidence for the generalisation comes not from the data gathered or the experience in itself, but more the reasoning drawing on wider sources of personal and academic knowledge prompted by the specific instance.

The factors and processes in research interpretation are also quite rich. In some cases results sprang directly from insights during the walk, in some it was the process of writing and talking that led to fresh interpretations, and in others there has been a rich feedback between third-party analysis and first-party reflection. In the future I also hope that more third parties will study the qualitative and quantitative data entirely independently. That is as a single person, and within this single, albeit extended, experience I took on roles from being the pure observer of others, to pure subject of study and pretty much everything in between.

Very often the outcome of these processes has not been a closed result, but more an open question. When preparing for the walk and talking about the experience to come, I frequently said that when a question is known and understood it is relatively easy to find solutions, and that what I hoped to learn most from the walk was new questions. This is surely the greatest benefit of research in the wild, not answering the questions one already has, there are other ways to do this, but in throwing oneself into a situation without control, of unbounded potential, to see the unexpected, the unplanned and truly extraordinary.

Acknowledgements Many thanks to all those individuals and groups who supported and encouraged me during "Alan Walks Wales". Thanks too to those who contributed to the crowd-funding initiative and the dot.rural RCUK Digital Economy Hub at University of Aberdeen (http://www.dotrural.ac.uk), which supported this research as part of its partner scheme.

References

Annas, G. (2010). Self experimentation and the Nuremberg Code. *BMJ, 341,* c7103. https://doi.org/10.1136/bmj.c7103.

Asimakopoulos, S., & Dix, A. (2017). Walking: A grounded theory of social engagement and experience. *Interacting with Computers* (in press, online 28 August 2017) OUP. https://doi.org/10.1093/iwc/iwx014.

Bender, B. (1996). Mapping alternative worlds. In S. Clifford & A. King (Eds)., *From place to place: Maps and Parish maps*. Common Ground, 1996, pp. 41–51.

Bidwell, N., & Browning, D. (2006). Making there: Methods to uncover egocentric experience in a dialogic of natural places. In J. Kjeldskov & J. Paay (Eds.), *Proceedings of the 18th Australia Conference on Computer–Human Interaction: Design: Activities, Artefacts and Environments (OZCHI '06)* (pp. 229–236). New York, NY, USA: ACM. https://doi.org/10.1145/1228175.1228216.

Bidwell, N., Siya, M., Marsden, G., Tucker, W., Tshemese, M., Gaven, N., et al. (2013). Walking and the social life of solar charging in rural Africa. *ACM Transactions on Computer-Human Interaction, 20*(4), 22:1–22:33.

Boylorn, R. (2008). Participants as co-researchers. In L. Given (Ed.), *The SAGE encyclopedia of qualitative research methods*. https://doi.org/10.4135/9781412963909.

Cheverst, K., Davies, N., Mitchell, K., Friday, A., & Efstratiou, C. (2000). Developing a context-aware electronic tourist guide: Some issues and experiences. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems (CHI '00)* (pp. 17–24). New York, NY, USA: ACM. http://doi.acm.org/10.1145/332040.332047.

Connolly, D. (2006, 2007). Short Guide to field survey, field walking and detecting survey. British Archaeological Jobs Resource, October 2007 (revised edition). http://www.bajr.org/documents/shortguidetofieldsurvey.pdf.

Coverley, M. (2010). *Psychogeography. Idea, pocket essentials*. ISBN 1842433474.

Cunningham, C. (2004). *Scientists discuss experiments on self*. Harvard University Gazzette, April 29, 2004. http://news.harvard.edu/gazette/2004/04.29/11-selfexperiment.html.

Curmi, F., Ferrario, M., Southern, J., & Whittle, J. (2013). HeartLink: Open broadcast of live biometric data to social networks. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13)* (pp. 1749–1758). New York, NY, USA: ACM. https://doi.org/10.1145/2470654.2466231.

Daiber, F., Jones, M., Wiehr, F., Cheverst, K., Kosmalla, F., & Häkkilä, J. (2017). UbiMount: 2nd workshop on ubiquitous computing in the mountains. In *Proceedings of the 2017 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2017 ACM International Symposium on Wearable Computers (UbiComp '17)* (pp. 1022–1026). New York, NY, USA: ACM. https://doi.org/10.1145/3123024.3124462.

Dix, A. (1987). The myth of the infinitely fast machine. In D. Diaper & R. Winder (Eds.), *People and Computers III—Proceedings of HCI '87* (pp. 215–228). Cambridge University Press. http://alandix.com/academic/papers/hci87/.

Dix, A. (1992). Pace and interaction. In A. Monk, D. Diaper, & M. Harrison (Eds.), *Proceedings of HCI'92: People and Computers VII* (pp. 193–207). Cambridge University Press. http://www.hcibook.com/alan/papers/pace/.

Dix, A. (1995). Cooperation without (reliable) communication: Interfaces for mobile applications. *Distributed Systems Engineering, 2*(3), 171–181. http://www.hcibook.com/alan/papers/DSE95/.

Dix, A., Ramduny, D., & Wilkinson, J. (1998). Interaction in the large. Interacting with Computers. Special Issue on Temporal Aspects of Usability (in press). http://alandix.com/papers/IwCtau98/.

Dix, A., Rodden, T., Davies, N., Trevor, J., Friday, A., & Palfreyman, K. (2000). Exploiting space and location as a design framework for interactive mobile systems. *ACM Transactions on Computer-Human Interaction, 7*, 3 (September 2000), 285–321. https://doi.org/10.1145/355324.355325.

Dix, A. (2010). Human-computer interaction: A stable discipline, a nascent science, and the growth of the long tail. *Interacting with Computers, 22*(1), 13–27. https://doi.org/10.1016/j.intcom.2009.11.007.

Dix, A., & Gongora, L. (2011). Externalisation and design. In: *DESIRE 2011 the Second International Conference on Creativity and Innovation in Design* (pp. 31–42).

Dix, A., & Ellis, G. (2015). The Alan walks Wales dataset: Quantified self and open data. In J. Atenas & L. Havemann (Eds.), *Open data as open educational resources: Case studies of emerging practice*. London: Open Knowledge, Open Education Working Group. https://doi.org/10.6084/m9.figshare.1590031.

Eslambolchilar, P., Bødker, M., & Chamberlain, A. (2016). Ways of walking: Understanding walking's implications for the design of handheld technology via a humanistic ethnographic approach. *Human Technology, 12*(1), 5–30. https://doi.org/10.17011/ht/urn.201605192618.

Facer, K., Joiner, R., Stanton, D., Reid, J., Hull, R. & Kirk, D. (2004). Savannah: Mobile gaming and learning? *Journal of Computer Assisted Learning, 20*(6), 399–409.

Gandevia, S. (2005). Self-experimentation, ethics and efficacy. *Monash Bioethics Review, 24*(2), 43–8. http://www.ncbi.nlm.nih.gov/pubmed/16208882.

Häkkilä, J., Cheverst, K., Schöning, J., Bidwell, N., Robinson, S., & Colley, A. (2016). NatureCHI: Unobtrusive user experiences with technology in nature. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16)* (pp. 3574–3580). New York, NY, USA: ACM. https://doi.org/10.1145/2851581.2856495.

Holtby, W. (1936). *South riding*.

Ingold, T. (2007). *Lines: A brief history*. Routledge. ISBN 0415424267.

Jones, M., Daiber, F., Anderson, Z., & Seppi, K. (2017). SIG on interactive computing in outdoor recreation. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '17)* (pp. 1326–1329). New York, NY, USA: ACM. https://doi.org/10.1145/3027063.3049289.

Kolb, D. (2015). *walking Wales: The data challenge*. Germany: Bachelor Project, University Konstanz.

Kostakos, V., O'Neill, E., Penn, A., Roussos, G., & Papadongonas, D. (2010, April). Brief encounters: Sensing, modeling and visualizing urban mobility and copresence networks. *ACM Transactions on Computer-Human Interaction, 17*(1), Article 2, 38. http://doi.acm.org/10.1145/1721831.1721833.

Leverhulme. (2014). *Research project grants*. The Leverhulme Trust. Accessed June 23, 2014. http://leverhulme.ac.uk/funding/RPG/RPG.cfm.

Macfarlane, R. (2005). A road of one's own: Past and present artists of the randomly motivated walk. *Times Literary Supplement*, 7 October, pp. 3–4.

Macfarlane, R. (2008). *The wild places*. Granta Books. ISBN 1847080189.

Macfarlane, R. (2010). *Mountains of the mind: A history of a fascination*. Granta Books. ISBN 1847080391.

Macfarlane, R. (2013). *The old ways: A journey on foot*. Penguin. ISBN 0141030585.

McCrickard, D., Horning, M., Steve Harrison, S., Harmon, E., Dix, A., et al. (2018). Technology on the trail. In *(Workshop) in Proceedings of GROUP' 18, 2018 ACM Conference on Supporting Groupwork*. ACM.

Morgan, A., Dix, A., Phillips, P., & House, C. (2014). Blue sky thinking meets green field usability: can mobile internet software engineering bridge the rural divide? *Local Economy* (in press).

Niu, S. (2017). AwareSpace: Collaborative surface system for text exploration. YouTube video. Dated 28/2/2017. Accessed October 23, 2017. https://youtu.be/GgkozPJV4n0.

Posti, M., Schöning, J., & Häkkilä, J. (2014). Unexpected journeys with the HOBBIT: The design and evaluation of an asocial hiking app. In *Proceedings of the 2014 conference on Designing interactive systems (DIS '14)* (pp. 637–646). New York, NY, USA: ACM. http://doi.acm.org/10.1145/2598510.2598592.

Pribeanu, C., Limbourg, Q., & Vanderdonckt, J. (2001). Task modelling for context-sensitive user interfaces. In C. Johnson (Ed.), *Interactive systems: Design, specification, and verification* (pp. 49–68). LNCS 2220. Springer. https://doi.org/10.1007/3-540-45522-1_4.

Razak, F. (2008). *Single person study: Methodological issues*. Ph.D. Thesis, Computing Department, Lancaster University, UK. http://www.hcibook.net/people/Fariza/.

REF. (2012). *Part 2D: Main panel D criteria, Panel criteria and working methods*. REF2014, Research Excellence Framework. January 2012. http://www.ref.ac.uk/pubs/2012-01/.

RSE. (2010). *Digital Scotland*. The Royal Society of Edinburgh. ISBN: 978-0-902198-36-4.

Solnit, R. (2001). *Wanderlust*. Verso. ISBN: 1844675580.

Solnit, R. (2006). *A field guide to getting lost*. Canongate Books. ISBN 1841957453.

Spillers, F., & Asimakopoulos, S. (2014). Does social user experience improve motivation for runners? In A. Marcus (Ed.), *Design, user experience, and usability. User experience design practice* (pp. 358–369). LNCS 8520. Springer. https://doi.org/10.1007/978-3-319-07638-6_35.

Stanton Fraser, D., Jay, T., Eamonn O'Neill, E., & Penn, A. (2013). My neighbourhood: Studying perceptions of urban space and neighbourhood with moblogging. *Pervasive and Mobile Computing, 9*(5), 722–737. https://doi.org/10.1016/j.pmcj.2012.07.002.

Townsend, L., Sathiaseelan, A., Fairhurst, G., & Wallace, C. (2013). Enhanced broadband access as a solution to the social and economic problems of the rural digital divide. *Local Economy, 28*(6), 580–595.

Virginia Tech. (2017). *What comes after CHI: Technology on the trail*, 2–3 March 2017. https://technologyonthetrail.wordpress.com/workshop.

WCP. (2014). *Hall of fame*. Wales Coast Path. Accessed June 29, 2014. http://www.walescoastpath.gov.uk/about-the-path/hall-of-fame.aspx.

"Research in the Wild": Approaches to Understanding the Unremarkable as a Resource for Design

Andy Crabtree, Peter Tolmie and Alan Chamberlain

This chapter outlines some key approaches towards understanding the unremarkable. It focuses first on a sociological orientation to the *everyday world* as key to the enterprise, and then on a variety of complimentary approaches for elaborating or surfacing the unremarkable character of everyday life. It considers the kinds of data resources that are routinely used to elaborate the unremarkable, and the relationship between data resource and analysis as a constituent element of working 'in the wild'. We hope this will be a valuable resource for researchers and students alike.

1 The Everyday World as a Phenomenon

The title of this section is an unabashed rip off, taken from a seminal sociological text written by Don Zimmerman and Melvin Pollner in 1970. Understanding the unremarkable does not demand that you become a sociologist, but your efforts might be usefully *informed* by (some) sociological thinking about the everyday world. The key thing about the unremarkable is that by definition it passes by without comment in the ordinary flow of things. This might lead you to conclude that the unremarkable is, therefore, of so little consequence that is not worth talking about let alone investigating or trying to base the development of computers on. Zimmerman and Pollner outline some good reasons why you might take it seriously, however. Indeed, if you read one sociological text in your research career, we suggest that *The Everyday World as a Phenomenon* (Zimmerman and Pollner 1970) is the one to pick up. It might seem like an old text of little relevance to contemporary life, but don't be

A. Crabtree · A. Chamberlain (✉)
University of Nottingham, Nottingham, England, UK
e-mail: Alan.Chamberlain@nottingham.ac.uk

P. Tolmie
University of Siegen, Siegen, England, UK

A. Chamberlain and A. Crabtree (eds.), *Into the Wild: Beyond the Design Research Lab*, Studies in Applied Philosophy, Epistemology and Rational Ethics 48,
https://doi.org/10.1007/978-3-030-18020-1_3

fooled by its age; just because it was written before you were born doesn't mean that is out-of-date. No matter how old, the everyday world will always be a phenomenon.

On reading the text you will find that Zimmerman and Pollner are engaged in an argument with sociology about the status of everyday life in sociological reasoning. You might wonder why you should care, but at the outset they make a point that is as central to the development of computing systems as it is to the development of sociology, and this is that the everyday world needs to be treated as a *topic* in its own right. The contrast to this, the thing that sociologists were doing at the time of Zimmerman and Pollner's writing, the thing that most of them are still doing today, and the thing that IT researchers might find themselves doing as well because they also rely in unexplicated ways on common-sense reasoning, is to treat the everyday world as a *resource* for theorising and, in the system developer's case, as a resource to draw on to shape technology too. There is, of course, a point at which you will need to draw on resources to elaborate the everyday world and the unremarkable nature of things therein but, following Zimmerman and Pollner's injunction, *first* you must treat the everyday world as a topic to be elaborated and not as a resource to be drawn on to motivate your studies or justify design work.

The *topic-resource distinction* invites us to suspend the common-sense perspective on the everyday world—a perspective which views this as an objective reality existing independently of individuals and consisting of an enormously varied array of organised structures that shape our everyday lives (families, schools, workplaces, legal and political institutions, etc.). Instead, we are invited to throw this world of 'commonly known facts' into question and ask *how are they produced* and produced *by society's members* as they *go about* their everyday lives? The topic-resource distinction invites us to treat what sociologists call 'the objective reality of social facts' as a problematic feature of human agency and action, as this is necessarily involved in its production (absent it—take people and what they do out of the equation—and there is no objective reality of social facts). The problem in treating the objective reality of social facts as a topic rather than a resource is one of understanding how action is put together, assembled or 'ordered' individually and collaboratively so as to produce and reproduce the familiar structures of everyday life. Thus, the topic-resource distinction invites us to consider the production of social order *in* action and to elaborate how, in the orderly ways of action's accomplishment, the familiar structures of everyday life are reflexively produced by people as they go about doing their everyday affairs: go about doing family life, doing education, doing work, etc. The focus shifts paradigmatically, then, from the everyday world as resource for theorising, to the everyday world as a site of practical investigation: from something drawn on to something actively studied as a problem to see *how it is put together and ordered by people in action* (Button and Sharrock 1997).

Treating the everyday world, 'the wild', as a topic in its own right is to open a door onto an unremarkable world. If we treat the family as a topic and site of practical investigation, for example, we see people getting up, getting dressed, making breakfast, listening to the radio, watching TV, handling the day's mail, reading the paper, getting the kids ready for school, hanging the washing out, preparing lunch, leaving, getting home again, doing homework, playing, making dinner, celebrating,

talking to family and friends, listening to music, working, getting ready for bed, etc. We see, in Zimmerman and Pollner's words, 'the occasioned corpus of setting features' which make the family the particular thing that it is. These are not features that are observable in a lab-based setting. If we look we can see that the corpus of setting features is produced through 'situated work' or particular courses of practical action and practical reasoning that coalesce to compose the activities and events in and through which particular setting features (e.g., making breakfast, doing homework, eating dinner, etc.) are put together. We can see too, if we look closely and carefully enough, that the situated work of a setting is assembled through particular 'practices', which members use to organise (order) the activities and events they are engaged in bringing about. The invitation to treat the everyday world as a topic in its own right reveals an utterly mundane world then, a familiar and unremarkable world for members. Yet it is a world whose orderliness as an accomplishment of members *situated work practices* is ignored when it is treated as a resource for theorising. With it go the insights that ground systems development in the *real world, real time organisation* of human activities and events (Button and Harper 1996).

Zimmerman and Pollner suggest that treating the everyday world as a topic is to render a familiar world strange. It certainly makes the investigator question the familiar. It makes the investigator strive to elaborate how settings, activities, and events are composed in and through action, and it focuses analysis on how the most familiar things in the world for any setting's members are done. Elaborating the mundane things that members do is critical to the enterprise, but it is not the point of analysis. We are not simply trying to describe that host of ordinary things that go to make up everyday life. The invitation to treat the everyday world as a phenomenon is not and invitation to state the obvious. Rather the aim, as Zimmerman and Pollner put it, is to surface the work of society 'in back of' the various situated appearances constituent of everyday, located scenes. In simpler terms, analysis is concerned to not only to elaborate the *situated work* of a location or setting—making breakfast, doing homework, eating dinner, etc.—but to show how these things are put together and socially ordered through *situated work practices*. Elaborating situated work practices renders the familiar strange in the sense that these practices are usually 'in back of' action to use Zimmerman and Pollner's somewhat clumsy phrase. Another way of putting it is that situated work practices are seen but unnoticed or invisible in their use and are, as such, unremarkable (Tolmie 2011). It's not that members don't know about them, but that they have no need to talk about them. They are too busy using them to do what needs to be done—to get breakfast made, to finish the homework, to eat dinner, etc.—than to stand around reflecting on them and how the activities they engage in are ordered in practice. Nonetheless, identifying situated work practice is key to understanding how everyday life is *organised* and elaborating it is our goal.

1.1 Elaborating the Unremarkable

Understanding the unremarkable turns upon the elaboration of situated work practice—on surfacing work practice and thereby foregrounding and making noticeable what is usually 'in back of' action. It is worth saying to avoid misunderstanding that the notion of work practice is not an industrial concept that refers to paid labour. Rather it is a generic sociological concept that applies to all human activity, in the workplace and anywhere else; one which recognises that action of whatever kind takes some kind of practical effort to bring about, that it takes work no matter how habitual and automatic it might be, and this work is in some ways organised (ordered) rather than randomly accomplished. The 'ways' in which action is situationally brought about and brought off in an orderly fashion is what the notion of work practice refers to. For Zimmerman and Pollner it orients us to an 'unexplored domain of inquiry' in which the situationally achieved orderliness of the commonplace world is thrown into sharp relief. Another way of putting it is that elaboration of the unremarkable turns upon surfacing the *ordinariness* of everyday life and how this is brought about. This way of looking at the everyday world suggests that the ordinariness of everyday life doesn't just happen, but has to be made to happen; that people have to work at 'doing being ordinary' (Sacks 1992) and thereby bring about the ordinary setting features that characterise and reflexively constitute the setting their actions are visibly located in (those activities and events that make family life observable, for example). Work practice orients us to the local production of ordinariness then—to what, for the members of a setting, is the same business as usual, the run of the mill, the routine—and the orderly ways in which this is brought about by members *in* action, i.e. *in* the particular things that they *do*.

Zimmerman and Pollner suggest that the locally ordered production of ordinary action may be uncovered through 'methodography', which is defined as a search for the practices through which the substantive features of the occasioned corpus (ordinary setting features) are made observable by members. What they are driving at here is the idea that work practice is possessed of particular properties that we can look out for and see in the course of an investigation. The suggestion is that ordinary setting features—making breakfast, doing homework, eating dinner, etc.—are assembled in a *procedural* fashion by a setting's members and otherwise employed as *methods* for detecting the orderly properties of activities and analysing ordinary setting features as they happen and unfold. The upshot of this is that we can elaborate situated work practice by searching for the procedural ways in which members do the situated work of a setting, thereby assembling ordinary setting features in an orderly way, and orient themselves (and us) to those procedures as methods enabling *recognition* of and *reasoning* about what is going on in a setting and how it is being done as 'an objective order of affairs' constitutive of some familiar structure of everyday life: of the family, the school, the workplace, etc. Situated work practice can be elaborated, then, by searching for, attending to and surfacing 'members methods' for doing, ordering, recognising and reasoning about the situated work of a setting. What we

want to consider next are some ways in which you might go about doing that in an IT research and systems development context.

2 Methodography

There are, of course, endlessly many ways in which IT researchers might investigate everyday settings. Not all of them are well-suited to the elaboration of situated work practice. Surveys, for example, will get you nowhere near the phenomena because they have an 'incongruous relationship' with work practice (Cicourel 1964); what is needed are approaches that work *in context* and (a) let you see the situated work of a setting (a survey, a set of pre-formulated, a priori questions, cannot do that) and (b) let you analyse situated work practice without misrepresentation (statistics, the analytic output of surveys, cannot provide adequate representation of members methods for doing, ordering, recognising and reasoning about the situated work of a setting). Surveys or questionnaires should be dispensed with then, along with the logic of inquiry that underpins their use, which emphasizes sample sizes, frequency of observed events, duration of study, and other *extraneous* measurements. The methodology of quantitative science will not help. It is incongruous with work practice. Below we consider three alternative approaches that do work. We are not saying that they are the only approaches that work, only that their use routinely produces insights into situated work and work practice. Broadly speaking, the approaches include contextual inquiry, ethnography, and probes. We say 'broadly speaking' because these categories gloss a variety of research practices, not all of them compatible with one another. We explicate each in turn, focusing on those practices that we have found valuable in our own work, to elaborate an IT research and systems development methodography for seeing and analysing situated work practice and grounding design in the unremarkable organisation of everyday life.

2.1 Contextual Inquiry

The most common category of research practice, contextual inquiry brings a number of complimentary research practices together, including fieldwork, in situ interviews and observations, and technology tours, to elaborate work practice. The first three of these research practices is closely associated with Contextual Design, an approach to systems development originally articulated by Hugh Beyer and Karen Holtzblatt in the 1990s. Beyer and Holtzblatt didn't develop fieldwork, in situ interview, and observation as research practices but, along with a growing cohort of IT researchers, they did appropriate them and put them to work for the practical purposes of systems development. Contextual inquiry was a turn of phrase coined by Beyer and Holtzblatt to convey how it is that they 'understand the customer' (or user more generally) in the course of systems development. Like a great many of their contemporaries,

Beyer and Holtzblatt recognised that 'any system embodies a way of working'. This is to say that a computing system is not just a technical system constructed through the arrangement of various technological components but a *socio-technical system* constructed through the arrangement of various technological components and human actors, which produce in their conjoint operation the organised structures of everyday life or at least do so if the technical is adequately constructed around the social organisation of human action; if its not then systems fail (Mumford 1987). The socio-technical character of computing systems was broadly recognised by software developers in the 1980s and led to the inevitable conclusion that systems development ought, therefore, to be predicated on a sound understanding of just what the work is that a system needs to embody and otherwise support. Contextual inquiry is a vehicle for arriving at that understanding.

In addition to consulting various stakeholders involved in the commissioning of IT research or systems development—whether they are executives and managers in commercial organisations, the holders of research project grants, partners in research, or research supervisors—contextual inquiry also demands that developers focus on users as a key driver for elaborating the requirements that need to be placed on future systems-of-work, whether those systems are for use in the workplace or any other ensemble of socially organised activities. This involves identifying who the users of a future-system-of work are and talking to or 'interviewing' them to understand what they do and what they need a future system to support. Contextual inquiry does not operate a common-sense notion of interviewing, however. It recognises that a setting's work is often habitual, so much so that the people often have difficulty articulating exactly what it is that they do, how they do it, and why they do it in the ways that they do. It is therefore necessary to conduct interviews 'in the field', i.e., in the settings where the work naturally occurs, rather than in abstraction over the phone or a coffee, for example, or in a quite office removed from its actual conduct. Interviews in contextual inquiry are coupled to the observation of the activities and events that constitute the work of a setting, then. This makes the habitual, the taken for granted, the unremarkable, visible and available to inspection and scrutiny. It enables the interviewer to see what is done and how it is done 'step-by-step' and to directly engage with the person who is doing the work and have them elaborate the rationales, motivations, and strategies that shape its visible conduct and accomplishment. This practice of situated observation-and-clarification in turn helps that analyst develop 'a shared interpretation' or understanding of work from the users' perspective; an understanding which may be fed into subsequent design activities, such as modeling work and developing future socio-technical solutions that support the real world, real time organisation of user activities.

Contextual inquiry reconfigures the interview as a technical practice. The interview is one of the most common kinds of research practice in the world, cutting across a broad range of science and engineering disciplines and the humanities too. As a technical practice—as something more than having a chat with someone about something that interests you—interviews come in two basic flavours: informal and

semi-structured.[1] Informal interviews lack structure; they are off-the-cuff, driven entirely by the unfolding exigencies of the situation unfolding before your eyes. It might be thought that contextual inquiry falls into this category of interview but it is arguably different, for while informal interview is driven by observation it does not have a stable focus or, rather, any stable focus it does have is entirely contingent on the researcher's interests. The contextual interview, on the other hand, always has a stable focus: regardless of the research interest, it always oriented to the situated work of the setting and its elaboration from the perspective of those who do it. The alternative to the informal interview is the semi-structured interview, which uses a pre-formulated interview script constructed with reference to contingent research goals and topics and the asking of ancillary questions on-the-fly. The contextual interview sits uncomfortably alongside this practice, at odds with it even insofar as it demands of us that we do not pre-configure just what is relevant about the situated work of a setting. This is not to say that you shouldn't approach a setting with particular issues in mind—research is clearly constrained and not everything that goes on in a setting will be relevant to your interests—but it is to say that you shouldn't preconfigure 'what matters about the work' that you do perceive as being relevant. The whole point of contextual inquiry is to enable the members of a setting to *show-and-tell you* what is important about their work in what is ordinarily, in the day-to-day run of things, the unremarked upon and unremarkable details of its conduct.

Contextual inquiry is at its core a disciplinary rendering of a generic research practice: fieldwork. It gives it a stable focus but it's fieldwork nonetheless. Fieldwork is probably even farther-reaching than the interview as a research practice. Geologists, botanists, palaeontologists, natural historians, anthropologists, and the members of a whole host of unconnected disciplines make use of fieldwork. This is to say that they *go and look* at their phenomena and a diverse array of phenomena at that. There is nothing special about fieldwork, anyone can do it and no general technical practices or analytic commitments underpin its conduct. You can learn a lot just by going and looking at the things that interest you and seeing for yourself how they work. You can learn more by exploiting technical practices (e.g., contextual interviews) and adopting a particular methodological stance (elaborating the situated work of a setting, for example) but, given the generality of fieldwork, it should be clear that there is (no matter what anyone tells you) no one way of doing fieldwork: anyone can go and look and the looking may be done in manifold ways. The only constraint, as far as elaborating situated work practice goes, is that the looking is done in congruous ways; i.e., in ways that permit the seeing and analysis of work practice which are compatible with and convey how a setting's members see and analyse it. Technology tours are another technical fieldwork practice that you might lever to do the job.

Technology tours (Baille and Benyon 2007) are another show-and-tell approach to fieldwork. This time, however, the showing and telling is focused on the situated character of technology in the settings that members operate within, both digital tech-

[1] Structured interviews also exist but these are otherwise known as 'questionnaires', the stuff of surveys and quantitative research.

nology and physical technology (the latter, of course, often being the focus for new systems development initiatives and augmentation if not replacement). The technology tour approach recognises that technology is already embedded in the everyday world and in the distinct places that it consists of: in the home, in the school, in the workplace, etc. Technology tours are a way of elaborating the *placement* of technology in everyday life, not only in the conventional noun-like sense of understanding what kinds of technology are placed where in particular settings but also in a verb-like sense of understanding who uses placed-technology and what activities it supports in its placement. There is a strong sense here then that technology is cemented into place through human action and technology tours thus become a way of seeing and elaborating the socio-technical character of existing systems, revealing just what technology inhabits a place, just where it is located, just who uses it, and just what they use it for. The tour itself also works through practices of situated observation-and-clarification; i.e., getting a setting's members to show you around the places they work in and to tell you what's what, which in turn enables you to map out the socio-technical landscape of a setting. While initially limited to elaborating who and what is involved in the use of existing socio-technical systems, there is no principled reason as to why technology tours cannot be complimented by contextual interviews to enable the researcher to also see how people do whatever they do with the technology as well and to thereby develop insight into the real world, real time organisation of situated technologies (see, for example, Crabtree et al. 2003a).

2.2 Ethnography

Ethnography is another fieldwork approach. Indeed, the word 'ethnography' is often used interchangeably with 'fieldwork'. There are some historical reasons for this. Ethnography is a social science research practice, one that originated in anthropology and the study of people who live in faraway places through direct immersion in the setting (Malinowski 1922), and one that was subsequently appropriated by sociology to study the lives of people closer to home. At home or abroad, the immersive character of ethnography meant that it involved fieldtrips and fieldwork, hence the interchangeability of the two terms in anthropological and sociological discourse. Following the recruitment of anthropologists at Xerox PARC in the early 1980s, in a bid to commercialise the personal computer by making it fit the real world needs of users, the interchange dropped into common parlance in systems development too. Nonetheless, whether it is used for the practical purposes of social science or systems development, it needs to be appreciated that despite the interchangeability of terms ethnography is not just fieldwork: it involves more than going and looking. It may make use of contextual interviews and technology tours along with other technical practices of research as occasion demands, but it also entails a methodological *commitment* to account for the production of social order and, with it, the organisation of society.

While order can be uncovered through contextual interviews and technology tours *if* you orient yourself to it, it is not a requirement of them; you are not obliged to account for the social order in using them. You are if you use ethnography and this is where the water gets extremely muddy as there are, to put it simply, innumerable ways in which the social order may be accounted for: through the exercise of power, class, rules, laws, politics, culture, capitalism, globalisation, etc. All of these accounts and a great many more make sense to us and they do so because, as Zimmerman and Pollner put it, both professional and lay analysts (i.e., the social scientist and the man in the street) share 'a mutual orientation to a common factual domain'—the objective reality of social facts—and are in 'tacit agreement' as to the substantive themes that should therefore be accounted for. However, the problem with this mutual orientation and agreement is that it turns social science and ethnography with it into a 'folk discipline' that takes the objective reality of social facts as given—as an unquestionable and unquestioned starting point—and in doing so leaves unexplicated, taken for granted and ignored, the members' methods, procedures or work practices which *produce* the lay and professional analyst's 'field of data' in the first place. Accounts of situated work practice are, then, substituted for theoretical accounts developed on the basis of common-sense reasoning about the 'objective structure' of social activities (see, for example, Dourish and Bell 2011). No matter how world-sensible these accounts are, the production of social order *in* action is left untouched by them.

Consequently, as practicing ethnographers, our methodological commitment is to Zimmerman and Pollner's research program and the elaboration through fieldwork of the occasioned corpus:

> … we intend the notion of occasioned corpus to organise for study the various practices members employ to sustain the sense of an objective structure of social activities, a society, **exhibited from** the vantage point of particular situations. The features of that society, from this perspective, are to be found nowhere else, and in no other way, than in and upon those occasions of members' work … through which those features are made available.

It should be said that this program—this methodological commitment to exhibit through fieldwork the practices that members use to 'structure' or order activities in particular situations—is not one that most ethnographers in anthropology and the other social sciences which make use of the approach are committed to. Nonetheless, it has had a significant impact on systems development, much more so than larger mainstream perspectives which treat the social order as a common-sense resource and so theorise it, rather than as a topic in its own right that is amenable to elaboration through practical investigation. The topic-resource distinction goes some way to explain the impact that this kind of ethnography has had on systems development; that coupled with the fact that Xerox PARC unwittingly recruited ethnographers who shared this methodological orientation when they turned to anthropology for help in the first instance. Wittingly or not, Xerox paved the way for an alternative *empirical* treatment of the social order to be factored into systems development through ethnography (Syzmanski and Whalen 2011).

This empirical treatment of the social order is otherwise known as 'studies of work', 'work practice studies' or (less commonly now) 'workplace studies'. While

some confusion has been caused by the use of the words 'work' and 'workplace' to describe these studies, they are not limited to organisations of work (i.e., the places we go and things we do to earn a living). Workplaces have been a major focus of these kinds of ethnographic study, because they have been a major focus of IT research, but they are not restricted to them. This approach to fieldwork can be used anywhere, in any kind of setting that is of interest and relevance to systems development. The notion of 'work' refers to the activities and events that define the occasioned corpus—the situated work that makes any setting or situation into the particular setting or situation it is. These studies often utilise contextual inquiry and technology tours in order to develop *thick descriptions* of situated work that provide us with *praxeological accounts* (Crabtree et al. 2012). Thick description takes us beyond show-and-tell research practices to provide detailed written accounts of the situated work made visible through them. Obviously, there are a great many features of work that could be described—an array of 'accomplishment levels' which may be indefinitely extended as the philosopher Gilbert Ryle (1970) put it. However, the production of a praxeological account—i.e., an account which sketches out the ways in which work is observably and reportably conducted in situ—brings the job of thick description to a close for the practical purposes of elaborating the occasioned corpus. It does so because in sketching out the ways in which work is actually undertaken—what people do, what they say, what knowledge they exploit, what equipment they employ, and what resources they make use of—praxeological accounts exhibit how work is *put together* step-by-step and thereby structured or ordered *in* action.

Praxeological accounts surface what is usually 'in back of' action, unnoticed and unremarked upon in the ordinary course of events, namely the *sequential order of work*, whose situational assembly makes the work practices members use to produce that order and create the sense that there is an objective structure to their activities visible and available to design reasoning (Crabtree et al. 2012). Orienting to the sequential ordering of a setting's activities, and how (therefore) the particular activities that characterise a setting are put together step-by-step, is good way of defining the occasioned corpus on any occasion of contextual inquiry. It is also a good way of creating an empirical record, which can be drawn upon to develop thick descriptions exhibiting the situated work practices that organise the corpus as an objective feature of society—i.e., as a feature of the home, the school, the workplace or some other social setting constituent of the common factual domain that underpins lay and professional analysis of society. That you may be doing ethnographic studies for the purposes of systems development makes no difference. If you are doing ethnography then it is incumbent upon you to make your studies answerable to and account for the production of social order. The only choice you have is whether or not to treat the social order as a resource or as topic in its own right. We would, of course, urge you to do the latter if for no other reason than that it begs the question of what you are going to *base* systems development *on*—an empirical understanding of what people do and how they do it or a theorised understanding that leaves the actual conduct of everyday life untouched (Crabtree et al. 2009)?

We would suggest, too, that you suspend other conventional ethnographic research practices. In its home discipline of anthropology, ethnography is a time-consuming

research practice conducted over many months and years. Systems development, on the other hand, is notoriously fast-paced and to be of continuous, ongoing use ethnography needs to fit into the time frames that are operative within it. It is a simple fact of life that you are not going to spend several years doing fieldwork in an IT development context. You may get a few months, often a few weeks, and occasionally a few days to conduct ethnography for the practical purposes of IT research or systems development. This is not to say that ethnography is therefore of limited value. A great deal can be learnt about the real world orderliness of human action from even a few short days in the field (Crabtree et al. 2013). Indeed, 'diminishing returns' set in for systems development if the traditional anthropological model is adopted (Hughes et al. 1994). Rather than disappearing into the jungle and going native for long periods of time it is, instead, better to do short periods of fieldwork and work through the results with others involved in the research to identify areas and topics of relevance to systems development. These can then be investigated in more detail through further field studies with work progressing in an iterative fashion, moving between empirical elaborations of situated work and work practice and reflections on this shaping the development of novel computing systems. In this way, ethnography can be configured and conducted to support different stages in the development process, from initial scoping and feasibility studies through to requirements analysis, conceptual design, iterative prototyping, and the evaluation of developed and developing systems.

2.3 Probes

Probes represent a radical departure from situated work practice, or they do in their home discipline at least. They were initially developed by researchers at the Royal College of Art as a resource for inspiring the design of new technologies. In contrast to the emphasis placed on rationality in science and engineering disciplines, the art-design perspective focuses attention on *aesthetic value* in a bid to open up new spaces for IT research and systems development. This perspective would have us recognise that human beings are not simply functional creatures with utilitarian needs; that we are defined as much by the ways in which we 'explore, wonder, love, worship, and waste time' as we are by the tasks that we are obliged to perform on a daily basis and the problems we must solve along the way. Human beings are therefore defined as 'homo ludens' or playful creatures, and the art-design perspective seeks to exploit *cultural probes* as a means of fostering the design of technologies that support 'ludic pursuits' in everyday life (Gaver 2001). The development of cultural probes echoes C.P. Snow's seminal work *The Two Cultures and the Scientific Revolution* (1961), which lamented the breakdown of communication between the two cultures of modern society: the sciences and the humanities. Snow thought it essential that the two cultures learn to talk to each other and work together to address the problems facing society. From the art-design perspective, a key problem is that 'the full range of values that make us human' are ignored in IT research and systems development,

with the result that people are being slowly but surely 'dehumanised' through rational practices of science and engineering.

At a practical level, cultural probes consist of an assortment of mundane artefacts—cameras, audio recorders, photo albums, maps, diagrams, postcards, diaries, etc.—which are 'aesthetically crafted' and put together in 'probe packs' to create a personalised and engaging means of getting to know people. The aesthetic crafting of probe packs also exploits specialised arts-based tactics of ambiguity, absurdity and mystery drawn from Dadaist and Surrealist traditions in an effort to 'provoke inspirational responses' elaborating new perspectives on participant's everyday lives (rather than needs or desires that people already understand). The fragmentary data returned by probes is not analysed to develop an objective view on participant's everyday lives and the problems they face, but is drawn upon to develop an 'impressionistic account' of participant's beliefs and desires, aesthetic preferences, and cultural concerns. This does not lead directly to design but instead works to familiarise artist-designers with participant's natural, social and cultural environments and in turn stimulates the imagination—an imagination driven as much by pre-existing conceptual interest in the arts as it is by the materials returned by the probes. Thus, instead of designing solutions for user needs, artist-designers seek 'to act as provocateurs through design' and extend the boundaries of systems development outside the norm. The aim is to 'shift current perceptions' of technology functionally, aesthetically, culturally, and even politically in order to offer people opportunities to appreciate their natural, social and cultural environments in new and intriguing ways (Gaver et al. 1999). Unsurprisingly, then, cultural probes reflect the conceptual and methodological commitments of the contemporary arts—to draw attention to alternative ways of apprehending the world through acts of provocation, whether those acts are embodied in human performance, the plastic arts, or the design of computers.

Interesting as the contemporary arts may be, the reality is that most of us aren't possessed of artistic talents, conceptually, methodologically, or practically—even 'aesthetically crafting' the contents of a probe pack is beyond most of us. No surprise either, then, that alternative treatments of probes have emerged. The first of these sees the approach appropriated to augment fieldwork. This treatment recognises probes as a 'self-report technique'—i.e., a technique whereby the participants in a study report on their own activities rather than having a fieldworker alongside them doing the reporting—a more elaborate version of the classic diary study (Lazar et al. 2010), but a version nonetheless. Ethnographers working in a systems development context recognised that probes could be usefully adapted to support investigations in settings where contextual inquiry is difficult. *Informational probes* emerged in the study of residents at a psychiatric hostel as a means of developing insight into the lives of those suffering from schizophrenia, paranoia and other debilitating illnesses that direct observation is highly likely to compound (Crabtree et al. 2003b). This adaptation of probes is intended to complement but not replace studies of situated work practice by providing biographical information about the day-to-day organisation of participants' lives. The information is generated through the use of the mundane artefacts contained in probe packs, which are aesthetically uninformed and unadorned, their 'crafting' shaped instead by methodological concerns with the production of

social order elaborated through fieldwork.[2] The probe pack material revealed a number of 'abiding concerns' or major preoccupations that shaped the residents' everyday lives. These included abiding concerns with the day-to-day management of medication regimes, safety and security in the local community where residents were objects of frequent ridicule and physical attack, and the maintenance of the rhythms and routines that glue everyday life together and lend it its stable character. These insights into the organisation of everyday life in turn suggested potential areas for systems development (e.g., Cheverst et al. 2003).

Probes have also been adapted by systems developers as means of driving the in situ development of future technology. In this adaptation, probe packs are replaced by novel computational systems. *Technology probes* emerged as systems developers turned towards the home as new site for computing (Hutchinson et al. 2003). They replace the contents of probe packs with systems that envision new socio-technical futures. Technology probes are not demonstrations of finished products or prototypes whose functionality is finessed through deployment in the wild, but vehicles for understanding the 'practical needs' and (in the domestic context at least) the 'playful desires' of a setting's members. They are installed in context and have a three-fold function:

> Technology probes are a particular type of probe that combine the social science goal of collecting information about the use and the users of the technology in a real-world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and designers to think of new kinds of technology to support their needs and desires. A well-designed technology probe should balance these different disciplinary influences. (Hutchinson et al. 2003)

Characteristically, technology probes are 'simple', which is not to say that they are easy to build or trivial in nature. It is to say that they intentionally exhibit limited functionality which is the focus of the probe, (typically a single main function with two or three ancillary functions), they are designed to be robust but flexible (exhibit a degree of ambiguity that provides for the possibility of unexpected use and multiple interpretations), and they are not concerned with usability. Technology probes are intended to be used as a throw away tool for challenging pre-existing ideas and influencing future design. They are used early in the development process to provoke and elaborate future practice through 'co-adaptation' where users adapt to a probe but also, in turn, adapt it in creative new ways for their own purposes. Technology probes are a research vehicle, augmented with data logging capabilities which complement field studies and support interdisciplinary analysis of novel design spaces (see, for example, Colley et al. 2013). Incorporating a well-engineered technological core at the outset, they have the added benefit that the results can be built on through the iterative construction of prototypes embodying solutions that are grounded in situated understandings of future work practice.

[2] In the case of the psychiatric hostel, through field studies of the day-to-day work and rounds of the hostel staff involved in caring for residents, which provided insights to craft the probe packs around and ask the residents questions about that they could elaborate by returning probe materials (photos, maps, postcards, etc.) at their leisure.

The adaptation of cultural probes has resulted in two very different but not orthogonal treatments of the approach within IT research and systems development. On the one hand, informational probes complement ethnographic studies of the *current organisation* of everyday life in particular settings and the identification of potential areas for systems development. On the other hand, technology probes complement interdisciplinary efforts to understand the possibilities for systems development in novel design settings and to inform the development of solutions that support the *future organisation* of everyday life therein. While coming at the problem from opposite directions and via different means, both approaches are concerned to elaborate concrete possibilities for systems development through the exploration and elaboration of work practice: one elaborates what it looks now as resource for building future systems, the other elaborates what it looks like in the future as a resource for building systems now. In doing, so both complement one another and both reframe the conceptual and methodological commitments that underpin cultural probes. In place of artistic concerns with aesthetic value, probes are instead adapted to elicit information about the 'workaday' world and to provoke situated work practice. This may sit uncomfortably with the proponents of cultural probes (Boehner et al. 2007), but the adaptations complement the development of computers that disappear unremarkably into the fabric of everyday life.

2.4 Resources for Elaborating the Unremarkable

Our discussion of probes and probe packs also raises the issue of *data* and the *resources* that can be used to elaborate the unremarkable. Each of the approaches outlined above not only engages researchers with users in some way but also produces a body of data resources over the course of that engagement. What we want to do here is consider those forms of data that are commonly gathered in the course of contextual inquiry and ethnographic study, and the unique resources made available via technology probes.

2.5 Audio-Visual Resources

Video recording is a commonly available resource these days and it is a powerful way of capturing what goes on in a setting and making it available to subsequent replay and analysis. Much the same can be said of audio recording, which is a useful way of capturing interviews. Photography is also commonplace and can provide a valuable visual record of setting features of interest and relevance to your research. The smartphone combines all of these in a single package, though dedicated equipment is advisable for fieldwork primarily due to issues of quality and quantity. HD video recordings and photographs eat up a lot of space; it is not uncommon to generate several gigabytes of data per day and fieldwork is often conducted for several days

at a time. Audio recordings are much smaller in size, but quality is something that you want to ensure. So using a professional device (e.g., a high end DSLR camera or camcorder with quality mic attached) is something to consider. It is also important to consider what you are using particular kinds of resource for. They each have their place in the research armoury - video is good for recording action, audio for interviews, photos for places and objects - and each has its limitations, which is something that should be taken into consideration too.

Video may seem like the best 'all round' option, just point it at the action and hey presto! Images and audio, it's all on there for future analysis. You can replay it at your leisure and pull out what you want: sequences of action, sequences of talk, still images, whatever, whenever. However, it needs to be appreciated that video is a) only as good as the person who operates it (if they miss something important, it will), and b) that the video camera does not see what the operator sees (its view is partial). It needs to be appreciated too that audio only captures what people say, whether or not what they say is interesting and relevant to your research. And photographs say nothing at all. There is a strong sense in which all of these data resources or materials have no value *if* they are not collected with due respect for what it is that they are supposed to be capturing. As Bannon et al. (1993) put it with reference to ethnography, and the same applies to contextual inquiry,

> "The 'materials' generated by ethnography consist mainly of field notes, audio and video 579 recordings, together with other displays of the setting's life. These materials are used to provide vivid exhibitions of the activities which generated them."

The use of audio-visual resources needs to be directed towards providing 'vivid exhibitions of the activities that generated them'—to the activities that characterise the setting and exhibit its work, and ultimately exhibit it in step-by-step detail to enable the elaboration of work practice. Even where interviews unaccompanied by observation are concerned, the work of gathering data resources should be oriented to elaborating the situated work of a setting and work practice. Simply put, if you don't look out for and gather data that captures work practice, you won't find it. It will remain seen but unnoticed 'in back of' action. You will find other things instead—people's thoughts and feelings about their activities, their attitudes, beliefs, likes and dislikes, things they would like to change, etc.—but not work practice. With it goes the unremarkable character of everyday life.

2.6 Physical Resources

The collection of audio-visual resources is embedded in the round of fieldwork activities that are involved in *getting to know the setting*—getting to know what goes on there, who its members are, and the things that they do. Physical resources can play an important part in this, whether they are used prior to, in conjunction with, or instead of audio-visual resources. The simplest but arguably important physical resource is your notebook, in which you can and should keep a set of 'fieldnotes'—i.e., descrip-

tions of the things that you see being done in a setting, snippets of conversation, thoughts and reflections on the setting's work, and questions and queries about it. Your notebook might include diagrams of the 'ecology of work' or the physical setting and the arrangement of space and equipment within it to document technology tours. This may be complemented by descriptions of who uses the equipment and what they use it for. You may even observe the technology in use and make a written record of what you see, describing the flow of work, the activities that compose it, any collaborations involved in the work, etc. Your notebook is a resource that helps you organise your observations and understanding of the setting. It may seem like a garbled mass of disconnected scribbles at first, but as you spend more time in the setting, as you see what goes on there and get to know it better, your notes will become more coherent, elaborating any audio-visual record you make and directing it too (i.e., telling who to talk to, what to watch, and where to point the camera).

It may also be useful to collect physical resources from within the setting itself—i.e., resources that are used by the setting's members rather than constructed by the researcher. A great many human activities make use of physical resources, even those that involve the use of digital technologies. It is not uncommon to find, for example, post-it notes, memos, lists, paper documents, etc., used alongside computers. Whether used alongside computers or not, capturing these in some way (either literally or by making copies or taking photos of them) is an important part of understanding the work of a setting. Accompanying these resources are descriptions of the uses they are put to—you need to understand their *life in action* and how it is that they are purposed by members in the course of doing their work, all of which may make further use of your notebook and audio-visual resources. Other kinds of physical resource are to be found in a great many settings too. These are concerned with the organisation of setting activities: resources such as process models, job descriptions, and work procedures that 'map' the organisation of work. Some of these may be embedded in the computers that people use—as, for example, in call centres where pre-formatted 'scripts' shape the dialogue—and others may be contained in physical manuals and documents that are not so prominent or easy to see. Either way, these are things that you can seek out, capture, and use to develop your understanding of the work of a setting and its organisation, being mindful of the fact that how the organisation of work is mapped and scripted is not the same as how it is carried out. Maps and scripts are a resource *for* action but not isomorphic with the ways in which a setting's work is organised *in* action (Schmidt 1997). A great many probe materials are also physical in nature—diaries, postcards, diagrams, etc.—and these may be drawn on in a similar fashion as 'maps and scripts' to sensitise you to important features of a setting's work and work practice. Again, they won't elaborate work practice, but they may put you onto important topics that you can elaborate through fieldwork and may otherwise complement the field studies you have done as per the psychiatric hostel study.

2.7 Digital Resources

Technology probes offer a rich seam of digital data that may complement studies of work practice. Technology probes may be instrumented to record use data. This includes machine states and user events along with records of the dates, times, and people who created them. Technology probes can also be used to record digital content—messages and media—and geographical information (location). Together, these digital resources can be drawn upon to 'reconstruct usage over time' (Hutchinson et al. 2003) and (potentially) provide unprecedented insight into the work practices shaping technology use. While enormously useful, the logs generated by technology probes need to be treated with caution. They may capture usage data, but they do not capture use. What is in the log is not work practice but the *residue* of work practice. Logs index or point to work practice but they are not equivalent with it. The logs produced by technology probes should be handled carefully then. They may be drawn on to identify patterns across the cohort of study participants, and the datasets they recorded, through statistical analysis and representation (again, see Colley et al. 2013, for example). In short, graphs and charts of probe usage can be developed from analysis of the logs. The patterns these representations make visible may then be validated through interview to determine their concreteness and queried to surface the work practices that give rise to them. The indexical character of logs means that their use must be married with other technical research practices. Relying on logs alone can only serve to reify the mundane orderliness of systems use.

It may also be the case on some occasions of inquiry that you manage to secure access to systems logs in the setting you are studying. These are not logs produced by technology probes, but logs generated by the systems that people already use in a setting to do their work. Computers permeate a great many settings today and despite their heterogeneous nature the one thing they all share in common is that they all keep records of their use. All kinds of records. From low-level system and network communication logs that you need an advanced degree in computer science to understand, to a host of application logs whose meaning is much more perspicuous: text logs, phone logs, video conferencing logs, video player logs, internet browser logs. Logs, logs, logs. There isn't much about computer use that isn't recorded these days, along with when and where it happened. You may seek these out as part of your research into existing technology use in settings of interest and they may make a valuable contribution to your understanding of the setting, its work and organisation, revealing detailed patterns of device, application and/or service use. Nonetheless, you need to treat any and all digital resources—i.e., resources generated by computers in the course of their use—with caution and respect their indexical character. At best, the analysis of logs may point to the work practices that give them their situated sense. At worst, their analysis may reify work practice. Systems logs are not an end in themselves then, but always stand in need of elaboration.

2.8 Getting and Working with Data Resources

The various data resources at your disposal aren't just going to drop into your lap. You're going to have to go and get them and this will take effort, whether it's the effort of doing fieldwork, installing a technology probe, or both. It's going to turn upon you finding and 'recruiting' participants or persuading people to be involved in your research—people who are willing to put up with being watched, interrupted, and put out to some extent through your interventions in their lives. An important part of the mix today, and an essential precursor to data collection of any form, is informed consent. This process let's potential participants in your research know what kinds of things they are letting themselves in for: what kinds of things you want to do, what kinds of things you want them to do, what kinds of data you want to capture, and what will be done with the data once it's in your possession. Informed consent is now a required feature of all research involving human participants and/or human data. It requires that you make potential participants fully aware—and thus fully inform them—of the aims and objectives of the research, its potential risks, and their rights, and that they accordingly give you rights within the confines of the agreed framework to capture and use data that in some way involves, is attributable to, and/or affects them. The framework is usually encoded in an informed consent form, which defines an enforceable ethical contract that every participant in your research must sign: break it and you are in trouble.[3]

The informed consent form defines which data resources you may capture and places constraints on its storage (e.g., that it must be kept securely in compliance with the Data Protection Act in the UK), but it doesn't tell you how to organise the data you collect and organise it you will need to do. The chances are that you are going to end up in possession of a great deal of data: hours and hours of video, reams of fieldnotes, bundles of photographs, stacks of log data, etc. You need to make some sense of it all and the first place to start is with the construction of data archive or record. Assembling the record will involve doing some pretty mechanical things like creating a directory, naming data resources, and adding meta-data to them so that you know where the data came from and when, who it refers to and what it is about, along with a whole bunch of contingent information that matters to your work. There is no prescriptive way of handling the record, it might be done mechanically through the arrangement of files and folders or through the creation of bespoke databases but recognising that there is a *relationship* between various data resources and organising them in such ways as to reflect those relationships will help you manage the wealth of data at your disposal.

One way in which you might go about organising your data at an analytic level is through *transcription*. Traditionally, transcription is constrained to writing down verbatim what was said and done by the parties to a piece of talk, which you have captured through interview and/or observations of work. It involves trawling through

[3]There are rare exceptions to written consent such as participants who cannot read or write - not including children (whose parents or legal guardians must consent to the research) - but where written consent can be obtained then it should.

the audio or video tape and writing down each and every utterance it contains, or at least each and every utterance that elaborates an activity or event that is of relevance to your research. You can also bring the other resources at your disposal into play here however, particularly where the transcription of observed events is concerned. You can, then, draw on other aspects of the video—its physical features—and thus weave descriptions of salient setting features (e.g., the use of tools, technology, equipment and other embodied actions) in with the utterances. You can draw on your field notes to fill out your description of salient setting features, embed photographs at salient points, and even add logged interaction to the transcription to round your account of situated work out (see, for example, Crabtree and Rodden 2009). And you can purpose meta-data to preface the transcription, telling the reader who, where, when, and what it is about. Developing these resource-rich transcriptions will take time, at least as much as it did to gather the data in the first place: every hour of video takes around eight to transcribe. With the ready availability of professional transcription services, it is tempting to hand the job over to someone else, but to do so would be to make a serious mistake. Not only would someone else miss many of the things you have seen—only you know all the resources you have gathered and the relationships between them—transcription also enables *you to get to know your data*. In turn, this enables you to develop your analysis and understanding of the setting, which potential systems development turns upon.

There will come a point at which you will need to write up a report about your research that details what you have found to date—the kind of thing that you can share with your colleagues, supervisor or boss to evidence your findings and support the continuing conduct of your work. Having a collection of resource-rich transcriptions to hand will give you a solid base to start report writing on. You can draw on this to provide an account of the work you have seen and its organisation. Again, there is no prescriptive way of writing but describing the overall process or sequential order of work in the setting, the individual activities that compose it, and the ways in which those activities are socially and materially assembled in action is sufficient to elaborate observational studies of work practice (see Crabtree 2004, for example). Alternatively, if you are working with probe logs, marrying statistical representations with vignettes taken from participant interviews will help you elaborate the accountable character of work practice, and these may be complemented by the findings from observational studies too. Fieldworkers may also, on occasion, use statistics to frame the presentation of fieldwork observations (e.g., Petrelli et al. 2008), but insofar as this is done it is important to appreciate that this use of statistics is not about making general claims that apply across society at large (as it is in quantitative research), but merely a way of characterising the distribution of observed events across the cohort of participants involved in a study. Order provides for the generalisation of fieldwork results not statistical measures (Crabtree et al. 2013), and the elaboration of order turns upon the elaboration of situated work practice. However, you go about doing it, this is what your report should seek to convey.

2.9 Combining Resources and Approaches

We have repeatedly mentioned the complementary nature of the approaches we have discussed here, or at least the complementarity of contextual inquiry, technology tours, ethnography focused methodologically on situated work practice, and both informational and technology probes. This not only means that there are a number of established ways in which you can tackle the unremarkable, but that you can combine approaches and the resources they produce as your research demands. Thus, and for example, you might conduct a technology tour of the home and elaborate technology use through contextual inquiry to get a feel for a technological intervention and then develop and deploy a technology probe. Alternatively, you might develop a technology probe and subject it to ethnographic study. Indeed, you could combine the approaches in various ways that meet the various needs of systems development: from scoping through to deployment and the evaluation of unremarkable computing systems, and ultimately to the iterative construction of fully functioning prototypes. To reiterate, we aren't saying these are the only approaches available; only that they have routinely worked in our own research and the research of many of the students whose work we have had the privilege to supervise. What makes these approaches complement one another is their interdisciplinary character and common orientation to 'the user'—i.e., the members of a setting, people. The methodography of unremarkable computing is human-centred and emphatically social in its centring, focused not on psychology and what's in the head (e.g., mental models), but on the social order and what's visible in action in an effort to shape the development of computing systems that resonate with the organisation of human activities and events as that organisation is manifest in conduct, in actual performance, *in the doing* of human activities and events.

The methodography provides a collection of in-the-wild approaches for conducting foundational research on socio-technical systems, moving the development of future systems out of the laboratory to engage directly with users at each turn in the development process. The methodography is a local take on Participatory or Cooperative Design. Not one that mimics or that attempts to mimic a Scandinavian approach to user-centred design, but one 'developed on the basis of a deep understanding of current possibilities' in contemporary contexts and one 'carefully modified on the basis of experience' (Kyng 1994). A locally modified Collective Resources Approach, in which users are involved in various capacities throughout systems development, and one that puts the principles enshrined in the international standard *Human-centred Design for Interactive Systems* into practice (ISO 9241-210). Thus, through the methodographic efforts of IT researchers to elaborate situated work practice here-and-now and in-the-future, users act as a primary source of data, provide the focus for ongoing development work, and engage in formative evaluation of developing systems in the wild to co-realise the construction of computing systems that can be woven *by users* into the unremarkable fabric of *their* everyday lives.

3 Surfacing Situated Work Practice

That said, the methodography is not enough. That is, the approaches and resources that constitute it are not sufficient in and of themselves to surface what is 'in back of' action, namely, situated work practice and the seen but unnoticed organisation of everyday life. The approaches and resources are necessary but just because you go and do contextual inquiry, ethnography or a probe of one variety or another, and just because you grab the various resources that can be grabbed via these means, does not mean that you will nail down the unremarkable *by fiat*. It is, to pick up on Bannon et al.'s (1994) point about data,

> … misleading to think of ethnography in terms of 'data' or the 'materials' it generates … data in this sense is not the critical thing which ethnographic work generates. It is the ethnographer's understanding of the setting from within which the exhibits are extracted which is crucial.

The same applies to contextual inquiry and informational and technology probes too. There is no guarantee built-into these approaches and the resources they generate that they will deliver results. Their efficacy turns upon something else—on the 'understanding' that drives and shapes their use. Not any old understanding you might arrive at through whatever approach or combination of approaches you adopt and whatever data resources you happen to get through them, or the understanding you might subsequently develop through the application of extraneous measurements or analytic strategies for making sense of the data—e.g., grounded theory (Glaser and Strauss 1967)—but an understanding of the unremarkable. It is this that is 'crucial' and it is towards its elaboration that the approaches and data resources are *put to work* in the first place.

Surfacing the unremarkable is not something that comes after the conduct of fieldwork or the design of probes then, it is not something that just drops out of the data. Rather, it is the constant companion of our research efforts, something oriented to throughout the process of investigation, something actively sought out and documented through the collection of 'vivid exhibits'. This is not to say that the researcher already knows what the unremarkable organisation of human activities and events looks like—that is an empirical matter—but that you cannot go about the business of finding out blindly. You need to be attentive to work practice from the outset, you need to seek it out, you need to be aware of and constantly exercise methodological sensitivity to the phenomenon. This will involve, as Zimmerman and Pollner put it, treating the activities and events that make up a familiar world known in common by lay and professional analysts alike as situationally 'strange' and analysing through the methodographic approaches and resources at your disposal how they are put together, recognised and reasoned about as practical accomplishments *by members*. Only then will the taken for granted organisation of human activities and events become visible and pronounced, surfaced as a resource for grounding system development in the unremarkable orderliness of the everyday world.

References

Baille, L., & Benyon, D. (2007). Place and technology in the home. *Computer Supported Cooperative Work: The Journal of Collaborative Computing, 17*(2 & 3), 227–256.

Bannon, L., Bowers, J., Carstensen, P., Hughes, J., Kuutii, K., Pycock, J., Rodden, T., Schmidt. K., Shapiro, D., Sharrock, W., & Viller, S. (1993). *Informing CSCW System Requirements*. Esprit Basic Research Project 6225 Deliverable 2.1, www.comp.lancs.ac.uk/computing/research/cseg/comic/deliverables/D2.1.ps.

Beyer, H., & Holtzblatt, K. (1999). Contextual design. *ACM Interactions, 6*(1), 32–42.

Boehner, K., Vertesi, J., Sengers, P., & Dourish, P. (2007). How HCI interprets probes. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 1077–1086), San Jose, ACM.

Button, G., & Harper, R. (1996). The relevance of 'work-practice' for design. *Computer Supported Cooperative Work: The Journal of Collaborative Computing, 4*(4), 263–280.

Button, G., & Sharrock, W. W. (1997). The production of order and the order of production. In *Proceedings of the European Conference on Computer Supported Cooperative Work* (pp. 1–16). Kluwer Academic Press.

Cheverst, K., Clarke, K., Dewsbury, G., Hemmings, T., Kember, S., Rodden, T., et al. (2003). Designing assistive technologies for medication regimes in care settings. *Universal Access in the Information Society, 2*(3), 235–242.

Cicourel, A. (1964). *Method and measurement in sociology*. New York: Free Press of Glencoe.

Colley, J., Bedwell, B., Crabtree, A., & Rodden, T. (2013). Exploring reactions to widespread energy monitoring. In *Proceedings of the IFIP TC13 Conference on Human-Computer Interaction* (pp. 91–108). Cape Town, International Federation for Information Processing.

Crabtree, A., Rodden, T., Hemmings, T., & Benford, S. (2003a). Finding a place for ubicomp in the home. In *Proceedings of the International Conference on Ubiquitous Computing* (pp. 208–226). Seattle: Springer.

Crabtree, A., Hemmings, T., Rodden, T., Cheverst, K., Clarke, K, Dewsbury, G., Hughes, J., & Rouncefield, M. (2003b). Designing with care: Adapting cultural probes to inform design in sensitive settings. In *Proceedings of Australasian Computer-Human Interaction Conference* (pp. 4–13). Brisbane: Ergonomics Society of Australia.

Crabtree, A. (2004). *The social life of Uncle Roy: Field report*. Equator Technical Report, EPSRC GR/N15986/01. www.cs.nott.ac.uk/~axc/work/URAY.pdf.

Crabtree, A., & Rodden, T. (2009). Understanding interaction in hybrid ubiquitous computing environments. In *Proceedings of the International Conference on Mobile and Ubiquitous Media*, Article No. 1. Cambridge: ACM.

Crabtree, A., Rodden, T., Tolmie, P., & Button, G. (2009). Ethnography considered harmful. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 879–888). ACM: Boston (MA).

Crabtree, A., Rouncefield, M., & Tolmie, P. (2012). *Doing design ethnography*. London: Springer.

Crabtree, A., Tolmie, P., & Rouncefield, M. (2013). 'How many bloody examples do you want?' Fieldwork and generalisation. In *Proceedings of the European Conference on Computer Supported Cooperative Work*. Paphos: Springer.

Dourish, P. and Bell, G. (2011) *Divining a Digital Future: Mess and Mythology in Ubiquitous Computing*, Cambridge (MA), MIT Press.

Gaver, W., Dunne, T., & Pacenti, E. (1999). Design: Cultural probes. *ACM Interactions, 6*(1), 21–29.

Gaver, W. (2001). Designing for ludic aspects of everyday life. *ERCIM News, 47*. www.ercim.eu/publication/Ercim_News/enw47/gaver.html.

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.

Hughes, J., King, V., Rodden, T., & Andersen, H. (1994). Moving out of the control room: ethnography in systems design. In *Proceedings of the Conference on Computer Supported Cooperative Work* (pp. 429–438). Chapel Hill: ACM.

Hutchinson, H., Mackay, W., Westerlund, B., Bederson, B., Druin, A., Plaisant, C., Beaudouin-Lafon, M., Conversy, S., Evans, H., Hansen, H., Roussel, N., Eiderbäck, B., Lindquist, S., & Sundblad, Y. (2003). Technology probes: Inspiring design for and with families. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 17–24). Fort Lauderdale: ACM.

ISO 9241. (2010). *Ergonomics of human-system interaction—Part 210: Human-centred design for interactive systems*. Switzerland: ISO.

Kyng, M. (1994). Collective resources meets puritanism. *Scandinavian Journal of Information Systems, 6*(1), 85–95.

Lazar, J., Feng, J., & Hochheiser, H. (2010). "Diaries", *Research Methods in Human Computer Interaction* (pp. 125–141). Chichester: Wiley.

Malinowski, B. (1922). *Argonauts of the Western Pacific: An account of native enterprise and adventure in the Archipelagoes of Melanesian New Guinea*. London: Routledge and Kegan Paul.

Mumford, E. (1987). Socio-technical systems design. In G. Bjerknes, P. Ehn, & M. Kyng (Eds.), *Computers and democracy: A scandinavian challenge* (pp. 59–76). Aveshot: Avebury.

Petrelli, D., Whittaker, S., & Brockmeier, J. (2008). AutoTopography: What can physical mementoes tell us about digital memories? In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp. 53–62). Florence: ACM.

Ryle, G. (1970). *The thinking of thoughts—What is Le Penseur doing?* University Lectures No. 18, University of Saskatchewan.

Sacks, H. (1992). Doing 'being ordinary'. In G. Jefferson (Ed.), *Lectures in Conversation*, Volume II, Part IV, Spring 1970, Lecture 1 (pp. 215–221). Oxford, Blackwell.

Schmidt, K. (1997). Of maps and scripts. In *Proceedings of the International Conference on Supporting Group Work* (pp. 138–147). Phoenix: ACM.

Snow, C. P. (1961). *The two cultures and the scientific revolution*. Cambridge: Cambridge University Press.

Syzmanski, M., & Whalen, J. (2011). Introduction: Work practice analysis at Xerox. In M. Szymanski & J. Whalen (Eds.), *Making work visible: Ethnographically grounded case studies of work practice* (pp. 1–17). Cambridge: Cambridge University Press.

Tolmie, P. (2011). Uncovering the unremarkable. In M. Syzmanski & J. Whalen (Eds.), *Making work visible: ethnographically grounded case studies of work practice* (pp. 53–73). Cambridge: Cambridge University Press.

Zimmerman, D., & Pollner, M. (1970). The everyday world as a phenomenon. In J. Douglas (Ed.), *understanding everyday life* (pp. 80–103). Chicago: Aldine Publishing Company.

Deeper into the Wild: Technology Co-creation Across Corporate Boundaries

Tommaso Colombino, Jutta Willamowski, Antonietta Grasso and Benjamin V. Hanrahan

1 Introduction

This chapter provides some reflection on a research project conducted over the course of three years that started with a series of ethnographic studies of outsourced customer contact centres (or call centres) operating on behalf of large telecommunications companies. The initial remit for the project was to look at the work of the call centre agents and their management, with an eye towards those parts of the job, such as compensation mechanisms and performance management practices, that were likely to be drivers of the high level of attrition they were experiencing. While a relatively high baseline level of attrition is to be expected for a job description which offers minimum wage and low job security (as a key part of the outsourced business process business model is to provide flexible staffing), there was nevertheless a feeling on the part of the business that their attrition was higher than it could or should have been. The studies were followed by some concrete technology proposals aimed at addressing what we, as researchers, had identified as an issue with the organization's performance management practices and technology infrastructure: the limited availability and visualization of relevant performance data for agents.

In its organizational features, the project was unremarkable: it was a technology development project driven by the findings of an ethnographic study; it was a collaboration between the research and business arms of a large corporation; it was organized according to standard and recognizable principles of project management, with a plan, tasks, deliverables, etc.

T. Colombino (✉) · J. Willamowski · A. Grasso
Naver Labs Europe, Meylan, France
e-mail: Tommaso.Colombino@naverlabs.com

B. V. Hanrahan
College of IST at the Pennsylvania State University, Pennsylvania, USA

A. Chamberlain and A. Crabtree (eds.), *Into the Wild: Beyond the Design Research Lab*, Studies in Applied Philosophy, Epistemology and Rational Ethics 48,
https://doi.org/10.1007/978-3-030-18020-1_4

We have come to assume that the value of the insight provided by ethnomethodologically informed ethnography is now recognized in the academic community and no longer needs to be justified per se (Crabtree et al. 2012). But a method that offers good analytic insight does not in itself guarantee success in a technology design project, and access to a cohort of users to deploy a technology prototype in situ does not guarantee a healthy environment for co-creation.

The direct involvement of the researchers not just in the conceptual development of a technology prototype but also in its integration and subsequent deployment raised, at various points throughout the project, the issue of ownership of the technology itself. More specifically, taking the normally iterative process of technology prototyping and testing "into the wild" blurred the distinction between prototype and product, as well as between experiment and deployment. This frustrated the research team because we felt that we were not being given the opportunity (or agency) to properly and iteratively test and verify the assumptions we made in the development of the prototype technology. It also frustrated the business group because seeing the prototype technology in their own environment at a relatively early stage of the project made them want the technology to be ready for deployment before the research team was ready to transfer it.

As researchers, we crossed an organizational boundary and stepped into someone else's territory, with some consequences. The emergent mismatch between our understanding of the work we had studied, and that of the business group's management, became a point of contention in the definition of the features of the technology content of the project. Furthermore, the direct involvement of researchers with the integration of the technology prototype "in situ", and the consequent interrogation of the technology infrastructure of the business group's operation in practice, exposed the limits not just of the infrastructure itself, but also of our understanding of it, and caused us to revisit what we had learned through the studies.

Another consequence of the confrontation between the researchers and the business group was ethical. The potential for tension between the researchers and the business group was always there, in the form of the question of whether research is done purely in service of the organization's goals, or if it does in fact also have a remit or the authority to redefine what those goals are. It could be argued that some of the findings of our studies were implicitly critical of the organization's policies and practices, not just in their efficacy, but in the way that they manage their workers, their compensation, their professional development, their professional skill and knowledge on the job, and even the capacity of the workers to process certain information. The confrontation between researchers and the business group "in the wild" therefore brought to the fore very different experiences of organizational accountability, where the managers of a business group had to shoulder a heavier burden of accountability (to a bottom line and to a rigidly hierarchical reporting structure) than the researchers whose bottom line (so to speak) was less likely to be affected by the relative success or failure of a single project.

In the next section, we will provide a more detailed overview of the project itself, with a description of its objectives and trajectory. We will subsequently articulate the challenges broadly outlined in this introduction as they emerged in the course of the

project itself, and in conclusion, we will offer some reflections of a methodological and ethical nature on how to bridge the gap between the (sometimes) long-term and visionary goals of research and the practicalities, compromises and constraints of the real-life environment that is both the subject and recipient of the research itself.

2 The Project

Customer contact centres, or call centres, provide an interesting but challenging context for technological innovation. As we previously discussed in (Colombino et al. 2014), the business process outsourcing business model is largely based on labour arbitrage rather than added value through technology content. This means that their technology infrastructure is generally an ad hoc combination of client proprietary (often legacy) systems and off the shelf solutions, and any investment in a proper integration of information systems or in-house development of platforms is restricted by the necessity to work within the client organizations' own infrastructure, and the profit margins of that particular service contract. On the other hand, the focus on labour arbitrage also means that outsourced service provider is typically given more freedom in defining and standardizing those organizational processes and policies which are directly connected to workforce management, such as compensation, performance, management, human resources, etc.

For that reason, in our initial engagement with the call centres, given our mandate to understand the underlying factors of attrition, we directed our attention to performance management and compensation practices within the organization. In the course of the project we uncovered a number of emergent problems in the operations of the call centre. In particular, we focused on the lack of access to up-to-date information about performance and compensation for the agents of the call centre (the employees answering the phone and responding to customer queries) (Colombino et al. 2012).

In call centres doing inbound activity (receiving phone calls from customers) agent performance is typically measured according to metrics, here on referred to as Key Performance Indicators (KPIs). The KPIs are derived from the call centre telephone switch and from assessments performed by quality analysts who listen to recorded phone calls and "score" the agents' performance on a set of pre-defined categories (e.g. "average", "very good", etc.). An example of a KPI derived from the telephone switch is Average Handle Time (AHT), which represents the average time an agent spends on a phone call with a customer. The call centre as a whole is expected to keep their aggregate average KPI values within a certain threshold (or upper and lower threshold values)—agents are therefore in turn expected to manage their phone calls so that their average values fall within those thresholds.

This organizational hierarchy is designed to ensure control and supervision of a "floor" that may total 800–900 agents in some of the larger call centres. The core business model of outsourced operations, such as the ones we observed, is one built around labour arbitrage, and the "productivity management" infrastructure described

above by and large arbitrates how the call centre makes its money—in other words the performance of the call centre operation as a whole is no more and no less than the overall average performance of its agents. It is of little surprise therefore that the compensation of the agents themselves is (with some exceptions) built around some type of Activity Based Compensation mechanism. We have in our observation seen a broad spectrum of wage mechanisms, ranging from fully variable pay based on per-minute piece rates, to mechanisms mixing an hourly rate with performance-based bonuses. In all cases the variable part of the salary (or the pay rate itself in case of fully variable mechanisms) was calculated using the quantitative and qualitative metrics describe above.

It should be clear then that the performance data is itself of interest to the call centre agents, because even if it does not directly pertain to solving customer issues, it is necessary for the agents to know where they stand with respect to their expected performance and how much money they might expect to make in any given pay period. What we discovered in the course of our observations was that performance data is made available to agents in most call centres, but with some significant limitations. More specifically, what we found was that the data (typically made available through some kind of performance management information system) was for the most part (a) hard to access in the course of the regular call-taking work as it required logging into systems that are not used as part of that work, and (b) not dynamic or up-to-date enough to help the agents understand how their performance was evolving with respect to weekly performance targets given to them by their supervisors or with respect to their compensation mechanism in the current pay period. The agents were thus not aware in real time of their current KPI status and of the latitude they had with respect to them when handling actual customer calls.

During our initial investigations, we concluded that the primary causes for this lack of support were to be found in the lack of investment in innovation on the part of an organization that was built around a labour arbitrage business model, and a consequent lack of investment in the technology infrastructure of the call centre and in the professionalization of its agents. To provide adequate support for the reasoning and contextual decision making that are crucial to the work of a call centre agent, we proposed, and subsequently prototyped and deployed technologies designed to pull performance data from the call centres' existing technology infrastructure and provide near real-time feedback to agents and supervisors (Castellani et al. 2013). As the agents' regular call taking work requires the use of a variety of different information systems and their desktops were already "cluttered" with lots of open windows, we decided that performance data should be made available at the agents' and supervisors' discretion, and without the need to open or log into additional portals or applications.

What we proposed was a widget designed to pull and visualize relevant performance data from systems which were not easily accessible to the agents. The widget was designed to provide a high level, colour-coded overview of a selection of customizable KPIs, typically varying in number between 1 and 10. The agent could then select one of them to have more specific and detailed information on the given KPI. Figure 2 shows an example of one of the visualizations. It shows information on

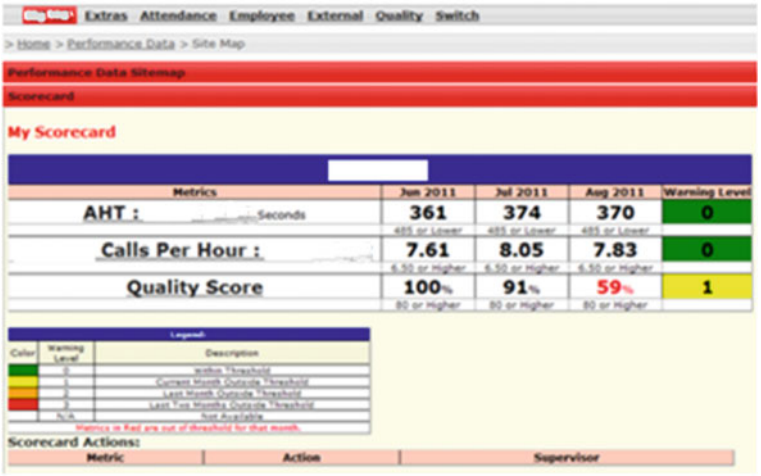

Fig. 1 Agent performance score card with KPI values displayed on a rolling 30 day average

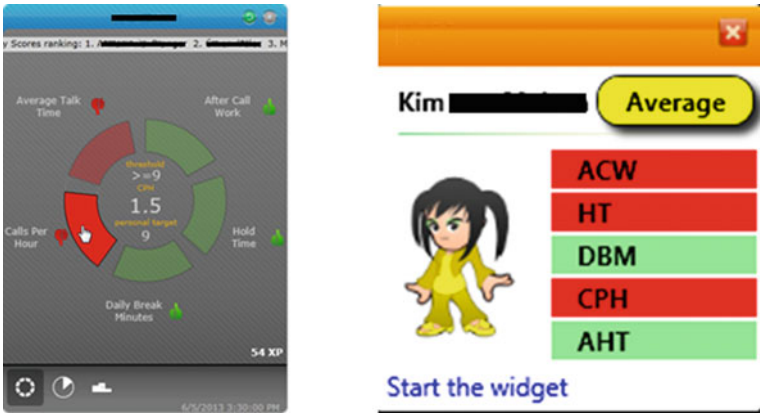

Fig. 2 Prototype widgets designed to provide up to date and dynamic performance data visualizations

performance with respect to three KPIs: AHT, After Call Work (ACW), and Daily Break Minutes (DBM). The visualization also includes an avatar which represents the overall health of the agent's performance and information about the team's performance. In the center of the widget additional information is displayed. In the example shown in Fig. 1 this is the current value of the selected KPI (DBM) and the personal target of the agent for it. The system was also designed to provide the team supervisors with tools and visualizations which display the same information present in the agent widget, but gives supervisors the ability to select and visualize the performance of any of the agents on their team, or the average performance of the whole team.

While the project ultimately came to fruition (insofar as the technology has been adopted and deployed by the business unit), the trajectory, as we mentioned in the introduction, was a troubled one, and many of the troubles could be described as emergent consequences of doing research "in the wild". Nevertheless, we do not intend to argue that the project would have been better if we had kept the technology concept development and prototyping to ourselves, perhaps limiting our interaction with the business group to the ethnographic field studies. Without the confrontation or dialectic with the business group and its technology infrastructure our own understanding of the workplace and its emergent practices would have been the poorer, and perhaps it would have been easier for us to ignore the potential ethical risks of our own involvement as a research entity with a business model that walks a fine line between optimizing productivity and regulation in what is admittedly a complex organization, and stifling the professional know-how of its own employees with overbearing bureaucracies of control.

We have articulated what we consider to be our more interesting lessons learned across three broad topics, where each section addresses a different facet of a broader challenge of finding a common purpose across organizational boundaries and the practical and ethical implications of doing research in the wild. The first section starts with the ethnographic studies, and a consequent mismatch between ethnographic and organizational configurations of the call centre agent, which revealed itself most consequentially in a disagreement over what should have been the core features of our technology proposal. The second section discusses what we learned about data as an organizational artefact, initially through the lens of ethnography, and subsequently through our direct interrogation of business group's technology infrastructure when we moved the project to a prototype testing and integration phase: we discovered that priority is given to upstream reporting to the client whereas providing the workforce with appropriate and valuable data to accomplish their work and adapt it to the actual context is much less supported. The final section provides some methodological reflection on the difficulty we experienced in establishing ownership of the research and the technology, more specifically through a practical difficulty in differentiating prototype from product and experiment from deployment.

3 Ethnographic and Organizational Configurations of the Agent

One of the key features of the call centres we observed, as we described in the previous section, is that the agents themselves are at the very bottom of a fairly tall organizational hierarchy, and that while (at least for us as external observers) the work the agents do is clearly knowledge work, the business explicitly views and models itself after a manufacturing process. Even the language the business uses to refer to itself confirms this: the time agents spend on the phone is called "production" time, and agents who are at work are referred to as being on the "floor".

Knowledge work differs from the traditional factory floor work the production metaphor comes from, in that irrespective of how routinized and distributed it may be, it is characterized by the often complex reasoning the workers (agents) bring to activities they undertake. Manual labour can be characterized as skilled, but it has to a large extent successfully been replaced by machines—so much so that there is now a clear distinction (and difference in value) between a product which is produced industrially and one that is produced by craft (and therefore embodies the skill and individuality of the craftsman).

In the case of the type of knowledge work we observed, the push to routinize and distribute the tasks as much as possible has not produced the same degree of de-skilling that has taken place with manual labour. It has, however, had the effect of making the skill (reasoning) the workers bring to the job less visible and valued within the process. A consequence of this is that the design of the process itself and its performance management and monitoring strategies may be such that they do not facilitate the skilled part of the knowledge work in question (the reasoning), or encourage its development.

The skill agents and supervisors bring to their job (or develop as a matter of course in the exercise of their job) is, for example, to extract relevant information, when they need it, from systems which are designed for monitoring and reporting or that try to direct their interaction with customers according to organizational guidelines and preferences. For example, Customer Account Management Systems in a contact centre allow agents to perform operations on customer accounts. They may, however, lock agents out of certain features or operations, depending on the level of support a particular agent is expected to provide or the level of support a particular customer is eligible for if they have not acquired an elective support plan from their service provider.

While this may be considered necessary from an organizational point of view, it also limits an agent's ability to manage emergent contradictions between customer demands and expectations and organizational policies. If a customer is not technically eligible for phone support for a particular issue (as an example, let us say they want to reset the password on their e-mail account), an agent may be instructed to direct the customer towards an on-line self-help resource. The customer may accept that, or they may feel that their issue has not been resolved and provide negative feedback to the organization which will in turn negatively impact the agent's KPI measuring customer satisfaction. The agent has thus to juggle between what they are allowed to do due according to policies and what is required to make the customer happy.

In any given case such as the one described above, we would argue that the agent has to use and balance hard skills (understanding of organizational policies and processes and how to affect them through the appropriate information systems) and soft skills (emotional labour and management of individual customer expectations) to determine whether it is best to enforce organizational policy or make a small exception for the sake of issue resolution (which is a key metric for customer service providers). An agent's performance is assessed through tightly controlled performance metrics (including the reduction or break down of quality assessment to standardized or normalized interactions with the customer). However, what makes

a good agent in practice is the ability to deliver a good service to their customers, even if it happens in spite of the systems and organizational policies imposed on them (which in and of themselves do not resolve inherent contradictions between quality and quantity of service).

We conceived our technology proposal as a means to help the agents to deliver good service and take the right decisions, aware of the actual call centre context and their individual current KPI values. When we approached the organization with this proposal, we did so on the assumption that the type of skill described above should be actively encouraged and nourished in a knowledge work environment, and hypothesized that giving agents better access to salient performance data would benefit both the organization and the agents by helping them to:

- understand and balance individual performance goals and objectives with respect to the requirements of the team or the organization as a whole;
- identify and handle outlying or exceptional situations;
- identify and address needs and requirements for professional growth.

Customer care work is rarely routine—product launches, system updates, changes in organizational can always affect the volume and complexity of the calls coming into the call centre. We therefore believed there would be a benefit to providing decision making tools to layers of the organization that are normally not involved in defining performance management strategies and expectations, but are nevertheless responsible for putting them into practice. The challenge for us was therefore to help agents and supervisors identify and respond to unfolding situations more rapidly and effectively than the call centre as a whole was able to do.

Underlying the technological "fix" that we proposed as a solution to the lack of integrated data visualizations was therefore possibly a more nuanced characterization of the agents' skill set than the one implied by the reduction of performance assessment to a subset of performance metrics. The practical value of this nuance, and of giving agents access to more data thereby acknowledging an emergent need for informed decision making on the job, was not however immediately obvious to the business group's management.

Our initial design was rejected by the project stakeholders for being "too complicated". What was being called into question was not just the relative merit of our design and the readability of the data it visualized (which in itself was a perfectly legitimate concern). What was being questioned was the ability and willingness of a low-skilled knowledge worker to interpret and make constructive and legitimate use of data which, from an organizational point of view, was not immediately related to ongoing call-taking activity (Fig. 3).

The rationale we had provided to the organization for an emergent need to balance quantitative metrics with quality of service in a contextually reasoned way was counteracted by a concern that agents could use the data to, for example, "work to the numbers", that is to say leverage their understanding of the performance and compensation mechanisms to maximize their own benefit at the expense of the interests of the organization. Whether this was a legitimate concern or not (which is not to

Fig. 3 The original design for the data visualization widget can be seen on the left. The simplified version based on feedback from the business group can be seen on the right

question the fact in any job you may find employees who act in bad faith), it was not the practice we had observed and described through our ethnographic studies.

But what we had described was an understanding of how it is that you do a "good" job as a call centre agent which was not altogether consistent with the one implied by the organization's performance management and compensation practices. That is to say, we made transparent the fact that part of the agents' responsibility was resolving emergent contradictions between the various performance metrics defined by the Service Level Agreement on behalf of the organization, thus maintaining the rational image of the organization's bureaucracies of accountability (see Sharrock 2011 and Bittner 1965) for a more nuanced discussion of the role of organizational constructs as points of reference for different parts of an organization), and doing so while compensating for the inherent weakness of the technological infrastructure they were provided with (something we will discuss in greater detail in the next section). However, we did not manage to change the organization's point of view and reach a common agreement.

We can argue (as we did in the introduction) that the persisting mismatch between the ethnographic and the organizational configurations of the agents presented here was the outcome of a strict implementation of organizational processes dictated by the burden of delivering measureable results for the managers in question. On top of the practical problem of compromising on the design of a technological artefact, we are also left with the uncomfortable knowledge, as researchers embedded in the organization, that the business model is ultimately undermined by the socio-technical compromises it appears to be obliged to make, and that the true cost of not acknowledging knowledge deployed by "knowledge" workers in the course of their work (in dissatisfaction and ultimately attrition, for example) remains hard to measure.

4 Data as an Artefact Revealed Through the Lens of Ethnography and Through Technology Prototype Integration

This section details the treatment of performance data in the outsourced call centre operations we observed, and in particular, we focus on how the practices of capturing, aggregating, and presenting data reflect the operation's overall concern with "reporting upstream" and accountability, and how the technological and organizational infrastructure of the call centre is shaped accordingly. We then discuss some emergent consequences of this organization of data management, which in particular take the form of some tensions between the emergent needs for data at certain levels of granularity and aggregation within the actual operations of the call centre, and its relative accuracy and availability.

This subsequently also lead to questions about the role of research in "exposing" particular limits in the business group's technological and organizational infrastructure, and whether we were in a position to push for costly investments on the part of the company for the sake of technology transfer from research.

As one of our key objectives was to provide more responsive data to agents and their supervisors, we had a significant amount of interaction with both the IT staff of various call centres as well as the development teams of several service providers. These interactions were necessary to understand how to support our initial round of experiments, how our tool would fit into their overall infrastructure, and what capabilities would need to be developed by whom. Fitting our tool within the existing infrastructure and obtaining data with the required accuracy and timeliness that we required for our applications, turned out to be next to impossible. In some cases, the data was not reliable enough to show in that level of granularity, in others the infrastructure could not handle the additional load. In other cases, the data was simply not made available by the client organizations in anything approaching real time. In the cases where our tool was eventually, successfully deployed, the amount of effort required by the IT and development organization was in the order of six to eight months.

Throughout our initial ethnographic studies, we observed a considerable amount of improvisations by the agents and their supervisors to get their job done in spite of the limitations imposed on them by the technological and organizational infrastructure. Through the process of conducting meaningful, ecologically valid experiments, as opposed to limiting ourselves to paper-prototyping (which we conducted in the initial stages of the study), we gained a deeper understanding and appreciation of several things. First, how these technological and organizational policies impact the work of agents and their supervisors. Second, we gained a deeper appreciation for the efforts of the agents and their supervisors than we had previously observed. Lastly, we also came to understand the rigidity and root of many of these limitations in budget constraints and contractual obligations.

Another important aspect that we came to understand was the manner in which data is prioritized and validated between the levels of management internal to the out-

sourced provider and between the outsourced provider and their client. This impacted the frequency with which data was made available and how changes to the technical infrastructure were prioritized. What should be relatively clear by this point was that the primary prioritization imposed by management on the development and IT staff was upstream reporting. As this was the primary use case for their data, data was validated meticulously and released in a weekly to monthly rhythm. There were several longstanding, established practices that went into the process of validation and reporting, none of which cast an eye for what the workers "on the floor" needed to better accomplish their work. We found that the IT and development staff were running at full capacity to keep up with the small set of emergent needs that arise from just communicating the performance in terms of the SLA to the client.

While this position is certainly understandable, it also left certain parts of the organizational hierarchy (e.g. agents, low-level managers, support staff) not sufficiently supported in their job function by data, policy, or infrastructure. While our project aimed to address a primary issue, the better reporting of performance data to the agents and their supervisors, we observed several other problems related to this data in terms of quality, availability, and the support provided for interpreting this data. One way that the lack of quality, interpretable data obviously hurt the organization was the manner in which live switch data was reported to supervisors. Live switch data is usually reported to supervisory staff to determine how long an agent has been in a particular state, examples being on break, on a call, on hold, etc. However, when used judiciously an agent could "game" the system to appear busy for the entire day and actually only take one or two calls. This was because the data was not reported in a way that supported much interpretation other than who has been in a certain state for how much time. In fact, even this usage was not particularly well supported as the data was not sorted, coded, or in any way distinguishable other than a scan of all agents and their time. We observed multiple instances where this mechanism failed agents and they requested help for a long call on their own to their supervisor. In fact, it was relatively common that a particular work activity was not terribly well supported by the data and the infrastructure that provided it.

One key aspect in terms of simply doing ones' research in the wild is to be prepared to study whatever may emerge while executing the initial plan. Throughout this project we learned much less about the efficacy of our tool and much more about organizational and technical limitations and how they were navigated and negotiated by actors. As well as, how data functioned within the organization.

Uncovering and potentially highlighting these various issues with the data and its uses resulted in additional tensions arising between the research and business arms of the organization, aside from the ethical concerns mentioned earlier. Clearly, doing research in the wild can uncover facts which are uncomfortable for the actors that are being studied. And where there is an organizational hierarchy involved the findings of a study of technology-in-use may make it difficult for researchers to remain neutral in situations where management and workers (as in our case) share a technology infrastructure with finite resources but do not share the same priorities with respect to how it is best used in the interests of their work requirements.

5 Ownership of the Technology: Differentiating Prototype from Product and Experiment from Implementation

While the goal of a research project in a corporation is ultimately to deliver the product of that research into its operations, in our experience this transition is never a simple one-step process. The trajectory from exploration to prototyping to product development needs to go through several iterations, as it is necessary for research to test and refine its assumptions, and for the business groups to understand the requirements for and implications of transferring the technology into its operations. Additionally, as our research by definition is about socio-technical solutions, the use and impact of the resulting new system cannot be fully predicted in the lab and iterations of testing, observing and adaptation are therefore always required. In light of this premise, the largest problem appeared as soon as we moved to testing our first technology prototype in a real-life environment: at this stage the distinction between prototype and product, and between experiment and integration, became blurred, and consequently so did the ownership of the research itself.

This was the first project in our team that got deployed in production and certainly this caused an increased difficulty in putting in place an iterative model. Furthermore, the business counterpart for this project was a new arm of the company, devoted to call centre outsourcing, working under strong business pressure, and without any experience of working with research but nevertheless with the company mandate to rapidly exploit innovation to address business needs. Despite the business pressure, from our perspective it was clear that the project could only be carried out in an iterative manner because of the nature of the research and the impossibility to completely foresee in the lab the results of introducing a resulting new technology "in situ". However we also knew that the business pressure was huge and combined with a lacking research culture on the recipient side. We could thus not expect the embracement of the iterative model just on the basis of understanding the nature of research. Therefore, in order to enable nevertheless an iterative model, we decided to adopt an industrial approach to iterative deployment: the Minimum Viable Product (MVP).[1]

The MVP approach has emerged in the context of start-ups and Internet technology in recent years as a means to rapidly test the value and uptake of a novel technology. The idea is that the first version of the product or service provides only the minimal set of functionalities that make it useful, but without any additional element or frill. Ideally this approach quickly provides a focussed outcome, reducing to the minimum the effort and time required before a first version can be tried out by early adopters who provide in turn useful feedback for adjustments and further development in the subsequent iterations.

Building on this idea, we identified a core set of functionalities for the first delivery including only a small subset of the envisaged full design, but which was however in our opinion already responding to an important need of the agents and their supervi-

[1] http://theleanstartup.com/principles.

sors. This functionality was to provide the agents and supervisors in real or almost real time with an up-to-date and easy to grasp view of the actual status of the KPIs used to assess their work and of their compliance with the call centre SLA. In our view this would have satisfied the business need to quickly see the transferrable value of innovation, while giving to us the time to develop the other functionalities integrating at the same time feedback from the first deployment. This plan however did not materialize causing major tensions among the teams on both sides and a dubious assessment of successful collaboration from the management.

We will now discuss more in detail how the MVP concept failed to support the collaboration. Just like discussed in the previous sections, there was again a misunderstanding between the two sides of the project, this time about the way it would be carried out: on one side we as researchers had adopted and were following the iterative MVP approach whereas the business counterpart on the other side was stuck with the one-step full vision and not conceiving to play the role of an early adopter as we had hoped and expected. In the following we will analyse more deeply why and how that happened.

5.1 Expectations, Business Context and Time Horizon

The main cause of our problems certainly lies in the difficult context of the project: the project itself and the relationship between research and the business unit was initiated by higher management with a strong organizational desire to exploit research and innovation, showing its value both internally and externally, and with the aim of gaining advantage over competitors. From the start the expectations on the business side where thus set very high. They somehow expected from the project and thus from the research to quickly make huge, impactful and differentiating contributions. Such an expectation is already somehow at odds with the MVP concept, the MVP idea being rather to iteratively build on an initial experimentation starting only with a reduced set of viable features that is then extended at each iteration. As a consequence, however, the business unit kept embracing the full envisioned concept of a "system to motivate agents and reduce attrition in the call center" while on the research side we had proposed and embraced the iterative MVP concept and started with a first minimal set of features towards that goal. The resulting first prototype was in consequence much more limited, but we felt it was meaningful enough to provide some value to the final users, and could therefore provide the ground for expanding it to move towards the full system vision.

The project context was furthermore complicated by the fact that the receiving business entity was used to run according to very short cycles and tight control of the advance. They saw us rather as a service provider than as a partner in the project, and, furthermore, being the business arm of the company, they felt they had the power and the responsibility to decide down to the detail what was going to be transferred. However, as we had already restricted the set of functionalities we wanted to provide with the first prototype, the control of the advance with the transfer resulted in revising

minor details of the first design, such as the colour schemes or graphical elements, instead of addressing more critical issues (for instance trying to reach a common understanding or agreement on the purpose, the scope and the management of the prototype and the whole project).

At the same time, the business unit still expected the impact of the system to be clearly and easily measured within a few quarters from deployment and this on the basis of statistically significant quantitative data. While it was obvious to us that the features included in the first MVP prototype were preliminary and still difficult to relate to the long term goal of affecting attrition and that they just constituted a first step towards that larger goal, the business unit did not perceive and understand that. While for us a success of the first MVP prototype was to observe higher awareness of their performances for the agents and better communication between them and their team supervisors (which is difficult to measure), the business unit was expecting a quick impact in terms of reduced attrition and costs (which is much easier to measure). This was however not realistic and added more tension.

To evaluate the success of our first prototype before moving on to the next iteration according to the MVP approach, we had planned to visit and observe the deployment site and collect feedback from the end users. Therefore, we asked for direct access to the sites and users to understand the new socio-technical set-up created by the introduction of our tool. This was another occasion when we did not get the expected support from the MVP-approach: Indeed, fearing to loose precious agent production time, and estimating that they had all the knowledge required about the setting and the addressed target users, the business group management decided to refuse this access, and to act instead as a proxy who could give us all the information required. However, this turned out to be difficult, as they had a very subjective view and little awareness of the way work was performed and organized on the floor, as we had observed and have explained in the previous sections. As a result, this created many delays and again more tensions and misunderstandings: On one hand, we needed access to end users and feedback about the system to proceed and were offered instead management knowledge as a proxy. On the other hand, the business units felt that research effectively had to prove, "before" installation, that it was "sure" of the value it was going to produce. We thus finally understood that the MVP concept of the "minimum set of viable features" it is really at odds with innovation coming from research: what is expected from research is a much wider and impressive impact, based on deep and long lasting studies. In other words, the idea of a research outcome which is "minimal" and requires additional, continuous testing and validation, is at odds with the business understanding of research as very deep, solid and providing results that are established "before" going into the deployment phase.

It became also clear that a concept like the MVP is certainly very effective in the context of a linear customer-provider relationship, where both partners interact with each other on the same level, where the provider proposes and motivates a (preliminary) solution which the customer then autonomously decides to try out, thus becoming an early adopter. In our case, the relationship was very different, with a mixed degree of autonomy and organizational demand from higher management in setting up the collaboration. This interfered with the need for an iterative progress

that required on our side direct access to the deployment site and interaction with the end users. While promising on paper, in this experience, the MVP concept was not helpful in facilitating the transfer collaboration from research into operations. We hope this case analysis contributes to a stronger understanding of this type of collaboration.

6 Conclusion

One of the virtues of using ethnography for design is supposed to be that it helps us understand the emergent complexities (and contradictions) of technology in use. It would therefore be unsatisfactory to treat ethnography simply as a requirements gathering exercise without then confronting the implications of your own findings (and consequent technological developments) in the same situated context.

We could almost compare the process of taking the findings of our original ethnographic studies back into the workplace in the form of a technology prototype to Garfinkel's breaching experiments (Garfinkel 1967; Crabtree 2004). The organizational configuration of the agents, and the weakness of the socio-technical infrastructure that supports their work that we described earlier in the chapter, were not immediately obvious to us. When we attempted to integrate and test a technology prototype that we thought would provide better support to existing work practices, we more or less directly forced two parts of the organization (one directly involved in the call centre operations themselves, one involved in managing a broad portfolio of call centre operations for a number of clients, and answering directly to corporate stakeholders) to either support or challenge a particular (and normative) view of how a call centre agent does his or her work.

We also exposed a weakness in our own understanding of the extent to which the data-management technology infrastructure in the call-centre was compromised in favour of the organization's bureaucracy of accountability. As we tried to negotiate a space for the iterative testing of our prototype, we learned that the infrastructure could not in fact support some of the principle features of our design (such as the real-time aggregation and visualization of agent-level Key Performance Indicators). This was not just a matter of logistics in an exercise in technological innovation. It was symptomatic of a strategic choice made by the organization to contain the cost of its infrastructure, which was indirectly supported by the agents' and supervisors' ability in dissembling and compensating for the lack of organizational and technical support for their routine activities, and delivering the expected organizational artefacts (in the form of aggregate productivity or performance reports for example).

The trajectory of this projected highlighted how the relationship between a thorough ethnographic understanding of the domain and technology innovation is not linear. Our initial observational studies of call centre agents at work were, in our own modest opinion, fairly comprehensive and conducted by experienced ethnographers. And yet our understanding of what we had observed ultimately went through as many iterations as the technology did.

Finally, we discussed the difficulties we had with the transfer and ownership of the technology we produced from our research. For us it was clear that a successful transfer of research into operations had to follow an iterative model, especially in a socio-technical context as the one presented here. To enable such an iterative process in this context of collaboration with a business group, we had adopted the industrial MVP approach. However, once we had implemented the first prototype and wanted to experiment it on site, it became clear that the receiving business unit had not embraced that model. They were not expecting a prototype with minimal viable features but rather a finished product with high impact, and consequently the prototype became, de facto, the product—useful to us researchers as a technology probe, but still far from a realization of our technology vision.

One of the goals of taking your search in the wild is to create opportunities for change and disruption (Rogers and Marshall 2017). There are, however, risks involved in assuming that positive change will be an emergent consequence of an exercise in co-creation. Change can also be for the worst, and technology appropriation can be hijacked by an organizational hierarchy or bureaucracy and repurposed to fit seamlessly within an existing organizational configuration.

The challenges involved in engaging stakeholders are not unknown to the research community. What we hope to highlight in this chapter is that even where a technology is "organizationally embedded" (Chamberlain et al. 2013), crossing organizational boundaries comes with challenges not unlike those one might encounter in the wild. Engagement cannot be taken for granted, and neither can be a shared perspective on what changes a given work environment (and the socio-technical configurations it contains) actually would actually benefit from. These challenges are not just methodological in nature, but also personal, political and ethical.

Nevertheless, and to sum up what at the end of this chapter may have come across as a list of negatives in a research project that did not quite go according to plan, we would like to emphasize that to face the challenges involved in confronting stakeholders in the wild as researchers remains a better alternative to ignoring those challenges altogether. Even when common ground proves impossible to find and technological innovation does not succeed, we can expect to come away with a more nuanced understanding of the work environment, and better equipped to recognize and face similar social, ethical and organizational challenges in future projects.

References

Bittner, E. (1965). The concept of organization. *Social Research, 32,* 230–255.

Castellani, S., Hanrahan, B., Colombino, T., & Grasso, A. (2013). Game mechanisms for production environments. In *CHI 2013 Workshop on Designing Gamification: Creating Gameful and Playful Experiences*, Paris, France.

Chamberlain, A., Crabtree, A., & Davies, M. (2013). Community engagement for research: Contextual design in rural CSCW system development. In *C&T 13: Proceedings of the 6th International Conference on Communities and Technologies*, Munich.

Colombino, T., Castellani, S., Grasso, A., & Willamowski, J. (2012). Agentville: Supporting situational awareness and motivation in call centres. In *Proceedings of the 10th International Conference on the Design of Cooperative Systems*, Marseille, France.

Colombino, T., Hanrahan, B., & Castellani, S. (2014). Lessons learned working with performance data in call centres. In *Proceedings of the 11th International Conference on the Design of Cooperative Systems*, Nice, France.

Crabtree, A. (2004). Design in the absence of practice: Breaching experiments. In *DIS 2004*, Cambridge, Massachusetts.

Crabtree, A., Rouncefield, M., & Tolmie, P. (2012). *Doing design ethnography*. Springer.

Garfinkel, H. (1967). *Studies in ethnomethodology*. London: Polity Press.

Rogers, Y., & Marshall, P. (2017). *Research in the wild*. Morgan & Claypool.

Sharrock, W. (2011). The project as an organisational environment for the division of labour. In *Ethnomethodology at work* (pp. 19–35). Farnham: Ashgate.

HCI in the Wild Mêlée of Office Life—Explorations in Breaching the PC Data Store

Richard Harper, Siân Lindley, Richard Banks, Phil Gosset and Gavin Smyth

1 Introduction

'HCI in the wild' was meant to be a call to get HCI investigations out of the lab into the mêlée of real life. This is of course a commendable suggestion, though begs questions about what kinds of methods and topics are suited for exploring in this mêlée as against in the lab. Claims by some experimentalists that they seek ecological validity in lab studies are largely missing the point since the thing that studies in the wild seek are essentially only those things that occur outside the lab—and hence are not things that can be replicated, modelled, or emulated. But in any case, some of those who have taken up the call for studies in the wild have taken this rather too literally—they have sought wild places, places where HCI researchers have not gone before. Needless to say this being HCI, the places in question are not often that wild, woods near Brighton, for example, street life in south Cambridge. What they ignore as they venture into these settings is the mêlée of office life, the place where the bulk of computer systems are located and the place in which, oddly enough, increasingly little HCI research gets done.

Office life is wild if one looks properly, if the label 'wild' is meant to highlight the complexities of and hybrid organisation in real-life practicalities. Consider the 'desktop', the fundamental interface of the PC in the workplace. While this might have been the apogee of HCI research thirty years ago, does it still fit the office? The technology that supports the desktop has changed, the networks that connect desktops to each other are different, the work practices the desktop supports are different, but little HCI research looks at the wild of this new office life. One wants

R. Harper (✉) · P. Gosset
The Institute for Social Futures, Lancaster University, Lancaster LA1 4WA, UK
e-mail: r.harper@lancaster.ac.uk

S. Lindley · R. Banks · G. Smyth
Socio-Digital Systems, MSR Cambridge, Cambridge, UK

A. Chamberlain and A. Crabtree (eds.), *Into the Wild: Beyond the Design Research Lab*, Studies in Applied Philosophy, Epistemology and Rational Ethics 48,
https://doi.org/10.1007/978-3-030-18020-1_5

to ask what is the mêlée of contemporary office life? How does this show itself in desktop behaviours? What impact would new HCI concepts have in this setting? In this paper, we report a project that sought to inquire into precisely these questions.

Its focus, in particular, is the file and its role as an anchor of the desktop. File abstractions were defined many years ago (Johnson et al. 1989). They reflected the infrastructure and purposes of files, as documents in the workplace and provisioned by networked workstations, as originally imagined by Xerox PARC researchers. From this beginning, the experience of digital objects has been almost entirely through the interactive architectures that these researchers devised: what is now known as the PC, and through that, the WIMP interface and interconnections to other users on their PCs via Ethernets and other protocols. We have—all of us—grown to understand what the terms files (and subsequently folders and directories) mean through our experience of them in this ecology.

Key to this context are a number of foundational design principles (Johnson et al. 1989, op cit). The file as represented by the system in the GUI is subject to direct manipulation, for example. The thing-as-seen by the user, moved and copied by their use of the mouse is pretty much the thing-that-is-stored by the computer. Also, this entity, the file, is represented at an abstract level but not merely as a thumbnail; this abstract form represents what is stored *and* things that can be done with that file. Files have powers, in other words, and hence the term 'Icon': something representing hidden functionalities.

It is perhaps worth reminding ourselves of what these powers are after all these years of daily use. It is not just that they are somewhat mundane when used to evoke the religious setting from which they are drawn but their ubiquity today makes them almost invisible. They are made up of a set of operations—Xerox defined these as Move, Copy, Open, Delete, Show Properties, Same (Copy Properties). This scoping remains startlingly similar to what is possible with current desktop machines and the Icons representing entities manifest there; there are some remarkable similarities too with new platforms—smart phones, tablets and so on.

Even so, today there are many types of files, not just office documents, spreadsheets and messages, but also images, sound files and social data, where the notion of files seems ill-fitting if not wrong—irrespective of the platform. Furthermore, the ways in which we experience and interact with these digital objects is changing. The things we do with our digital files has expanded, in other words, with sharing, copying, viewing and tagging practices being of a different order than before. And the thing that we understand our digital stuff to be has changed too—files are just a part of that stuff and even here the form these files has is now greater, more diverse.

This is nicely illustrated with image files. Over the past few years, we have gone from a situation where a digital image that exists as a single file on our PC can become a large nebulous collection of data on a Web page once posted upon a site like *Flickr*. This collection can include basic details about the image (a name, description, date taken); complex data derived from the camera, mechanisms for sharing (if it is added to a 'Group'), and information about structure (both through time—the image is part of a stream of photos ordered by chronology—and through user action, if the picture is added to a 'Set'). The picture can also be tagged (by the owner or by others, and even

by software), commented on, marked as a favourite, and it can have items and people within it identified, either by the person who uploaded it or by others. In computer file storage terms, this large nebulous collection of data is usually described as a graph. In some Web based systems, all data are treated as elements in a graph—and not just image files and associated data. This is explicitly the case with Facebook, for example, where the Facebook Graph File System affords new ways of interacting with one's digital data.

One interpretation of this situation would be to conclude that traditional files on the PC lack richness; that they have a coarseness in their relationship with other entities when compared with online files. Online files are formed from a cloud of metadata and file streams that hang together, but also overlap, sharing properties with other files, and connecting to other people, places and events through their attributes (for example, through friends, location and time). Therefore, one might argue, the model of the file as an entity on the Web should supersede the model originally applicable to the world of the PC.

This might miss something of importance however: it could ignore some of the values of digital entities on the PC, a value that is to be found in their relative simplicity. This simplicity might afford benefits that the apparent richness of the Web elides.

For example, it is commonplace to hear complaints from people about how they no longer feel as if they 'own' the pictures they put on the Web—on Facebook, say. As Odom et al. note (Odom 2012), users observe that what was once a thing on their desktop, an object in their file directory, becomes something different on Facebook. The former is an object they can keep or delete, put away as they feel fit; it is a directly manipulable abstraction to put it in Xerox terms. When the object goes on Facebook, it seems to lose some of these properties—some of its powers as an Icon—and starts to obtain a life of its own over which the users have less or even no control. Terms that are often coined by users to account for their relationships with digital files, like ownership, possession and responsibility, and even more crude terms like 'thinginess', seem to lose their valence; certainly the operations defined by Xerox seem pallid and inappropriate when articulating what the Icon of a file on the web might stand for.

Of course, one would be remiss if one neglected to note that it is in this respect that the value of applications (or services) like Flickr or Facebook is to be found. Their transformation of the digital entity from its form on a PC into something else allows Webs of annotation and comments to accrete around a picture, say, and thus allows the creation of a kind of social life—one for the participants, the commentators and the original creator (or poster) of the image. One might even say, following Appadurai, for the object itself (Appadurai 1986). The point is that these benefits, substantial though they are, come at a cost, a cost that users have no alternative but to pay: their sense of a loss control. Certainly the powers that they have come to understand are vested in the Icons they associate with their files is somehow corrupted, some of its capacities being removed while new ones are added that are unclear, opaque to view.

It might be, then, that the two types of digital world, one a domain of singular entities, files, objects as we describe, and the other a world of more hybrid, networked

and interrelated entities, has been poorly integrated. Movement between the two worlds does not support the virtues of each—presuming for the moment that there are virtues to be found.

At the current time, these virtues all appear to reside on one side: the fervour for Web-based experiences more or less obscures any values that the architecture of digital entities on the PC enable. These values might relate to a sense of control that users feel is lost when they move away from this context, as just mentioned. Though, as we point out, it was many years ago when Xerox asserted the benefits of direct manipulation of an Iconographically rendered abstraction, that this could be key to future evolutions of files that might move beyond the PC is something that has been picked up by other researchers over the years. Dourish and Button argued this in their *Technomethodology* paper (Button and Dourish 1996), for example, where they urge designers to make accountable (or visible) the operations that could apply to a file wherever it might be. Odom et al's user studies paper mentioned above echoes this claim albeit unwittingly. The complaints of users reported there might not be merely a reflection of these users struggling to learn how to deal with new experiences; it might flag *correctly identified* issues to do with systems design. Their complaints point toward their interaction with diverse architectures made manifest in abstractions and the operations applicable to them, architectures that seem to compete with one another in confusing ways. Users do not find accountable what their files can do when those files move from the PC to the Web and they are right to note this—even if they find the words to articulate their concerns awkward and fear their complaints likely to be mocked by the 'more knowledgeable'. One should not forget either, that just as the values of the PC have lacked valorisation, so the virtues of Web-based applications have not been applied or investigated in relation to PC-based architectures. If files on a PC were more like files on, let us say, Flickr, with a complex Web of data associated with each that allowed new interconnections between them all then this could give added meaning to individual files. Placing them in a Web of relationships would not just provide new ways of viewing and organizing particular ones, then, it could also facilitate understanding those individuals in richer ways. Meaning could be multifaceted, with files being viewed and managed in diverse ways, in sets and singularly; in arrays or freestanding. Of course, something might be lost in this move toward the web-based architectures on PCs, just as something might be lost when design principals from the PC start invading the Web.

1.1 A Step Along a Research Path

Many issues are thus evoked by the changing nature of digital objects, the interplay between their constitution on PCs and on the Web. In the project we report in this paper we examine some of these possibilities, in particular what is afforded when a PC-based system is given some of the virtues of how the Web treats digital objects. Whereas PCs have been architected to treat digital objects as singular, directly manipulable entities, we have been exploring what is enabled when these entities can also

be engaged with as part of graph relationships—as part of associations between (or across) files where the nature of that manipulation alters and where ways of rendering digital objects alters too.

The goal of this research harks back, then, to the opening paragraph of this paper: to the question of how we define and understand the digital entities we engage with. As Dourish and Button note, the abstractions that articulate these entities, whether those entities be composites within a graph store, singular objects in a file repository or any hybrid of these (and other possibilities), should be tractable to the user and engineerable for the computer scientist. As we ourselves have argued in a prior companion paper (Oleksik et al. 2009), they should allow users to grasp what it is they are handling and thus ascertain how they can act with it; they should allow the engineers to embed those actions in computational specifications; and they allow also designers to render visual forms (icons) that reflect the actions applicable to digital things.

1.1.1 Engineering a Method

To explore these topics we developed a new, low-level data store on a PC, called CamFS. This combines the current file-centric model associated with Windows and its associated data store, NTFS with notions of files taken from the Web, particularly, graph models that describe relationships between files. These can be delivered as required, with a name value store being used as an index of these files and graph relations that allows fast access to digital data and the delivery of that content to a new GUI.

It is very important that it be understood from the outset that CamFS is not a ‘solution’, however. We have built it to let us inquire into the issues of concern. For example, the name value store enables us to design a new user interface that combines the rendering of files as singular entities alongside files when seen as combinations or sets. These sets can be dynamically reconstituted in real time and thus can allow a re-specification (in theory) of the meaning of individual files. In other words, CamFS allows us to visit what interacting with files through or with reference to graph relations engenders—interactions with files and their associations that were not possible or even imagined before—whilst confining that concern to a world we are deeply familiar with, our own PCs.

Nevertheless, our research does have its limits. The possibilities that CamFS enables relate to how single users interact with their digital stuff, not with how multiple users deal with shared entities on the Web. But CamFS does allow us to consider how users might mediate their files between their PC and the Web; how a new store on their PC might pattern and document their social systems of exchange. If the forms of interaction traditionally possible with files was defined by Xerox and we are considering how this might be altered by some of the styles developed on the Web, then CamFS is also allowing us to consider what is implied when users share or give a file, or associate it with other content. These considerations point towards new operations that act on digital files and the icons that articulate them, operations

that lead the power hidden in the icon to be greater (or at least different) from that specified all those years ago in Palo Alto.

1.2 Related Work

For reasons of space, we can only point to our own prior review of papers that discuss research on file directories on the PC (Harper et al. 2013). This research is substantive and very rich, as we remark in our assessment. Over the years, investigations have considered how to improve the efficiency and ease of use of files by placing them as entities in a database, for example, and has explored how threading between different file types can better reflect work tasks—linking emails and Word documents, PPT and spreadsheets. Tagtivity (Oleksik et al. 2009) also pointed towards how interactions on the PC are bleeding into interactions on the Web. Research looking at the Web itself has tended to avoid addressing the issue of file abstractions as a topic, though as we note above there is considerable research on how users struggle to make sense of their experiences of digital file management on the 'domestic' devices and in the semi-public world of social networking sites—and thus the Web more generally. This points back to the need to reconsider what the concept of a file might be, and how it ought to evolve in ways that allows users to better manage both their own data stores and those of applications such as Facebook.

1.3 Our Research

It was with this as background then that our research entailed building a new data store that would allow Web-like interfaces to be developed and then 'lived with' on our PCs for a period of several months. Two of the research team committed to doing this full time during this period, as many of the files these individuals were routinely dealing with would be stored within and rendered by the application. The resulting experiences of use was documented. This documentation entailed noting particular problems of understanding and use, system errors and failures, as well as more encompassing reflections on how file entities and their rendering in the GUI were experienced. Weekly meetings were held to share those experiences and to guide future note taking. In all, the system has been used continuously for six months; it is still deployed.

Given what we say about the status of the system—its nature as a research enabling tool—we propose that our study consists of a kind a breaching experiment, a formulation originally coined by Garfinkel (1963). This has been extensively reported in the HCI work of Poole, for example (Poole 2012), Crabtree (2004), Tolmie and Crabtree (2008). It has its echoes in other studies that draw on 'reflections in use' (Boehner et al. 2008) and 'autobiographical design' (Neustaedter and Sengers 2012).

Key to breaching is the claim that much of the interaction that is possible on and through computing entails tacit and taken for granted common sense practices. These constitute a body of know-how that enables users to focus on certain aspects of interaction while taking for granted others and also provides a resource for reference and constitution of meaning. Breaching entails uncovering some of the 'taken for granted' through altering the ease with which activities can be done—through altering the interface say, or making the functionalities of a data function in a visibly different way.

The system itself, CamFS, works as follows. It augments the PC file system, allowing the benefits of a graph relationship to be tested within an environment that the user knows well, namely their own computer. To begin with, existing NTFS file structures have two elements added. The first is the ability to connect arbitrary items together on the same or on different pieces of hardware through the implementation of a graph system. The second is the ability to define simple layers of data through the use of a name value store. These two elements, the graph and the name store, enable us to build a file system that allows for some of the subtle interconnectivity and extended properties highlighted in Web-based experience, allowing us particularly to play with aspects of *property* and *structure* that are unified under the term name value. These aspects have a fluidity and ambiguity in online 'files' (such as a Flickr photo) which, through CamFS, we can bring to bear on a more traditional file system, on a PC.

Our goal with CamFS is thus is to show a simple evolution from a world in which the *folder* is paramount as a structural concept, to one in which other structures are allowed, and from a world in which the properties of a file have to live *in* that file in order to exist, to a world in which properties can be layered on top of files as needed but without the requirement to abandon the essential characteristics of a file itself.

As a simple example, we might want to connect multiple files together because they are part of the same project that we are working on. We might then give the connections between those items the same name (the name of our project), tying them together, in essence, with a tag; a *name value*. These are concepts that are common online, but rare in our operating systems. As it happens, users can create such connections on PCs through adroit management of folder hierarchies; as we mention above, too, some effort has gone into affording threading of files on the PC already. Our system however embeds what have typically been interface designs into the data store. In the following, we describe the back-end to CamFS in more detail, before outlining the user interface.

1.3.1 The System

CamStore consists of a file system, a graph store and a name value store. In a typical file system, digital objects are single files. The file system itself is constructed as a series of nested folders, and the digital objects or files sit within one of the folders. The folder structure is usually either created for the benefit of the Operating System, for the applications that run on it, or for the benefit of the user to be able to make

sense of and find their files. In a graph file store, the graph consists of a mesh of connected objects, where the objects are the nodes of the mesh, and the relationships between the objects are the connections between nodes, usually called edges. It is common in a graph for nodes to be multiply connected, thereby being related to many other nodes. By carefully constructing the appropriate graph, it is possible to store objects and the relationships between objects so that information about the system and the relationships between objects can be retrieved quickly and easily. Thus, a single object can be the member of many sets, a single node can be related to many other nodes through various relationships, and the properties themselves are raised to have the same status as the files that they belong to, and can be used as a way of navigating between file objects. It is these that are defined as 'name values'.

To make CamFS non-destructive to the user's existing file system and thus allow the sense of real files being used in real ways, it was decided to leave files within the user's file system, and simply to add file nodes that stand as proxies to the files within the graph. Thus, in CamStore, the file store behaves like a typical file store, but files can also be nodes of the graph. The graph part allows for relationships between nodes to be defined. To move between the file system and the graph, a name value store is used. This store provides a fast information retrieval mechanism.

To leverage these functions, certain categories or file type features had to be predefined. Without these, the graph fields in CamFS could not be utilised. Necessarily there was some arbitrariness in this selection.

First, the *thumbnail* of every file is taken and recreated in a number of sizes to be used in CamFS to display item and set information. Thumbnails are a particular type of graphical representation; others are available—standard renderings with names, for example. Choosing thumbnails allows the GUI to be devised to echo some of the forms data stores take on the Web. Second, and relatedly, the file *type* is determined. This is achieved by testing the file extension against a known list, and ascribing a file type for each extension. For example, file extensions .jpg, .png, .tiff, thumb and .bmp all correspond to file type Image. This allows CamStore to retrieve all files of the same type, to request thumbnails if available and if not to render standard forms, and for the resulting amalgams to be displayed. The defined types are: Image, Music, Video, Document and Application. Type is added as a property node in the graph. Third, the *date* associated with the file (of whatever kind) is determined. For most documents it is taken to be the Last Write Time, although for images the Date Taken time is used. The date is then broken down into a number of properties, so that all items from the same date, month and year can be quickly displayed. Fourth, every folder in the file path is used to create a *set* that the file belongs to. For example, a file with the path /Photos/Barcelona/Gaudi07.jpg would create sets Photos and Barcelona within the graph and link the file node to both. Additional attributes are included with a view to supporting further development of CamFS—these include owner, location and device.

To use CamFS, a user is required to move files and folders to a specific directory, typically called MyCamStoreFolder, within their file system. Once this is done an application called CamStoreCreator processes the files and folders within this folder

Fig. 1 CamFS home page

and creates the CamStore. CamStoreCreator works by creating a list of all of the files that lie under the defined location, and then processes each file in turn.

Upon opening CamFS, the user is presented with a homepage displaying three groupings of objects: a group of Favourite items, a collection of recently interacted with sets, and a collection of recently interacted with items (see Fig. 1). On first use, the Favourites section is empty, and recent items are organised according to the dates in CamStore.

The expectation from the outset is that the interface becomes richer over time and through use. For, in addition to using the sets that are automatically created by the system, date, type and so on, the user can create sets, add objects to existing sets (which also adds that set to the recent sets list), and mark items as favourites (which causes them to appear on the Favourites list on the left, in the order by which they were made a favourite).

The items themselves are presented in such a way as to highlight the graph-like relationships present in the system between file objects. In Fig. 2, the right hand side shows a predefined set of details of the item, namely owner, date, location, type, and as it is an image, what camera took the picture. In addition to the details, a predefined subset of the sets that it is a member of is also shown. It is a member of the sets Cool architecture, Barcelona and Architecture.

In addition to the sets, a list of 'related items' is given, which is a list of items created before and after the current item. All of the above sets and lists are relationships that are constructed within the graph. If one of the lists, e.g. Image, is clicked, then that set is expanded to give some sense of what is in that set. So each individual

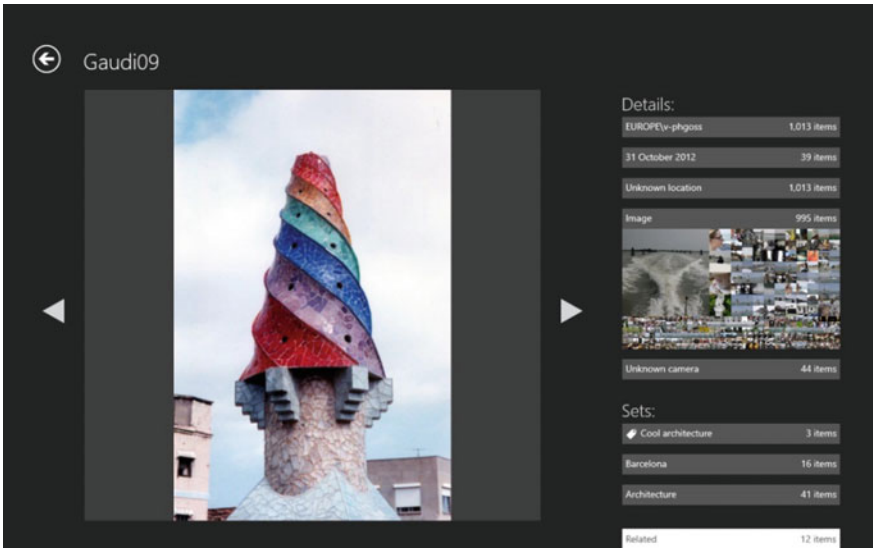

Fig. 2 CamFS item page with set expanded

item connects not just to the details of that item, but also to the sets of items that are related to it, and these relationships support navigation through the system.

2 Using Camfs: A Breaching Experiment

As should be clear, building CamFS took considerable effort; as it happens well over a person year in coding. These efforts produced a system that not only offers a fairly comprehensive and fully interactive interface but is robust and extremely fast. Users—us—really can engage with our digital stuff in and through the system. Our approach to using CamFS has been (and continues) to be one of engagement with it as far as possible: that is to say to treat it as a practical, real worldly tool, and as we do so, to see what it evokes, enables and prohibits: to force us thereby (through *breaching*) to provoke our 'sluggish imagination' into insight about future forms of data stores on PCs and on the Web, as well as their interaction.

2.1 Typologies, Topologies, Arrays

As described, various categories (and ways of grouping) were designed into CamFS at the outset. These were chosen as initial ways of uncovering potential values. Our experience of the system made us consider both these and different typologies and

topologies in relation to sets and their constituents, files. It also led us to confront some of the taken for granted benefits of file hierarchies—a form of set making though with different consequences for what is displayed (and displayable) in a GUI.

2.1.1 Scale of Arrays

One of the most notable features of using CamFS is the contrast it highlights between how file hierarchies hide content whilst this graph-based data store makes content visible. Or, to put this another way, CamFS reveals files that are hidden in Windows Explorer, a file hierarchy interface. This was especially striking when CamFS was first used, this being shortly after building a CamStore directory (that is to say, soon after a selection of files had been copied into the MyCamStore folder), and thus when we had thought ourselves confident that we knew what would be included in the system. Yet, when confronted with how CamFS rendered content, we were surprised—if not taken completely aback—by the volume of files to be seen. The surprise here was great not because we were completely unprepared for a different rendering of their content, but because of the scale of the content. With CamFS, the enormity of the number of files that are ordinarily produced through normal working practices becomes visible.

To give an example, on one of our machines, a folder entitled 'Publications' accessed through Windows Explorer contains 13 sub-folders, 3 Word documents, 1 XML file, 1 RTF file and 1 text document. Opening the equivalent Publications set in CamFS presents an incredible 1410 items. Before saying anything about this number, it is perhaps worth remarking on what they are and how they can be associated through CamFS. Arranging these items by Date, for example, reveals that the first document was created on the 5th of January, 2004. Arranging them by Type reveals that the contents are not only Documents but also Images, Videos, and Applications (there are 10 of these), as well as two files with no extension.

Be that as it may, the bigger question is why this number is so considerable. In this case, the self-defined Publications folder acts as a kind of 'working documents' folder for this colleague. It collects what she is working on 'now', if you like. But, as it happens, all the 'worked-on-already' documents are also filed away, put in a 'done' folder that also sits in the overall Publications folder. This includes entirely finished papers and prior versions of ones that this colleague is working on at the current time.

When this colleague uses Windows, and hence File Explorer to render abstractions of these files, only the ones currently being worked on are shown at the top level. Each file sits within a folder, with one folder being parent of all others. From a File Directory design point of view, this is a virtue: nesting allows occlusion and the efficient use of screen real estate; it gives organization to the files. This in turn makes the GUI tractable to the user—in this case these folders have got every version of every paper this colleague has worked on but does not make these available all at once. This larger set, for want of a term, includes all the files this individual is

working on at the current time and those they are keeping ‘just in case’; it includes in addition to this ‘completely done with’ files too.

To be sure, our colleague is like many ‘users’; like them, she produces and seeks to engage with numerous files, so many in fact that they cannot all be accommodated on a ‘desktop’. As digital documents of all forms have become more prevalent in the workplace (and elsewhere) the number of files that need filing has increased. Solving this problem—or rather offering design solutions to it—is reflected in contemporary file directory design: in File Explorer and so on. As we say, this is how the tension between real estate and the need for organisation has come to be solved.

CamFS inverts this, however; or rather, it forces one to reconsider the benefits that ensue. The set of 1410 mentioned above alludes to both the need to manage one’s digital output in a way that does not result in overload (visual, cognitive, say) at point of interaction, on the desktop say. But it also points towards a different question: whether one’s efforts are produce an undue surfeit. To put this provocatively, an entirely unexpected consequence of using CamFS is a kind of schizophrenic frisson: we come to ask whether we are industrious and producing a good volume of stuff or if we are deluding ourselves into producing too many things: in this view, volume is a measure of franticness, of papers for papers sake.

Confronting the number of our digital files does not make us *only* grateful for the benefits of file directory design, then. It leads us to think twice about the relationship we have with our digital affairs: it points us towards housework minimally; sometimes more searching questions. Most obviously, it suggests that filing away does not need to be a difficulty for a graph based system; rather, a graph based system might provide a handle on what needs sorting, what needs doing and what measures might be applied to oneself and one’s output. It might allow the user to see at a glance their digital stuff so that they can then embark on the right subsequent course of action. From this view, they might determine what is best ‘hidden’, what needs safe-keeping and what should not be forgotten but should be actively dealt with: thrown away perhaps; it might even induce them to reduce their output, to be more consolidated in their affairs.

2.1.2 Visual Functions of Arrays

In Xerox’s original design of the desktop, the decision had been made that icons should offer some differentiation in the way that they represented different file types, but all types were to be icons—with the ‘hidden powers’ listed above justifying use of the term. CamFS, meanwhile, relies upon thumbnailing file types. But in our use of CamFS we have come to see that the glance-ability of different thumbnails varies according to the properties internal to the file in question and this is consequential for how one engages with those files.

For example, in the case of one of our documents being prepared, CamFS takes from Word a thumbnail; this renders the first ‘page’ of the file in question, the Word ‘.doc’ file. But this creates problems when comparing multiple versions of a document which often appear similar when seen as thumbnails. After all changes in a Word file

are more likely to be toward the end of the document than on the first page. The first page—with a title, author, say—is likely to look similar across multiple versions.

On the other hand, thumbnails of PNGs, of pictures, are very much more useful. Indeed, using CamFS does bring home how useful it is to see picture files alongside other picture files. We have found that some of our individual pictures, often created as part of a series, seem better understood as such; that is to say as part of a series of pictures taken at various points in time or from some particular vantage point. Their unity provides value as does their dissimilarity; the distinctions part of their charm as self-created visual objects. Word files often have no similar value delivered through bundling them into an array or set of thumbnails; as we say, sometimes only muddling results.

In sum, the turn to thumbnails in the CamFS interface results in eliding some of the relevant properties of file entities while privileging the properties of a particular subset. One might add that the latter are those files whose features point towards something essential in the thing in question—a thing to be seen at a glance, as against a thing with a more complex visual geography. One is a picture, the other a text of sorts, a document say of several pages.

This feature of CamFS also draws attention to what actions different objects permit beyond the simple distinctions alluded to here (display/not display, set together, set apart). Different actions have distinct values in the context of file types. 'Create' makes sense for 'documents', but not quite for 'photos'; for Word files or .tiffs say. Similarly, to 'favourite' may mean different things for different types—PPT or mp3. Favoriting could serve as a reminder for action with regard to some presentation (as exemplified in accounts of Tagtivity) or it could signify that an mp3 file is indeed a favourite song.

2.1.3 Arrays and Topologies as Performative

CamFS use also highlights something else that was, presumably, of no concern to the Xerox researchers. As we have remarked, when first confronted with files rendered in CamFS, one can be taken aback by the totality of one's digital stuff. Leaving aside the question of the housework this provokes, something else is also brought to the fore: the possibility that display itself is a value. We are led to wonder whether hitherto our desktops have been organised to make their arrangement a matter of private engagement, while with CamFS the question of whether others might want to engage highlights whether this engagement might be of a different order.

A comparison that was brought to our mind might help here. There are various types of libraries, of which two can be noted. The first is the one most frequented by readers of this article: an academic library. The other is the domestic or personal library. Each affords a different function and this is reflected in the role of display in each. In one, the purpose is to store content so as to make it conveniently available to those who need it. Seeing the content is thus not so important as being able to find it. The invention of the duo-decimal index reflects this very need: it allows users to identify where content is without having to search through that content itself. They

do not need to look at the stacks of books and journals to find what they want. In contrast, the purpose of a personal library, the one kept in the home, is not so much to be an information repository as it is intended to display cultural acumen and reading history. The display of books acts as a symbolic representation of the owner, of their cultural capital. When we use CamFS we realise that our design merges and mixes this functionality: it certainly is beneficial to see the files we are working on, but only insofar as one can thereby get more directly and easily to the stuff in those files: to the site of work, as it were. But we also find that CamFS does not offer the kind of visual economy of the duo-decimal index of a library. Instead it points toward and enables a desire to display one's activities, not to engage with them. Indeed, we find great delight in demo-ing CamFS for this very reason. Our managers too seem to relish the opportunity to 'show it off'.

Leaving aside the foibles of research cultures (our own or anyone else's) there will be, clearly, times when this showability is just what is sought for. If on one's own desktop, there might be less value for such display, this might well become a value when the location of our digital stuff is available for public view. There the social act of display might very well be the sought for value—as indeed our managers' keenness attests to. There will be nuance here, too, when it might be that a person wants to create a public version of their own desktop and one that is as it were private. In a sense, one might be like a studio of one's stuff, arranged to celebrate one's industry, this will be public; while the other is more like a painter's hidden palette—a surface with various resources and components, but not something very edifying to look at, its centrality in the creative process notwithstanding.

2.2 The Work Before Arrays Become Possible

Making these (and potentially other) dimensions explicit points towards questions such as how a graph representing a collection that is curated might differ from a graph that encompasses multiple versions of the same essential document that has yet to reach the stage of needing curation—of being worth 'showing'. Given part of the purpose of CamFS is to highlight issues to do with the interaction between and relative affordances of Web-based file types and those on the PC, this particular issue seems salient indeed—it points to the problem of just when files can start moving from the PC to the Web and just what sits in-between.

This issue pertains to files that have reached a threshold, one where they can begin to have some kind of social life—in display, for example. But the opposite end of the life cycle of digital entities became increasingly prominent as we leveraged CamFS in our daily affairs. We came to see there is a cusp between set making and what comes before; a moment when one is engaging with entities in ways that cannot be effectively articulated with reference to graph relations as represented in CamFS. Our digital entities have, as it were, a pre-graph status, a condition before they can be 'set' so to speak and before questions of show-ability make sense. Certainly CamFS has a home page, a screen that presents favourites and so on, but essentially CamFS is a

tidy place, a display of organised files—or those files that are in a state where 'setting' is a sensible thing to do. But CamFS does not let us identify the 'just whatness' of different entities. And this 'work', if work it is, is something we came to realise we do on the desktop.

There will be, doubtlessly, various ways that desktops are used—and indeed the HCI literature is replete with such studies going right the way back to Malone's thoughts on 'piles'(Malone 1983; see also Sellen and Harper 2003). Without wanting to review that literature too carefully for reasons of space, what one can note with our experience is that ordinarily a desktop is the site of a diverse practices that reflect a combination of 'things done' and 'things to do' as well as a place in which things exist 'that are still undefined'.

We discovered, also, that these sorts of practices are not only on the virtual desktop, though at least one of used that space for this 'work'. One other used a combination of applications in ways that is analogous: as a place where those entities that are still undefined sit before they are dealt with. In their case the applications were email and OneNote.

In particular, files already created by some Other person join this person's desktop via email. The particular moment of their arrival, their form and volume, is, of course, contingent—dependent upon another and hence to some degree unpredictable. Our colleague finds some of the things sent via email easy to 'put away' on receipt (into one set or other, into a folder or a list of to do items), while other things are harder to sort out. Some remain in the in-tray of the email tool; some are saved into the folder structure. As it happens this manner of work with email is well documented (Whittaker and Sidner 1997).

Our colleague also makes notes and jots down ideas in OneNote. OneNote is used to make raw text notes, collect images, Web content and so on. Again, and as with email associated material, there is a contingent aspect to this, it being uncertain beforehand how much stuff gets produced through and kept in OneNote; only some of it is eventually transferred to a Word document or some other file, thus finding itself part of the folder hierarchy.

The important point is that this colleague has various objects at hand, objects that will end up in different forms and places but the specificities of which might be unclear at any moment in time. They are, if you like liminal. The tidiness of CamFS then highlights the possibility that there needs to be a special place for this work; a place, properly, of the liminal; of a state of disorder that one attends to so as to create order.

This has implications for the relationship between this place, graph-based data stores and resulting GUIs, and the Web more generally. One possibility is to treat the 'desktop' (or its equivalent) as analogous to the bowl by the front door; that is to say as a domain where things come to and get dealt with in various ways but which at any moment consists of a heterogeneous set of unclassified stuff. Or, rather, as a place where the applicability of classification as implied by graph-based systems like CamFS might be misleading. Those classifications are subordinate to or subsequent to other work.

But this other work could nevertheless be supported by graph based stores—if not in the way CamFS does—tidily, for display. After all, this work entails classification: users are distinguishing, firstly, what a thing is—not its computational nature, but what it represents in relation to their doings. They identify it as, say, something that can be thrown away (deleted), or something that points to work in the future, or a confirmation of something that has been done, that is now in the past. Some of these relations might be helpfully rendered in terms of creation and production: in the work of the palette to use a metaphor from above.

Once this work has been done, then a new place might be found in which the graph-based data store instantiated by CamFS might be ideal. This could afford some of the benefits of juxtaposition between graph stores and file hierarchies mentioned above—most obviously the contrast between making visible on the one hand and hiding on the other.

It also points towards what might go on Web-based stores—ones beyond CamFS if you like. For these are places of yet another sort: ones where the display-ability of sets is perhaps the main function, when the things in themselves are not to be represented as icons with hidden powers but as merely symbols of the creator, the one who organised them as such. In this respect, the Web is then not a place for back-up and storage, but a site of performance through what is chosen to store and display. Already users of Flickr recognise this, treating their accounts not as repositories of their pictures but as devices that show their élan at picture selection (Lindley et al. 2013). Our research on CamFS is suggestive that this might be a more widespread phenomenon, albeit not well supported at the moment.

3 Discussion

As should be clear, investigating a new data-store like CamFS does not allow the kind of enquiries typical of CHI papers—a design with user testing in the lab or 'in the wild'. It does require, to be sure, engineering and giving the result of that engineering to users. But here those users are ourselves and this makes the testing peculiar, or so we have argued. Our engagement with the technology is not, as it were, intended to let us figure out how to appropriate the technology; our research has entailed engaging with it so as to fathom our own imaginations made real through use of the technology.

Key to this has been unsettling some of our taken for granted practices with files and their abstractions as well as pointing towards hitherto un-thought of possibilities. As we seen, we have found ourselves revisiting questions that we thought long dead in HCI while at other times have come to see current issues and topics in HCI in new light.

3.1 Graph Stores and File Abstractions

It seems entirely sensible to keep a history of changes to a file (a document say) during the process of its production. Indeed, on the Xerox Star system, the associated word-processing system supported the ability to annotate text and to keep records of changes and thus the history of a file. In the case of Xerox, this evidence of history were, however, embedded in the file. Consequently, in terms of file abstractions, there was only ever one. Versions of the file were visible *only* through engagement with the file icon. Since that time, however, our practices have evolved as has our treatment of file abstractions. The long and short of these changes has been that the singularity of the file abstraction in Xerox's design has been replaced by the production of multiple files to record this history. Our own process of producing this paper attests to this—as will be recalled one of our folders had 1410 items in it and this included *versions* of files; multiple abstractions and hence, multiple icons muddle evolution (history) with category (what a file is about).

It seems to us that rendering all files and the history of work with them through icons seems misleading, or at least begs the question of what a thing is—a topic or a history. What seems implied through our use of CamFS is that version history might be better when not given the same status as a file. The singularity of the file abstraction that was central to Xerox's design could be preserved (or reinstalled) in current designs, and the display of 'versions' only be possible through the selection of disclosure once 'inside' a file.

If this were the case, then the operations on the file abstraction operand are as follows. **History** becomes a **property** of the **Icon**, along with **Move, Copy, Open**, etc. Though the operand might remain singular, this does not mean that types of history might not be plural; that the operations on the operand, the file, might be varied. Authorship of changes might be displayable, for example, or the degree of change across versions (e.g. 500 new words have been written), or the sections where these changes have been made (e.g. I'm writing mostly in the 'using CamFS' section).

Second, if it is the case that some files have a history, that they are as it were 'works in progress', then our experience with CamFS suggests that there is an important distinction between these and those files that have reached a state of 'completeness'. At this juncture, the history of a file no longer has the valence it once did. Moreover, just as history is no longer pertinent, other operations too, like editing, lose their relevance once this state has been reached.

As it happens the importance of this distinction is we think elided by a common practice that we ourselves abide by. Typically, we manifest this distinction by converting the file in question from one application to another; in the case of word processing files, for example, we change the file from Microsoft Word to Adobe PDF format. This transformation is used by us as it is by many-as a way of announcing a shift in what can be done with a file. Of course, the assumption here is that none of us have a full Adobe license and therefore the closure on the editing of a file occurs when the move in application is made. The point is that this shift in status might be consequential in terms of operations on the operand. In effect, what was

once an icon when rendered as a Word file becomes a symbolic representation when presented as an Adobe Acrobat file. One alludes to interaction with its content, the other represents a sealed nature as regards the file in question.

Be that as it may, while both these entities might be kept for the record—the file with-a-history and the file-as-finished-object—the former is likely to be filed away, while the latter may be stored and shown, displayed say, shared and even hosted online. One should not think that actions on files cease when they file's contents become stable, then; that operations on operands end. It is, rather, whereas clicking on the icon representing unfinished files opens up the insides of those files for editing, changing and reviewing, so in this new context, editing has to do with the relationship between one file and others. It is, as it were, actions external to the file that become possible at this point.

We think that this shift should be manifest in the design of how the entity is rendered and in terms of the operations possible in ways that is more robust than the ad hoc move between Word and Acrobat. If icons represent powers with regard to the internal features of a file, then another form of icon needs developing that indicates a file has shifted its status from 'in preparation' to 'done', and which privileges interaction related to **external features** as against **internal ones**. Of course, it is currently applications that normally provide these external functions—as in CamFS. What we are learning through using CamFS, however, is that it might be better if the abstraction articulated this for the reasons just described.

Since the actions in question are related to the connections between the file and other entities, we propose that this rendering be called a **gossamer**, alluding to a spider's Web and yet a shroud at the same time. Operations on the gossamer operand might well include the already defined Move, Copy, and Open, but might also include **Set**. This is already an operation possible in CamFS. Set might be better articulated as **Link**. In any case, the purpose of this action is to subject the file in question to a move, one that puts it in a nest. This nest can simply be a collection of similar items or a context in which tags, comments and other metadata can be associated.

Third, our experience with CamFS has suggested that there might be a relationship between these different functionalities and the place (albeit virtual) where this interaction occurs. As we noted, the virtual desktop affords 'place' while combinations of applications can as well but the important point is that however constituted, this is a place where patterns of engagement with file entities combines the creative process along with what we called pre-work. This kind of work is, in a sense, essentially private; the output of that work, the defining of files into categories, into things that can be set, equates in our mind with a move from back stage to front stage, from messy and inchoate into tidy and ornamental, even visible. However, this is not then strictly a move from private to public, but a move in performative value.

At the same time, the way that CamFS provides a way of looking also draws attention to the unique status of the desktop as a domain of a particular form of engagement—here the value of graph based rendering is of another order. Our research also points to the possibility that graph relations might also be of value in working with files that are still being produced. Graph relations can highlight histories

of changing files, they might highlight connections between different sources and entities—Tagtivity comes to mind.

If this is so, if there are then at least two places in our digital lives created by the introduction of a graph store, then it seems to us that a fourth consequence from our inquires is the idea that the location on which a file is displayed, namely the desktop or some version of CamFS, should also implicate the functional unit, the abstraction. Operations possible on the icon representing that abstraction should reflect this context. As we have alluded, the difference here might be related to the distinction between 'internal' and 'external' functions.

It is also clear from our experience that the location of one or other of the two fields is not fixed in cement; sometimes files that are finished come back to life and need to be re-edited. Sometimes one wants to show things that are not quite 'done'. To facilitate this we think that a combination of desktop and a graph store like CamFS should allow easy movement between their respective domains, as in a drop and drag process for an icon. Once an icon is dragged into CamFS it becomes a finished object; when dragged back onto a desktop it becomes open to editing again.

4 Conclusion

We have covered a great deal of ground in this paper and have elided many important topics. Nevertheless, we think a number of insights have been produced thus far, which we have elaborated. In summary,

- The first has to do with relationships between file abstractions, the history of file content and the finished state of a file;
- The second, the distinction between engaging with the internal contents of a file and external operations that affect the placing of that file alongside others;
- third, the functionalities of File Directories in putting away or hiding content and the reverse role of graph directories like CamFS in making work outputs visible;
- Fourth, the relationship between domains of interaction that might be engineered in the future—one being creative, for pre-work, another for display;
- And last, the role of graph-based stores on the space for this creative work, for the management of the liminal, the unsorted, the incomplete, the stuff of the mind if not for the gallery.

References

Appadurai, A. (Ed.). (1986). *The social life of things: Commodities in cultural perspective*. Cambridge: Cambridge University Press.

Boehner, K., Sengers, P., & Warner, S. (2008). Interfaces with the ineffable: Meeting aesthetic experience on its own terms. *ACM Transactions on Computer-Human Interaction (TOCHI), 15*(3), 12.

Button, G., & Dourish, P. (1996). Technomethodology: Paradoxes and possibilities. In *Proceedings of CHI 1996* (pp. 19–26). ACM Press.

Crabtree, A. (2004). Design in the absence of practice: Breaching experiments. In *Proceedings of 2004 ACM Syposium on Designing Interactive Systems* (pp. 59–68). ACM Press.

Garfinkel, H. (1963). A conception of, and experiments with, 'Trust' as a condition of stable concerted actions. In O. J. Harvey (Ed.), *Motivation and social interaction* (pp. 187–238). New York: The Ronald Press.

Harper, R., Thereska, E., Lindley, S., Banks, R., Gosset, P., Odom, W., et al. (2013). What is a file? In *Proceedings of the 2013 Conference on Computer Supported Cooperative Work—CSCW* (pp. 1125–1136). ACM Press.

Johnson, J., Roberts, T., Verplank, W., Smith, D., Irby, C., Beard, M., et al. (1989). The Xerox star: A retrospective. *IEEE Computer, 22*(9), 11–26.

Lindley, S.E., Marshall, C.C., Banks, R., Sellen, A. and Regan, T. (2013). Rethinking the web as a personal archive. In *Proceedings of the 22nd international conference on World Wide Web* (pp. 749–760). ACM.

Malone, T. (1983). How do people organize their desks? Implications for the design of office information systems. *ACM Transactions on Information Systems (TOIS), 1*(1), 99–112. (TOIS Homepage archive).

Neustaedter, C., & Sengers, P. (2012). Autobiographical design in HCI research: Designing and learning through use-it-yourself. In *Proceedings of the Designing Interactive Systems Conference* (pp. 514–523). ACM Press.

Odom, W., Harper R., Sellen. A., & Thereska. E. (2012). Lost in translation: Understanding the possession of digital things in the cloud. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 781–790). ACM Press.

Oleksik, G., Wilson, M., Tashman, C., Rodrigues, E. M., Kazai, G., Smyth, G. (2009). Lightweight tagging expands information and activity management practices. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 279–288). ACM Press.

Poole, E. S. (2012). Interacting with infrastructure: A case for breaching experiments in home computing research. In *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work*. ACM (pp. 759–768). ACM Press.

Sellen, A., & Harper, R. (2003). *The Myth of the paperless office*. Boston: MIT Press.

Tolmie, P., & Crabtree, A. (2008). Deploying research technology in the home. In *Proceedings of the 2008 ACM Conference on Computer Supported Cooperative Work* (pp. 639–648). ACM Press.

Whittaker, S., & Sidner, C. (1997). Email overload: Exploring personal information management of email. In S. Kiesler (Ed.), *Culture of the Internet* (pp. 277–295). Mahwah, NJ: Lawrence Erlbaum Associates.

Supporting Shared Sense of History Within a Rural Village Community

Keith Cheverst, Nick Taylor and Trien Do

1 Introduction

In this chapter we present our longitudinal study of a community photo display system known as the Wray Photo Display (Taylor and Cheverst 2009, 2012) and how members of the community used this display to interact with their past (and each other). Our development of the Wray Photo Display commenced in 2006 as part of a research project which set out to investigate how situated displays could support rural communities, and in particular how such displays could support coordination and notions of community.

The Wray display (see Fig. 1) was co-designed with the residents of the village of Wray. Wray is a rural village in the north of England with a population of approximately 500 people. In carrying out our research, we have made significant use of technology probes (Hutchinson et al. 2003) and the use of longitudinal studies 'in the wild' (Rogers 2011). Indeed our situated display-based application was designed as a technology probe and has undergone a number of revisions since its initial deployment in 2006. These revisions were made in order to satisfy requests for additional functionality received from the village community as part of a participatory development cycle inspired by action research (Hayes 2011). In particular, in 2010, a significant design modification saw the Photo display functionality supplemented with additional functionality to allow residents to post advertisements and event list-

K. Cheverst (✉)
Lancaster University, Lancaster, England, UK
e-mail: k.cheverst@lancaster.ac.uk

N. Taylor
University of Dundee, Dundee, Scotland, UK

T. Do
University of Oxford, Oxford, UK
e-mail: trien.do@ndm.ox.ac.uk

A. Chamberlain and A. Crabtree (eds.), *Into the Wild: Beyond the Design Research Lab*, Studies in Applied Philosophy, Epistemology and Rational Ethics 48,
https://doi.org/10.1007/978-3-030-18020-1_6

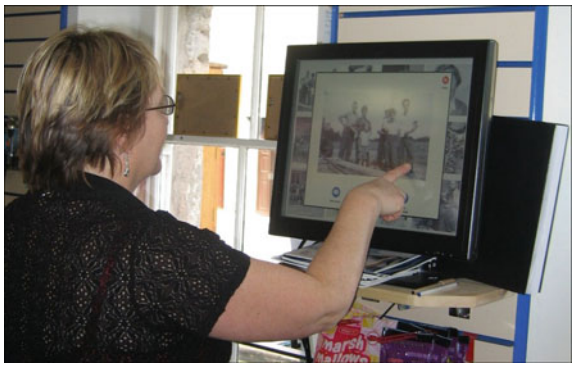

Fig. 1 The original Wray Photo Display. This display was deployed in the post-office and the figure shows one of Wray's residents interacting with one of the uploaded Historic photos

ings and from this point the display system was renamed WrayDisplay (Taylor and Cheverst 2012).

A local technology enthusiast agreed to act as a 'champion' in the community and work with us to deploy technologies and organise meetings with other residents. The significance of having such a person available to help the research team and support the success and sustainability of the project over a longitudinal period cannot be overstated.

Beyond an early collection of seeded photos, the content of the display was entirely determined by the residents of the village. One early and key design decision was to enable village residents to create and take ownership of their own content categories, including delegated moderation. Two of the first categories to be created and moderated by residents of the village were: 'Old Photos' and 'Wray Flood'.

WrayDisplay is, of course, not the first example of a technology focused community system supporting cultural heritage. Much of the earliest work investigating local intranets or "community networks" found that such tools supported the recording of history in a community. To take a well-known example, studies of the Blacksburg Electronic Village (Carroll and Rosson 1996, 2013) saw various groups within the community maintaining pages which celebrated the town's history, including input from local schoolchildren. However, community-centric situated display deployments have typically concentrated on awareness of current events and individuals in the community rather than the past. One important property of a situated display based system is that the display(s) can be placed at key locations in the community (and by the community) and these placements will typically have certain expected audiences. For example, a WrayDisplay is currently (October 2017) deployed at the village pub (previously displays have been deployed in the village post office,, community hall, garden centre and the village café) and these are all places in the village that are frequented by both residents of the village and visitors to the village, e.g. families on holiday. Since the first deployment of a display in the village in 2006, in excess of 3000 photos have been submitted to the system. A content analysis carried out in 2015 showed that a significant portion of content submitted to the system related to Wray's local history and cultural heritage (Do et al. 2015).

We have recently updated the system to support Locative Media Experiences (subsequently abbreviated to LMEs) that can be consumed using an Android based mobile app and authored using both Web-based and mobile authoring tool. The LMEs available for Wray can be viewed and downloaded via WrayDisplay.

The remainder of this chapter is structured as follows. In the next section (Sect. 2) we present Background to the research and related work around the areas of 'sense of community' (and how this relates to a community's shared sense of history) and situated displays/locative media applications that have been built to support exploration of cultural heritage materials. In Sect. 3 we present an overview of the design, deployment and use of the Wray Photo Display with particular emphasis on those issues relating to Wray's cultural heritage and associated user interaction. In Sect. 4 we describe recent updates that support the authoring and consumption of LMEs within Wray. Finally, Sect. 5, presents our concluding remarks.

2 Background and Related Work

Two areas of related work are applicable to the research presented in this article. These are 'sense of community' (and its relationship to shared cultural heritage) and technology based solutions (and in particular situated display and mobile technologies) that support the capture and sharing of cultural heritage materials.

2.1 Sense of Community and Cultural Heritage

McMillan and Chavis (1986) define sense of community as "a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together". Further to this they highlight four key elements, namely: 'membership', 'influence', 'integration and fulfilment of needs' and 'shared emotional connection'. It is this last element that is of particular relevance to this proposal and which McMillan and Chavis describe as:

> the commitment and belief that members have shared and will share history, common places, time together and similar experiences. This is the feeling one sees in farmers' faces as they talk about their home place, their land, and their families….

As discussed later in this article, it is content relating to this shared history that appears to have had such a strong connection with members of the Wray community.

2.2 Situated Displays, Locative Media and Community

Research into 'situated displays' belongs in CSCW, Ubiquitous Computing and HCI fields and has received considerable interest in recent years due, in part, to the widespread availability of cheap display devices and wireless communications. An excellent foundational text for the topic area is: 'Public and Situated Displays: Social and Interactional Aspects of Shared Display Technologies' (O'Hara et al. 2003).

Fundamental to this notion of 'situated' is the notion of 'place' which Harrison and Dourish (1996) define as "a space which is invested with understandings of behavioural appropriateness, cultural expectations, and so forth". Within the village of Wray, the situated nature of our display deployments was crucial with all deployments being places in so-called community hubs, e.g. the village shop, the village hall, the local pub, etc.

In terms of previous research in this particular area one early example is that of the Campiello system (Agostini and Valpiani 1999), which was designed to support the place based community in a neighbourhood in Venice. More specifically the research aim was:

> …supporting the dynamical exchange of information and experiences between the Community of People living in Historical Cities of Arts and Culture, their local cultural resources, and foreign visitors.

In addition to supporting web-based access, members of the community could also interact with the system through a large screen display, referred to as the CommunityWall.

Other relevant work in this area includes the Byker Lives Table (Taylor 2014). Like the Wray Photo Display, this display collected photographs and other media contributed by the community in Byker, an area of Newcastle, UK. However, the emphasis of this work was on divisions within the community, particularly over how a significant redevelopment of the community in the 1960s was interpreted as either a positive or negative event. The deployment explored how these photos could be curated as part of an exhibition while remaining inclusive and highlighting a variety of contrasting views.

Locative Media (Galloway and Ward 2006; Hight 2008) and how it relates to this article can be considered as follows:

> The development of locative media applications is not simply about the physical location or social setting in which the interaction occurs, but rather about situating the media within the social setting of a community. (Willis and Cheverst 2011)

Although predating the term, the research that took place in the late nineties on mobile context-aware city guides provided early examples of locative media systems. For example, the GUIDE system (Cheverst et al. 2000) was designed to provide visitors to the city of Lancaster and local residents with context-aware access to services and digital (hypermedia) content. The content was ostensibly related to

the cultural heritage of Lancaster and included historical information relating to attractions within the city, e.g. the City Castle and Maritime History Museum.

Another early example of Locative Media (again one that existed before the term had actually been coined) was the project '34 North 118 West' (http://34n118w.net/). This project from 2002 again coupled location sensing (GPS in this case) with mobile computing devices in order to support a 'locative narrative' in which users would be pushed audio narratives relating to places (and their associated history) they passed by in Los Angeles. At a similar time, the 'Urban Tapestries' project (urbantapestries.net) set out to explore how "…by combining mobile and internet technologies with geographic information systems, people could 'author' the environment around them". The project ended in 2004 and was then followed by the 'social tapestries' project (socialtapestries.net) which focussed on "exploring the potential benefits and costs of local knowledge mapping and sharing, what we have termed the *public authoring* of *social knowledge*". While few research publications relating to the project exist, a comprehensive report is available from the project web-site.

More recently, a myriad of context-aware/locative media mobile applications have arisen from both the research and commercial domains—the latter being to cater for the burgeoning smart-phone market. One important feature of these smart-phone applications is their ability to support the automatic tagging of photos with their location before being uploaded to social media sites such as flickr. There is then the potential to use the tagged content as feed for community displays, an approach adopted by the Citywall project (Peltonen et al. 2008) in Helsinki.

Supporting personalised access to Cultural Heritage is one growing area of research that focuses on personalisation aspects and appears to show significant future potential for benefiting the user experience. Two recent projects that represent current state of the art in this area are 'Locast Tourism' and 'Memory Traces' (Boghani and Casalegno 2012) which the authors describe as following "a systematised approach for designing online locative platforms in support of unique user experiences with situated sociocultural topics." A comprehensive overview of research concerned with ICT support for content organization and dissemination in cultural environments is presented in Styliaras et al. (2010).

3 Development of the Wray Photo Display

In this section we describe the on-going development of the Wray Photo Display and describe our approach that features participatory design and longitudinal evaluation as critical components.

Fig. 2 Wray Village Hall, the site of the first display deployment

3.1 Early Design Workshops

The adopted participatory design approach with the Wray community has involved extensive use of design workshops and the provision of appropriate feedback channels such as the comments book placed next to the Wray Photo display.

During the first design workshops (which took place in May 2006) it was necessary for the researchers present to convey to the residents the role that photos could have in supporting sense of community. In the pub where the design workshop was held there were a number of framed photos on the wall showing Wray from the past and the researchers highlighted these pictures to the residents in order to illustrate how photos (in this case historic and clearly related to the cultural heritage of Wray) related to the 'Wray community'.

A decision was then made for the researchers to go ahead with the development of a simple system that would be placed inside the village hall (see Fig. 2) and would display photos from the forthcoming scarecrow festival (an annual community event in which residents would build ornate scarecrows which would be placed in their gardens for public viewing during the so-called scarecrow festival week).

3.2 The First Deployment of the Wray Photo Display

The first display (see Fig. 3) was an extremely simple but reliable prototype: a touchscreen display connected to a concealed computer which showed pages of ten thumbnail photos and users could move back and forward through the photo collection using on-screen controls. Photos could be transferred to and from the display using Bluetooth file transfers from mobile phones. In terms of hardware, the

Fig. 3 Deployment of the first display

first display application was driven by a 2006 Mac Mini that was selected due to its near-silent operation and small form factor (that allowed it to be placed out of view) and the display itself is a resistive touch screen monitor.

The first version of the Photo Display was deployed during an annual event known as the produce fair (which takes place a few weeks after the scarecrow festival) and this took place in the village hall (Fig. 2a). A comments book was placed next to the display and early hand-written comments left by residents and visitors to the village pointed to the desire for old photos to be included as future content. For example, the first comment left in the comments book (August 2006) was:

> This is a very good idea. Very interesting for the village people. It would also be good to see some of the old photos of days gone by.

And other similar early comments included:

> Photo Album – wonderful idea. Would be great to see some of the historical pictures of the village…

However, despite obvious enthusiasm for growing the collection, the Bluetooth-based system for uploading content was not popular or convenient. In response, we developed a web-based application for uploading photos to the display, which also allowed us to add a more robust system for categorising photos. In discussion with members of the community, it was agreed that in order to foster a sense of ownership by the community for the system and its content, any member of the village would be able to add a category but that person would then have to pre-moderate any content before it would appear on the display.

3.3 Photo Categories

One of the first new content categories to be added was that of "old photos" (examples shown in Fig. 4).

Fig. 4 Two sample images included in the "Old Photos" category

Comments received in the comments book shortly after the introduction of the new category were positive:

a great way of recording a living history of Wray

Love the different Categories. The old photos are fascinating

and a delight for those who were born here and to go down memory lane

I particularly like the old Photos of Wray – very interesting

These early comments signified at an early stage the importance that cultural heritage was going to play in the project.

Shortly after the addition of the "Old Photos" category (which typically contained photos of Wray from 20th Century) a new category was added called "Wray Flood". The Wray flood occurred in 1967 and the first images to be uploaded to this category were clearly scans of newspaper pictures (see Fig. 5).

At around this time (October 2006) the display was moved from the village hall to the village Post office. Figure 6 shows the display placed in the Post Office with one of the younger village residents making use of the system's commenting feature. The new Post Office location also allowed the research team to receive feedback of

Fig. 5 Two sample images included in the "Wray Flood" category

Fig. 6 Using the WrayDisplay's commenting feature in the village Post Office

use from the shop owner who could observe users of the display. The shop owner informed us that some visitors would spend 20 min or longer interacting with the display.

3.4 Support for User Commenting and Captions

When uploading a photo the user has a choice of whether or not to include a caption. Typically a caption was not included but where a caption was included this would often provide interesting context. Often, this was simply a list of who appeared in the photo or where it was taken. However, in Fig. 6 there is a photo relating to contemporary cultural heritage that shows one of the town's scarecrows from the year 2000 and the user who submitted this photo included the caption:

> 2000 - no scarecrows 2001 due to foot & mouth outbreak

This caption refers to the fact that in 2001 there was no scarecrow festival in the following year because of enforced restrictions during the outbreak of the highly infectious 'foot and mouth' disease (*Aphthae epizooticae*) which had a devastating effect on rural farming communities (such as Wray) during the turn of the millennium.

However, the majority of photos were not provided with captions. For historical photos in particular, this often led to requests for information from the community. For example, one early hand-written comment left in the comments book read:

> We have some names and descriptions of the photos (old ones) of wray and dates – How and When ??? could we put them on ?

In response to frequent requests, we implemented a commenting feature using a reasonably straightforward on-screen keyboard (Fig. 6). Many of the comments subsequently posted were used to express positive opinions about the photos, but many also provided additional context that had been missing. One example of an early photo submitted to the "Wray Flood" category which has no caption but two associated user comments is shown in Fig. 7. The two comments are:

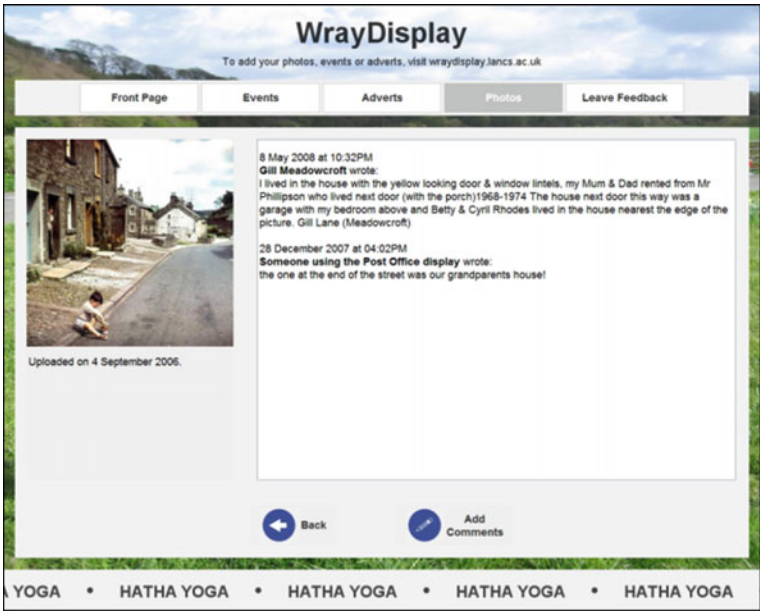

Fig. 7 An uploaded historic image with two associated comments

> 8th May 2008 at 10:32 pm Gill Meadowcroft wrote:
>
> I lived in the house with the yellow looking door & window lintels, my Mum & Dad rented from Mr Phillipson who lived next door (with the porch) 1968-1974. The house next door this way was a garage with my bedroom above and Betty & Cyril Rhodes lived in the house nearest the edge of the picture. Gill Lane (Meadowcroft),
>
> 28th December 2007 at 4:02 pm
>
> Someone using the Post Office display wrote:
>
> the one at the end of the street was our grandparents house!

In another example, on the photo that made mention of foot and mouth disease, one user respond with a poignant comment simply saying: "*Sad*".

It is interesting to note how the content of these comments is both informative, providing detailed information relating to occupancy of the buildings shown, but also very personal to particular individuals in the community, celebrating their emotional or familial connection to the heritage that is on display.

3.5 Further Deployments

A second display was deployed in the village cafe (following a request made in the comments book) and later functionality included news and events features. More

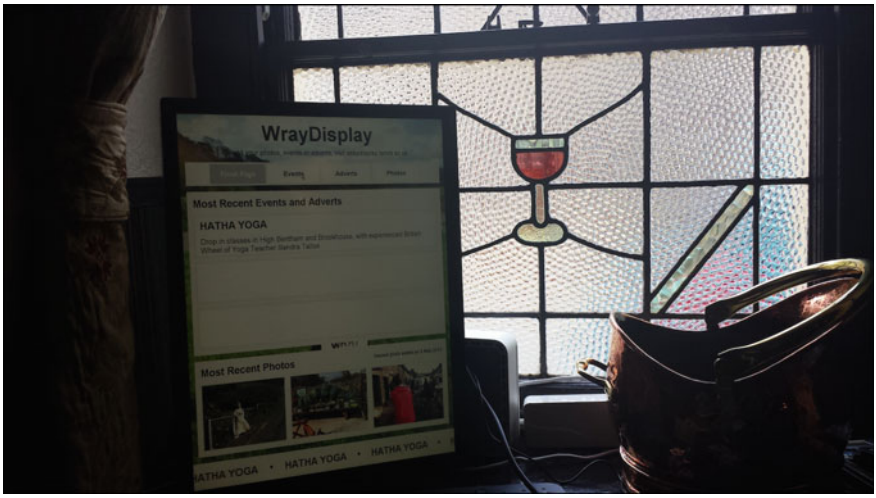

Fig. 8 The Wray Display currently deployed in the Village 'George and Dragon' Pub

recently the Wray display was moved from the village cafe to the pub (see Fig. 8). While the cafe was mostly frequented by visitors to the village, the pub is a social hub for residents of the village: it is notable that the walls were already decorated with historical photos of the village.

With the display in place, it has continued to act as a probe to learn about the community and villagers' use of the display, collecting community-generated content and logging all interaction. This allowed us to identify types of content that were popular in the village and approximate patterns of usage. To gain a deeper understanding beyond this data, we continued to meet with residents at regular intervals to discuss their thoughts about the display, how the community was using it and how they would like to see it improved. We also regularly attended community events, such as the annual village fair.

3.6 Issues of Sustainability

The collection of cultural heritage on the displays has led them to be highly valued by the community, who wished to maintain the display after the conclusion of the original project. Although we had always indicated that the community could retain the displays, the realities of handing over a research prototype to everyday users are fraught with difficulties (Taylor et al. 2013), not least maintaining the technology itself. In recent years, there has been considerable interest in how projects carried out with close cooperation of communities can have a sustainable benefit for participants. This has been highlighted as a difficulty in the use of action research in HCI (Hayes

2011), given that HCI research often relies on prototypes that communities may be ill prepared to support once researchers are unavailable. For our project, we saw an ethical obligation not to simply abandon the long-term deployment, as well as to maintain the village as a valuable research environment for others.

Although there are technical challenges, the social challenges of maintaining engagement with the system are perhaps more challenging. Balestrini et al. (2014) developed a series of guidelines for supporting sustained engagement, including fostering a sense of ownership, utilizing off-the-shelf technology and facilitating face-to-face discussion. Referring specifically to public displays, Hosio et al. (2014) discuss the need for displays to have value for the venues that host them, while some of the most recent thinking on civic technologies has promoted common ownership by stakeholders, including the created content (Balestrini et al. 2017). In the case of WrayDisplay, many of these guidelines were met, which has helped to support sustained engagement thus far. As we have described, creating a sense of ownership of both the display itself and its content was particularly important.

Finally, as the end of the original project approached, it became clear that community members were most concerned about access to the valuable content on the display more than the technology itself. For this reason, we had previously provided a back-up tool that allowed our champion to download an archive of content. The current project plans to involve the community in the development of an agreed exit strategy at an early stage of the project that will then be finalised and implemented towards the end of the project in order to complete the handover process.

4 Support for Locative Media Experiences

In this section we describe our recent developments to support the authoring and consumption of Locative Media Experiences (LMEs) in order to enable both residents and visitors to share in Wray's local history cultural heritage while walking through the village. In order to support this, we have developed the SHARC Locative media framework (Cheverst et al. 2016). This software framework includes both web-based and mobile tools to support the mobile authoring of LMEs (Cheverst et al. 2015) and an Android 'Player' app that employs a push-based approach for presenting multimedia content as a given Point of Interest (PoI) is approached (sensed using the phone's GPS).

In the following sub-section we describe our approach for producing an initial locative media experience with the help of a local historian. Next, we describe the way in which 'published' locative media experiences can be browsed through an updated version of WrayDisplay and then downloaded for consumption via an Android 'Player' app. This is followed by a summary of a design workshop (in which residents contributed their own media) and the deployment of an updated WrayDisplay at Wray's Garden centre.

4.1 Interview with Local Historian

In order to gain a greater understanding for the breadth of cultural heritage related to Wray we met with an amateur local historian, called Sarah. She was a recently retired university academic with particular interest in 19th and 20th century, who lived in a neighboring village. The contact was made through our village champion via e-mail and the interview tool place on 19th July 2013.

The interview was semi-structured and lasted approximately 70 min and was basically split into two parts. The first 50 min took place in the village café (a former deployment site for one of the Wray displays) while the final 20 min involved the historian taking walking us on tour through the village. We had not asked (nor expected) the historian to take us on this tour but (as described below) it proved very fruitful. Two of this chapter's authors acted as interviewers (but with one taking the lead in the discussion while the other raised points for clarification and operated the dictaphone.

During the café part of the interview the historian provided some useful information regarding the provenance of some of the historic photos that had been submitted to the system and the details of other historians local to village and the texts that they had produced. He also helped clarify the (somewhat complicated) parish boundaries delineating Wray from its neighboring villages with ran into some interesting discussion regarding notions of identity within the community and the association with geographic features in the surrounding area, e.g. those living in a certain valley, those living north of the river, etc.

In the tour part of the interview, the historian took past various significant places in the village some of which we were aware of from our past work and some not. On several occasions we were aware of the significance of a place but has not been aware of its name, one example being 'Kitten bridge' which was destroyed in the flood of 1967 (a key event in Wray's local history and one referred to on several occasions by Sarah). During the tour, as a significant place was approached or came into view, Sarah would describe the significance of the place, e.g. "Over there the Wray flood, the Wray bridge was swept away", and on numerous occasions this would involve referring to what used to be located there, e.g. "This was a wood yard…", "That was the blacksmiths", etc. Occasionally she would point or gesture to make a location clear, e.g. "that was the village shop before they moved there" [points to new location].

On two occasions the historian volunteered her ideas regarding the possible forms that the technology/tools could take. For example, in the excerpt below he refers to the potential of a mobile tool supplementing existing signage.

Historian:	Yeah, have you seen the bus shelter with the flood sign on it?
Interviewer:	No
Historian:	Cause I thought in a place like this, if you have a series of points where you have a little bit of text and a photo and it says underneath and you've got a mobile - if you want to see more photographs of what this was like here, click on this - then people can stand on the street and look at them while they are

Fig. 9 Signage outside the village hall showing photos of Wray's cultural heritage

> there… people could have a look at more pictures… be like having a guided walk but instead of having posters all around the village with pictures and some text you just have a little bit and if you want more then go on-line and interact with it.

The other example occurred when we approached a signage situated outside the village hall that showed a selection of photos relating to Wray's cultural heritage (see Fig. 9).

> Historian: These look like they have been replaced quite recently because they do fade here …. by the looks of it you are converting something like this into an interactive digital mobile experience.

4.2 Development of Sarah's Walk LME

Prior to the interview the authors had already considered the potential of having walks and tours as effectively another type of user-generated-content that could be supported by the Wray displays and mobile tools and that such content could be of value to both residents and visitors to the village. Our reflection on the highly engaging nature of the historian's tour further strengthened our opinion that the tour coupled with associated media would provide a compelling LME. Consequently, we used the web-based authoring tool to create an initial LME for Wray called *Sarah's walk*. This experience consisted of 9 Points Of Interest and focuses on a single Event Of Interest (the Wray flood of 1967). Where appropriate, we used actual audio

Fig. 10 Interface design for presenting LMEs, in this case showing the *Sarah's walk* LME

snippets from Sarah's commentary. The image files used were selected from images submitted to the digital noticeboard system.

The WrayDisplay has been updated to allow users (residents or visitors) to browse LME uploaded to the system. The authoring of these experiences is supported via the Web-based or Mobile authoring tools available through the SHARC framework (Cheverst et al. 2016). The updated user interface is shown in Fig. 10. The screenshot illustrates what is presented when a user has selected *Sarah's walk* as the LME.

The main point to note is the addition of a new tab 'Experieces/POIs' (contrast this to the user interface screen shot shown in Fig. 6). If the experience appeals to the user then they can press the 'Download to my Android device' button in order to instigate the downloading of a file package containing the mobile player app and all associated media files over a WiFi hot-spot. The decision to package the media files with the player app was taken to remove the need for data connectivity while consuming the experience because of the poor mobile data connectivity throughout Wray village.

An selection of illustrative screenshots of the mobile player app is shown in Fig. 11.

4.3 Design Workshop

A design workshop with village residents took place on 30th April 2015 (see Fig. 12) and provided a good opportunity for feedback on the LME and for the contribution of

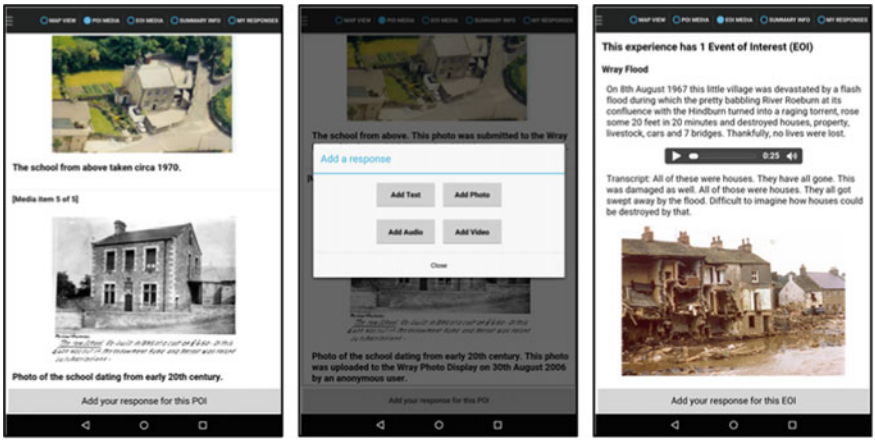

Fig. 11 Interface screenshots of the mobile player app showing the *Sarah's walk* LME

Fig. 12 Discussing accessibility issues with village resident during a Design Workshop

additional content. A week before the workshop our champion posted an invitation on the Wray Facebook page for residents to attend the workshop and spoke, personally, to individuals whom she thought might have an interest. On the morning of the workshop the authors set up a laptop running the web-based authoring tool (with internet connectivity via the Wi-Fi available in the village hall) together with the WrayDisplay displaying *Sarah's walk* LME.

In the afternoon, five residents attended the workshop (no reward for attending was offered) with some attending just briefly to see what the project was about

while others remained for the duration of the workshop (nearly three hours) and had significant involvement and input.

One significant theme that arose from the workshop related to the issue of accessibility. This issue first came up in discussion with a long time resident of Wray called Anne (not her real name). Anne was a keen walker but was currently waiting for a knee replacement operation and required the use of a crutch for walking. She was keen to use the mobile player app and we decided to walk a shortened version of *Sarah's walk*.

Before leaving the village hall Anne read the description of the walk on the digital noticeboard. The description (wrongly) stated "No accessibility issues". Anne described the frightening experience she had suffered when pushing her mother-in-law's wheelchair on the tarmacked downhill path between Wray School and Kitten Bridge:

> I did it once and I shouldn't have done because I went the route where I would take a pram and I very foolishly started going down the hill and scared myself because I just hadn't realised what the weight in the chair might mean and I was crossing my fingers and bracing myself…

Later, while Anne used the mobile player app we returned to the issue of accessibility with Anne commenting:

> you've got things like disabilities organisations, they are seeking specialist information which is of particular interest to wheelchair users about the quality of the loos, the access, the entrances, all that sorts. If you got people like that really interested in the community and sharing the resource then I can see that working …

So Anne had clearly identified a community around accessibility that could benefit from capturing and sharing locative media related to accessibility. We then went on to discuss notions of crowdsourcing and how images could include "drop curbs here…". It was agreed that authors of a locative media experience should have the facility to specifically highlight potential accessibility issues.

Anne also suggested new content to be included as part of 'Sarah's walk' locative media experience. This new content took the form of some archive video footage showing the rebuilding efforts undertaken immediately following the Wray flood of 1967. This video content was added to the *Sarah's walk* LME which was field test during Wray's annual vintage car rally which took place as part of the village's May Day celebrations. Full details of this field trial are presented in (Cheverst et al. 2016).

As Anne walked through the village with the authors, consuming the Sarah's walk LME via the mobile player app, it was clear that she had a strong knowledge of Wray's local history and could speak about this eloquently. For example, as we approached Wray school (and the locative media was triggered) she described her understanding of the school's history, providing a slightly different perspective from that which we had heard/read previously. It would have made an excellent audio clip to associate with the school POI but on finishing her piece she said:

> I don't want you to use that but you are just doing it for the purpose of… [this trial].

Anne had earlier said that she: *"was not a social networking person" and "I don't like how much information some people make available – I mean it's just scary"*.

However, a little later in the walk Anne expressed the following (that perhaps suggests a different reason, more associated with self-confidence, for not wanting to share her response):

> In a way I am used to using the old ways, if they work, but … I've not got used to putting my own two penny worth in… but I have got a two penny worth or so in terms of knowledge, but its just that I don't always think it is interesting to anybody else.

4.4 Deployment at Wray's Garden Centre

In September 2015 the updated version of WrayDisplay was deployed at the village's Garden centre, known as the Garden Rooms (see Fig. 13).

The Garden Rooms shares a large parking area with the village Tearooms and is consequently a good location for visitors. During the day of deployment the authors were able to discuss with villagers the new digital noticeboard and its support for locative media experiences. There was also opportunity for one of the residents, to create his own 'Labyrinth' experience using SHARC's mobile authoring tool (see Fig. 14, left) and publish this for display on WrayDisplay (see Fig. 14, right).

Fig. 13 Deployment at Wray's Garden Rooms

Fig. 14 Resident using the mobile authoring tool to create his own 'Labyrinth' LME (left) and the published LME appearing on WrayDisplay (right)

5 Concluding Remarks

In this chapter we have presented our 'in the wild' research exploring the long-term real-world deployment of a situated display based system in the rural village of Wray. In particular, we have focused on the community's use of the Wray Photo Display for interacting with and communicating through user generated photo content and associated comments. A significant proportion of the images uploaded to the system relate to the village's cultural heritage (both past and contemporary). Furthermore, many of the comments added by residents were to add additional context and insight to an image and this is the kind of engagement that we hope to see again when adding the tour/walk category.

It is important that the design of these tools is done in a participatory fashion to help ensure both their appropriateness to the requirements posed by the broad community (given the range of technical abilities for example) and also to foster a greater sense of ownership on behalf of the community.

Furthermore, a 'one-size-fits-all' tool is unlikely to be appropriate given the range of contexts of use, e.g. curating Locative Media Experiences for consumption by established members of the village community versus curating for consumption by residents new to the village versus curating for consumption by visitors. Some tools may be mobile applications that support the capture of content in situ, whilst others may involve the tailoring of existing technologies within the village, for example modifying the colour photocopier in the village post office in order to support the simple scanning of historic village newspaper articles.

In terms of technologies to support the consumption of these narratives we envisage that both mobile technologies and situated displays provide suitable properties and affordances. In particular, our experiences with situated displays have taught us

that their placement is crucial (e.g. siting the display where the audience has due time to interact) and again consultation with the community is vital in order to promote sense of ownership and avoid inappropriate placements.

Acknowledgements This research has been funded through a Microsoft Research European PhD scholarship and the EPSRC-funded CASIDE: "Investigating Cooperative Applications in Situated Display Environments" and SHARC: "Investigating Technology Support for the Shared Curation of Local History" projects (grant numbers: EP/C005589 and EP/K015850/1 respectively).

References

Agostini, A., & Valpiani, A. (1999). *Appreciating cultural heritage by activating local communities*. Position Paper at the workshop on 'Artificial Intelligence & Cultural Heritage' within AI*IA99, 6th Conference of the Italian Association for Artificial Intelligence, Bologna, Italy, 14 September 1999.

Balestrini, M., Bird, J., Marshall, P., Zaro, A., & Rogers, Y. (2014). Understanding sustained community engagement: A case study in heritage preservation in rural Argentina. In *Proceedings of the CHI '15* (pp. 2675–2684). ACM.

Balestrini, M., Rogers, Y., Hassan, C., Creus, J., King, M., & Marshall, P. (2017). A city in common: A framework to orchestrate large-scale citizen engagement around urban issues. In *Proceedings of the CHI '17* (pp. 2282–2294). ACM.

Boghani, A., & Casalegno, F. (2012). Open Locast: Locative media platforms for situated cultural experiences. In *Proceedings of the 4th International workshop on Personalised Access to Cultural Heritage*. Available at http://patch2012.wordpress.com/.

Carroll, J. M., & Rosson, M. B. (1996). Developing the Blacksburg electronic village. *Communications of the ACM, 39*(12), 69–74.

Carroll, J. M., & Rosson, M. B. (2013, July). Wild at home: The neighborhood as a living laboratory for HCI. *ACM Transactions on Comput-Human Interaction, 20*(3), Article 16.

Cheverst, K., et al. (2000). Developing a context-aware electronic tourist guide: Some issues and experiences. In *Proceedings of the CHI '2000*, Hague, Netherlands (pp. 17–24). ACM Press.

Cheverst, K., et al. (2015). Supporting the mobile in-situ authoring of locative media in rural places: Design and expert evaluation of the SMAT app. *International Journal of Handheld Computing Research, 6*(1), 1–19.

Cheverst, K., et al. (2016, April). Supporting the consumption and co-authoring of locative media experiences for a rural village community: Design and field trial evaluation of the SHARC2.0 framework. 2016. *Multimedia Tools and Applications*, 1–32.

Do, T. V., Cheverst, K., & Taylor, N. (2015). Content analysis of a rural community's interaction with its cultural heritage through a longitudinal display deployment. *British HCI, 2015,* 46–55.

Galloway, A., & Ward, M. (2006). Locative media as socialising and spatialising practices: Learning from archaeology. *Leonardo Electronic Almanac, 14,* 3.

Harrison, S., & Dourish, P. (1996). Re-place-ing space: The roles of place and space in collaborative systems. In *Proceedings of the CSCW 2006* (pp. 67–76). ACM.

Hayes, G. R. (2011). The relationship of action research to human-computer interaction. *ACM Transactions on Computer-Human Interaction, 18*(3), 15.

Hight, J. (2008, July). Directions in locative media. *IEEE MultiMedia, 15*(3), 4–5.

Hosio, S., Goncalves, J., Kukka, H., Chamberlain, A., & Malizia, A. (2014). What's in it for me: Exploring the real-world value proposition of pervasive displays. In *Proceedings of the Pervasive Displays '14*. ACM.

Hutchinson, H., Mackay, W., Westerlund, B., Bederson, B. B., Druin, A., Plaisant, C., et al. (2003). Technology probes: Inspiring design for and with families. In *Proceedings of the SIGCHI Con-*

ference on Human Factors in Computing Systems (CHI 03), Ft. Lauderdale, Florida, April 5–10, 2003 (pp. 17–24). ACM Press.

McMillan, D., & Chavis, D. (1986). Sense of community: A definition and theory. *Journal of Community Psychology, Special Issue: Psychological Sense of Community, I: Theory and Concepts, 14*(1), 6–23.

O'Hara, K., Perry, M., Churchill, E., & Russell, D. (2003). *Public and situated displays: Social and interactional aspects of shared display technologies, Series on CSCW*. Kluwer Academic Publishers. ISBN 1-40020-1677-8.

Peltonen, P., et al. (2008). It's Mine, Don't Touch!": Interactions at a large multi-touch display in a city centre. In *Proceedings of the CHI '08 (pp. 1285–1294)*. ACM.

Rogers, Y. (2011). Interaction design gone wild: Striving for wild theory. *Interactions, 18*(4), 58–62.

Styliaras, G., Koukopoulos, D., & Lazarinis, F. (2010). *Handbook of research on technologies and cultural heritage: Applications and environments*. Hershey, Pennsylvania: IGI Global. https://doi.org/10.4018/978-1-60960-044-0.

Taylor, N. (2014). Supporting community participation in interactive exhibits. In *Proceedings of the Pervasive Displays '14* (pp. 74–79). ACM.

Taylor, N., & Cheverst, K. (2009). Social interaction around a rural community photo display. *International Journal of Human Computer Studies, 67*(12), 1037–1047.

Taylor, N., & Cheverst, K. (2012). Supporting community awareness with situated displays. *IEEE Computer, 45*(5), 26–32.

Taylor, N., Cheverst, K., Wright, P., & Olivier, P. (2013). Leaving the wild: Lessons from community technology handovers. In *Proceedings of the CHI '13* (pp. 1549–1558). ACM.

Willis, K. S., & Cheverst, K. (2011, September). Editorial: Special issue on locative media and communities. *International Journal of Human-Computer Studies, 69*(10), 615–617.

Community-University Research: A Warts and All Account

Jon Whittle, Maria Angela Ferrario and Will Simm

1 Introduction

A recent trend in Human-Computer Interaction (HCI) research is to take researchers away from the safety of their labs and ask them to carry out development embedded within a community. This so-called "research in the wild" (RIW) (Chamberlain et al. 2012; Brown et al. 2011; Johnson et al. 2012) is seen as a paradigm shift in HCI research which has a long tradition of controlled experiments with participants who are brought into the lab for fixed periods of time. The move towards RIW is to overcome some limitations of lab-based HCI research, such as the inability to generalize results obtained from controlled laboratory settings to the noisy, uncertain and constantly changing contexts of the real world (Crabtree et al. 2013). At the same time, RIW brings new challenges in carrying out real-world deployments of research prototypes: such prototypes need to be usable, reliable and robust over long periods of time and in evolving and challenging environments (Crabtree et al. 2013).

Although RIW may have specific challenges of its own—such as the need to respect participants' data privacy preferences, which may be significantly more challenging than in a lab environment—many of the challenges faced and, therefore, many of the methods used by RIW researchers are much more familiar. RIW often draws on action research (Hayes et al. 2011), participatory design (Kensing 2003), co-operative inquiry (Heron 1996) and methods of co-design (Sanders and Stappers 2008). These approaches address issues of participant engagement, ethics in real-world scenarios, and long-term sustainability of solutions by encouraging users to

J. Whittle (✉) · M. A. Ferrario · W. Simm
Faculty of Information Technology, Monash University, 25 Exhibition Walk, Room G49, Clayton campus, Melbourne, VIC 3800, Australia
e-mail: jon.whittle@monash.edu

M. A. Ferrario · W. Simm
School of Computing and Communications, Lancaster University, Bailrigg, Lancaster LA1 4YW, UK

A. Chamberlain and A. Crabtree (eds.), *Into the Wild: Beyond the Design Research Lab*, Studies in Applied Philosophy, Epistemology and Rational Ethics 48,
https://doi.org/10.1007/978-3-030-18020-1_7

take ownership; these issues are not new or specific to RIW, although the focus on technical innovation may provide a different perspective. Indeed, anthropologists and sociologists have arguably been carrying out RIW for hundreds of years; for them, doing research in the "real world" is standard.

Attempts at RIW to date have been numerous (see Crabtree et al. 2013 for good examples) but largely remain researcher-centric. That is, the researchers retain control—they define the research questions, the research methodology, and the research outcomes. The research team goes out "into the wild" but few, if any, decisions are made by participants in deciding what to study. This goes against many of the fundamental principles of methods such as co-production, where emphasis is placed on users taking ownership of a product to be developed as a way to encourage more active engagement with it.

In the Catalyst project,[1] an initiative at Lancaster University, we have made a serious attempt to involve communities—charities, social enterprises, community groups and individuals—as equal partners in a range of research projects. Communities and academics jointly define the research questions to be studied and jointly imagine and build digital prototypes that in some way address social challenges embodied in those research questions. Over a three year period, Catalyst has carried out twelve such research projects. Each has produced a digital prototype which has been co-produced and then evaluated "in the wild". These projects have been quite diverse in topic area—ranging from technology for hard-to-reach groups such as the homeless and autistic adults, to issues of sustainability such as technology to promote renewable energy and data analytics to promote more local spending. Despite this diversity, each project has been built on the same principles of community-university partnerships leading to an "in the wild" research prototype.

Whilst there have been a great many successes in the twelve Catalyst research projects, there have also been numerous challenges. This paper gives a frank account of some of the challenges we have faced; we offer them as food for thought for others embarking into community-university technology-driven research projects. These challenges are structured into four different categories: those related to working in the community (i.e., outside of a University research lab); those related to how to ensure innovation in community-focused projects; issues of cross-disciplinarity, since these projects are cross-disciplinary by definition; and practicalities of making such projects work in reality. We raise a number of issues in these four categories illustrating them with specific instances from Catalyst projects. We also identify specific actions which helped to overcome some of the challenges that we faced.

2 Terminology

Before delving into the details of the Catalyst project, this section defines the terminology which we will use in the rest of the paper. Research projects that go "out of the lab" are common in a variety of disciplines, and a variety of methods have been used

[1] http://www.catalystproject.org.uk.

to facilitate such projects. Typically, each discipline comes with its own approach and terminology. Participatory design, for example, has strong roots in Scandinavia and has historically focused on bringing democratic principles to the design of new IT systems for the work place (Kyng 2010). Co-design (Sanders and Stappers 2008), on the other hand, comes from the discipline of design and implies that end-users do not merely "participate" but co-operatively design a product; hence, some would argue that co-design is inherently more participatory than participatory design (Sanders and Stappers 2008). A related term is co-production, an approach widely used for service design, which argues that those affected by a service are in the best position to (re-)design it (Bendapudi and Leone 2003). In HCI, there is a long tradition of user-centered design (Steen 2011); again, the implication here is that users are consulted but do not necessarily make decisions. In addition to these approaches, there is also action research (Susman and Evered 1978; Reason 1999), and, in particular, participatory action research (PAR) (Baum et al. 2006; Walter 2009), which involves an embedding of the research team into an environment where interventions are made in-situ in a series of iterative loops. PAR's central concept is that power is transferred from the researcher to the participants as a means of empowerment. Hence, in PAR, the community makes decisions about the direction of a project. Hayes discusses the relationship between action research and methods typically used in HCI (Hayes et al. 2011).

A more recent term, which has come out of the HCI community, is research in the wild. RIW is defined as a specific attempt to encourage HCI researchers to leave the comfort of their labs and deploy working systems in the real-world (Crabtree et al. 2013). This has very real implications as technological prototypes in the real-world must be robust, reliable and usable. A controlled lab-based experiment with a prototype need not satisfy such high demands. With RIW, the researcher is not present. Hence, whereas RIW presents compelling advantages in that it potentially offers more data in more realistic situations, it can be difficult to achieve in practice because researchers must go to the effort of developing industry-quality software for a fledgling idea that may ultimately not be worth it.

In a sense, all participatory methods are "in the wild"—they inherently involve the researchers leaving the lab and engaging with end-users on the end-users' "home turf". However, not all RIW is participatory: a prototype could be designed exclusively by researchers but then deployed in a real-world situation without any input from end users at all.

In reality, it is difficult to draw clear boundaries between these different terms. Definitions presented in the literature can be at odds with each other, and researchers' perceptions about what is meant by these terms also differs. In addition, the very nature of participation means that approaches have to be adapted in-situ: participatory research projects typically involve a diverse set of people with different skills, opinions and backgrounds, and so whatever method is applied needs to be highly adaptive to an ever-changing context.

In this paper, we prefer not to use the term RIW at all. This is because the very phrase conjures up negative connotations. It implies that anything outside the lab—that is, real-world situations—are "wild". And this is too easily interpreted as saying that the people, who are typically end-users or stakeholders of the research, are wild

as well. This is not the kind of impression that a research project which cares about its participants ought to convey.

This negative connotation was starkly illustrated to the authors of this paper during a seminar a few years ago. A well-known speaker had been invited to Lancaster University to speak on issues of global sustainability and climate change. As this topic was of key interest to many local inhabitants of Lancaster, invitations had been sent out to the local community, and many local community groups had come to listen. After the talk, a discussion ensued about the value of community-University research. During this discussion, one academic commented that a grant had recently been acquired from a fund which aimed to support "research in the wild", and the academic went on to explain what was meant by this term. Predictably, the reaction of the local community was one of shock, mixed with a sense of amusement. Behind the humour, though, it had become clear that the very term "research in the wild" worked against the principles that RIW was aiming to follow.

This paper will henceforth, therefore, not use the term RIW. Instead, our focus is on what we call community-University research partnerships. Whilst this term is also not without its problems, we argue that the word "partnership" adequately captures the notion that, as in Catalyst, academics and non-academics jointly make decisions about the research project. All Catalyst projects were intended to follow the principles laid out below:

- A team made up of academics from multiple disciplines and non-academics (charities, community groups, social enterprises, and/or businesses) jointly decided what problem to address and jointly decided on the research questions to be investigated.
- The team jointly devised a "solution" in terms of a digital prototype, which was intended to address a social challenge in some small way. This prototype was jointly evaluated by the team in a real-world situation with real users.
- The team jointly made decisions about the future of the research project, i.e., whether it had a future, and, if so, what form that future should take.

Hence, our notion of community-University partnership is that of co-production applied to technology prototypes with joint decision making at all points of the process. Whilst, in practice, some of the Catalyst projects followed these principles more than others, all projects made a serious attempt along these lines.

3 The Catalyst Project

For context, we briefly describe the Catalyst project. Catalyst (Citizens Transforming Society: Tools for Change) is a cross-disciplinary research project on digital social innovation where the research agenda is jointly set and carried out by academics and non-academics. Although Catalyst is first and foremost a research project, its goal was to have direct impact on communities through the research. Therefore, each Catalyst project was required to deliver academic publications but also a working

digital prototype addressing a particular social challenge and a plan for disseminating and sustaining this prototype within the communities over the long term.

Catalyst sets up partnerships where academics and non-academics have equal status in defining and carrying out the research agenda. The guidance given to projects was that neither the academic nor non-academic deliverables should dominate at the expense of the other. All activity in Catalyst was expected to contribute to two broad research themes:

- What is the role of digital technology in addressing important societal challenges?
- What is the vision of next-generation technologies designed explicitly to address these societal challenges?

Catalyst is organised as a series of short-term research intensive cross-disciplinary sub-projects that each develops new digital technologies to address a social need. There are two types of project in Catalyst:

- Research Sprints last 6–9 months and must contribute to one of the Catalyst research themes. Each sprint is a "co-laboratory" in which academics and non-academics immerse themselves in each others' activities. Each sprint receives a grant to support the research as well as three (later, four) full-time research associates, each from a different discipline (computer science, sociology, management, design).
- Launchpads are smaller in size and are more speculative. Launchpads work as a pilot for ideas for future sprints or allow promising ideas that come out of a sprint to be continued. The duration of launchpads can vary but is typically between 4–9 months.

To reflect upon the ways of working, we applied PROTEE (Duret et al. 2000; Valve and McNally 2013), a management process designed to ensure that projects learn from failure as well as success. PROTEE involves several 3-hour dialogues with sprint and launchpad project teams to glean insights to support innovation, project management and cross-disciplinarity.

Selection of sprints and launchpads is via an application process, mediated by procedures to match-make academics and non-academics. All projects must satisfy the Catalyst criteria: (i) the project must be a genuine partnership between a specific community group(s) and a group of academics—decision-making about the direction of the research is carried out equally; (ii) the project must address an important social challenge; (ii) the project must involve academics from multiple disciplines; (iii) the project must result in a digital innovation which addresses a real social need.

Over a period of three years, Catalyst has:

- Carried out 12 community-University research projects
- Created a network of over 90 "#catalystas" from various Universities and community organisations
- Successfully obtained or contributed to over £900 K in follow-on funding for Catalyst research projects

- Been directly involved in, and made significant contributions to 23 public events outside of Lancaster University. Examples include Manchester Science Festival, the NHS Think-Tech Event, and Fueling Manchester.
- Published over 20 academic or non-academic publications
- Won the Telling Tales of Engagement award from the Engineering and Physical Sciences Research Council.[2]
- Produced 13 videos, designed to bring research results to the wider community, all available on YouTube.[3]
- Given over 20 invited presentations on Catalyst, including invited seminars at UC Berkeley, the University of São Paulo and the University of Cambridge.
- Facilitated thousands of conversations between members of the University and members of local, national and international communities.

Catalyst projects have covered a diverse range of topics including: digital services for the homeless, a digital anxiety management tool for people with autism, a mobile trading tracking application aimed at supporting local trading practices, a tool for sharing biometric data across social networks aimed at supporting local athletes in improving performance, and tools that encourage energy users to reflect on the supply side of energy management so that society can be resilient in the face of inevitable energy shortages yet to come.

All these projects[4] share the common themes of: (1) citizen-led innovation through equal partnerships between the University and its community; (2) digital innovations addressing real problems with real people; (3) a commitment to sustaining the partnerships over the longer term by providing assistance with follow-on funding and training in entrepreneurship.

3.1 Methods

The twelve Catalyst projects have applied a variety of methods to ensure equal participation by academics and non-academics. Taken individually, none of these is new; it is in the integration of methods where Catalyst has innovated. For example, each of the sprints applied a project management framework which we call Speedplay (Ferrario et al. 2014). Speedplay is a response to the fact that developing software prototypes to address social challenges requires new methods.

3.1.1 Speedplay

The value of software in promoting social change is now well recognized. In recent years, there have been attempts to boost such efforts by using rapid prototyping

[2] www.epsrc.ac.uk.

[3] https://www.youtube.com/channel/UCZYEeI1BZst8BDQ7cqnwKfQ.

[4] For more details on all projects see http://www.catalystproject.org.uk.

to quickly develop applications for a social context. One such effort is the rise of hackerspaces or hackathons, which are informal gatherings of software developers and representatives of community groups. These groups come together with the aim of developing software applications to address a social problem in a very short space of time (e.g., 24 h or a weekend). Kera (2012) followed and participated in a number of hackerspaces and found that they foster knowledge production and sharing between those involved, reinforcing a sense of community.

Despite these tangible benefits, in many instances prototypes from hackathons do not have a life much beyond the initial event. Although many hackathons aim to address a particular social issue, developers' understanding of the issue is usually obtained informally, through dialogue with social representatives present at the hackathon. This ignores formal methodologies from social science that are aimed specifically at gaining a deeper understanding of social contexts.

The integration of principles from user-centred design (UCD) with software engineering has been explored as a possible method to strengthen collaboration between users and practitioners, especially in agile development (Larman 2004). Like agile development, UCD has a core set of principles established in the 1980s (Gould and Lewis 1985). Sharp et al. contend that UCD and the customer collaboration seen in eXtreme Programming (XP) already share the aim of "involv[ing] users effectively in software design" (Sharp et al. 2009). Indeed, they state that the integration of UCD techniques may be useful and welcomed by the software community. This sentiment is echoed by Fox et al. who observed the successful practice of varying degrees of UCD applied to agile development in the software industry (Fox et al. 2008).

As previously noted, Catalyst's main focus is social change. Here, software and digital artifacts are viewed as vehicles for social change, rather than end products or solutions to problems. It quickly became apparent in the early stages of Catalyst that existing methods from social and computer sciences were not adequate for the kind of social innovation that Catalyst aims for. On the one hand, whereas agile development methods are good at quickly prototyping potential digital solutions, they do rely on having a "customer" who gives feedback on current prototype iterations and decides which features to implement next. This remains true even when UCD is incorporated as in the approaches above. However, with the kind of democratic projects that Catalyst deals with, there is no single customer who can decide which features should be implemented. Rather, there needs to be a collaborative process of obtaining consensus around which problem to tackle and what a solution should look like. This, of course, is where participatory methods come into their own. However, participatory methods can often be lengthy endeavours taking many months to complete. This length of engagement was not possible given the short term nature of the Catalyst sprints.

The solution to this dilemma—that is, the Speedplay framework—is to combine agile, iterative prototyping with participatory action research in a way that gives sufficient time for cooperative engagement on a problem space (but not open-ended time), encourages co-design of potential solutions, and develops a final solution through agile, iterative prototyping. Added to this, Speedplay incorporates a streamlined version of the PRINCE2 management methodology (Murray 2009) to ensure that the

projects remain output-driven and consideration of the longer term sustainability of the projects is built in to the project from the beginning. We argue that, taken in isolation, none of these individual approaches (i.e., participatory action research, PRINCE2, agile methods) are suited to a software development context that aims to deliver: (a) working digital prototypes with social impact, (b) within a short time frame and (c) in partnership with a range of stakeholders that includes community groups.

The Speedplay process model in Fig. 1 shows each step of Speedplay flowing into the next. The process is paced through the delivery of tangible outputs or prototypes at each step. The prototypes may consist of both hardware and software and evolve from very early paper sketches to working prototypes. This output-driven, disciplined (Boehm et al. 2004) approach is inspired by PRINCE2 but is a lightweight approach in that Speedplay produces minimal project management documentation, usually limited to monthly highlight reports. The steps in Fig. 1 are of similar duration but of different 'pace' where the pace is relative to the time between each prototype version release. This is represented by the narrowing of the spiral from step 1 (slowest, a 10–12 week cycle) at the bottom, to step 3 (fastest, 2–3 week cycles) at the top.

Each step is characterized by a specific theoretic approach: the Prepare step is grounded in action research principles and deploys qualitative research methods for initial user requirement capture. Key for ramping up the pace of this first step is the focal point, an event usually scheduled within the first 10 weeks of the project requiring the team to collaboratively produce a tangible output for an external audience. The Design step embeds action research and participatory design principles into the design process and aims to visualize and design systems that can address user needs. This helps with the refinement of the requirements captured during step 1. The Build step adopts a classical agile approach with short development cycles; it further refines the user requirements and concludes with the release of a stable technology prototype. Stakeholders and end-users are involved at every step of the process, particularly in the Sustain step where wider partnerships are sought to support long-term development and deployments of the prototypes. The refinement of the user requirements is represented by the tapering of the spiral in Fig. 1.

Figure 1 also highlights the differences between Speedplay and other iterative models such as action research, user-centred design, and spiral models in software engineering (Boehm 1988). User-centred design (leftmost in Fig. 1) supports iterative development through design, development, evaluation and analysis cycles (Hayes et al. 2011) but users are not necessarily equal partners in the design process. Action research (centre in Fig. 1) brings an incremental transformation of social practices through the continuous iterations of three phases: plan, act and reflect. Action research, like Speedplay, is incremental and works through iterations of planning, action and reflection. However, Speedplay allows specific methods and techniques drawn from both participatory design and action research to be adopted in parallel, separately or in combination depending on the context. The Speedplay model shares a similarity with Boehm's spiral model (rightmost in Fig. 1) in that it is iterative; however, Boehm's is meant for large-scale projects whereas Speedplay emerged from small-scale projects. In addition, Boehm's spiral model is risk-driven, whereas

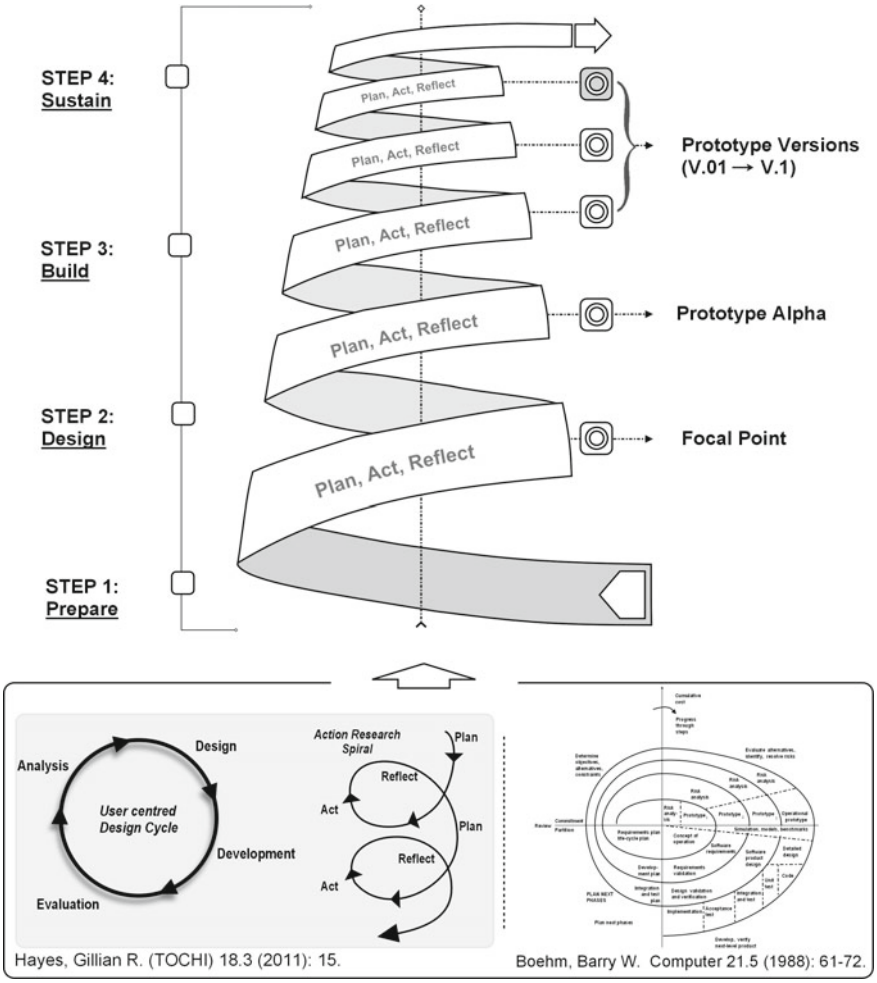

Fig. 1 The speedplay framework

Speedplay helps to pace uncertainties. In other words, Speedplay has an opportunistic approach to risk; in Speedplay, risks are treated as an uncertainty that has the potential to be harnessed, mitigated or discarded.

Further detail about Speedplay can be found in Ferrario et al. (2014).

3.1.2 Other Methods

Only the sprints in Catalyst applied Speedplay. This was because the sprints came with a team of researchers, whereas the launchpads were simply given financial

resources to staff the project in any way that was appropriate. As a result, there is a greater diversity in the methods applied in the launchpads.

In the launchpads, existing participatory practices were widely employed—see (Kensing 2003; Muller 2003; Ehn 2008) for examples, many of which were followed. These practices were also applied within Speedplay; usually, particular practices were associated with a particular step from Fig. 1. The key point to note is the flexibility required within the Catalyst projects: no single method was applied blindly; rather, a suite of methods was applied as circumstances demanded, which allowed projects to be adaptable to change.

Stakeholder meetings are formal meetings between the stakeholders of the project. In Catalyst, stakeholders typically include academic staff from multiple disciplines, representatives of community organizations or local authorities, and/or individuals who are the intended users of the technology to be developed. Stakeholder meetings are where progress is reviewed and decisions about the project's future direction are taken.

Co-Design workshops are events which bring stakeholders together to jointly imagine, build and develop a product (Sanders and Stappers 2008). In Catalyst's case, the product is a digital prototype. Co-design workshops are usually run democratically and give all stakeholders a chance to have input into what problem the group is trying to solve as well as the design of the solution. Co-design workshops can be used at any stage of development, from initial idea generation to solution development.

Co-Implementation is a special case of co-design where stakeholders jointly code the digital solution using an appropriate programming language. We distinguish co-implementation because of its digital nature, and hence, particular relevance to Catalyst. Co-implementation is a difficult activity to carry out because most stakeholders will not know how to code. It may need to be preceded therefore by up-skilling (see below).

Prototypes have been used in two ways within Catalyst. Firstly, they were used to explore a problem space in collaboration with stakeholders. As an example, in one project, the team wanted to build a relationship with residents of a remote Scottish island, who were potential users. To do this, rather than develop the final product immediately, the academics developed a digital Christmas tree and presented it as a gift to the residents. This is a form of technology-mediated co-design in which co-created prototypes are seen as a way to share knowledge rather than as an end-product in themselves. Secondly, Catalyst has used prototypes as a way to gather requirements on the eventual product. As well as using traditional rapid prototyping techniques (Acosta et al. 1994), where the prototype is an early version of the final product, Catalyst developed prototypes which may look very different from the final product but present alternative ideas in a way where concrete feedback can be elicited.

User trials, where users try out prototypes for extended periods of time, are, of course, important in evaluating the products produced in any participatory design

process. In Catalyst, user trials were used in two ways: either with a narrow group of users selected from the project team, or a much wider group more representative of eventual users.

Training is important in Catalyst projects, and we consider this to be a participatory design practice because training allows users to better understand the designers' world, and vice versa. Catalyst used training in two ways: either to train academics in the domain of study, or to train stakeholders in research principles. An example of the former is where researchers needed training in issues of homelessness because they were to be working with homeless people. The latter tends to be more about communicating what research is all about (e.g., publishing conventions, setting research goals, importance of originality) rather than training in any specific method. Both types of training serve to build understanding across the team.

Side benefits refers to cases where a project undertook an activity off the main line of the project. For example, when working with a homeless charity, the project team built a new website for the charity. Since the website in itself was not a research project, it was not on the main line to developing the final product; however, it showed willingness from the academic team and therefore helped to build the relationship. Many of the Catalyst projects included this kind of side benefit. It is especially important in a partnership research project because the non-academic organization must accept that benefits from the digital prototype may only be realized in the longer term. These more immediate side benefits, therefore, mean that the project is less one-sided.

Up-skilling workshops are events where one group of stakeholders teaches the others a practical, hands-on skill such as computer programming, chemistry, or smartphone use. These workshops may develop skills that directly lead towards the final product, or they may be more about trust building. They also typically lead to side benefits as, for example, homeless people learn a new skill which they can write about on their CV and improve their employment chances.

Citizen science is a method for harnessing the collective power of a large population to carry out science (Hand 2010). It is more commonly thought of as using a crowd to collect data, e.g., bird sighting. Here, we use the term for any practice that crowdsourced opinion, design ideas, or design solutions. For example, one project on community film making built a crowdsourcing application for collecting short video pieces from the public as a way to build community cohesion.

Ethnographic methods includes any observational technique for studying users and understanding their context.

Focus groups are well-understood and were used frequently within Catalyst. Similarly, user interviews.

By **digital ethnography**, we refer to online observational methods. For example, one project studied problems experienced by adults with autism by observing an online community forum.

4 Challenges

In this section, we unpick some of the major challenges we faced in applying the Catalyst sprint and launchpad model to community-University partnership research projects. We draw on specific examples where appropriate.

4.1 Working in the Community

At its inception, Catalyst articulated a strong principle of joint decision making in partnership projects. That is, projects were told to avoid a model of researchers as the drivers of the project. This principle was put in place for two reasons. Firstly, community groups were investing precious time in working with the university. Catalyst took their involvement seriously and wanted to avoid researchers "parachuting" in and then leaving nine months later when the funding ran out. Secondly, it was argued that community ownership of the research outputs was critical for longer term sustainability of the outputs and of the partnerships themselves. There was little point in researchers developing a digital solution if the community partners were not invested in its success and were prepared to take ownership of it in the longer term.

As working in partnership with communities was a major element of Catalyst, we reflect in this section on some of the major challenges we faced.

4.1.1 Shared Values

The vision for Catalyst was for truly democratic community-University partnerships. In practice, of course, the extent to which each Catalyst project achieved this democracy varied. All projects took a participatory approach to understanding the problem and designing a solution. However, the extent of participation differed across projects—cf. (Whittle 2014). In addition, whilst the principle of democratic decision making is admirable in the abstract, in practice it can be difficult to achieve. Each project typically involved a wide range of stakeholders, each with their own desires and needs. These needs did not necessarily match, nor did each stakeholder necessarily understand the needs of the other stakeholders. Assumptions were rife and, inevitably, tensions surfaced from time to time when it became clear to one stakeholder that their desires did not match the others.

Table 1 summarizes some typical "needs" of a variety of stakeholders in various Catalyst projects. For example, academics have a primary need to publish, whereas community groups at least partially need to demonstrate some short-term tangible benefit which they can use to satisfy their funders. Similarly, local authorities need to address internal government priorities as well as to provide a benefit to those who use their services. Table 1 is intended to be illustrative only and in no way completely captures the complex set of needs of a wide range of different stakeholders. Indeed, in all cases, stakeholders typically had an underlying personal need to "make a

Table 1 Examples "Needs" of different stakeholders

Stakeholder type	Example needs
Catalyst principal investigator	Conference and journal publications Non-academic impact
Academic staff	Conference and journal publications
Post-doctoral researcher	Conference and journal publications Career development
Community group	Positive impact on community members (e.g., upskilling, empowerment) Financial assistance Short-term benefits (e.g., new website)
Social enterprise	Solution with a viable business model
Local authority	Adherence to government priorities and objectives
Those served by a community group or local authority	Impact on personal situation

difference". One should not ignore the fact, however, that stakeholders have pressures on them from their institutions and/or funders which mean that they have to produce certain kinds of outputs. And these outputs may differ according to the stakeholder.

We discovered early on that it is difficult, if not impossible, to fully articulate the needs of all stakeholders at the beginning of a project. Whilst all projects had a written, and signed, contract describing what the project set out to achieve, the needs were not explicit in the contract. The reasons for this are twofold. Firstly, not all stakeholders knew their needs at the beginning of a project, or were not up-front about them. Secondly, the participatory nature of the projects meant that the outputs changed frequently mid-stream. Early work in the Catalyst sprints realized that "need" or "desire" of stakeholders was not the right level of discourse. Rather, a much more constructive approach was to talk about "values". Whereas stakeholders might differ wildly in their needs, they often had a core set of values shared by all. Where values were not shared, this inevitably led to members of the team disengaging or even leaving the project.

The truth is that, for most Catalyst projects, no stakeholder group's needs dominated, and, it could be argued, a different kind of project would better have served individual needs. For example, if the only concern is for academic publications, a more effective approach would have been to carry out a series of lab-based experiments on new digital prototypes and reduce the participatory aspects. Similarly, more immediate impact on community groups could have been provided by giving a small amount of money for a near-term, non-research objective, such as a new website. The benefit of Catalyst projects, therefore, lies not in servicing any one stakeholder group's needs, but in forming relationships that potentially survive in the longer term and inspire and empower the participants. This is exactly where a set of agreed values becomes crucial. Although stakeholders may have differed in terms of how they were

to be ultimately evaluated (e.g., on publications versus level of service provided), values, such as the desire to improve society through the use of digital technology, were shared in most cases.

As a concrete recommendation for future partnership projects, the Catalyst experience recommends that project stakeholders explicitly capture their shared values at the beginning of a project and, moreover, that these values are revisited from time to time during the project, especially when key decisions need to be made. Although this was sometimes done within Catalyst, the application of this recommendation was patchy. A number of frameworks for discussing values in a simple and straightforward way are available. One example is the Common Cause Handbook, which advocates a focus on intrinsic values over extrinsic "needs" (Holmes 2012). There is also research in values-based design which is relevant here (e.g., Knobel and Bowker 2011).

4.1.2 Management

Another important challenge for community-University partnerships is who makes key decisions. Given that the Catalyst projects were run on democratic principles, and given that the needs of each stakeholder were so different, it is clearly a difficult task to make decisions in a way that keeps all stakeholders engaged. Although each Catalyst project had a designated project leader—sometimes an academic, sometimes from a community—the line management structure was non-traditional. In the sprints, for example, there were 3–4 post-doctoral researchers working full-time on a sprint. The project manager was typically only allocated 10–20% of their time due to other commitments. Both academics and community activists have to juggle many balls; this meant that many project managers did not effectively keep up to date with the work of the researchers, who were often left to manage themselves. This in turn made it difficult for project managers to make key decisions, because they did not necessarily have the backing or knowledge of the researchers.

In many cases, key decision points were where the mismatch in needs re-surfaced. As an interesting example, we refer to the second Catalyst sprint, a project called Access ASD, which aimed to use digital technology as a means to support autistic adults in their daily lives.

In the Access ASD project, a partnership involving a multidisciplinary team of academics, care-service managers from a local authority, mental-health therapists and practitioners from national Autism charities came together for nine months. The initial brief was intentionally wide: investigate technology applied to social anxiety experienced by adults diagnosed with High Functioning Autism/Asperger Syndrome (HFA/A). In the end, a technical prototype called Clasp emerged from a deep insight into how anxiety is experienced by HFA/A adults. Clasp (Simm et al. 2014) is a novel tactile anxiety management, communication and peer support tool. Clasp connects a tactile anxiety coping device to a smartphone, which records and communicates anxiety levels for self-feedback and reflection. The data may be shared for real time online social network support, or aggregated over time to allow users

Fig. 2 Clasp: A digital tactile anxiety management device supporting self-reflection

to identify patterns or situations in which they feel most anxious. This can then lead to behavioural interventions, either applied personally or suggested by clinicians. Clasp was prototyped with a Bluetooth connected stress ball, Android smartphone and the Diaspora social network—see Fig. 2.

Access ASD, as other Catalyst sprints, was managed using the Speedplay framework. One aspect of Speedplay is that there are *focal points* during the co-design process, where important potential ideas are considered and then selected. These focal points are crucial decision-making events: as with any co-design project, the opening up of ideas eventually has to be anchored into a specific project that is to be produced. In Access ASD, a major focal point arose after a week long retreat by a subset of the research team. Before the focal point, a number of competing ideas had been suggested. After the focal point, a decision was made to pursue the ideas that would eventually become Clasp.

It was just after this focal point that tensions arose as to whether Clasp really was the best choice as the digital output of the Access ASD project. It emerged that some of the project stakeholders had different ideas in mind as to what should be developed, and that these ideas, whilst claimed to have been in the mix since the beginning of the project, had not necessarily been articulated before. In essence, the choice was between Clasp, which was considered by some in the research team to be an innovative and highly novel application, and a more traditional social network that would both serve as an information portal where autistic adults could go for help, but would also serve as a way to identify autistic adults not currently known to the local authority. The thinking was that an information portal would "draw in"

autistic adults, who would then have the opportunity to use the local authority support services. This need to identify as yet unknown participants was seen as important by the local authority because of an internal mandate to improve access to their services.

These two very different visions resulted in tensions that were never fully resolved. The decision was made by the post-doctoral researchers to go with Clasp. This was the preferred choice of the so-called "core user group", a small group of autistic adults that had been involved in the co-design process. It was not, however, the preferred choice of the local authority. The problem surfaced tensions between the core user group, the post-doctoral researchers, the local authority and the academics on the project. Curiously, the local authority, whose role ostensibly was to serve autistic adults such as those in the core user group, disagreed with the core user group as to the direction of the project. These disagreements were serious enough that personnel left the project soon after this: a senior academic left and the local authority representative considered leaving, before eventually deciding to stay and putting his support behind the Clasp development.

This example illustrates some of the realities of co-design and participatory projects. In the participatory design literature, the word "democracy" is prominent. There is much talk of the intangible benefits to those who participate: they feel listened to and empowered. However, this is to mask the realities of what happens when hard choices have to be made, choices that, by definition, will not satisfy everyone.

This example also points to one of the major difficulties which projects like Catalyst face: the lack of managerial expertise. Management is difficult at the best of times. Managing cross-disciplinary projects is more challenging still. Imagine then the complexity of managing a multidisciplinary project with community participation at multiple levels—core user group, local authority, other related stakeholders. There are very few managers who are equipped to deal with such complexity. One recommendation from the Catalyst experience then is as follows: given the recent trend towards cross-disciplinary research, as promoted by research funders across the world in an effort to tackle the so-called "wicked" problems that need expertise from multiple disciplines, there needs to be greater consideration given to training managers and future leaders of such projects. It is not enough to set projects up and then leave them to it.

4.1.3 Responsible Innovation

Ethics approval by University committees is standard procedure in research projects. However, our experience with community-University partnerships has raised some particular issues related to responsible innovation that are not typically considered by ethics committees.

The first of these relates to the investment of time from community groups and the expected return on that investment. Catalyst took pains to make it clear from the beginning that the partnership projects were *research* projects and hence could not offer any immediate tangible benefits to community groups getting involved. In order to clearly manage expectations, discussions took place as to exactly what

research means. It was clearly explained that Catalyst projects would only result in benefits in the longer term, if at all, and that the benefits might be to a broader group rather than directly to the community group involved in the project. To their credit, all the community groups responded well to this. Indeed, it appears that community organisations are much more willing than, say, businesses to take a leap of faith into the unknown if there are potentially wide-ranging societal benefits down the line somewhere.

Catalyst considered, however, that simply managing expectations in this way was not a sufficiently considerate way of treating community groups. To further support the community groups that got involved in the research, two actions were put in place. The first was a decision that community groups could, and should, be paid for their time. This is not necessarily a trivial decision to take. UK Research Councils fund *research* and this typically means that staff costs are expected to be in terms of academic or research staff time. Indeed, the original funding bid for Catalyst did not include staff costs for community organisations; rather, a budget was included to pay participant expenses, but not a way to directly pay staff time on the community side. Within the first few weeks of Catalyst, however, it became clear that this was not presenting the right message: Catalyst was technically funded to the tune of £1.9M (although around half of this was immediately lost in University overheads) and so to offer nothing to community groups would be patently one-sided. Catalyst got around this problem by paying community staff as researchers: these projects were research projects, after all, so community staff working on them could be considered researchers even if they did not have the PhD to show for it.

The second decision that Catalyst took was to consider the sustainability of Catalyst projects from the beginning. Procedures were put in place from day one of each project that would support the projects in having a lifetime beyond the Catalyst funding. A dedicated sustainability consultant was hired to provide support to all projects. More than this, though, the researchers took it upon themselves to embed a consideration for sustainability into the projects from the beginning; indeed, this became a core part of the Speedplay process used in the sprints. In terms of how this was achieved in practice, there was no magic formula. Rather, the sustainability issue was always at the forefront of any conversation about the future of the project. Links within and outside the project team that could support sustainability were actively fostered. This, of course, takes a substantial amount of time, and comes back to the issues of "needs" outlined in Sect. 4.1.1: it was not necessarily in the interests of the researchers to pursue a sustainability agenda because it meant taking time away from writing publications; however, the researchers considered sustainability to be a top priority and put their personal resource into it accordingly.

In large part, the sustainability efforts in Catalyst have been successful. Most projects have a life beyond the original Catalyst funding. The exact nature of this life differs in each case. The digital prototype from the first sprint, #Pat, became the inspiration and a core work-package for a successful £300 K Big Lottery Fund bid, put together by a consortium of charities in the NW of England, and aiming to use the prototype as a front-end to a case worker database. Although this follow-on project is now funded and operating, it remains to be seen to what extent the #Pat prototype will

remain part of it. The Big Lottery bid included more "mundane" plans in addition to those inspired by #Pat, and there is a danger that, over time, the #Pat element will get lost. This illustrates the difficulty of sustaining research projects, even when there is subsequent funding: to maintain the #Pat ideas uppermost, constant nudging is required from the original project team, but this becomes increasingly difficult over time as the research team has moved on.

Despite the successes in sustainability in Catalyst—which, in addition to the Big Lottery grant mentioned above, includes two further Research Council grants totalling £550 K—this success has not come without difficulties. If we were to design Catalyst from scratch again, the single biggest thing we would change is the inclusion of business expertise into projects. Although there was a business specialist serving on the Catalyst advisory group, Catalyst projects did not have their own dedicated business expertise to draw on. This usually became a problem because the teams reached a point where they would like to explore commercial opportunities, but lacked the knowledge, expertise or time to do so. Access ASD was a good example of this. Towards the end of the project, team discussions focused on perhaps creating a social enterprise to take Clasp further. However, no-one on the team had any experience of creating a social enterprise. Nor did anyone have the time to commit to such a thing: everyone already had "day jobs". In the end, a decision was made to go for additional research funding (which was successful) to collect more evidence of the effectiveness of Clasp, and to explore commercial opportunities further down the line.

Another issue related to responsible innovation relates to the well-being of the postdoctoral researchers. In Catalyst, the researchers switched projects every nine months. This led to problems due to the social mandate of Catalyst to work with under-represented and marginalized groups. In the first two years of Catalyst, the researchers first worked with homeless people and then with autistic adults, having had no experience of working with such groups in the past. Research leaders should not underestimate the stresses that can be put on the research team when they go into situations such as these. Although Catalyst endeavoured to provide training in the relevant issues at the start of each sprint, this training was necessarily light-touch and could not prepare researchers for the emotional burdens that come with working with groups such as the homeless. Researchers were often asked to serve as proxy counsellors or got involved in personal problems of participants. This is a problem with all participatory research but was exacerbated in Catalyst because of the model of a series of quick sprints, which demanded that the researchers switch from one sensitive project to another.

The conclusion of Catalyst here is that ethics processes are set up to "do no harm" to participants, but they typically do not give much, if any, consideration to the well being of the researchers themselves. Our recommendation is that ethics committees take a good look at this issue, especially in HCI research where such considerations are perhaps less usual than in, say, health and medicine research.

This discussion plays into the broader context of responsible innovation (Grinbaum and Groves 2019). There have been recent attempts to take a more holistic view of what responsible innovation means. For example, a European report looks at issues

surrounding emerging technologies such as nanotechnology and synthetic biology and hopes to ensure that research in these areas is undertaken with consideration of potential negative side-effects (Von Schomberg 2011). In the UK, the Observatory for Responsible Innovation (ResponsibleInnovation 2019) provides resources for research that considers social conscience. The debates within this broader responsible innovation literature, however, are somewhat different than the ones considered in this section. Rather than concerning itself with general issues of the social responsibility of science, Catalyst has encountered very specific challenges related to well-being of community partners and researchers themselves when engaging in real-world research on social issues.

4.2 Novelty in Community-University Partnership Projects

One question about community-University research projects, and participatory projects more generally, is to what extent their outputs are genuinely novel. On the one hand, it can be argued that academic staff know how to innovate and therefore, these research projects will be innovative. On the other hand, the need to work with a community group, which may have more immediate needs, could act to counter more radical thinking. In this section, we discuss a number of issues related to the levels of novelty and innovation achieved in projects like Catalyst.

4.2.1 Mundane Versus Revolutionary Innovation

The first issue is what Wilson and Blackwell call incremental versus radical innovation (Wilson and Blackwell 2013), or what has been elsewhere called mundane versus revolutionary innovation. It can be argued that cross-disciplinary research more readily leads to radical innovation because it encourages researchers to cross disciplinary boundaries and hence be exposed to whole new ways of thinking. On the other hand, cross-disciplinarity can lead to compromise between the disciplines as radical innovation in any given discipline is discouraged because of the need to fit in with the other disciplines.

This tension risks being exacerbated in community-university research projects, which are not only cross-disciplinary but also involve community groups. On the one hand, communities should have a better understanding of "real" problems, and so the results of the research should be more useful. On the other hand, communities will naturally have an understanding of their own particular problems and may not necessarily understand the bigger picture, so research results may not be generalizable. In particular, it can be argued, community organisations are investing scarce resources—their staff time and energy—into a research project, and so will want to see some tangible benefit in the near term. This situation can be guarded against—as Catalyst has done—by carefully managing expectations, but when push comes to shove, it may be that community-University partnerships default to the more familiar.

An interesting example of this was in the first Catalyst sprint, a project called #patchworks. #Patchworks brought together a charity providing support services for the homeless with a group of academics from social, computing, environmental and health sciences. The team came up with a number of interesting ideas for digital prototypes that could, in some small way, assist either homeless people or those who provide support to the homeless.

In #Patchworks, this meant choosing between two prototype suggestions: a hand-held microbe detector and an RFID appointment printer (see Fig. 3). Each object promised a different kind of future, and many strong opinions were held on the different values that each represented. The microbe detector was a device for measuring the state of living conditions of the homeless, envisaged as a low-cost version of more expensive commercial devices. The RFID appointment printer was a way for those without internet access to quickly and easily get personalised information on services by swiping a RFID-enable card or bracelet. The microbe detector would facilitate a political statement; it was a way of showing politicians and public services the unhealthy conditions that homeless people were sometimes expected to live in. The printer was a more obviously useful device: it was a way of providing internet access about important medical and service to appointments to homeless people who otherwise do not have access to such information.

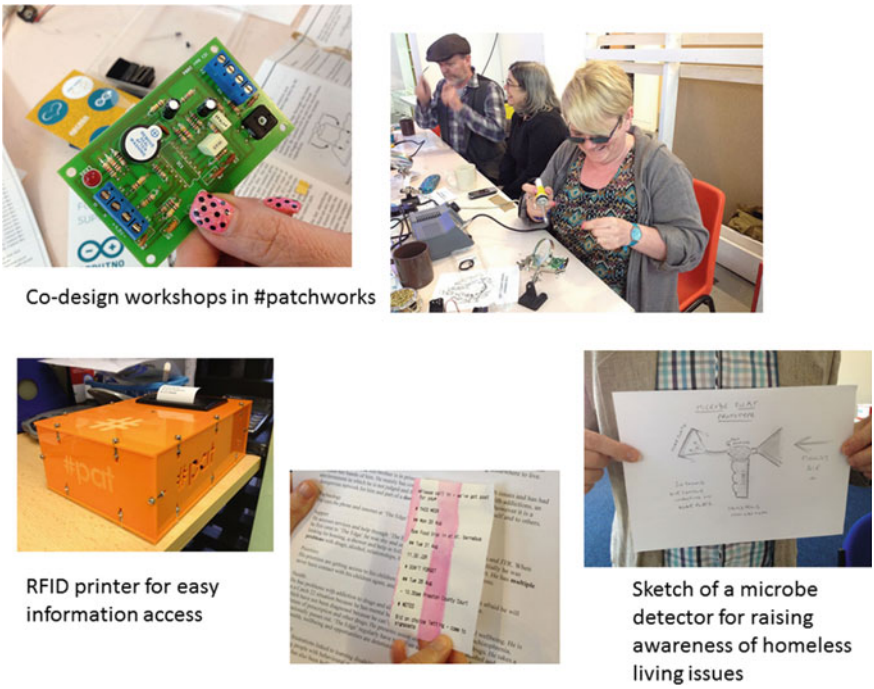

Fig. 3 Competing prototype ideas in the #patchworks project

These two potential prototypes embodied different aspirations. The microbe detector was more radical and more risky; it represented the political idea of a collective action but it also mobilized a fear of individuals being recognised as "trouble" by landlords and social services, of accommodation being closed down for renovation and its inhabitants being made homeless again. Nevertheless, the enthusiasm and empowerment around discussion of this object, the imagined future of being able to have a voice and be heard by those in authority, was plain to see and hear in the enthusiasm of participants.

The RFID printer, however, was seen as something much more readily put together; as a device it could be made and trialled easily with a small number of participants using low cost hacking and assembling methods. The main discourse around it was that it would help to organise the lives of chaotic people. Initially unspoken, but nevertheless recognised, was that this was imagined to make the lives of those involved in the workshops easier and so would have an immediate effect on the work of charity. Although this was the least radical option, it was far more tangible and closest to the everyday reality of homelessness.

In terms of deciding which of these two prototypes to pursue, there were different risks associated with each prototype, and different voices supporting those risks, with different kinds of power associated with them. While representatives of the charity and the University endorsed the RFID printer, the postdoctoral researchers and service users expressed enthusiasm for the microbe detector, suggesting that it gave marginalized people a new voice through collective action and a kind of scientific evidence.

In the end, it was decided to go with the printer, for the reasons that it provided a more realistic and tangible short-term benefit. As the #Patchworks project leader said, "It ticks all the boxes". It was suggested that the microbe detector could be pursued as a separate, new project. Enthusiasm for participation in #Patchworks dropped off at this point as some volunteers and service users stopped attending workshops. The future that was being built through them was not / no longer the one that they most wanted. The seemingly less risky prototype, was not without its own risky consequences; like other mundane outcomes, its riskiness was disenchantment and disappointed expectations.

The example illustrates a natural trend towards the mundane, even if this trend was never explicitly acknowledged. It arises in a completely understandable way. Academics are trained to push boundaries, community groups are not. And in a community-University partnership, the natural inclination of academics to go beyond these boundaries is dumbed down because of the desire to help the communities and the people that form them.

Catalyst attempted to guard against these pressures in a number of ways. Catalyst projects were given informal mentors who could be consulted for advice on which was the best direction to take. The Catalyst Principal Investigator often acted in this capacity and, in some cases, pushed projects towards a more innovative path than otherwise might have been taken. There remains a question, of course, as to what is considered to be innovative, as different disciplines have different ideas about innovation. We discuss this particular consideration further in Sect. 4.3. In

addition to the mentors, the Catalyst sprints made efforts to provide communities with more mundane side-benefits as part of the participatory process. For example, the researchers in #patchworks managed to procure a new, free website for the homeless charity: this new website did not contribute to the overall research goals of the #patchworks project, but it took the pressure off somewhat as it gave much more direct benefits to the community organisation thus freeing the community from worrying too much about whether participation was worth its time.

Overall, it appears that from a technological perspective, Catalyst has not been radically innovative. There is no new piece of hardware, no new programming language, or no new algorithm to come out of Catalyst. But then this was never the intention of Catalyst. Such innovation, although it may require inspiration from other disciplines, is grounded in a single discipline. Catalyst, on the other hand, was always more about the application of novel technologies and the innovation therefore comes from the application of technology in a new and interesting context. There is, however, a wide disparity across Catalyst projects as to the level of innovation of the final prototype products: compare, for example, the RFID printer from #patchworks with Clasp, the digital anxiety tracking device from Access ASD. The latter is clearly more "innovative" if the technology alone is considered.

4.2.2 Innovation in Process

One realization that came early in Catalyst was that the innovation in Catalyst comes not only from technological outputs but also from the processes that are applied. This was particularly true in the sprints, which devised a whole new process, Speedplay, described earlier in Sect. 3.1.1.

Here, we briefly illustrate Speedplay on the third Catalyst sprint, OnSupply. OnSupply was a nine-month partnership with the Tiree Development Trust looking at the challenges and opportunities posed by the time-varying availability of renewable energy supply and the role of technology in addressing such challenges and harnessing the opportunities. Tiree is a remote island off the coast of Scotland on the edge of energy supply and communication infrastructure. A few years ago, the Tiree community got together and acquired funds to install a community windturbine, "Tilley", which was erected in 2010. The OnSupply vision for Tiree, as a community, is to become an exemplar of a future sustainable and integrated energy ecosystem.

onSupply included an interdisciplinary team of academics (software and electronic engineering, HCI, interaction design, and management), and freelance developers from Lancaster, Dundee, and Tiree. Every month, the researchers of the core Catalyst team in turns took the responsibility for organising research and development activities on Tiree according to their skills and the phase that the project was at. On the island the team lived together and engaged with project stakeholders and the community both in research and in social activities.

As a result, the project developed a suite of technologies that were created, produced, assembled, and developed in partnership with the community. Such technolo-

Table 2 Five onsupply digital prototypes

Prototype	Description	Reach at end of project
Energy pulse App	Renewable energy data forecasting system for responsive and responsible energy consumption	Households, workplace
Energy detectors	Renewable energy data discovery and measurement devices	Children, school
Energy data hub	On-line data map for energy detectors data log-in and open energy data access	Families, general public
Datarium	Energy data display system for forensic environmental science	School, public spaces
SQRL	Energy-data radio-controlled system for automation of renewable energy consumption	Households, workplace

Fig. 4 Sample prototype from the onsupply project

gies were never presented as 'solutions' to problems but as means to better understand the connection between the natural elements (sun, wind, water) and the energy that we use in everyday life. One of our participants who helped with the development of one of the prototypes—the Tiree Energy Pulse—defined it as "an interactive and visual way of seeing the energy and the weather and the relationship between the two so that you get […] the feel of the wind versus how much energy is being produced". Five prototypes were developed over the course of the project (Table 2). These were showcased during the Tiree Agricultural Show in July 2014 (Fig. 4).

The OnSupply project illustrates the principles of the Speedplay innovation management framework. As described earlier, Speedplay is a reflective process characterised by four distinct and iteratively overlapping phases: prepare, (co)design, build, and sustain. Crucially, Speedplay is not dogmatic about its methods, but applies whatever methods are appropriate for a given point in a given phase in a project. To hold everything together, Speedplay adheres closely to six core principles: (1) work in partnership with all stakeholders including end-users; (2) support team building by engaging in cross-cutting tasks; (3) promote individual self-direction by matching individual skills with primary responsibilities; (4) be 'un-disciplined' with methods; (5) be opportunistic with change, and (6) develop technology as part of the enquiry (Ferrario et al. 2014).

4.3 Working Across Disciplines

Community-University partnership projects are by definition cross-disciplinary. They tackle a particular social issue and a full understanding of a social issue can only be achieved by approaching the problem from different angles. #Patchworks, for example, involved academics from health and medicine, computing and social science, as well as experts in providing services to the homeless, and, of course, homeless people themselves. Access ASD included academics from sociology and computing as well as experts on providing services to autistic people, and autistic people themselves. OnSupply included academics from computing and design as well as a wide range of representatives from a remote local community and from sustainability experts.

As anyone who has tried it knows, working across disciplines is difficult. There are the oft-cited terminological misunderstandings, but these are just the tip of the iceberg. Understanding each other turns out to be the easy part. It is relatively straightforward to get past the barrier of unknown terms. However, getting past unwritten assumptions and deeply held prejudices—which all disciplines have—is much harder. Academics from a particular discipline have been trained for decades in how that discipline works: how it thinks, which methods it applies, and what is the "right way" to do things. The academic system encourages academics to be protective of their discipline; academics, if they are not careful, will view their own discipline as superior to others, which clearly makes working across disciplines problematic.

In this section, we reflect on our own experiences of cross-disciplinarity from within Catalyst. However, rather than dwelling on the positives of cross-disciplinarity—which have been widely written about and promoted (cf., for example, (Wilson and Blackwell 2013; Nissan 1997; Hacklina and Wallina 2013)), we focus on the challenges of cross-disciplinary research. This is not to say that we disagree with cross-disciplinarity. Quite the contrary: we agree wholeheartedly with the argument that today's problems (such as climate change, deep social inequality, and global poverty) are too "wicked" for a single discipline to tackle alone. However, we do not wish to repeat oft-cited arguments in favour of cross-disciplinarity, and

so, instead, take the contrary view, if only to balance the discourse a little. Below, we present, somewhat tongue in cheek, our top reasons *not* to get involved in cross-disciplinary research.

Before we do so, we give a quick disclaimer. Our comments here focus exclusively on the academic side of cross-disciplinary research. Catalyst actually involves two elements of working across disciplines: academics from different disciplines working together, and academics working with non-academic experts. Frankly, the former is much more problematic. In the latter case, people are driven much more by solving a problem and are less dogmatic about particular methods that should be used. That is not to say that there cannot be tensions between non-academic experts and their academic counterparts. We have certainly witnessed some tensions. However, we do not focus on them here as they have been largely covered in Sect. 4.1.

4.3.1 Reasons NOT to Do Cross-Disciplinary Research

It takes too long to unlearn disciplinary bias. Each discipline comes with its own (biased) set of methods, ways of working, philosophies, and idea of what constitutes an "output". Reconciling conflicting philosophies can be extremely challenging, if not impossible. An academic from a certain discipline will have been trained to think in a certain way since at least their doctoral, if not their undergraduate degree. It is almost impossible to overturn prejudices from these philosophies: even if an academic is open and willing to do so, the publication culture in his/her discipline may not allow it.

One example of this kind of clash of philosophies is that between computer science and critical theory in the social sciences. On the surface, a combination of critical theory and computer science could offer some fundamental advances in thinking in digital innovation. Computer science could be criticized, for example, for not always fully appreciating the ramifications of developing new technology: an obvious example is the development of social networks which offer unprecedented ways of allowing people to connect but come with consequences in terms of corporate control of people's private data. A critical approach, taken before a new technology is developed, could uncover some of the hidden assumptions of the technology and hence guard against some of the negative connotations of a new digital innovation.

In practice, however, such a combination is deeply problematic. The early Catalyst sprints tackled this head-on by integrating sociologists, taking somewhat a critical approach, into the software development teams. However, this simply did not work. Anything can be critiqued. And it is easier to critique than to offer solutions. What happened in some of the Catalyst projects is that computer scientists or designers would come up with ideas of systems to develop, which were then inevitably critiqued, perhaps on reasonable grounds. The social effect of this, however, is that the sociologists come across as consistently negative and overly critical; they are not offering their own solutions to the social challenge (or at least not technologically innovative ones) and become a barrier to progress. Their interest is ultimately not in digital innovation at all, but in a socio-theoretic understanding of the problem under

consideration. This illustrates starkly how academics, through no fault of their own, are often unable to step outside their own disciplinary prejudices. In this example, a critical theorist needs to accept that not everything should always be criticized and find a way that critical theory can contribute to digital development without shutting it down. We will put our hand on our heart and say that Catalyst failed to do this.

We do not mean, of course, to lay the blame solely at the door of the critical theorist. The computer scientist and designer must also be willing to modify the way they work. Computer scientists and designers like to build things, and improve things by iterating on built artefacts. One could argue that they need sometimes to be more willing to step back and be self-critical about their own artefacts. But this is a debate that will continue beyond the confines of this paper: the benefits and drawbacks of just "doing it" and seeing what works are in conflict with those of taking a more deeply theoretical rather than experimental approach.

Time is relative across disciplines. Different disciplines work at different timescales. We have already commented, for example, how agile software development methodologies, created in response to a rapidly changing software industry, are all about speed, whereas many methods of social science take much longer. It can take years to properly carry out even a relatively straightforward interview-based study. Participants have to be recruited, then interviewed. Interviews are then transcribed, at which point begins the lengthy process of analysis and synthesis of interpretations of the data in the interviews. In contrast, the software industry moves at a lightning fast pace. Technology, whether you like it or not, changes very quickly. A computer scientist hoping to make impact on the world of technology simply cannot spend years analysing and understanding a problem; the technology will have moved on by then.

Catalyst attempted to marry these differing timescales through the sprint mechanism, although admittedly the focus in the sprints was on doing things quickly: the nine month time limit clearly is biased towards the "fast" way of thinking. There was an attempt, however, to incorporate social science within the loop: the challenge for social science was to contribute by turning around insights much faster than is usual. In practice, Speedplay was the most successful way of reconciling these timescales. As noted earlier, Speedplay gives equal play to action research and agile development methods, but it does expect both to be done quickly. Applying Speedplay is incredibly intense, which has impact on the well-being of the researchers involved (see Sect. 4.1.3). And yet, this is our "best effort" at finding the "best of both worlds".

Given these differences in speed and time, some disciplines most naturally work better together than others. Design and computer science are obvious bedfellows. Both believe in rapid prototyping, quick reflection, and iterative improvements. These are in stark conflict with qualitative methods in social science.

Academics can be selfish towards their own research niche. Let us qualify this statement. Whilst every academic involved in Catalyst had a desire for projects to succeed and to really have an impact on society, the system within which they operate mandates that they protect themselves in a number of ways. In reality, this means that academics are internally conflicted: as a simple case, they may try, for example, to immerse themselves in and understand a foreign discipline, but they ultimately are

rewarded for publishing in their own discipline, which means that at some point they must withdraw from the more selfless aspects of research, and do what is required of them for promotion, career development, or even simply to keep their job.

From the beginning in Catalyst, it was recognized that special consideration would be needed to encourage and support academics to step outside of their discipline and engage in what was somewhat risky community-University research. During the bid preparation process, the strategy for this was to explicitly cost in time for academics that would allow them to take part. Each Catalyst project, therefore, when preparing its budget, was asked to include percentage FTE for the academic staff. The idea was that if an academic was costed in at a certain percentage, this would be taken into account by their Head of Department when allocating teaching duties, and so the academic would receive a lighter teaching load to allow them to take part in Catalyst.

In reality, this mechanism was ineffective, for two reasons. Firstly, University processes are not responsive enough to take into account allocated percentages on short term projects like those in Catalyst. Typically, Catalyst opened up applications for projects, and it took a matter of just a month or two between when an application was submitted and when the project started. Once started, the project duration was nine months maximum. However, teaching allocation processes work on an annual cycle, so, in practice, the teaching allocations *during* when a particular Catalyst project took place would have already been decided, and could not be changed at short notice. Some academics managed to get future credit for Catalyst time: their Head of Department agreed to include the percentage time in the following year's allocation. But, more generally, the procedures for allocating teaching, and the extent to which grant time is taken into account, differs widely in different departments. This makes it difficult for a project like Catalyst to incentivise academic participation when the models for incentivisation are wildly different across the disciplines.

Secondly, and, more importantly, academics do not get involved in projects because some of their time is allocated for it. They do not "work to order" so to speak. Rather, academics get involved with something if it is intellectually and/or personally stimulating. Academics are over-worked anyway, so a modest (say) 10% allocation in a workload allocation model will make little practical difference to their workload. This aspect played out in Catalyst as follows. Academics would sometimes get involved in Catalyst projects, but then withdraw at some later stage. This happened because of the co-design nature of the projects: at the beginning of a co-design project, all ideas are on the table, and so it is easy for academics to engage, knowing their personal academic interests are "in the mix"; however, at some stage, the decision to focus is made and this invariably will not match all of the academics' research interests. Some academics (the selfless ones!) will continue to engage, knowing that they can still make some contribution to the overall project. Others, however, make a decision to disengage at this point, realizing that the project will not result in publications in their area of interest, will not further their careers, or can no longer be justified to their Department. Whilst we in no way wish to imply that academics are purely Machiavellian creatures, driven only by an egotistical need to publish and be recognized, there is some truth to the fact that the academic system rewards individual achievement over group collaboration, and the latter is the fundamental underlying principle of community-University partnership projects.

University structures promote cross-discipline competition not collaboration. In a similar way, Universities, although nowadays they universally promote cross-disciplinary research, are often not set up for it. The Faculty structure of UK universities, for example, creates clear boundaries between the physical and social sciences. These boundaries can sometimes be hard to cross because Faculties, and within them Departments, compete internally for University recognition and resources. University Departments are evaluated partly on the research income they generate and so a question arises for any cross-disciplinary initiative, which is how to divide the research income from a project across Departments. This has very immediate ramifications since those Departments then compete with each other, partly according to research income, for future investment. Some universities, of course, promote cross-disciplinarity more than others. Cross-disciplinary centres can alleviate the problems of competition to a certain extent. However, there remains something deeply culturally embedded at all levels of academe that encourages each discipline to consider itself "better" than the others. This manifests itself every day at committee meetings across the University where Departments are asked to report on various metrics of success, and then those metrics are implicitly or explicitly compared with other Departments.

We believe that strong community-University partnerships can only flourish when this kind of competitive culture is actively broken down in favour of a more collaborative style of working. In Catalyst, for example, which initially involved six Lancaster University Departments, great pain was taken to allocate research income equitably across the Departments. The School of Computing and Communications was the lead partner, and so could have decided to take the lion's share of the expenditure. However, it was decided early on to apportion all research income and expenditure pro rata across Departments according to the named academic staff from those Departments involved in Catalyst. Whilst this created an administrative overhead—and one which the University was not set up for—it did go some way to promote Catalyst as properly equitable when dealing across disciplines.

4.4 Practicalities

We finish this section by briefly reflecting on some of the very practical considerations of a cross-disciplinary community-University research project such as Catalyst. Some of these have already been touched upon—such as the lack of procedures for apportioning research income across Departments for projects where this is no single cost centre. In short, there are a whole plethora of logistical challenges that must be navigated or created for a large community-University partnership such as Catalyst. It is difficult to generalize to Universities as a whole as logistical support for community-University partnership differs. We limit our discussion here, therefore, to some of the major challenges we faced at our own university, while accepting that other universities may already have better (or indeed worse) procedures in place.

The main point we wish to make in this section is the need for clear policies and procedures to be in place in community-University research projects. Whereas many research projects—even large, collaborative ones—can "get away" with a light touch in terms of documentation of procedures and processes, this is not possible in community-University partnerships. We have already emphasized the need to manage expectations both on the University and community side. In addition to this, there needs to be clarity in all aspects of how the project is managed. The community groups are external entities, who will not necessarily have an understanding of the idiosyncratic ways that universities operate, and their continued engagement with the University is largely driven by the nature of their experience with it.

Catalyst involved a number of activities which required clear policies and procedures to be put in place: the grant application process, subcontracts with community groups, expectations on the form and nature of project outputs, transparency in paying expenses for community representatives, project governance, etc. Fortunately, this complex arrangement of activities and procedures can be navigated relatively simply by remembering a single key principle: transparency. As with all initiatives where external parties are involved, and are asked to participate, any policy should be defined, driven and monitored according to its transparency. Catalyst made every attempt, at all stages of the project, to follow such a principle.

Whilst these efforts at being fair and transparent at all times were largely successful, there were cases where Catalyst had to either circumvent the system or faced unsurmountable barriers from the system. One of these relates to how community organisations were remunerated for their participation. As mentioned in Sect. 4.1, the original Catalyst bid included funds for paying community expenses but not for paying community members for their time. This oversight was quickly rectified, but it was not immediately clear how community members could be paid. Research money is usually used to pay research staff, employed by a University. The solution was that the community members were viewed as temporary research staff and then a variety of methods had to be used to employ them. Depending on what was best for a particular individual, some were employed on short-term University contracts, some were paid as consultants, and some organisations were sub-contracted. None of these arrangements was new or unusual in of itself, but the need to pay particular attention to the sensitivities of each community organisation, and the need to design a solution that worked for them, did require a lot of time and effort on the part of University administrative staff.

A more serious barrier arose in the follow-on funding of one of the Catalyst launchpads, Local Trade. This project was a collaboration between a local social enterprise, promoting local trading cultures as a way to improve community cohesion, and academics from design and computing. The project was initially funded as a Catalyst launchpad by the end of which a tool had been developed which aimed to track people's spending behaviours and present visualisations showing the percentage of local versus non-local trades and the benefits to the local economy of higher local trade percentages (Fig. 5). The project was successful as a Catalyst launchpad, producing a digital prototype with strong commitment from a local social enterprise that was intent on taking the project forward towards real-world use. However, the

Fig. 5 The local trade launchpad (which has since evolved into BARTER: barterproject.org)

project was still in its early stages, and so the partners decided to apply for further research funding from EPSRC's Research In The Wild programme to further evaluate and test the technology. They were successful in doing so. However, a problem immediately presented itself.

The Research in the Wild programme is set up to encourage real-world deployments of digital innovations where end-users work in partnership with universities. This is exactly what the Local Trade partnership was about. Unfortunately, there was a stipulation in the funding call that partners could not receive any monies. Presumably, this was in place to avoid research funding being given to for-profit companies. However, for social enterprises, as was the case in Local Trade, or charities/community groups as partners, this constraint presented a real barrier to the research going forward. In the case of Local Trade, the social enterprise simply had to accept that whilst the University would receive around £200 K in additional funding, the social enterprise, who was an equal partner from the start, would receive nothing. We have seen other similar calls from research funders that also prevent funding going outside the University system. There is clearly a case to review such policies: research councils are actively pushing academics to evidence more impact from their research, and yet, they sometimes put barriers in place to making this realizable in practice.

5 Conclusions

In this paper, we presented some reflections from a major community-University collaborative research project, called Catalyst, which, over the course of three years, and through twelve collaborations, explored how digital technologies can promote social change. Crucially, the approach was for all partners to co-design research questions and research solutions. Each project was multidisciplinary, involved community organisations, and resulted in a digital prototype which was tested and evaluated in the wild. As such, Catalyst combined a variety of research methods, ranging from participatory and co-design, to so-called research in the wild, whereby digital research prototypes are evaluated in real-world situations rather than in the safety of a lab. The project encountered many challenges, including those associated with research in the wild such as ensuring the robustness and adaptability of the prototypes, but also those in a more broader context, such as how to equitably and efficiently manage community-University partnerships.

One of the key findings from this research was the importance of incorporating broader human values into digital prototypes. Due to the nature of the community organisations we worked with, human values—such as privacy, reputation, tradition, trust, social responsibility, and integrity—were often uppermost in the discussions around how a prototype should be designed. We realized through this research that software and system development methodologies, while they do a relatively good job of ensuring that software has the functionality intended, at an affordable price, and that is secure and safe, very rarely consider broader human values. HCI, of course, has studied how to design systems in an inclusive and accessible way, and there is a large body of work on values in HCI, such as values-sensitive design; however, work in the software engineering field has hardly considered values at all. Until it does, we will continue to build systems that do not reflect the society in which we live. A fruitful avenue for future research, therefore, is to extend methods such as values-sensitive design to ensure that values are given primary importance in requirements engineering, software design, and software verification and validation. The team is now actively working on this new challenge.

Acknowledgements The research presented in this paper would not be possible without the selfless and dedicated community groups, social enterprises, charities, local authorities and individuals who believed in the projects and put their time and expertise into them. In total, Catalyst worked with around 90 such organisations—too many to name individually—in a range of different capacities, from exploratory, through advisory, to collaborative projects. We deeply thank all of them.

References

Acosta, R., Burns, C., Rzepka, W., & Sidoran, J. (1994). Applying rapid prototyping techniques in the requirements engineering environment. *International Conference on Requirements Engineering* (pp. 66–74).

Baum, F., MacDougall, C., & Smith, D. (2006). Participatory action research. *Journal of Epidemiology and Community Health*, *60*(10), 854–7.

Bendapudi, N., & Leone, R. P. (2003). Psychological implications of customer participation in co-production. *The Journal of Marketing*, *67*(1), 14–28.

Boehm, B., & Turner, R. (2004). Balancing agility and discipline: Evaluating and integrating agile and plan-driven methods. *26th International Conference on Software Engineering (ICSE)* (pp. 718–719).

Boehm, B. (1988). A spiral model of software development and enhancement. *Computer*, *21*(5), 61–72.

Brown, B., Reeves, S., & Sherwood, S. (2011). Into the wild: challenges and opportunities for field trial methods. *In the ACM CHI Conference on Human Factors in Computing Systems* (pp. 1657–1666).

Chamberlain, A., Crabtree, A., Rodden, T., Jones, M., & Rogers, Y. (2012). Research in the wild: understanding "in the wild" approaches to design and development. *Conference on Designing Interactive Systems* (pp. 795–796).

Crabtree, A., Chamberlain, A., Grinter, R., Jones, M., Rodden, T., & Rogers, Y. (2013). The turn to the wild. *Special Issue of ACM Transactions on Computer-Human Interaction (TOCHI)*, *20*(3).

Duret, M., Martin, S., Latour, B., Bischof, H., Reyse, S., Sondermann, K., et al. (2000). PROTEE: procedures dans les transportes d'evaluation et de suivi des innovations considerees comme des experimentations collectives, Final Report for Publication, European Commission. Belgium: Brussels.

Ehn, P. (2008). Participation in design things. *Proceedings of the Tenth Anniversary Conference on Participatory Design* (pp. 92–101).

Ferrario, M. A., Forshaw, S., Newman, P., Simm, W., Friday, A., & Dix, A. (2014). On the edge of supply: designing renewable energy supply into everyday life. *Proceedings of ICT4Sustainability, 2nd International Conference*.

Ferrario, M.-A., Simm, W., Newman, P., Forshaw, S., & Whittle, J. (2014). Software engineering for social good: integrating action research, participatory design, and agile development. *International Conference on Software Engineering (ICSE)* (pp. 520–523).

Fox, D., Sillito, J., & Maurer, F. (2008). Agile methods and user-centered design: how these two methodologies are being successfully integrated in industry. *Agile Conference* (pp. 63–72).

Friedman, B., Kahn Jr, P. H, Borning, A., & Kahn, P. H. (2006). Value Sensitive Design and information systems. *Human-Computer Interaction and Management Information Systems: Foundations* (pp. 348–372). New York: ME Sharpe.

Gould, J., & Lewis, C. (1985). Designing for usability : Key principles and what designers think. *Communications of the ACM*, *28*(3), 300–311.

Grinbaum, A., & Groves, C. (2019). What is "Responsible" about responsible innovation? understanding the ethical issues. In R. Owen, M. Heintz, & J. Bessant (Eds.), *Responsible Innovation*. UK: Wiley.

Hacklina, F., & Wallina, M. W. (2013). Convergence and interdisciplinarity in innovation management: a review, critique, and future directions. *The Service Industries Journal*, *33*(7–8), 774–788.

Hand, E. (2010). Citizen science: people power. *Nature*, *466*(7307), 685–687.

Hayes, G. R. (2011). The relationship of action research to human-computer interaction. *ACM Transactions on Computer-Human Interaction (TOCHI)*, *18*(3). Article number 15.

Heron, J. (1996). *Co-operative inquiry: research into the human condition*. London: Sage.

Holmes, T., Blackmore, E., Hawkins, R., & Wakeford, T. (2012). *The common cause handbook*. http://responsible-innovation.org.uk/torrii/

Johnson, R., Rogers, Y., van der Linden, J., & Bianchi- Berthouze, N. (2012). Being in the thick of in-the-wild studies: the challenges and insights of researcher participation. *In the ACM CHI Conference on Human Factors in Computing Systems* (pp. 1135–1144).

Kensing, F. (2003). *Methods and practices in participatory design*. Denmark: ITU Press.

Kera, D. (2012). Hackerspaces and DIYbio in Asia: Connecting science and community with open data, kits and protocols. *Journal of Peer Production*, *2*, 1–8.

Knobel, C. P., & Bowker, G. C. (2011). Values in design. *Communications of the ACM*, *54*(7), 26–28.
Kyng, M. (2010). Bridging the gap between politics and techniques: On the next practices of participatory design. *Scandinavian Journal of Information Systems*, *22*(1), 49–67.
Larman, C. (2004). *Agile and iterative development: A manager's guide*. Addison-Wesley Professional.
Muller, M. J. (2003). Participatory design: The third space in HCI. *Human-Computer Interaction: Development Process* (pp. 165–185).
Murray, A. (2009). Managing successful projects with PRINCE2. Stationery Office Books.
Nissan, M. (1997). Ten cheers for interdisciplinarity: the case for interdisciplinary knowledge and research. *The Social Science Journal*, *34*(2), 201–216.
Reason, P. (1999). Integrating action and reflection through co-operative inquiry. *Management Learning*, *30*(2), 207–225.
Sanders, E., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *Co-Design*, *4*(1), 5–18.
Sharp, H., Robinson, H. & Segal, J. (2009). Integrating User-Centered Design and Software Engineering: A Role for Extreme Programming? Presentation. www.ics.heacademy.ac.uk/
Simm, W., Ferrario, M.-A., Gradinar, A., & Whittle, J. (2014). Prototyping clasp: Implications for designing digital technology for and with adults with autism. *Designing Interactive Systems (DIS)* (pp. 345–354).
Steen, M. (2011). Tensions in human-centred design. *CoDesign*, *7*(1), 45–60.
Susman, G. I., & Evered, R. D. (1978). An assessment of the scientific merits of action research. *Administrative Science Quarterly*, *23*, 582–603.
Valve, H. R., & McNally, R. (2013). Articulating scientific policy advice with PROTEE. *Science, Technology, and Human Values*: *38*(4), 470–491.
Von Schomberg, R. (Ed.). (2011). *Towards responsible research and innovation in the information and communication technologies and security technologies fields*. Luxembourg: Publication Office of the European Union.
Walter, M. (2009). Participatory action research. In M. Walter (Ed.), *Social Research Methods* (pp. 1–8). Oxford: South Melbourne.
Whittle, J. (2014). How much participation is enough? A comparison of six participatory design projects in terms of outcomes. *Participatory Design Conference*.
Wilson, L., & Blackwell, A. F. (2013). Interdisciplinarity and innovation. In E. G. Carayannis (Ed.), *Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship* (pp. 1097–1104). Berlin: Springer.

Ethics and Consent in the (Sociotechnical) Wild

Ewa Luger and Tom Rodden

1 Introduction

Ethics are the identification and articulation of principles intended to promote good and minimise harm. A product of moral philosophy, they describe the codified process of determining which human conduct is right or wrong, good or bad, and have become core dynamics within research that touches upon humans. Whilst ethics have long been a cornerstone of philosophical debate, practices in the late 20th century highlighted the harm that could arise if research was carried out unchecked. In response, the notion of informed consent was foregrounded as a mechanism to ensure that research subjects were adequately protected, resulting in a greater focus on how ethics might be articulated within research practice. This core idea, that those participating in research should be allowed the opportunity to make a measured, voluntary and informed decision about their participation, has remained relatively unaltered since 1964 (Declaration of Helsinki) and has seen adoption beyond the medical sphere, into all forms of social research.

Whilst there is little debate that research subjects should be protected, informed and able to freely decide whether or not to participate, there is some question as to the extent to which current models of consent truly support this. In general, informed consent relies upon both predictable research conditions and a relatively static context of study. However, many fields of research are moving towards the investigation of social phenomena in naturalistic settings resulting in highly mutable, less controllable and relatively unpredictable contexts of study. One field where such 'wild'

E. Luger (✉)
University of Edinburgh, Edinburgh, UK
e-mail: ewa.luger@ed.ac.uk

T. Rodden
University of Nottingham, Nottingham, UK

A. Chamberlain and A. Crabtree (eds.), *Into the Wild: Beyond the Design Research Lab*, Studies in Applied Philosophy, Epistemology and Rational Ethics 48,
https://doi.org/10.1007/978-3-030-18020-1_8

approaches have gained considerable ground, is that of Human Computer Interaction (HCI).

2 An HCI Turn to the Wild

As a field of research, HCI has pushed beyond the confines of the laboratory, in favour of studying the impact of systems 'in the wild', so that a richer and more situated understanding of human behaviour might emerge. Having long since adopted and accepted the common bioethical approach to research ethics, this non-traditional direction means that our orientation to ethical practice must also undergo change. As we move towards "experimenting with new technological possibilities that can change and even disrupt behaviour" (Rogers 2011: 58), so the potential for unanticipated behavioural influences and harms are expanded. Such technologies, intended to augment the human condition, are increasingly deployed within real world settings where they are both subject to unanticipated influences and not directly controlled by the researcher at all stages of deployment. Such ambiguous conditions, whilst eliciting rich and fascinating social insights, further complicate the context of consent, raising new ethical questions.

The term 'In the wild' has come to describe practice that seeks to elicit a socially situated understanding of "the mechanisms and reality" (Callon and Rabeharisoa 2003: 195) of coproduction within socio-technical systems. This can be broadly understood as "the development of systems in real world settings" (North et al. 2013: 84) and is predicated upon the belief that studying human interaction with systems, removed from the social context, is unlikely to elicit a true understanding of their impact (Chamberlain et al. 2012). Such studies have been cast as representative of a 'paradigm shift' (Chamberlain et al. 2012) within HCI, and describe a fundamental reconfiguration of the nature of the relationship between the research professional and the lay person, creating a distinctly different power balance.

According to Callon and Rabeharisoa (2003), this practice is characterised by a hybridization of knowledge or exchange of knowledge. For example, user (lay) knowledge is revaluated as equal to that of the researcher, challenging the notion of 'researcher as expert'. Through these altered conditions, 'wild' research seeks to better understand the complexities of the world in ways not possible within laboratory or experimental settings. It seeks not to uncover objective 'truths', but to understand contextual factors and situated conditions arising from the deployment. As one might expect, such approaches challenge the protocols and boundaries associated with more controlled forms of research. For example, investigations around the use of public displays (interactive screens) amongst specific target communities have meant leaving the screens in situ, over an extended period of time (North et al. 2013), without the level of researcher oversight associated with lab-based studies. Such research, which seeks to understand situated behaviour, necessarily implicates an 'in the wild' methodology. Without deploying such technology in the natural community setting, there would be no way of understanding its social use. Without deploying such

systems 'in the wild' we would not, for example, elicit and be able to observe the real tensions arising from collective practice or community use.

3 Dynamic Research, Static Ethics

Whilst such approaches afford richer pictures of technology use, when research conditions are not easily set then the risks and implications associated with such studies cannot be predictably catalogued in quite the same way. New variables, such as third parties, can come into play creating a highly dynamic research environment that stymies the identification of right or wrong conduct through a host of unexpected temporal, social and other contextual factors. Whilst prior approaches to protection of the participant have been adapted to meet these challenges, and ethical guidance is beginning to reflect the online context (ESRC guidelines 2010 (updated 2012)) these developments are glacial in comparison to the requirements arising from technical innovation. With innovation comes the development of systems that are Internet-enabled and ever more reliant on the capture, storage, conflation and algorithmic analysis of human data. Whilst recently there have been developments to highlight the important of Responsible Research and Innovation (ORBIT-RRR 2017[1]), with more and more of such systems being deployed and tested in the wild, it is time to consider how we might ensure that the participant consent process retains its integrity and validity.

It is clear that how we might seek, inform, secure and support participant consent for this emerging form of research requires some reconsideration. In order to better frame the problem space, this chapter seeks to first establish the novel conditions raised by 'in the wild' studies and consider these in respect of consent. Having highlighted some key tensions arising from 'wild' research, we then draw upon prior research with experts from multiple disciplines in order to identify those issues relevant to such studies. Reflecting upon the key challenges posed to consent by a life amongst ubiquitous systems, we highlight expert opinion in order to frame the weaknesses inherent in our current approaches and highlight the areas that would benefit from further development.

4 Sociotechnical Challenges in the Wild

We are increasingly living in a world detected, understood and informed through multiple, pervasive, lightweight sensors. Through the vision of Weiser (1991), these ubiquitous systems are, quite literally becoming woven into the fabric of our lives resulting in a sort of panoptic awareness. Every iteration of a context-aware system is designed to enhance or augment an aspect of our lives; to free us from sweating the

[1]ORBIT Responsible Research and Innovation https://www.orbit-rri.org.

small stuff, allowing us to focus on broader goals. As designers, we already imagine realities populated with internet-enabled devices that sense deficit and replenish, identify waste and modify purchase, monitor aspects of our lives and alert us to dis-balances or excess. They do so by compiling profiles of our practices and preferences and anticipating our requirements; sometimes even, responding to our direct commands, such as 'Hey Siri'.

However, creating the perfect socially-situated system requires an equally perfect understanding of context, a goal not easily achieved in the lab. The ways in which such systems might augment the unremarkable rhythm of our social lives (Tolmie et al. 2002) require thorough and situated investigation. This recognition has precipitated a turn to research 'in the wild' as systems are deployed and tested in situ, in order to better inform more responsive design, reflective of human practices. However, these ubiquitous systems bring with them a raft of attending challenges. Not least of these is the opportunity for monetisation that exists wherever data is generated, bringing with it the potential for exploitation. Bohn et al. (2005) identify two key technologies which characterise the economic processes inherent in such systems, namely (a) technologies that can track 'real world entities' such as people, and (b) the capacity, of 'smart' objects, for introspection. The interleaving of such technologies, where data generated by our routine interactions inform this 'introspection' and subsequent action, can result in a reduced space for uninhibited *human* agency. This transference of power, occurring as a subtle aside to our awareness acts as an intervention, bringing with it considerable ethical dilemmas. Traditionally, whenever a research intervention occurs, the principle of consent is invoked. Where systems are low visibility but high agency, the question of where and when consent might be sought, and the mechanisms by which it might be informed, becomes of pressing concern.

5 What Is Consent?

There is no doubt that consent is a concept that is socially familiar to us. It underpins our dominant political beliefs (Miller and Wertheimer 2010), is represented in the law, and is a social expectation that governs our behaviour in the public and private spheres. Consent, as an autonomous and informed authorisation of what might otherwise be considered an intrusion or invasion, allows certain behaviours that would otherwise run counter to our norms. It changes the moral relations between two entities. By consenting to a proposition, we are actively choosing to waive certain rights and quite often we do this with a goal in mind whether that be securing medical assistance, a product or a service, or engaging in social endeavours. Whilst colloquially, consent is often used as a synonym for assent, the concept actually draws from four key principles enshrined within the Nuremberg code; that it should be voluntary, competent, informed and comprehending (Faden and Beauchamp 1986). This means, first, that valid consent must be voluntarily given and, as such, cannot be the result of coercion, force or fraud. Theoretically, there should be a genuine

choice involved. Secondly, the person giving consent must be competent to give it, therefore not a child or otherwise vulnerable or impaired. Thirdly, the consent-giver must be sufficiently informed about the proposition being put to them and, finally, there should be a reasonable expectation that they understand. Within the context of research ethics, consent should also be revocable, allowing the research subject to opt out at any time and request that their data be omitted from the study. Whilst certain types of research allow a level of deception, for example some psychological studies, it is generally expected that any such research should be in the wider pubic good and that participants are fully informed once the study is concluded.

However, work within the bioethical sphere has raised question as to whether consent in its current form truly meets its ethical responsibilities. Manson and O'Neill (2007) highlight a series of weaknesses which, they argue, limit the ongoing utility of consent. They ask (a) whether it is truly possible to be fully *explicit* and completely *specific* in all instances of consent, (b) what is meant by the *autonomy* of the subject, and whether this is necessarily an appropriate principle, and (c) the weaknesses inherent in the notion and process of *informing.* Whilst bioethical considerations tend to relate to actions that are invasive (violation of bodily integrity) rather than intrusive (infringement of specific liberty rights), such concerns are equally noteworthy in the context of HCI, where we are seeing newly blurred boundaries around the nature of the data collected. However, before we revisit the notion of consent, it is helpful to understand some of the history that led to its widespread adoption and current form.

5.1 A Brief History of Consent in Research

It is interesting to note that, within research practice, the emphasis upon informed consent is relatively recent. The need to embed protective measures within research practice originates largely from two specific and well-known cases where research subjects experienced extreme violations; namely the Nuremberg trials and the Tuskegee Syphilis Experiment. The well-charted atrocities carried out during the Second World War resulted in the development of a formalised code of practice in respect of ethics. These ethical principles encoded the need to secure a subject's tacit consent on the basis of the four characteristics previously mentioned; that participation was "voluntary, competent, informed and comprehending" (Faden and Beauchamp 1986: 155). Whilst providing a foundation for ethical practice, these principles failed to reflect a sufficiently wide range of research contexts. Subsequently, the World Medical Association (WMA) began to draft a more tailored ethical code, which ultimately became the Declaration of Helsinki (1964). Building upon the existing tenets, this development distinguished between therapeutic and non-therapeutic research and cast consent as a central requirement of ethical practice, in particular the requirement that it be explicit and specific.

It was, however, a revelation in the 1970's that stimulated a greater focus upon consent as a means of addressing the distinct power imbalance between subject and researcher. In 1972, The New York Times drew attention to a 40-year observational

study conducted in Macon County, Alabama; the Tuskegee Syphilis Study. It emerged that in that period, over 400 black sharecroppers with syphilis had been drawn into a non-therapeutic study with the promise of treatment. In reality, no treatment was given, nor was there access to alternative therapies or counselling on how to limit the spread of the disease. This directly resulted in over 100 men dying either from syphilis or complications arising (Corbie-Smith 1999). The resulting review of United States federal regulations revealed that there were no consistent or adequate governmental mechanisms for either reviewing experimental procedures or securing participant consent (Faden and Beauchamp 1986). The further significance of Tuskegee was that it instigated the on-going challenge of realising fully informed consent, particularly when working with vulnerable populations (ibid).

Whilst the harm done to the Tuskegee sharecroppers was a clear and extreme case, the nature of HCI is often such that any risks or long-term effects are not so straightforward or immediately identifiable. The dynamic nature of 'in the wild' research further complicates matters as the context is rarely set and, as such, identification of harm is not always predictable from the outset.

5.2 Predicting Harm in the Wild

The anticipation and avoidance of harm is fundamental to research ethics. It is also central to the informed consent process, ensuring that where the risk of harm cannot be avoided, it is clearly and thoroughly articulated to the research participant in order to inform their decision. According to the ESRC Framework for Research Ethics, "harm to research participants and researchers must be avoided in all instances" (ESRC 2012, p. 3). This is predominately managed through a carefully monitored process which relies upon planning, transparency and informed consent. Specifically, "research staff and participants must normally be informed fully about the purpose, methods and intended possible uses of the research, what their participation in the research entails and what risks, if any, are involved" with some variation for specific research contexts (ESRC 2012, p. 3). However, if one considers the scale and variability of factors which come into play during technology deployments 'in the wild', it is clear that solely relying upon a priori informing is unlikely to offer a sufficiently responsive solution. Defining and proving harm has always been a challenging issue for society. One accepted justification for interfering in the liberty of another is where an action would *otherwise* result in harm. In this way, the moral principle of harm is one measure to decide whether an act, which would otherwise infringe another individual's liberty, is allowable (Feinberg 1984). This principle, also foundational to the way in which Liberal societies legislate, has seen much debate and extends to include both the prohibition of "actions which lead, with a high probability, to harm" (DeMarco 1994: 117) in addition to harm resulting from inaction. We know that, when a power imbalance exists between two parties, the less powerful party is also far less likely to be able to insulate themselves from harm. Therefore, those within

elite positions in society, such as researchers, have a moral and legal obligation to minimise harm, both potential and actual.

Defining harm, and its likelihood, whilst seemingly straightforward is notoriously difficult in practice. The definition of harm, whilst of course specific to context, can be broadly understood as "a [wrongful] setback to an interest…to something in which a person has a stake" (DeMarco 1994: 118), including 'hurt'. Feinberg (1984) defines such 'interests' as (a) broad, stable long-term life goals and the instrumental desires related to achieving them, and (b) sustaining welfare, including physical and mental health and wellbeing, the latter of which being also protected by law (Feinberg 1984). It is clear from these definitions that harm is relative, context-specific, and difficult to predict and metricate even in controlled settings. This is likely to be even more the case within the dynamic social context of 'in the wild' studies, making the securing of meaningful consent especially challenging. For example, how might we assess potential harms within a context over which we have limited control and what are the limits of our responsibility? The types of pervasive, intelligent systems we might seek to deploy and study can record, conflate and respond to social and personal data in unprecedented and often unpredictable ways. For example, systems increasingly make use of software agents that act on the basis of data generated by users interacting with those systems. They develop contextual 'knowledge' on the basis of preferences and repeat behaviours, inferring appropriate actions. However, both user and system actions may not be predictable at the onset of the study. Where systems are empowered to act on behalf of users in this way, identifying potential harm becomes ever more challenging for the research practitioner.

Equally, the likelihood of third parties being unexpectedly implicated within such studies is high. Smart scales collecting your visitor's data, energy meters inferring the presence of guests, or vision and voice systems such as Xbox Kinect or Amazon's Alexa inadvertently capturing third party images or conversations are all quite likely scenarios. When those images are of minors, vulnerable or non-consenting adults, even more problems arise. With so many dynamic variables, how can we be certain we have predicted harm sufficiently well? As an example, a recent study sought to identify how members of a household might orient to the collection and sharing of data in their home via multiple sensors (Speed and Luger 2014). What was discovered was that the sensor data not only implicated household members, but also that certain 'phantom' profiles appeared which could be attributed to identifiable third parties.

The participating households each made judgements as to whether to alert their visitors to the study. In this case, whilst the researchers had not sought consent from those parties, they were clearly and unknowingly implicated through their data profiles, somewhat problematising the consent process. In this way, the implication of third parties also drew the role of participant into the spotlight. Here, when sensors were deployed in the home, participants made judgements about whether or not to expose the study to their guests. Whilst the participants of this particular research exercise were all academics and so fully conversant in research ethics, one can imagine a situation where this is not the case. Consent relies upon a shared understanding of the implications of one's actions. If the research subject is making judgements about whether or not to notify their visitors, and allow researchers to make use of

the resulting data, the boundaries around participant and researcher can become somewhat blurred.

6 Revisiting Consent

It is clear that the way we currently approach informed consent is not aligned to the realities of socially situated research. Whilst every effort is made to anticipate factors affecting participants and researchers within sociotechnical studies, the nature of emerging systems means that both are at times vulnerable. Understanding how consent should function in the wild necessarily requires looking beyond our current processes and reviewing them in light of these changing conditions. By revisiting questions of what we understand as consent, how it operates in a social sense, and exploring the challenges arising from technology deployed in the social context, we can begin to re-establish what it might mean for our practice going forward. In order to begin the thinking in this area, we now turn to the experience of 'experts' from a range of fields cognate to this effort. We draw from the analysis of our previous study (Luger and Rodden 2013) where experts from multiple disciplines were interviewed in order to better understand how consent might operate within a world of pervasive systems. On the basis of these findings, the remainder of this chapter begins to explore how consent might be thought of within naturalistic settings.

6.1 A Changing View of Consent

Whilst only a narrow proportion of academic work focuses specifically upon both technology and consent (Luger and Rodden 2013; Bonnici and Coles-Kemp 2010), there exist potential contributions to this subject from a range of disparate disciplines. The experts approached for interview were amongst the most senior academics and prolific authors within the field. The following analysis draws from the wider findings emerging from a series of 20 semi-structured elite interviews conducted with experts from multiple domains and disciplines. These included Philosophy, Bioethics, Law, Sociology, Psychology, Criminology, Computer Science, Regulation, Data Policy, HCI, Cultural Anthropology, Informatics, Engineering, Systems Engineering, Data Analysis and Criminology. The following analysis draws upon those key themes considered relevant to 'in the wild' research.

The purpose of conducting elite interviews was, firstly, to map the problem space from a series of competing perspectives in order to identify/construct a common conceptual foundation of consent in the sociotechnical context. Secondly, it enabled identification of how consent might be rethought or 'designed' within such settings. Early analysis revealed the common perspective that consent was a fundamentally social process and, as such, was indivisible from the social context within which it was given. It was therefore considered highly contextual. Whilst the contractual/legal, a

priori model of gaining consent necessarily remains as a recognised standard of practice, it was cast as one insufficient to meet the ethical demands of socially embedded systems. In light of this consent as 'an act' was seen as too instrumental a definition, and experts instead cast the concept as mutable, highly contextual and indivisibly tied to social life (Luger and Rodden 2013). Many discussions surrounding consent have placed the emphasis upon securing user *assent* alone. However, our research found that in order to reflect both its ethical tenets and the demands of socially situated systems, the focus of the consent process should rest upon *sustaining* consent in light of changing conditions. Experts raised issues of power, co-design, granularity and choice, the weaknesses inherent in informing, the issue of data sensitivity, and the dynamic nature of the social context.

6.2 The Balance of Responsibility

During the course of the interviews, experts made numerous suggestions as to how consent should be addressed within the context of sociotechnical systems. Underpinning the majority of suggestions was the need to return the concept, and other concepts related to achieving consent, to both their philosophical origins and the social environment that was seen as forming them. One participant made this point explicitly.

> Both consent and risk and all these concepts are part and parcel of a real shift in governance and that's why, when you say methodologically how do we approach these, I think that because this language has been co-opted…that the richer discourses are found in human rights language and that's why qualitative research is a better source of data because it allows us to plug into these broader social meanings that link to dignity, that link to autonomy, that link to respect. (Criminology)

This theme, of 'returning to the forces that shaped consent', was dominant amongst those disciplines most closely aligned to the social sciences and law. Expert responses implied, and in some cases made explicit, that the current instrumental view of consent, and the neo-liberal ideology that underpins it, had allowed practice to drift too far from such origins. The broadly accepted single point of agreement model, whilst acceptable in legal terms, was seen as far from being so when one considered the act in the context of society and the social and moral obligations tied up within it. Viewed from this perspective, such a model was seen as akin to a switch; one used to transfer responsibility and rights within a single moment. As such, it was felt to make simple and binary that which would otherwise be a rich and complex human interaction, obscuring the aspects requiring attention. Related to this, experts expressed concerns that continuation of such an instrumental view would dislocate consent from the rich social meanings that frame and explain it as a process.

> It's kind of a label for my own way of wanting to conceptualise consent is that in the same way that I want us to move away from this idea of consent being an individualistic moment, where a person asserts their autonomy by clicking 'I agree' or saying 'I accept' in a

> contract…I want to move away from that…So, we move away from consent being based on an understanding of an individualistic model or individual projects, to understanding consent within its broader social meaning. (Law)

Framing consent as a point at which responsibility is transferred from one party to another is a perspective reflective in the research process. The consent form, when signed by the participant, acts as a mechanism by which they indicate their knowing agreement to the conditions of the study. Unlike the bioethical context, social research is not always able to fully explicate all risks associated with a study. In these cases the consent form functions as an artefact that sanctifies the coming activity, and symbolises a level of trust in the researcher. The participant trusts that the study has been carefully designed, will be controlled, and that the researcher will seek to minimise harm. When we consider 'in the wild' studies, there are no such certainties. The researcher cannot necessarily ensure safety and therefore the transferral of responsibility sanctified by consent is far less neutral. The researcher cannot bring to bear the same level of assurance and therefore the trust relationship becomes the more delicate and negotiable.

6.3 User-Centred Consent

When discussing the utility of consent, particularly amongst those experts representing spheres where it is a more dominant concept (i.e. law, health and bioethics), it was clear that consent had developed to be a mechanism protective of the consent-seeker or information controller rather than the user.

> Consent is there to protect the collector of the information, whereas if you wanted to protect the person whose information was being collected, you'd look at some kind of fiduciary obligation and some other kind of mechanism. (Criminology)

Suggestions made by over half of the interviewed experts implied that the weight of protection within consent should rightly rest with the user. This related strongly to notions of control and foundational concepts such as power, agency and autonomy. Drawing from consent as inherently social, and its design as privileging the consent-seeker, was the notion that any further review of consent should be participatory by nature. From this perspective, consent should be developed not just by designers or researchers, but also in close consort with users.

> I think one of the things that that does is rather underplay the creativity of people in understanding their own current circumstances, potentially alternatives to those circumstances and role that technology plays. I think some interesting things might arise out of trying to reconceptualise those relationships and imagine users as innovative, as creative, and expert in a way that the consent process, amongst other kinds of elements of the research process fails to adequately account for. (Computer Science)

The notion of consent as protecting the practitioner seems a fair reflection of our processes. We seek ethical approval to 'pass' our studies so that we can go about

the business of research, safe in the knowledge that we are doing the 'right' thing. However, without a thorough understanding of the deployment context, we cannot be certain of this. In the wild studies reframe the relationship between participant and practitioner. They cast the participant as expert and, consequently it might make sense for us to revise our ethical approaches to include greater input from participants during the ethical screening process.

7 Co-designing Consent for Everyday Life

Underpinning the theme of user-centricism were concepts such as promotion of autonomy, agency and voluntarism. This was seen as best secured through enablement, affordance and support for genuine choice—the latter point described by one expert as designing to enable the 'difference between picking and choosing'. It was also noted (both explicitly and implicitly within the wider narrative of interviews) that design of any system should proceed in a way that was 'socially sensitive'. In this way, support for consent might be subtly designed into a system.

> I think, where we're going to solve a lot of these problems is with good design. Socially sensitive design, so design that's sensitive to these issues and not necessarily just legislating the hell out of these issues, because those things don't solve the problems like good design can. That's my prejudice maybe. (Psychology)

Experts expressed various suggestions on how a reconsideration of consent might be approached through design, most of which involved drawing the user into the creative process.

> So, to frame users as being sort of creative and on the edge, and the designers as people who remain much more sort of making much more incremental tweaks in the process is one that I think would be a useful way to reconceptualise some of the things that are going on in respect of consent. (Computer Science)

Returning to conceptual basics, through defining and delimiting what work consent was actually being asked to do, was a common theme. This was seen as particularly important where concepts were being transferred to new contexts.

> One of the things that particularly interests me is the difference between, say, privacy and consent in the real world and privacy and consent online, and how do you map from one to the other? And I don't think that's been very well fleshed-out yet. And if, when you do start to map from one to the other, what's the… what does it look like, in a technology setting? What's the equivalent of… at home if you want to be a bit more private you close the curtains. What's the equivalent online? Is there an equivalent online? (Informatics/Systems Engineering)

Within this theme, one suggested approach was of particular salience. That of functional equivalence.

> we don't give up on whatever the value underlying consent was in the first place, we don't give up on that so we're not on the other end of the continuum, but at the same time we're

> willing to recognise that it's not the kind of consent that we used to talk about and used to demand and require. It's something different. So, it's a proxy for consent, or to use the language of the methodology that interests me the most; it is a functional equivalent of consent. (Law)

The purpose of this approach is to review concepts when "*we've shifted our paradigms in such a way that some of the old rules don't work*" (Law). From this perspective, by adopting a 'technology neutral stance', one can establish the purpose of each of the components of a concept, in this instance consent. For example, one component of contractual consent in the traditional sense is a physical signature; a component that conveyed to the signatory that they were engaging in a significant act that demanded their attention.

> So when writing was required, or rather when a signature was required, the signature was required because there existed a context; it was a paper-based world where blobs of ink on pieces of paper made total sense. So, what happens when we move from blobs of ink on pieces of paper to software-based word processed documents? …what was really important about a signature to begin with? What were its functional elements? And just to draw on the example of it, a signature for example is meant to do two things. It's meant on the one hand to authenticate a document, in other words, when I sign a contract it ties that document to me in the sense that somebody's able to recognise my handwriting, but it is also an external manifestation of my assent to the agreement. So it's also a way of my expressing that I agree to it, and I'll be held to it and I'll be held liable for it. There is an evidentiary piece to it and there is a sort of a requirement and there is a sort of requirement of contract that's private. So all of sudden we move into the electronic realm and the digital age and those things are no longer blobs of ink on pieces of paper, but we figure out what the functional equivalents are, and then we find a way to carry those out in the new model. (Law)

The need to return to more 'neutral' terms was also mentioned by one other expert. Similar to the conceptual stripping away described by functional equivalence, experts raised the need to a step back from emotionally 'loaded' terminology and a move towards discussions of more neutral concepts.

When asked what other methods, approaches or theories might help to better support understanding of consent, the majority of experts from an academic background suggested approaches which related strongly to (a) better understandings of the user, and (b) the social context within which consent occurred or the technology might be situated. In particular, those experts who drew from an HCI or computer science background were clear to establish the idea that pervasive systems were purposely not in themselves distinct from daily life. This framing of systems as unremarkable (Tolmie et al. 2002) and interwoven then raised a different question. If we consider consent as a highly situated social practice, the question becomes not 'how does one design consent' but 'how does one design for everyday life'?

> So, one of the interesting challenges perhaps is how we match our design processes to the fact of ubiquitous computing as a day to day reality for people. So the idea that Ubicomp technologies are radical, different, and a major disjunction from people's everyday experience, but rather that ubiquitous computing is something that already happens and things that they already do and it's a world that they already live in and the kinds of things that are being introduced by designers are perhaps more mundane than the designers would like to imagine. (Computer Science)

7.1 Granularity and Choice

When considering the design challenges one might experience when tailoring a system to be more reflective of the tenets of consent, the most dominant organising theme was that of granularity and choice. From this perspective, blanket approaches to consent had no place within sociotechnical systems, which were seen as requiring disaggregation of activities within a context. Even within current systems it was felt that allowing users more granular choices would enhance their agency. Perhaps unsurprisingly, this theme had a strong relationship to context in that different contexts were seen as requiring alternate options to enable differentiation on the basis of consent requirements.

These options were also seen as needing to be highly granular (also described as 'sensitive'). This could be predicated upon (a) sensitivity of data, (b) the anticipated use of that data by the data controller and/or third party (c) the complexity of the system, (d) the social situation, (e) the principal/other activity of user focus, (f) the actual time of the activity or the temporal point in the experience, and (g) user revealed preferences, (h) preferences modelled on the basis of user prior-behaviour. For example, there are some instances of use where the user may wish not to share their data, for example during specific personal activities within spheres of the home usually considered private.

However, not all experts felt that allowing users greater agency through design would necessarily result in more meaningful consent decisions.

> Well, I'm a little bit sceptical I have to say. In a way, given that most users will not have a clue as to how effective, or how it should be set, and effectively choosing where to set a line between more rigorous control or less rigorous control, and some of the stuff in the psychology of deception suggests that most people always go for a middling amount of whatever. (Philosophy)

The need to involve participants in the design and negotiation of the consent process speaks directly to the context of wild research. However this drive requires that, rather than relying upon our traditional methods, we revisit the functions of consent and identify the work that consent is being asked to do. Having indentified the functional requirements, we are then free to consider how best to meet them within these new research environments. By considering consent through a participatory design lens we afford the opportunity to creatively address the problem and incorporate the needs of participants in the process. Our experts offered a series of suggestions for how one might empower the user to make finer grained choices about the ongoing sharing of their data with a system. This seems an appropriate consideration for wild studies. Consider, for example, a study where timed video is taken of individuals in their living room watching television in order to understand their interactions with the set. Within a lab-based study one might construct a living room where the sole purpose was to watch television. In reality, rooms in our home are subject to multiple, and sometimes competing uses. The sitting room might concurrently be used to eat our dinner, epilate our body hair, wear a face pack, or even engage in more intimate activities. Being able to review and edit aspects our data before handing it to the

researcher might well be a critical safeguard to our privacy in such cases. It may also have the added benefit of preparing participants to become more reflective curators of their own data.

7.2 'Informing' as a Composite Concept

When asked about the key challenges going forward, all except one expert made mention of revisions required in the process of informing the consent-giver (user). Within this organising theme, comments suggested that 'informing' was an umbrella term for (1) content (of the communication), (2) context (the informational and social context within which it was received) and (3) form (the shape that the communication took and the mechanism(s) by which it was delivered.

When describing what the content of informing *should* include, experts felt that this should include, at a minimum, the requirements set out by law but also (a) the 'controls' and 'protections' in place within the system (b) the potential consequences of user actions (though there were also views that this might prove impractical) (c) as much of the system complexity as is practical, (d) information about data flows and the implications of these (though it was recognised that communicating data sharing would be challenging unless processes were standardised), (e) an overview of the rights that users are giving up by consenting, and (f) that this might best be presented as 'trade-offs'.

The idea of informing consent through standard form documentation was also seen as problematic in that it not only conflated in the mind of the user the idea of contract and consent, but also that this model failed to allow for negotiation, which should be central to both consent and the idea of contract.

> Once fine print enters into the picture, the idea of consent starts becoming a bit more tortured; when you can negotiate things, the process of negotiating a contract means that you become informed about the terms of the deal. When all of a sudden you're presented with something on a take it or leave it basis, our assumptions about whether you understand becomes more attenuated. (Law)

The context within which the user received the information was another factor considered important. It was felt that informing should be sufficiently subtle that it did not distract the user from other activities and as such would have to be sensitive to the rhythm of daily life. This was particularly linked to the wider theme of temporality in that on-going informing, and reminders for review or revocation, needed to be both subtle and delivered at a time suitable to the user. This basic theme was linked to the wider organising theme of sustaining consent over time. More broadly, there was recognition amongst experts that informing, as a component of the consent process, could not be expected to do everything and that, often, it was inappropriately conflated with information, which cast the technology/product in a positive light. This was seen as something that could potentially affect user voluntarism.

> And I think a lot of times these technologies are couched in these sort of really positive, utopian ideas about oh, if we get all this data tracked about you, you can, you know, be healthier. Oh, if you know where your kids are at all times the family unit can be improved in some way. Or isn't this a sort of magical, wonderful, delightful thing to go through. (HCI)

Whilst within a research context the consent form is required documentation, the idea that consent should be sustained through ongoing informing and multiple reflection points seems pertinent for wild research. Due to the nature of such investigations, studies are often much longer in duration that those conducted in the lab. As such, one should consider that participants' orientation to the study conditions may alter over time. Allowing reflection points, where participants might consider their initial decision, could potentially allow them to review any altered conditions and ensure the offer of consent revocation is meaningful.

8 Wider Challenges of Sociotechnical Systems

Having discussed the broader issues relating to consent, experts were asked to consider what they felt to be the key challenges going forward. Beyond the design issues, experts discussed the shortcomings of the treatment of personal data in law, and the issues facing consent within the wider social context.

8.1 Data Sensitivity, Convergence and Context

Within the theme of legal infrastructure, the most common basic theme was that of the treatment of data. A key basic theme was that conceptions of what constituted personal data required both revision, and a degree of consistency to ensure a common language. This theme, whilst most closely aligned to comments relating to law and policy, was also to be found in relation to design. Those for whom this was not an issue were those experts who worked with health services and/or large-scale data. Within these sectors, definitions of data were very specific and tied closely to data protection and ethical conduct in terms of use limitation. However, more broadly, it was felt that the current understanding and definition of what constituted 'Personally Identifiable Information' was likely to come under some pressure. This was attributed to advancements in analytic instruments (allowing greater triangulation) and the altering nature of the data being collected.

> So, the criterion of the data protection legislation, that is it is personally identifiable information that is the problem, is perhaps going to come under technical pressure, because it's going to be too easy you see. I only have to know that it's a person of a certain age, with a certain postcode and with a certain disease and I know 'ah, yes, it's Jan Smith'. (Philosophy)

From this perspective, it was felt that adherence to data protection regulation ought to represent a 'floor not a ceiling', meaning that as data in all forms had the

potential to become 'increasingly sensitive', so that same data should, at a minimum, be protected against misuse. More broadly, regulation within the area of data protection was perceived as having outlived its usefulness (in its current form) and was in need of considerable revision. This perspective, whilst considered an ideal, was problematised in that experts recognized that effectively predicting data sensitivity was difficult and likely beyond the normal pace of legal development. Overall, however, it was clear that experts felt it was a time for consideration of what new restraints might be needed and where those restraints might lie. One expert suggested that it might be more effective if regulations stated clear use limitations for data processors.

> So, you see, you could put constraints at a different position, and I believe that we may come to look at the data protection legislation as rather primitive; you can't do anything with this information. No processing, and then unfortunately have a very unclear definition of personal information. But, actually we need to use that information all of the time and the proper question may be, what may you not do with it. However, it's difficult to prevent people doing things, once they know something. (Philosophy)

One particular issue raised by a legal scholar was that courts currently fail to recognise the dignitary harm of data misuse, and instead saw it as a by-product of the risks a user takes when engaging in online activities. This was seen as an extension of *caveat emptor*, a point made by a further expert.

> Courts don't recognize the harm, the dignitary harm of getting your private information out there, because the assumption is that if you are online you don't have any privacy expectations in that particular way. (Law)

> There's a sort of branch between, which I see as very much a sort of dividing line between the sort of biomedical area, where we have jacked-up the standards of consent, and the commercial where on the whole we, although there are the consumer protection issues on the side, but on the whole we take it that it is a case of caveat emptor, buyer beware. (Philosophy)

Ideally, however, it was felt that protections of that data (and therefore the individual) should extend far beyond current regulation. Further to this, the majority of those discussing the nature of personal data indicated that the focus should not be upon the data as isolated bits of information but, more importantly, regulation should focus upon the use that that data is put to and regulate in respect of 'what you may or may not do with that data'. One expert explicitly noted that consent only made sense if the user had some control of the purposes to which their data would be put, though this was reinforced by several other experts.

> I think the way to make it more effective actually, is not to focus on consent, but to look at purposes. We could have said okay, if you're in an instrumental relationship, you're either a merchant and a consumer, or you're a person at your bank, you're even talking to your doctor when it comes to some kind of procedure that you're going to go through. Just because they've given consent doesn't meant that all purposes are equal, and so in our legislation, we have a clause that says, you know, if organisations can use information for purposes that a reasonable person would consider appropriate in the circumstances. A number of us have been pushing our privacy commissioner and our government to actually take that clause seriously. I think one of the reasons we haven't is because consent's been given such a large proportion of the debate, you know, it's all about consent. Consent only makes sense if there's some control over purposes as well. (Criminology)

8.2 Sustaining Consent

The idea of 'time' and its effects was another organising theme across the majority of expert interviews. The (a) changing nature of system functionality, (b) significance of data, (c) uses that data is put to, (d) influence of external events, and (e) user expectations and attitudes were the most often raised points within this theme.

> I think it's much more like our attitudes change all the time…I might think six very contradictory things about my privacy within the course of a day. But at any particular moment I might be consistent. (Philosophy)

Linked to these dynamics was the idea that informing should also change over time. This related to the notion that systems dealt with dynamic data in on-going and ever-changing ways and that user consent was only meaningful in relation to the context within which it was initially given. From this perspective, it was felt that what users needed to know was also mutable, and driven by how they experienced a system over time: "*I think the main issue for me is…being informed changes over time as you use a system*." (Computer Science)

The majority of experts felt that, whilst there was no denying that an initial indication of agreement was necessary prior to user engagement with a system, meaningful consent could not be a single moment in time within ubiquitous computing systems.

> So consent is a sort of on-going thing, a process, not a sort of initial state you go into the system with. And, in just the same way, more generally, how you use a system is something that changes in the course of your experience of that system, rather than something you just walk in and start knowing and doing from day one. (Computer Science)

> You're assuming that you can tell who the user is, because if you put these into the environment, where is the point, let's call it the tick and click point, where is the equivalent point for going up and hopping onto someone's scales? (Philosophy)

The basic themes of bi-directionality, negotiation, revisiting consent decisions, the right to revocation and the need for reminders to reengage users was considered important in sustaining consent.

> I think the biggest challenge is that people don't know the ultimate implications of releasing that information at the time that the request is made. So, you need to do the best you can to inform them, but I don't think that will ever be enough because you need to be able to revisit and see the implications of those decisions to consent. So, you need to have the ability to kind of backtrack on things and I think from some perspectives that's not a technological challenge so much as it is a social and legal challenge. So, calling on regulatory bodies to essentially require API s to systems to allow people to build tools to let people visualise the implications of release of information and then be able to retroactively call back the release of information. (Computer Science)

Whilst there are clear legal limits around the processing of data, research ethics demand a different perspective. From an ethical perspective the notion of dignitary harm does indeed hold some relevance as researchers are bound to minimise harm in all its forms. When deploying complex data-driven systems in the wild, there are likely to be a number of points at which data convergence might result in an alteration in data sensitivity. The notion that data sensitivity alters with context and

convergence is a particular concern for wild studies. For example, a recent study collected sensor data within a family home (motion, light, energy and humidity) in order to assess member orientation to data sharing. In practice, the study made visible specific bathroom practices of the children within the household. When data was viewed independently each sensor indicated very little of what went on in the home. However, when all readouts were taken together it was brisk work to indentify who was in the bathroom, at what time, for how long and whether or not they were static or using warm water. Such exposures, whilst unproblematic in the context of that study, may have proven difficult if the identified behaviours had run counter to household norms or expectations. Such conflations of data subtly alter the potential for harm and, given the dynamic nature of wild research, such observations reinforce the need to offer more granular and regular options to review and revoke consent in specific instances.

8.3 The Dynamic Nature of Social Things

The issue of social challenges pervaded many of the basic themes. Fundamentally however, when discussing the future of consent the dominant feeling was that due to the nature of the potential harms, it was no longer sufficient to assume that users would alter their behaviour on the basis of poor experience.

> When people pull back is when they get burned. As they learn that these technologies are not just cool, they start to change their behaviour in public spaces and start to pull back their use of technology. When you're talking about Ubicomp, it may be too late now. (Criminology)

In response to this, two prominent social challenges arose. These were, firstly, comments related to the need for social education and public awareness to support consent. This included education around IT systems, profiling (social inference) and machine learning to support a wider societal, and more realistic, understanding of risk and the ways that ubiquitous systems alter the everyday. This was felt to be one side of a potential solution in that, whilst the design of systems could enable better consent decisions, the space had to be open to allow users to find their own responses.

> I think it's very important that people begin to realise that with ubiquitous computing environments this is not something they can use, this is something they must interact with, and that's a paradigmatic shift in relating to your environment. I mean I'm not interacting with my coat I'm just wearing it, but the minute my coat begins to send information to my insurance company about the fact that though it's very cold I'm not wearing it, and I'm probably going to be sick, and this is going to cost, you know. This, of course, is entirely fictional but once I begin to acknowledge that then I'm going to interact with my coat. I might tell my coat, okay, I don't want you to send this information, or I might take my coat for a ride by taking with me but not wearing it, well, whatever way. (Cultural Anthropology)

Whilst it was felt, by some experts, that the media offered a 'critical check' within the consent system, but this was felt as only one part of the potential solution. The second prominent social challenge spoke of the need to better understand users,

including (a) their perceptions of and attitudes towards consent, (b) the social contexts within which consent was likely to occur, (c) their expectations in respect of the public/private boundary, (d) how users manage and respond to the 'multiple audience' of their data, and (e) their attitudes to risk. If carefully managed, such findings are likely to arise as a biproduct of wild research. If we reconsider the design of consent at this stage of our practice and allow for a more negotiated, reflective and granular form of consent, we may also be able to inform the ethical design of systems into the future.

9 Where Now for Consent?

It is clear that our current ethical practice is challenged when studies are conducted 'in the wild'. Not only does wild research reframe the role of practitioner and participant, it affects the stability, understanding and temporal ordering of the way in which HCI research is conducted. This realisation brings with it a level of responsibility; if we know our approaches to research ethics no longer have the effect of protecting our participants, it falls to us to begin the process of reflective redesign. According to Rogers (2011), "for the wild approach to be valuable to researchers and designers alike, we need to develop *wild theories*" (Rogers 2011: 62). This call, for the development of a wild-focused conceptual infrastructure, speaks equally to the context of research ethics. Whilst there are doubtless a range of factors which might be brought to bear when considering wild research, four aspects arise from our research; (1) the complexity of context and its effect upon informing, (2) the dynamism of the sociotechnical context versus the static nature of consent in its current a priori form, (3) the greater social unpredictability of risk, and (4) the challenge of sustaining consent when the sensitivity of data is not easily predictable.

9.1 The Need for Responsive Informed Consent

Wild research speaks directly to the notion that consent and context are intimately related. Popularly, context can be understood as "the circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood" (Oxford English Dictionary). Context, therefore, embraces everything that can be known about a situation, and it is a desire for this situational understanding that it is the driving force behind wild research. Cognate literature arising from the sphere of pervasive systems casts context as something of a broad theoretical church. This is not unique, but reflective of a much longer tradition where nailing down a single precise understanding has proven close to impossible (Duranti and Goodwin 1992). In the words of Paul Dourish, "it is a concept that keeps to the periphery, and slips away when one attempts to define it" (Dourish 2004: 29).

Research Council ethical guidance states that participants must be fully informed as to what their "participation in the research entails and what risks, if any, are involved" (ESRC 2012, p. 3). When informing participants, a comprehensive understanding of context is critical; how can one evaluate and communicate risk if conditions are partially or entirely unknown? Within traditional lab-based studies, context was something to be carefully controlled and therefore all potential factors could be assessed, and risks articulated, to within a reasonable tolerance. However, this becomes something of a challenge when context is not static but "continually renegotiated and defined in the course of action" (Dourish 2004: 29). If we cannot imagine all possible actions and reactions that might occur within a deployment, how can we possibly hope to protect the research participant from harm?

It is clear that the dynamism inherent in 'wild' deployments can serve to undermine our current approaches to participant consent. However, if we reframe consent as something more responsive, to be sustained or renewed on an ongoing basis, might this better meet our requirements? If not all aspects of the research can be explained, or if there is a level of ambiguity, this raises a new sphere of vulnerability requiring address. Whilst currently, our response to this tends to be set during the ethics committee process, we would argue that there is need for an ongoing, responsive, review of ethical practice undertaken by the researcher. One means of formalising such practice may be through the use of reflective diaries kept by the researcher and accessible to the ethics board, or other more granular and transparent reporting mechanisms.

9.2 Participant as Researcher

Key to 'in the wild' studies is the notion of participant knowledge as being equal to that of the researcher. Within such studies we seek to know "how people come to understand and appropriate technologies on their own terms and for their own situated purposes" (Rogers 2011: 59) over time. The dynamic here is distinctly different. It is no longer the researcher bringing the participant into a world of their construction and "showing them their place" (ibid). Instead the participant is allowing the researcher to enter theirs. Equally, the researcher tends to be absent from the site of study and is therefore not able to signpost the technology as clearly. By introducing a prototype into the wild, the researcher creates new vulnerabilities within their research but is limited in their understanding of the context of deployment.

For example, Rogers (2012) describes a prototype tabletop which, when deployed in the wild, elicited distinctly different behaviours from participants that they had 'taken for granted' in the lab. This altered control dynamic, from researcher to participant, necessarily means that researchers will not always be able to anticipate risk in the same way as within a controlled laboratory study. Equally, when deploying in the wild, what is being asked of the participant can blur the boundaries between researcher and research subject. One study, for example, deployed a system that allowed spectators of a marathon to 'tag' runners, using a mobile device. The par-

ticipant spectators were directed to tag any runners freely, as often as possible, and were sent motivational messages via text (Anstead et al. 2014). This act, of handing a device to research subjects and asking them to gather data could be framed as a mechanism by which the participant becomes researcher. Cast in this light, the participant becomes a de facto part of the research team. A role that could be termed as peer-researcher. Even within the private sphere we are increasingly playing with such boundaries. Where studies place sensors in a participant's home, they cast that subject in a role of responsibility, allowing them to make judgments about whether their visitors' movements are recorded and shared without their knowledge.

We are still in the process of exploring what these altered conditions might mean in terms of ethics. There are currently no right answers. However, one way of dealing with this hybrid peer-researcher might be to embed ethical training for participants prior to the study tasking place to ensure they understand the ethical and legal parameters under which they operate. Counter to the participatory nature of in the wild studies, the ethical process is still top-down and consent is conducted a priori, setting the participant-researcher relationship. Whilst current approaches to ethical assessment are sufficiently rigorous to support traditional HCI studies, we must now ask the question; how can we better scope and anticipate risk in a way that is rigorous, ongoing through the life of the study, and involving of the participant.

One means by which participants might be more closely involved in the research process is by involving them in the ethical screening process would be through "temporary advisory bodies that involve lay people in cooperative deliberation informed by expert advice" (Brown 2006: 203). This approach has been successfully adopted in other spheres of political interest (ibid). For example in 2006 the UK developed the National Learner Panel, a group of volunteer learners drawn from across Further Education, created in order to advice government on proposed changes to the sector and a toolkit was developed to support 'learner representatives'.[2] Such approaches have the effect of casting the participant as 'trustee', acting as a counter to centralised power and enriching deliberation (ibid).

9.3 A Return to Trust

Within the bioethical consent process, the role of trust has been extensively considered in the context of patient, physician and the public (Bonnici 2013). Within these contexts, it is the opposing force against which the need for consent is set. Historically when trust in institutions fails, such as the case of the Tuskegee Syphilis experiment (Corbie-Smith 1999), the importance of transparency and accountability is foregrounded and consent is invoked (O'Neill 2004). Informed consent is also a mechanism by which trust might be built (Friedman et al. 2000). From this perspective, whilst trust can *affect the conditions* of consent, and consent can *stimulate* trust, it remains a separate and complex concept with an associated 'quagmire of concerns'

[2]Toolkit for Learner Representatives at http://tlp.excellencegateway.org.uk/tlp/xcurricula/toolkit/.

(Harper 2014). Within the traditional consent process, the need for participants to trust the researcher, whilst desirable, is superseded by the consent form. The form, in this instance, is something of a legitimising artefact by which the human relationship between the researcher and the participant is formalised and a power balance is set. However, 'in the wild' studies create a new frame for research, and therefore ethical practice. It alters the trust relationship and therefore calls into question the salience of the consent artefact. No longer is the participant operating within the confines of a study designed and controlled by the practitioner. When deployments occur in the wild, it is the participant who controls the conditions of deployment; they are uniquely positioned to manipulate or subvert the study should they so choose. In this way, the trust relationship is again foregrounded as the practitioner and participant negotiate the conditions of deployment. This negotiation is currently managed informally. However, one future approach might be to install a channel of communication that allows the participant and practitioner to renegotiate and build trust as deployment conditions change. In this way, the receding of the consent artefact gives ground to the development of a redefined trust relationship between the researcher and participant.

9.4 Designing Ethically Sensitive Research

Principal tenets such as respect for Autonomy, Nonmaleficence, Beneficence and Justice frame the foundations of our ethical decisions. Even where insufficient guidance exists, drawing upon ethical principles can stimulate moral action in a research context. Whilst in the wild research presents unique challenges to the way we might approach consent, tools are emerging that can help us to navigate these complex ethical waters. The Engineering and Physical Sciences Research Council (EPSRC) Framework for Responsible Innovation is one such development. Whilst targeted at the broader process of innovation funded by, the intention is that developments are "aligned with the principles of Responsible Innovation, creating value for society in an ethical and responsible way" (Framework for Responsible Innovation). Whilst not a prescriptive methodology, the council offer a framework intended to guide innovation, and the research that informs it, towards more ethical practice. The AREA (Anticipate, Reflect, Engage and Act) framework defines responsible innovation as an approach which (a) anticipates the potential impact of research, (b) reflects upon the purposes, motivations, implications and uncertainties surrounding innovation, (c) engages stakeholders in such reflections, and (d) support action by making use of the outputs to influence the direction of the research and innovation. However, whilst such broad frameworks support us to begin to think in a more ethically-motivated way, there are also more practical instruments which might be of use. Ideation Cards offer one such method. Originating from the sphere of design, such cards are intended to stimulate creative thought in the design process (Golembewski and Selby 2010) and their application has been applied to a number of areas such as the sphere of human values in the design process (Friedman & Hendry, 2012), to encourage par-

ticipants to think about security threats (Security Cards), and to support people in exploring online privacy, and thought around data protection issues within the design process (Luger et al. 2015).

Whilst these examples offer some tools one might apply, the wider issue is one around the need to design research that is both ethically-sensitive and, critically, is considerate of the wider implications of the 'wild' context. Consent is the mechanism by which we ensure our participants are informed and protected. It is the mechanism by which we allow actions and behaviours that would otherwise remain inappropriate. However, all too often it is reduced to a legitimisation of our research and, once secured, is rarely if ever revisited. Studies conducted in naturalistic settings present us with a number of altered conditions and these conditions pose ethical challenges that are only now surfacing. It is increasingly clear that 'in the wild' research offers unique opportunities to understand how users truly respond to technology and, as we develop better 'wild' methodologies, so should we be taking steps to revise our approach to consent and the ways in which we respond to questions of ethics in the wild.

References

Anstead, E., Flintham, M., & Benford, S. (2014). Studying MarathonLive: Consent for in-the-wild research. In *Proceeding of UbiComp'14 Adjunct*. ACM.

AREA Framework, EPSRC. http://www.epsrc.ac.uk/research/framework/area/.

Barnard-Wills, D. *Privacy game*. http://surveillantidentity.blogspot.co.uk/p/privacy-card-game.html.

Bohn, J., Coroama, V., Langheinrich, M., Mattern, F., & Rohs, M. (2005). Social, economic, and ethical implications of ambient intelligence and ubiquitous computing. *Ambient Intelligence*, 5–29.

Bonnici, C. J. (2013). An extended conceptual model of consent for information systems. In *2013 IEEE 26th International Symposium on Computer-Based Medical Systems (CBMS)*, Seiten (pp. 149–154).

Bonnici, C. J., & Coles-Kemp, L. (2010). Principled electronic consent management: A research framework. In *Proceeding of 2010 International Conference on Emerging Security Technologies* (pp. 119–123). IEEE.

Brown, M. (2006). Survey article: Citizen panels and the concept of representation. *The Journal of Political Philosophy, 14*(2), 203–225.

Callon, M., & Rabeharisoa, V. (2003). Research "in the wild" and the shaping of new social identities. *Technology in Society, 25,* 193–204.

Chamberlain, A., Crabtree, A., Rodden, T., Jones, M., & Rogers, M. (2012). Research in the wild: Understanding 'in the wild' approaches to design and development. In *Conference on Designing Interactive Systems 2012*. ACM.

Corbie-Smith, G. (1999). The continuing legacy of the Tuskegee Syphilis Study: Considerations for clinical investigation. *The American Journal of the Medical Sciences, 317*(1), 5–8.

Declaration of Helsinki. (1964). World medical association. *Bulletin of the World Health Organization, 2001*, *79*. At https://www.who.int/bulletin/archives/79(4)373.pdf.

DeMarco, J. P. (1994). *A coherence theory in ethics*. Rodopi.

Dourish, P. (2004). What we talk about when we talk about context. *Personal and Ubiquitous Computing, 8*(1), 19–30.

Duranti, A., & Goodwin, C. (Eds.). (1992). *Rethinking context: Language as an interactive phenomenon*. Cambridge University Press.
ESRC Framework for Research Ethics (FRE) 2010 [Updated September 2012]. (2012).
Faden, R. R., & Beauchamp, T. L. (1986). *A history and theory of informed consent*. Oxford University Press.
Feinberg, J. (1984). *Harm to others*. Oxford University Press.
Framework for Responsible Innovation, EPSRC. http://www.epsrc.ac.uk/research/framework/.
Friedman, B., Felten, E., & Millett, L. I. (2000). *Informed consent online: A conceptual model and design principles*. CSE Technical Report Seattle: University of Washington.
Friedman, B., & Hendry, D. (2012). The envisioning cards: A toolkit for catalyzing humanistic and technical imaginations. In *Proceeding of CHI'12*, ACM.
Golembewski, M., & Selby, M. (2010). Ideation decks: A card-based design ideation tool. In *Proceeding of DIS'10*. ACM Press.
Harper, R. (Ed.). (2014). *Trust, computing and society*. Cambridge University Press.
Luger, E., & Rodden, T. (2013). An informed view on consent for ubicomp. In *Proceeding of Ubicomp'13*. ACM Press.
Luger, E., & Speed, S. (2014). Seeing behind closed doors. In *The co-productions of data-based living (1): Mediated life: Technologies, affect, routine*. *RGS-IBG Annual International Conference*. Royal Geographical Society (with IBG).
Luger, E., Urquhart, L., Rodden, T., & Golembewski, M. (2015). Playing the legal card: Using ideation cards to raise data protection issues within the design process. In *Proceeding of CHI'15*. ACM.
Manson, N., & O'Neill, O. (2007). *Rethinking informed consent in bioethics*. Cambridge University Press.
Miller, F., & Wertheimer, A. (2010). *The ethics of consent; Theory and practice*. Oxford University Press.
North, S., Schnädelbach, H., Fatah gen Schieck, A., Motta, W., Ye, L., Behrens, M., & Kostopoulou, E. (2013). Tension space analysis: Exploring community requirements for networked urban screens. In *Proceeding of INTERACT 201*3, Cape Town, South Africa, September 2–6 (pp. 81–98).
Observatory for Responsible Research and Innovation in ICT (ORBIT). (2017). At https://www.orbit-rri.org/about/.
O'Neill, O. (2004). Accountability, trust and informed consent in medical practice and research. *Clinical Medicine*, *4*(3), 269–276.
Rogers, Y. (2011). Interaction design gone wild: Striving for wild theory. *Interactions, 18* (article 4).
The Security Cards. At http://securitycards.cs.washington.edu/index.html.
Tolmie, P., Pycock, J., Diggins, T., MacLean, A., & Karsenty, A. (2002). Unremarkable computing. In *Proceeding of CHI'02* (pp. 399–406). ACM Press.
Toolkit for Learner Representatives at http://tlp.excellencegateway.org.uk/tlp/xcurricula/toolkit/.
Weiser, M. (1991). The computer for the 21st century. *Scientific American, 265*(3), 94–104.

Practical Ethics

Nick Race, Dave Randall, Mark Rouncefield and Roger Slack

1 Introduction: 'The Man Came Through the Door with a Gun in His Hand, "Show Me Your Ethics" He Snarled, "and Make It Quick"'

Wittgenstein: 'My whole tendency and, I believe, the tendency of all men who ever tried to write or talk Ethics or Religion was to run against the boundaries of language. This running against the walls of our cage is perfectly, absolutely hopeless. Ethics so far as it springs from the desire to say something about the ultimate meaning of life, the absolute good, the absolute valuable, can be no science. What it says does not add to our knowledge in any sense. But it is a document of a tendency in the human mind which I personally cannot help respecting deeply and I would not for my life ridicule it.' (A Lecture on Ethics)

Raymond Chandler's reported advice to writers, "When in doubt, have a man come through the door with a gun in his hand." seems particular apposite when considering the ethical aspects of HCI research 'in the wild', where doubt has become rife, sometimes to the extent that any certainty about research, ethical research, appears almost impossible. Wittgenstein's position, expressed in the above quote, is quite simply that there can be no general ethical principles founded on facts. Our principles are, tout court, our principles and we are entitled to celebrate them. We should not pretend, however, that they have any evidence-based foundation. This because, as Moore (1993) put it in relation to the naturalistic fallacy, ethical statements cannot

N. Race (✉) · M. Rouncefield
University of Lancaster, Lancashire, England, UK
e-mail: n.race@lancaster.ac.uk

D. Randall
University of Siegen, Siegen, Germany

R. Slack
Bangor University, Bangor, Wales, UK

A. Chamberlain and A. Crabtree (eds.), *Into the Wild: Beyond the Design Research Lab*, Studies in Applied Philosophy, Epistemology and Rational Ethics 48,
https://doi.org/10.1007/978-3-030-18020-1_9

be reduced to natural facts (for those interested in such matters, this is a version of David Hume's proposition concerning 'is' and 'ought' statements). Such a view is, it has to be said somewhat controversial (see e.g. McInerny 1997) but in any case the point we want to make is that, in the rush towards establishing moral and ethical guidelines for research activity, relatively little attention seems to have been paid to the relationship between principle and practicality.

Of course, it is reasonable to suggest that everyone (excepting the occasional sociopath), regardless of social position, is assailed by ethical doubt on occasion. However, and it seems to us that this is an important matter, ethical doubt is, for most people in the course of their everyday lives, precisely an occasioned matter. Almost by definition, if whatever ethical stance we choose to take is obviously appropriate for the situation we find ourselves in, then ethical considerations will not normally arise. Ethics, for ordinary people, are foregrounded when troubles occur, troubles which have to do with questions such as, 'what should I do here?' or, 'did I do the right thing?', in other words by the realisation that the consequences of a decision are personal perhaps when recognising that an action may problematise one's reputation as a 'good person', by feelings of guilt, and so on. They are not, we suggest, typically questions of a general kind.

This contrasts with what we might think of as a fairly typical academic HCI stance (and here we are not so much concerned with institutional policies, IRBs and the rest, although we will refer to them). Trenchant analysis of the relationship between institutional procedures and ethics can be found in Hammersley (2009) which largely implicates theoretical commitments of one kind or another. That stance is more likely to be taken in advance of the design work, or results from reflection after design work. Thinking in advance or reflecting post hoc may be occasioned by the realisation that a policy (design or otherwise) has had unforeseen, and unfortunate, effects. It also may be occasioned by a more gradual realisation which is not consequential upon a specific event but may be thought of as having to do with our accumulated experiences in our chosen community. It may associate, for instance, with the realisation that we have no coherent means by which to judge possible effects in advance and so might need to develop them, by the realisation that possible ramifications may not be desirable (Winner 1980), as a result of reflection on the way in which new mediating technologies can prescribe behaviours (see Verbeek 2006, 2008), by the principled need to inject an explicitly ethical approach into the decisions made, or by the somewhat cynical recognition that institutions and individuals need to protect themselves from legal and other ramifications (newspapers, television and the social media are never far from our minds). Regardless, it is likely, we feel, that at some point theoretical commitments come into play, and may be analysed from a number of disciplinary auspices. Again, it should be obvious that these various theoretical commitments do not all share exactly the same features (although they all, in some sense, implicate a degree of generality). They may, like philosophical positions, be (for the most part) highly abstract; they may draw attention to various kinds of power relationship; they may be prescriptive and/or they may be empowering. We need to stress that we have no objection to any of these goals. Like Wittgenstein, we 'cannot help respecting'. What we will suggest, however is that the kinds of ethical guid-

ance provided are not often enough accompanied by in situ descriptions of ethical problems that actually occur.

Philosophers, not least, have spent a vast amount of time considering the nature of moral and ethical problems from a variety of perspectives (see for example Becker and Becker 2003; MacIntyre 1988; Berges 2015) on teleological, deontological and virtue ethics. These reflections have sometimes been brought to bear on design (see for instance Whitbeck 2011). It is not our task here to adjudicate between ethical theories, but rather to point to an issue raised in consideration of one specific approach, sometimes disparagingly known as 'trolleyology' (see Foot 2002; Edmonds 2013; Singer 2011a). The 'trolley method', as O'Connor puts it (2012: 243), involves, *'discussing the use of trolley problems … which offer perhaps the most extreme instance of treating imaginary hypothetical cases as the raw data for a quasi-scientific approach to ethics.'* It involves the construction of hypothetical 'thought experiments' of which the best-known is the one where the driver of a tram/trolley is forced to make a choice between staying on the line and killing five people who are tied to the track after his brakes fail or deciding to switch to a spur and thereby killing one (also tied to the track). In the 'fat man' problem, we are invited to actively throw the fat man off the bridge in order to save lives. Now, 'trolleyology' is of no particular interest to us (apart from the fact that cases of this kind are quite amusing), but it does indicate a wider issue. This is, as Wood (2011) puts it, that: '*Trolley problems … abstract not from what is irrelevant, but from what is morally vital about all the situations that most resemble them in real life.*' In other words, whatever philosophical, or other theoretical, commitments one might have, it is only in the actual, real-life decision-making process that one will see what ethical ramifications are in play.

In much the same way, we find general commitments of various types in such orientations as value based design (e.g. Friedman and Kahn 2003); feminist theory (Bardzell 2010); participatory design (e.g. Mumford 1995; Kensing and Blomberg 1998; Bratteteig and Wagner 2014), user-centred design (e.g. Bødker 2000; Abras et al. 2004), critical design (see e.g. Dunne and Raby 2001, 2013; Bardzell and Bardzell 2013), 'disclosive' ethics (Brey 2010) and so on. In each case, unsurprisingly, we are reminded that we should be mindful of various interests and need to deploy methods which reflect and manage those interests. Again, and to be clear, we have no objection to the ethical principles espoused in the above- quite the reverse. Nevertheless, we contend that such general principles are largely a product of 'before' and 'after' reflections and, moreover, that typically they provide too little in the way of descriptions of what ethical issues actually arise in the research process, issues which may affect not only the researcher but also other participants. To give a flavour of the very contingent relationship between general commitment and actual problems, consider the following experience of one of the authors:

"So, I gave the usual guarantees, of course. I had a meeting with all the people I would be watching and specified that I wasn't interested in individual qualities, and wouldn't be naming any names. I had a separate meeting with some middle management and told them exactly the same things. To cut a long story short, it was obvious to me when observing work in the office that one of the women there was the fount of all wisdom. Everyone went to her for advice about procedures. Anyway,

once the observations were all done, the management team called me in for a debrief, and one of the first questions I was asked was, 'so, what do you think of (this woman), because we don't think she's very good.' " I remember thinking, 'Oh my God, they're going to sack her.'"

The more philosophical, or at least theoretical, arguments about consequences, moral imperatives or particular virtues, can sometimes be contrasted with, sometimes supplemented by, the more mundane, but, to some extent more pressing and important 'practical' ethical concerns that arise in the research process. Whilst the philosophical approach seems to offer little in the way of resolution, merely comparing and contrasting the cold and unsympathetic reason of Kantian moral imperatives with the faux-scientific calculations of utility or an appeal to virtues that become increasingly difficult to define; a recent emphasis has been on what might be regarded as 'practical ethics' as a set of ideas and practices that shape the actual conduct of the research. Again, 'practical ethics' is something of a slippery concept—as Peter Singer suggests in 'Practical Ethics' (2011b): "Practical ethics covers a wide area. We can find ethical ramifications in most of our choices, if we look hard enough. …I regard an ethical issue as relevant if it is one that any thinking person must face"—an idea that is not especially valuable or useful for most researchers. In these circumstances practical ethics divides into two: firstly, a set of largely bureaucratic or 'audit' concerns [as in Strathern's notion of 'audit culture' (2000)] that emphasize institutional review or ethics board approval and that, especially in recent HCI research, has focused on a complex of issues surrounding the notion of 'informed consent' (see for example Rodden et al.). Secondly there are a range of related issues that centre on the 'ethical' treatment of participants and their relationship with researchers and the research process itself: as Crabtree et al. (2013) suggest, "Being real in this new era for HCI means going beyond the researcher as passing visitor or tourist of previous participatory design periods. It involves a greater degree of embedding and engagement with those with whom we seek to partner." The management of these practical concerns is the central concern of this paper.

We should not overplay our complaints, for we are certainly not the first to be concerned and exercised by some of the practical ethics involved in HCI research in the wild. Waycott et al. (2016), for example, report on some of the ethical issues that arose in the course of their experimental deployment of Google glasses with what might be seen as vulnerable participants or sensitive settings. In the course of their project they identified four general 'ethical' themes concerning their own research practice, focusing on *high expectations and initial letdowns*; *effort, time and withdrawal*; *hope and self-depreciation* and *risks and vulnerabilities*. Particularly relevant here and to our own work is the theme of initial high expectations and what the participants thought they might gain from participating, followed, when these perhaps unreasonable, expectations failed to be realized, by some initial (and perhaps inevitable) disappointment and letdown.

Managing user expectations also features strongly in Taylor et al.'s account of 'leaving the wild' (2013); of what happens when a research project ends and everybody goes home (taking their toys with them). Users have been encouraged to engage in and commit to a research project and then, seemingly suddenly and without warn-

ing, the project ends. Despite the best intentions of the researchers, relationships that have built up over a number of years appear to be simply terminated, and participants can feel abandoned if not tricked or duped into participation. As they argue, this raises questions, philosophical, ethical and practical questions, about the way we do HCI research: "If we are designing interventions intended to have some positive impact on the lives of users, what happens at the end of the study? While researchers can leave this process with valuable findings, the technologies designed with the community are often simply taken back to the lab or redeployed with new users, leaving study participants without a technology they may have come to value and that is not available to purchase". They then develop a set of guidelines for researchers involved in such 'in the wild' deployments that focus on managing expectations and resolving the resource and technical support issues that often emerge at the end of a project. These are fundamentally issues of practical ethics: "By making this clear at the very beginning, it allows prior planning for handover and may also help participants to decide on how much time and effort the are willing to commit to the project, which might be larger or smaller depending on whether they expect to keep the technology or not…. Expectation management, skill building and robustness are considerations that must have bearing on our decision-making throughout the development and deployment of prototypes."

In 'Five Provocations for Ethical HCI Research' Brown et al. (2016) question some of the taken for granted foundations of ethical issues in HCI research, in particular the various ways in which "virtuous but impractical positions are advocated, and little attention is paid to how seemingly ethical positions can delay, damage or stop research". They believe that ethics in HCI has its own distinctive ethics because of the way in which research technologies can impinge on people's lives. The 'provocations' they propose as 'tools for critical thinking' include challenging the notion of 'informed consent'; the thorny 'qui bono?' issue, or who exactly benefits from research; the importance and role of anonymity in HCI research; the purpose and value of institutional review boards; and the availability of research generated data. They suggest this approach highlights important ethical issues in HCI research: "The five provocations point to unintended consequences of regulation, oversimplifications of unresolvable moral conflicts, a bias in social desirability over what is ethical in effect, and a failure to consider the value of research". Accordingly they propose 'situated, ordinary ethics grounded, not on the classical philosophical positions but in the particular sensitivities and everyday judgments of research participants and 'the practice of being ethical': "Notions such as busyness, getting things done, minimising harm, altruism, and showing respect by understanding that the participants are also striving to behave ethically, need to be adopted to make ethical research become practical and achievable".

Finally, in 'The Ethical Implications of HCI's Turn to the Cultural' Benford et al. (2015) challenge the simplistic transfer of conventional Social Science ethical approaches to HCI identifying particular ethical challenges for HCI research and specifically its engagement with cultural applications (transgression, boundaries, consent, withdrawal, data and integrity) and consider some implications in

terms of managing tensions and challenges between overlapping ethical frames and how this in turn might promote Value Sensitive Design in HCI.

As ethical issues become increasingly important and problematic in social science research, this chapter reflects on our own investigations into some of the ethical considerations involved in the long-term research relationship between a university Computer Science department and user research conducted 'in the wild' in two 'living labs'. We consider perceptions of the role and responsibilities of research grant holders to two rather different communities, the role of 'lead users' or 'mediators' in the communities, and various perceptions of participants themselves to the research process and the researchers. In particular, we consider two relevant issues: the effect of a long-term relationship with a community, and the delineation and relevance of 'practical' ethics in the process. What becomes clear from our interrogation of the available data is that issues of responsibility, including those of how we identify what our responsibilities might be; who holds them; what they entail, and how we discharge them are matters of the negotiated order. It has long been the case that engaged researchers have argued for the treatment of participants in a more reflexive way and we fully subscribe to such commitments. Nevertheless, in a context where research relationships are predicated on lasting commitment, they are not, and cannot be, determined by us alone. They evolve over time and in delicate relation to the needs and desires of our fellow research partners and participants—this is what 'practical ethics' entails.

2 Research Approach: The 'Living Lab'

We use this chapter to document some of the findings of a detailed investigation into the ethical considerations involved in the long-term relationship between Lancaster University Computer Science department and two 'living labs'. The first was the village of Wray, some 15 miles away from the campus, and the second various 'feedback enabled' student residences on campus. Although we have used these settings for a number of investigations—one of the advantages of the 'living lab' approach—here we are especially concerned with the deployment, use and evaluation of an interactive TV application and its impact, especially in terms of any experience of social connection. Here however, we report our conclusions concerning, firstly, perceptions of the role and responsibilities of project itself to the community of Wray, the role of 'lead users' or 'mediators' in the community, and perceptions of participants to research; and secondly, some rather different conclusions reached after discussions with a student population. Much of what we say here is predicated on a series of interviews conducted over several years but more recently focused specifically on the issues attending long-term relationships, including ethical matters. Interviews conducted specifically during the course of this evaluation were unstructured, both individual and group interviews lasting between one and two hours. Interviews were, with the permission of subjects, recorded. In all these conversations two issues were broadly salient: the ethics and impact surrounding a long-term research relationship

with a community, and the development and relevance of some notion of 'practical' ethics.

Such 'Living labs' have emerged in a number of different contexts, but perhaps originated in a concern with the domestic arena, in particular 'smart home' research, for example; Orange At Home (see e.g. Randall 2003); the Philips HomeLab (De Ruyter and Aarts 2004); Placelab (Intille et al. 2005); and the Helsinki Virtual Village (Eriksson et al. 2005). Følstad (2008) argues that 'living labs' typically fulfil functions of evaluating or validating new IT solutions; gaining some form of insight into unexpected uses and new opportunities; experiencing and experimenting with technology in contexts familiar to the users, and thereby enabling medium to long-term studies with users. As Schuurman et al. point out (2009) there are different, at least two, ways in which the 'living lab' can be constituted. Firstly, they can 'make the technology or product available in the home of the users' and secondly one can develop, 'a home where the technology or product is available and where users come to stay for a certain period'—that is, the approach can emphasise either its 'lab-like' or its 'living' qualities. There are also other possible sources of variation, since such a lab can be located in a setting where people might stay for various periods of time; can be specifically targeted towards one user group; and can be more or less 'naturalistic'. We draw extensively on the 'living' or naturalistic version of the 'living lab' perspective for our own research but the notion itself does not come circumscribed by methodological rules, which are more likely to be more closely linked to the phenomenon or technology under investigation. The nature and purpose of living lab sites is heterogeneous, and the evolving nature of the relationship between researchers and 'subjects' seldom discussed. Certainly, the nature of, and difficulties inherent in, research responsibilities towards the community have seldom been foregrounded and the evolution of shared responsibilities rarely discussed. Moreover, as Eriksson et al. suggest, various ethical issues concerning the appropriate treatment of, or stance towards, users, are apparent in the use of 'living lab' approach: ". …. *The human-centric approach in Living Labs conceives of human beings, citizens and the civic society as a source of innovation and not just as users or consumers in a narrow sense being an object for R&D activities … (it) strives to break the trial and error process of product development previously described, and change that into a co-design process where users and developers actively work together*".

Furthermore, and of some ethical importance, although it is argued that 'living labs' constitute an approach for including 'interactionist' perspectives, little is typically said in this perspective about the *role of analysts* or about *interactions between* participants in the process. One exception is Brown et al. (2011) who, in a thoughtful and insightful way, discuss the 'messy details' of field trial practice, focusing on some key issues—of interaction and demand characteristics—that they identify as underrehearsed. They make a number of suggestions as to how to develop and demonstrate some sensitivity to these issues. They suggest, for instance, treating 'investigators as participants' in various ways and, conversely, treating 'participants as investigators'. Taken together, these observations represent a methodological critique and point to the value in rehearsing both how social arrangements influence research results and how the same can be said of how researchers and 'subjects' interact. Here, then,

we take data from two quite distinct settings, both of which can be characterized as 'living labs' and seek to identify both the 'contingencies' of our approach and the degree to which the 'troubles' (our term) that Brown et al. deal with extend to this type of work and can become problems of 'practical ethics'.

3 Technologies Involved and Background to the Case

A number of technologies have been designed, installed and evaluated in the village over the ten-year period in question. They include: the initial installation of a broadband wireless mesh network; a number of projects that looked at the deployment and use of 'situated displays' for community; a number of projects on interactive (peer-to-peer) television; and projects that examined the use of mobile phones for displaying travel information (for research examples see Harding et al. 2013). Lancaster University, and more specifically the Computing department, established a relationship with the village of Wray some ten years ago. The origins of the relationship were serendipitous and developed from community 'push' rather than research 'pull'. As one very active member said, '*we knew there was funding available for self–help rural broadband and we wanted to build a network. We heard that [a Lancaster researcher] was involved in a project and invited him along to talk to us. Initially, he said he had no funding but we wouldn't let him leave and we rather bullied him, so they cobbled something together for us.*' The initial collaboration, then, was informal and involved the acceptance of responsibility on a more or less personal level. No formal ethical relationship was established at that point. The development of that personal relationship led to a willingness by key community figures to be involved in formally constituted research projects. In each case, grant applicants and consequent procedures have held closely to ethical guidelines established by research councils; the European Union, and the university itself. Nevertheless, over time, researchers who have relied on their contacts in the village have become increasingly aware of the perhaps changing nature of their ethical responsibilities towards the community and the individual villagers. These responsibility issues arise in various ways. Firstly there is the aspect of 'communal consent' and community ethics—individuals sign our ethical consent forms and yet often the community may be involved in aspects of our work—ethical responsibilities in a 'living lab' may accrue not simply to individuals but also to families and various social groups. Secondly, because 'living lab' research unfolds over long time periods, responsibilities may develop and change over the course of a project. In particular long-term involvement in a community sharpens the ethical issues that remain after research projects have finished—these concern both the data and the technology.

4 Ethical and Responsibility Issues

The university has always abided by codes of ethics defined both by research councils and their own procedures: before, during and after the research process. The point we make, however, is that such protocols, while necessary, are not sufficient, to the conduct of ethical and effective research. For convenience, we can distinguish the 'formal'-guidelines, procedures, etc, and the 'practical'-in situ relationships, obligations and practices. It is these that are our principal concern. We initially identified the fact that there were some ethical issues that had not previously been engaged with in the course of project work in the village and the university. It was felt that further effort needed to be made to identify what factors affected the success or failure of long-term relationships. Two researchers (the authors) assumed responsibility for the investigations, largely because they had both, to a varying degree, been involved in evaluative work in relation to various projects and hence already knew some of the participants.

Our investigations have centred on the village of Wray and 'wired apartments' in the university. Some contrasts, as we will argue, can be observed. The most striking has to do with the difference between 'long term' i.e. over many years' duration and across several different projects, and more 'short term' (i.e. different individuals at different times with no mediating presence). In addition to interviews and focus groups, we have asked a small number of individuals to maintain diary records of their activities over the past 6 months and observed interactions on existing Facebook and Twitter sites (with the consent of participants).

4.1 The Deconstruction of the Notion of 'Community'

While much is made of the notion of 'community' in relation to research into the Internet, for instance, it is evident from our data that this concept needs to be disaggregated in some way. Thus and for instance, the village in question has some 600 inhabitants distributed amongst 230 households. Age, family circumstance and individual interest have a powerful effect on knowledge about, and willingness to be involved in, university research. One evident feature is that some members of the community have needs that are more urgent than others. Some individuals live in isolated spots, some are old (including one resident who is over 100) and some live relatively impoverished lives on rural wages. The point here is that our involvement with the community inevitably brings both knowledge of these needs, and demands for their servicing (a simple example is a request to provide a means for the aged resident and others to be able to stream church services), demands which at best need prioritising in some way and at worst cannot be met at all.

Students, in contrast, live much more individualistic lives and, even if the word 'community' is appropriate for some purposes, it is not defined by the building in which they live. To the extent that they can be said to live in a community at all, it is

defined by patterns of friendship with an attendant set of social obligations. The point is that these tend to be much more fluid, and this may well define their relationship with researchers in the university as well.

4.2 The Role of Mediation and Its Absence

In the nature of research relationships of this kind, some individuals become more critical than others. These people often have a powerful mediating effect. They, for instance, have a crucial role in the enlistment of individuals and, in our sample, made decisions about the suitability of potential participants on the basis of their local knowledge. This also creates certain difficulties in relation to their role. Their sense of self- worth, their allocation of time, their awareness of the fluid nature of their relationship with other community members consequent upon their acquired role (as one respondent said to us, '*there are people in the village who will cross the street when they see me coming*') are all delicately negotiated matters. It is not a trivial observation to say that here is an interactional arena where the personal and the political are very closely intertwined. In contrast the student population was notable for the complete absence of anyone who took on a mediating role.

4.3 Trust—The Formal and the Informal

One striking feature of our talks with participants was their indifference to formal ethical considerations. Most confess they had not read the ethical guidelines given to them in written form or available online. As one said, '*we're not that interested. If we didn't want you doing this work we wouldn't have anything to do with you. We get something from it and, as long as we do we're happy with you.'* As another said, *'my relationship with the university is brilliant, excellent. I don't really care what you're up to as long as I can see the benefit*'. None of this is to reject the importance of formal ethical structures. It does, however, point to maintenance issues that exist over and above formal statements of responsibility. These, it has to be said, have to do with personal contact between researchers and participants and on the nature of relationships in the community. Indeed, one of the ways in which participants assess university work is on the basis of judgements they make about individuals involved in the research process. They make frequent reference in our data to the difference between rather anonymous figures who *'flit in and out, repair stuff and then disappear*' in contrast to, '*X … who is such a nice guy … he always very helpful … and he can be pressured [said with a smile]*'. We might also point to the fact that our own investigations of these issues prompt, to a degree, positive feedback on relations with the university, as in, '*it's nice when you guys are here … sitting here with coffee and cake … and you always make certain to fit in with all the other things we have to do … that's very good.*'

4.4 The Effect of Time

In consequence, one obvious feature of a long-term relationship of this kind is that, and unlike other projects, it is not possible or desirable to 'parachute in'. Obligations of a subtle nature are often evident. These include a willingness to be available at times relevant to the needs of community members, a need for technical expertise and support beyond the life of individual projects, and a nuanced view of entitlements in respect of 'kit'. It also involves a recognition of the efforts made by participants. It was interesting to see the different perceptions of two leading figures in the village, both of whom have been heavily involved in research projects with the university and with other initiatives. While one, for reasons she identified as being to do with her own character, continued to view work with the university very positively, for the other frustrations over the amount of work she had had to do, and the communication difficulties she perceived meant that she had more or less ceased to collaborate. Both intimated, to differing degrees, that there were times when they felt 'taken for granted'.

Further, although the conditions under which research will be undertaken are made clear and available to participants, it is not easy to remove equipment from them at the end of the project cycle if one has to rely on the same constituency again in the near future. This has led to a degree of negotiation concerning rights over equipment. As one interviewee said to us in response to a question about this, '*I told [him], you'll have to shoot me if you want to take that away. I rely on it and my kids need it. You can't have it*'.

In conclusion, what was clear from our interrogation of available data is that issues of responsibility, including those of how we identify what our responsibilities might be; who holds them; what do they entail, and how do we discharge them are matters of the negotiated order. It has long been the case that engaged researchers have argued for the treatment of participants in a more reflexive way and we fully subscribe to such commitments. Nevertheless, in a context where research relationships are predicated on lasting commitment, they cannot be determined by us alone. They evolve over time and in delicate relation to the needs and desires of our partners.

5 Discussion—Researchers and Participants

We described our student population as members of a 'Living lab' but if so we need to disentangle some features of this in order to understand their reactions to the technology in question and how this might be understood as in part related to their positioning as subjects in the research and our (very limited) relation to them. We have already alluded to the fact that students were generally both experienced and expert in the use of existing digital TV facilities. One consequence of this was their reluctance to treat the research tool with any degree of patience. This, despite the fact that the device was being trialled was made explicitly clear. Oddly, the fact that

the set top box they were provided with had been manufactured to a high standard of 'finish' made them more intolerant when the remote control proved to be a little 'clunky' in use or when various services proved relatively difficult to use. They were, in short, intolerant of any perceived quality failings:

> I'd be happy to download and wait a few days to watch content in order for it to be of higher quality

That is, when there was an overhead to the use of the system, students were generally dismissive. They demonstrated a manifest indifference to research interests:

> I just want it to work, don't want to have to care about what's happening…

Our student focus group also had rapidly evolving expectations and were also acutely aware of their developing choices:

> the precedent has been set regarding the cost of media distributed over P2P. People see it as a way of getting free content…
>
> …at the moment we are just getting used to watching what we want when we want… it won't be long before we are demanding higher quality…

As a consequence, some students were quite negative about certain features:

> what is the value added in terms of watching live TV over the Internet…?

This is not to say they were entirely negative, and they did consistently report that the ability to investigate programmes through a variety of functions embedded in IPTV was attractive to them: "*I like the ability to directly interact with programmes, for instance, to go onto the Internet to investigate particular aspects of a show*". More pertinently, however, it has to be said that these responses were at least to some degree a function of our own methodological approach at this point. It proved difficult to attract students to the study, and impossible to control to any degree their prior attitudes and expectations. Just as importantly, the fact that our contact with the students in question was at best occasional and opportunistic meant that no significant relationship between researcher and researched ever existed. No one involved in the research could usefully be described as a 'lead user' in Brown et al's sense. We believe that this, along with their previous sophistication, was a significant factor in the kind of responses we obtained. Put simply, rather than the kind of 'eagerness to please' that Brown et al. report on, our students were broadly indifferent to, and uninterested in, our research demands. As a result they were intolerant of fault. For them, the technology had been put in place for them to use, not to evaluate.

In contrast, our relationship to participants in Wray has to be understood in a very different way. Not least, our relationship with certain members of that community goes back a long way. As a Living Lab, the population of this small Lancashire village have been extensively studied as various technologies, such as public displays, have been trialled there and this fact, along with the different kind of social arrangements to be found in a small village, may explain some differences in the results we obtained. Similarly, being a Living Lab of some standing, the villagers have also got used to, and often enjoyed, a range of (occasionally bizarre) methodological research

techniques. In this instance we were interested in villagers experiences, preferences and expectations of TV viewing and accordingly, before the installation of the set top boxes, we deployed several 'cultural probes', using diaries and photographs, to gather some information on their television viewing habits. We then facilitated a simple focus group to gather some reaction to IPTV. In this case they had had an opportunity to use the system for a couple of months. We also engaged in a number of lengthy follow-up interviews. Just as importantly, we enlisted a 'lead user' to help us gather willing participants This person not only acted as a proxy for the university in explaining the purposes of our research activities, but also acted as an intermediary in a more practical way, informing the research team when faults occurred, explaining to participants how certain functions worked- even providing support for the network. Now, 'Carol' as we shall call her, did not watch very much television. Indeed, she suggested that the only time she makes an effort to watch television is when specific programmes are recommended by her daughter, or when her grandchildren are in the house. On the face of it, this is quite different from the kind of 'lead user' reported by Brown et al. Here we have someone who makes little or no use of the research technology in question but nevertheless makes huge efforts on behalf of the research team:

> It's got to fit into your life … it's got to be of some use … but for me, it's a way of paying the university back for the broadband …; they still fall by the wayside cos it depends on how busy you are, what you're interested in, how much trouble it is … but it's my role to encourage them. What I would do, if we could get the chat working better, would be to use it to help … give people instructions.
>
> Working with the community, do you get frustrated?
>
> No, I love it … it's so rewarding, I can do it all day … showing people how to do things. They'll come to you if they want something. To be entirely honest- I know you work for them- if anything is frustrating, it's the university … [goes on to detail various problems she has to contend with when working with researchers]

A striking feature of our villagers' reaction to the system was their overall enthusiasm for its functionalities and their tolerance of fault. This was very different from the reactions of students. Hence:

> I really like it … I've been missing it on holiday … I really like it … I've found, with perseverance, that it's much better now than it was when we first got it. I've got used to the Dalek voice …
>
> Dalek voice?
>
> Yeah, you know the Dalek voice …
>
> Yeah, the noise distortion … but by pressing the right hand button for ten seconds, it seems to get rid of it …

This population of users, most of whom had been involved in other 'technology probes' were willing to investigate when things didn't go according to plan, and were much more accepting of 'failure':

> yeah, there are lots of things that are not altogether perfect like I can't see the writing … I've tried to wear glasses and I've found it quite difficult … we've got a little telly and it

> really does make it a problem … I wrote down a list, let's see if I can remember … it's quite erratic, the search …
>
> I found that, a programme you begin to watch one day … you can't find the next … that happened yesterday … but on the whole I use it much more than I used to use the iplayer …
>
> but overall, it's just easy to use … from my point of view, I just go on to the searches, browse it, and find things I haven't seen … I know it's on the box and I can watch when I like, and its good.
>
> You don't get the same problems as the iplayer … I used to find that would freeze halfway through … that's about being in the village [a bandwidth issue]…
>
> (Researcher) So you're really positive about it?
>
> Yeah
>
> (Researcher) And is it to do with the flexibility?
>
> Absolutely …
>
> (Researcher) And if you're being negative, it's the interface …
>
> The iphone is definitely the thing to use … it makes things much easier and its reliable …

Our point here is that although this population of users was quick to recognize faults in the system, they were also keen to find its useful features. This, we feel, was a function of their awareness of their 'guinea pig' status, along with the fact that they were getting 'something for nothing'. Some of our respondents had participated in other trials and all were aware that such trials took place with a degree of regularity. There was, in short, a willingness to examine their own responses that that we did not find in the more critical student population. Thus:

> (Researcher) Can I ask you about your overall experience of being guinea pigs? How do you find that generally … the reason I ask is because there was a study done with students using a web- based version of this …on the face of it they've got something they like and they're getting it for nothing, after all, and it seems that cos it's a research tool and it's not entirely shiny … it seems that they were just intolerant of it and we were wondering whether … because you're more familiar whether you're more willing to experiment, more tolerant ….
>
> Yeah, yeah, it's fun … you do realize that it's quite important and you're part of something … and there's other things we have to get used to and you just think, oh well, it'll get sorted …
>
> We live in a village and we're used to it … we got the most appalling television pictures year after year … there were shadows all over the screen … being part of your research and experiments … it's great … having the chance to use gadgets …

Inevitably, and in contrast to field trials, the long running nature of our 'Living Labs' means that some of the recurring themes that emerge from our studies of TV use and expectations, in particular the regular emphasis on notions of control and choice, resonate particularly with Silverstone's (2005) notion of 'domestication'. The idea of domestication embraces a series of notions—"appropriation", "objectification", "incorporation" and "conversion"—that capture the transformations that a technology undergoes in becoming 'ordinary', in being 'tamed' and 'domesticated'. As Haddon (2007) argues; "*these describe how the entry of ICTs into the home is managed, how these technologies are physically (and symbolically) located within the home, how they are fitted into our routines and hence time structures and how we display them to others, and by so doing give out messages about ourselves*". It

is in this sense that the Living Lab, (and our emphasis on content, interactivity and control) becomes particularly important as a research tool since, as Lehtonen (2003) suggests "'*domestication' does not suggest one-sided control, but rather entails a state of becoming affected, as the term refers to a learning process whereby things and people reciprocally influence each other … a new technology cannot become a success—or be perceived as a need—unless it passes the multiple tests and trials that potential users put it through. These have to do with the device's image, its utility and the manner in which it can be fitted into everyday practices and relationships*". Whilst there is some theoretical debate over exactly how (and why) these processes occur our interest, and our problem is specifically design related, and lies in supporting the different needs of a variegated population of users. Students have time on their hands, rely heavily on friendship networks for their social lives and sometimes have very high standards when it comes to the robustness and functionality of equipment. They are familiar with, and expect, high quality 'look and feel'. Villagers, and those with small children especially, have busy lives, are concerned for the moral welfare of their offspring, need 'quiet time', and so on. For them, the features they need are those that simplify the organization of their busy lives rather than those that extend social possibilities. The emergence of various functionalities for the new generation of interactive television will, we think, have to pay account of these differences. We suspect there may be many other sources of variation that are as yet opaque to us and the process of 'domestication' will ultimately depend on the discrete attitudes towards, and behaviours with, content, interactivity and control will need to be reflected in the design of the technology.

6 Conclusion: 'Don't Be Evil'—'Do the Right Thing'

We began by contrasting a generalising tendency in ethical theory to a more 'practical' view, and arguing that an interest in the former does not always provide us with tools to help us determine 'what to do'. This, we suggested, is because, as with Wood's (2011) 'trolleyology' critique, such general views pay too little attention to the 'moral vitality' of human beings, to the practical issues (which can be of many kinds) they contend with. Our methodological and ethical reflections about 'living labs' reflect that. We have argued that they need to be understood in terms of two forms of interactivity—interactivity among participants (such that we can understand the importance of lifestyle; of prior experience; of 'genre', and of patterns of ordinary life) and interactivity between 'participant and researcher' (such that we can better understand the level of indifference towards research activity we saw among students and, conversely, the enthusiasm for the research we found among some villagers). Living labs have been promoted as a simple and cost effective way of both collecting information from users and involving them interactively in the development of new products and services, that is, as a form of 'co-realization' (Hartswood et al.). Concerns with 'Living labs' as a methodology have often seemingly focused on the degree to which they are either 'living', that is are 'natural environments' in which 'real peo-

ple' live out 'real lives'; or the extent to which they have lab-like qualities that permit something akin to the manipulation of variables in the experimental method. What is less commonly discussed is the particular kind of social practices that generate user experiences in the more 'naturalistic' of these settings. In our student population we discovered a relatively homogeneous collection of experiences, views and attitudes dependent on something we can call a 'student lifestyle' and which needs further decomposing at some point in the future. The other, a village where the attitudes and opinions expressed depended both on the facts of village life; the long term existence of the village as a site for investigation and, more specifically, the rhythms of family life which inform the viewing experience. Our evidence suggests that the latter leads to a much more differentiated response. Our point here is that 'living labs' need to be treated as sites for social difference as much as anything else.

Overall, our studies suggest that the extent to which our participants are 'active' viewers, how they search and plan their viewing, who or what they trust in terms of guides to viewing and how would they might anticipate coping with any changes consequent on the introduction of interactive television depend on specific conditions in their social lives. Students and villagers, in our two studies, live very different kinds of life and their reception of interactive TV substantially depends on this. These two very different studies of current and future users of interactive television indicate some interesting variations, in current consumption or usage of TV, and expectations around future issues of content, choice and control. They open up some interesting theoretical and practical, design related, possibilities. For students, where peer group and lifestyle considerations are paramount, chat (in some form), recommendation and so on were welcomed. For our villagers, the rather more pressured nature of family life meant that functionalities that *assisted in the organization of their lives* were welcomed, those that potentially expanded their social interactions less so. The ability to structure viewing in advance for children, for instance, thus controlling not only content but also the length of their viewing was strongly welcomed by parents with young children.

Equally, as we have pointed out, the response of the two populations to fault was quite different. Students, it seems, have a demand for high quality and are unforgiving of fault. Our villagers are appreciably more tolerant and more willing to investigate sources of problems. The most likely explanation for this is that they are relatively regularly exposed to innovation and have developed a 'feel' for the kind of results that researchers are interested in. We should point out, however, that this is not the same thing as Brown et al. point to, and our results do not support their contentions about 'demand conditions'. Our version, as we argue below, has much more in keeping with Turner's (1970, 1974) who points out that more than one '*technical* description' of an event is possible.

It does not, however, provide members with what to say about those activities. The point here is that, just as interviewers of whatever kind (doctors; the police, and so on) ask questions which are relevant above all to the task in hand, so do researchers. In much the same way, however, initial utterances, responses and so on by respondents will be given in accordance with how respondents *construe* the task in hand. 'Recipient design', that is, does not refer to responding in a way that the

interviewer wants, but to responding in accordance with what one knows about the interviewer (notably, that he/she may have an interest in certain technical matters) and, indeed, whatever other cultural resources the respondent sees fit to bring to the exchange.

Our research policies were such that it is probably true that we gave little opportunity for our student population to be 'participants as researchers' whereas our work in the village was more 'artful' and depended much more on a 'lead user' to field difficulties, make appointments for us, arrange meetings and so on. Having said that, our view of 'demand conditions' is substantially different from that of Brown et al., at least as we read them. Brown et al. see the issue of lead users as being connected in some way to arguments attending on the Hawthorne experiments. The troubled history of the Hawthorne experiments has been reported at length and we need not go into it here (see Brannigan 2017, for a useful review). Suffice it to say that—for Roethligsberger and Dickson at least—the behavior of groups was *causally* affected by the fact of *experimentation*. We see them, rather, as being associated with what ethnomethodologists call 'recipient design'. Ethnomethodologists have, on innumerable occasions pointed to the way in which any sociological method, but notably interviewing, can be seen as the artful production of participants. (See e.g. Hester and Francis; Benson and Hughes; Stoddart; Cicourel). In the first instance, it can be argued, as Turner does, that the sociologist, 'inevitably trades on his member's knowledge in recognizing the activities that participants are engaged in …'. Secondly, of course, the same is true for other participants. Thus, conversation can be seen to be 'recipient designed'.

Now, this digression into the wilder shores of disagreement between ethnomethodologists and sociologists-at-large may seem sophist to an audience concerned with the practicalities and ethical implications of method but we want to show how it is, in fact, quite consequential. Brown et al. are not arguing that the 'eagerness to please' of lead researchers problematises the research but rather that knowledge of such matters helps us contextualize and evaluate our own research approach and perhaps the associated ethical practices. We do not mean to suggest otherwise. Having said that, our own participation in conversation with 'subjects' leads, in some respects, to a quite different set of conclusions. Lead participants' are not necessarily characterised by enthusiasm for research. Working with participants is an artful business, both for researchers and for participants. Processes of domestication are not one-sided. Reward can, in some circumstances, be psychologically important.

7 Lessons Learned and Recommendations: 'Implications for Ethics'

A number of lessons or what might be regarded as 'implications for ethics' emerged from this research—some of which support the findings of previous research but some of which are somewhat novel. For example, formal ethical guidelines, while

necessary, do not adequately encompass the 'real' issues. Indeed, we might go so far as to say that issues of 'informed consent' etc. were of little interest to our subjects, even when explicitly pressed on the matter. Similarly, methods need to be implemented which improve and facilitate regular communication between researchers and their 'subjects'. Regular meetings explaining intentions, progress (or the lack of it) and encouraging feedback, facilitate understanding. Typical failures on the part of researchers can include not explaining in a timely way why there might be implementation failures; not explaining why problems cannot be dealt with 'right now', and not making research aims clear. Just as importantly, given the nature of different projects, heterogeneous research groups are not always well-known to participants. This impacts on trust.

Much like Taylor et al. (2013) and Brown et al. (2016) we insist that, as a matter of practical ethics, users be taken seriously. In the case of long term relationships of the kind we see in Wray, it can easily be forgotten that there is a significant investment on the part of some village partners in terms of time; acquiring expertise, recruitment and mediation. Without a constant, and two-way, process, this is not always understood. Similarly, both recruitment and long term willingness to engage depends on the work of community figures. One cannot assume a willingness to engage with research as a default position, especially in long-term work. Bad experiences with technology, in particular, affect willingness and the role of mediators is at this point, critical. The role of mediation cannot be over-stressed. The success of the university's long-term collaboration with the village depended almost entirely on the ability of one, possibly two, people to recruit, persuade and engage. As ought to be clear, the level of commitment and expertise demonstrated by such volunteers is, not to put too fine a point on it, remarkable, and collaborations of this kind could not succeed without their work. It is notable that successive projects have 'piggybacked' on this goodwill, but efforts to maintain good relations and show the requisite appreciation need to be consistent. Similarly, our mediators have developed a considerable degree of technical expertise over the years and often involve themselves in significant repair and development work. This needs to be better appreciated and supported. This extends also to support for other participants who do not always understand technology in the way that researchers do. For the most part, 'training' has been very limited and mainly takes place at the beginning of project work. More regular reinforcement is certainly required.

In outlining what Brown et al. (2016) might view as mundane situated ethics, temporal factors become particularly important. It is both an advantage and a challenge for 'living lab' research that it unfolds over long time periods. This allows us to chart the ways in which responsibilities develop and change over the course of a project and also the ethical issues that remain after research projects have finished. This remains a problem with ICT projects 'in the wild', (e.g. concerning issues of ownership and maintenance of both ICT and data), and results in avoidance or rather unsatisfactory compromises. Even though documenting a single piece of research in a 'living lab' we are describing long- term collaboration, time is a relevant factor in the short term as well. The lives of most people are governed by a series of routines, and the lives of villagers are no different. What is evident is that the routines

of university researchers and those of villagers are not necessarily contiguous. In these circumstances reward becomes important. For some users, mere participation constitutes reward. More than one person reflected on the pleasures of participation, but equally that this was enhanced when 'the university takes some interest in us'. Having said that, some frustration was expressed over the time it took to fix problems; the disappearance of technology at the end of projects; and over 'being taken for granted'. One respondent, involved for the whole of the ten year cycle we report on, commented as an aside, '*I've never received a single penny for what I've done.*' It says much about the relationship between researchers and participants that the two researchers present when this was said were somewhat shocked and dismayed. Comments to the effect that, 'I had no idea she felt like that' were subsequently exchanged. One further observation has to do with community- identified needs. Although there are evident limits on what researchers can do outside of the formal remit of the research, it is noticeable that appreciation of efforts made 'above and beyond' was significant. Hence, '*X helped us a lot with the setting up of the mesh network, even though there was no funding at that time. He's a very nice man.*'

Finally there are a number of areas where general ideas about practical ethics and particular notions about responsibility overlap. There is a need for clear allocation of responsibility. Our own feeling, based on our interviews, was that users did not always feel 'championed'. They commented, as we have pointed out, on the somewhat reticent behaviour of (for them) anonymous people who 'come out, fix the equipment, say nothing and then disappear …' They expressed some frustration at the inability of researchers to understand the demands of family life and its routines, and their inability to identify exactly who they need to be talking to. Clear allocation of responsibility for communication with participants at timely moments would help a great deal. But responsibility issues tended to arise in interesting ways: and we were concerned with documenting what might be regarded as 'community ethics'—documenting the subtleties involved in mapping ethical responsibilities in a 'living lab' and the various ways these may accrue not simply to individuals but also to families and various cross-cutting social groups. Similarly we are interested in outlining some differences in ethical responsibilities towards individuals and their data. Research protocols generally assume a consistent and uniform responsibility towards every participant, but in the long-term research associated with 'living labs', individual involvement can change and evolve; some become 'champions' of the technology, others less interested. We are concerned with documenting how this plays out in terms of changing ethical responsibilities. The important aspects of responsibility identified in the case study, of community, the complexities of temporal change and data ownership and management and the development of increasingly 'virtual' techniques are likely to provoke considerable interest and discussion. Furthermore, this case study also facilitates our ongoing investigation of Silverstone's notion of the 'domestication' of ICT, embracing the "appropriation", "objectification", "incorporation" and "conversion" of ICT in the mundane process of living with, and effectively 'taming the technology'. Observing and documenting each of these processes has important and relatively underexplored implications for our understanding of ethical responsibility in ICT research. Given the growing interest

within the human computer interaction community in 'value driven design', these research findings should build into a framework of more general concerns, lessons, practices and values that are relevant to a range of technologies and settings beyond those directly involved in the study.

References and Further Reading

Abras, C., Maloney-Krichmar, D., & Preece, J. (2004). User-centered design. In W. Bainbridge (Ed.), *Encyclopedia of human-computer interaction* (Vol. 37(4), pp. 445–456). Thousand Oaks: Sage Publications.

Bardzell, J., & Bardzell, S. (2013). What is critical about critical design? In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 3297–3306). ACM.

Bardzell, S. (2010). Feminist HCI: Taking stock and outlining an agenda for design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1301–1310). ACM.

Becker, L. C., & Becker, C. B. (Eds.). (2003). *A history of Western ethics*. Psychology Press.

Benford, S., Greenhalgh, C., Anderson, B., Jacobs, R., Golembewski, M., Jirotka, M., et al. (2015). The ethical implications of HCI's turn to the cultural. *ACM Transactions on Computer-Human Interaction (TOCHI), 22*(5), 24.

Berges, S. (2015). *A feminist perspective on virtue ethics*. Springer.

Bødker, S. (2000). Scenarios in user-centred design—setting the stage for reflection and action. *Interacting with Computers, 13*(1), 61–75.

Brannigan, A. (2017). *The rise and fall of social psychology: An iconoclast's guide to the use and misuse of the experimental method*. Routledge.

Bratteteig, T., & Wagner, I. (2014). *Disentangling participation: Power and decision-making in participatory design*. Springer.

Brey, P. (2010). Values in technology and disclosive computer ethics. In *The Cambridge handbook of information and computer ethics* (pp. 41–58).

Brown, B., Reeves, S., & Sherwood, S. (2011). Into the wild: challenges and opportunities for field trial methods. In *Proceedings of the 2011 Annual Conference on Human Factors in Computing Systems (CHI '11)* (pp. 1657–1666). New York, NY, USA: ACM.

Brown, B., Weilenmann, A., McMillan, D., & Lampinen, A. (2016, May). Five provocations for ethical HCI research. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (pp. 852–863). ACM.

Crabtree, A., Chamberlain, A., Grinter, R. E., Jones, M., Rodden, T., & Rogers, Y. (2013). Introduction to the special issue of "The Turn to The Wild". *ACM Transactions on Computer-Human Interaction (TOCHI), 20*(3), 13.

De Ruyter, B., & Aarts, E. (2004). Ambient intelligence: Visalising the future. In *Proceedings of AVI '04*, Gallipoli, Italy. ACM Press.

Dunne, A., & Raby, F. (2001). *Design noir: The secret life of electronic objects*. Springer Science & Business Media.

Dunne, A., & Raby, F. (2013). *Speculative everything: Design, fiction, and social dreaming*. MIT Press.

Edmonds, D. (2013). *Would you kill the fat man?: The trolley problem and what your answer tells us about right and wrong*. Princeton University Press.

Eriksson, M., Niitamo, V.-P., & Kulkki, S. (2005). State-of-the-art in utilizing Living Labs approach to user-centric ICT innovation—A European approach.

Følstad, A. (2008). Living labs for innovation and development of information and communication technology: A literature review. *The Electronic Journal for Virtual Organizations and Networks*, 99–131.

Foot, P. (2002). *Virtues and vices and other essays in moral philosophy*. Oxford University Press on Demand.
Friedman, B., & Kahn, P. H., Jr. (2003). Human values, ethics, and design. In *The human-computer interaction handbook* (pp. 1177–1201).
Haddon, L. (2007). Roger Silverstone's legacies: Domestication. *New Media & Society, 9*(1), 25–32.
Hammersley, M. (2009). Against the ethicists: On the evils of ethical regulation. *International Journal of Social Research Methodology, 12*(3), 211–225.
Harding, M., Finney, J., Davies, N., Rouncefield, M., & Hannon, J. (2013, September). Experiences with a social travel information system. In *Proceedings of the 2013 ACM international joint conference on Pervasive and ubiquitous computing* (pp. 173–182). ACM.
Intille, S., Larson, K., Beaudin, J. S., Nawyn, J., Tapia, E. M., & Kaushik, P. (2005). A living laboratory for the design and evaluation of ubiquitous computing technologies. In *Proceedings of CHI '05*. ACM press.
Kensing, F., & Blomberg, J. (1998). Participatory design: Issues and concerns. *JCSCW, 7*(3–4), 167–185.
Lehtonen, T. K. (2003). The domestication of new technologies as a set of trials. *Journal of Consumer Culture, 3*(3), 363–385.
MacIntyre, A. (1988). *Short history of ethics: A history of moral philosophy from the homeric age to the twentieth century*.
McInerny, R. M. (1997). *Ethica Thomistica: The moral philosophy of Thomas Aquinas*. CUA Press.
Moore, G. E., & Baldwin, T. (1993). *Principia ethica*. Cambridge University Press.
Mumford, E. (1995). *Effective systems design and requirements analysis: The ETHICS approach*.
O'Connor, J. (2012). The trolley method of moral philosophy. *Essays in Philosophy, 13*(1), Article 14.
Randall, D. (2003). Domestic settings and new technology: A case study. In R. Harper (Ed.), *Inside the smart home*. London: Springer.
Schuurman, D., Evens, T., & De Marez, L. (2009). A Living lab research approach for mobile TV. In *Proceedings of the Seventh European Interactive Television Conference*. New York: ACM press.
Silverstone, R. (2005). 12 Domesticating domestication. Reflections on the life of. In *Domestication of media and technology* (p. 229).
Singer, P. (2011a). *The expanding circle*. Princeton, NJ: Princeton University Press.
Singer, P. (2011b). *Practical ethics*. Cambridge University Press.
Strathern, M. (2000). *Audit cultures: Anthropological studies in accountability, ethics, and the academy*. Psychology Press.
Taylor, N., Cheverst, K., Wright, P., & Olivier, P. (2013, April). Leaving the wild: Lessons from community technology handovers. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1549–1558). ACM.
Turner, R. (1970). "Words, utterances, activities". In Jack D. Douglas (Ed.), *Understanding everyday life: Towards a reconstruction of sociological knowledge* (pp. 169–87). Chicago: Aldine Publishing.
Turner, R. (1974). (Ed.) *Ethnomethodology*. Harmondsworth: Penguin.
Verbeek, P. P. (2006). Materializing morality: Design ethics and technological mediation. *Science, Technology and Human Values, 31*(3), 361–380.
Verbeek, P.-P. (2008). Morality in design: Design ethics and the morality of technological artifacts. In *Philosophy and design* (pp. 91–103). Springer Netherlands.
Waycott, J., Munteanu, C., Davis, H., Thieme, A., Moncur, W., McNaney, R., Vines, J., & Branham, S. (2016). Ethical encounters in human-computer interaction. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (pp. 3387–3394). ACM.
Whitbeck, C. (2011). *Ethics in engineering practice and research*. Cambridge University Press.
Winner, L. (1980). Do artifacts have politics? *Daedalus*, 121–136.
Wood, A. (2011). Humanity as end in itself. In D. Parfit (Ed.), *On what matters* (Vol. 2, pp. 58–82). Oxford, UK: Oxford University Press.

Orienting to the Wild

Peter Tolmie

1 Introduction

A core proposition when researchers speak of 'in the wild' deployments of technology is that the technology will somehow be tested in, and/or made to work in, real-world settings as opposed to fabricated ones such as laboratories (Marshall et al. 2011; Rogers 2011, 2012). In this chapter I want to take this proposition seriously and examine what research orientations to 'the wild' actually look like and what the implications of those orientations might be.

So, one orientation, for instance, might be towards gearing a technology deployment in the wild towards its seamless integration into real-world activities (Balka and Wagner 2006; Bødker and Klokmose 2011; Bossen and Dalsgaard 2005; Carroll et al. 2002; Desjardins and Wakkary 2013; Dourish 2003; Höök 2006; Mackay 1990; Salovaara 2007; Ventä-Olkkonen et al. 2017). Another orientation might be towards placing technology in the wild not for the purposes of making it 'fit' in its own right, but rather to use the deployment to illuminate what a 'fit' would need to look like (Brereton et al. 2015; Hertzum and Simonsen 2010; Heyer and Brereton 2010; Jones et al. 2007; Kim et al. 2016; Ko et al. 2011; Odom et al. 2016; Rosner and Ryokai 2009; Saslis-Lagoudakis et al. 2006; Wulf et al. 2011). Yet another orientation could be to encourage people to engage with the technology in novel and 'interesting' ways, potentially only for a limited time-span rather than as something to be adopted and 'made at home' (Benford et al. 2012; Blythe et al. 2010; Foucault et al. 2007; Gaver et al. 2003; Halbert and Nathan 2015; Holzer et al. 2015b; Morrison et al. 2007; Petersen 2004). Some technology deployments can also be oriented towards being deliberately disruptive, where the goal is to breach the order of the real-world

P. Tolmie (✉)
Universät Siegen, Siegen, Germany
e-mail: peter.tolmie@gmail.com

A. Chamberlain and A. Crabtree (eds.), *Into the Wild: Beyond the Design Research Lab*, Studies in Applied Philosophy, Epistemology and Rational Ethics 48,
https://doi.org/10.1007/978-3-030-18020-1_10

setting so as to reveal something about the way that setting is currently organised and what approaches to technology deployment in that setting in future might therefore need to look like (Crabtree 2004; Holzer et al. 2015a; Poole 2012; Schwartz et al. 2013; Taylor et al. 2017).

These are, of course, only some of a wide variety of possible considerations. However, one of the key points I shall be examining here is how the research orientation to deployments in the wild is fateful for what kinds of results are got back from the exercise. More than this, I want to look at how the articulation of a deployment for a particular setting will come with a set of assumptions about the nature of the setting how the deployment will be realised that amounts to what I am calling here a propositional 'grammar'. This grammar, I shall argue, is of central importance with regard to how the technology will be engaged with in. I shall further suggest that the way members of the setting themselves orient to that grammar is profoundly impactful for how the technology will be handled in the course of their everyday activities. In particular, I shall be discussing how this local orientation to 'what the deployment is about' can be at significant odds with the orientation adopted by researchers themselves, leading to a variety of potential troubles. Some of these troubles might be overstepped if researchers understood better the game they are stepping into when they seek to deploy their technology in the wild.

2 Orienting to the Wild: Some Views from the Literature

Before examining some specific grammars of deployment in greater depth, I want to first of all flesh out the outline of different possible research orientations to deploying technology in the wild mentioned above. As has already been noted, these research orientations come in many flavours, but they can be grouped together principally around four main concerns that relate to two fundamentally opposed positions: *blending in*; or *standing out*. I shall explore these positions further below.

2.1 Blending In

With regard to notions of blending in, one can find research agendas where there is already a reasonably mature technology to be deployed and where there is an interest in deploying the technology so it is integrated into practice with a minimum of fuss. At the same time, there may be technologies that are only at the stage of early prototypes, but where the end-goal is nonetheless reaching a point where the technology is made at home in the everyday world. Here, deployments in the wild are oriented to as a kind of 'test', where deployment is undertaken to discover what still needs to be done to make future integration possible.

2.1.1 Integration, Appropriation, Domestication: Making the Technology at Home

Some of the earliest studies of how computer-based technology designs were getting incorporated into everyday practice relate to the use of CAD systems in engineering and industrial design. In a study dating back to the early nineties, Gantt and Nardi (1992) looked at the role played by collaboration between users when using CAD systems to build applications. The details of this study are of less interest here than the orientation Gantt and Nardi adopted to what they were doing, which serves to set the scene for the remaining commentary. Noting that, at the time, many studies were showing that the introduction of computing systems into offices and factories was not fulfilling the expected gains in productivity, they put forward the following view: "We believe that a description of how users actually get applications written will inform our understanding of how to better organize and manage work practices, and how to better design computer products and research prototypes." (op. cit.: 108). The message here is quite clear: to get computer systems to fit in effectively with people's work practices you have to actually go and look and see what those practices are and base design upon that understanding. More profoundly, the claim amounts to being that, if you want computer systems to fulfil their potential, then they are going to need to fit in with actual practice. There have been numerous studies over the years, across many domains, that have articulated this concern with deployments causing minimal disruption and fitting in with the things people already do.

This view is, of course, at least part of the licence for engaging in **user studies and ethnographic work** prior to the concrete development of any design or its deployment, so that an effective understanding of what might or might not fit can already be formulated. The relationship between studies of practice to actual deployments of technology can vary from tenuous to concrete. Sometimes this is a consequence of the orientation adopted, sometimes it is down to how projects are structured and how planned development and deployment then comes about. By and large, ethnographic work in relation to the development of technology is pitched towards the above interest, which can be loosely formulated as being a concern with making sure that the chances are maximised that the technology will be 'made at home' (Crabtree et al. 2012; Harper et al. 2006; Kirk et al. 2016; O'Brien et al. 1999; Rogers and Bellotti 1997; Sacks 1992a, b), something that, in the broader sociological literature is often referred to as 'domestication' (Aune 1996; Berker et al. 2005; Haddon 2003; Silverstone and Haddon 1996; Sørensen 2006). However, as will be seen below, there are many ways in which this orientation and the proposed relationship between ethnography and design can be fine-tuned according to different perspectives.

A strong view in the literature, especially in the context of participatory design, is that ethnographic work and related technology development can only take you so far, because the actual ways in which new technologies come to be used in practice can sometimes be informed by interests that no-one could have foreseen. This frames a proposition that users should themselves be active participants in the design process so that they can articulate for themselves the ways in which a technology might be relevant to the things they do (Höök 2006). It also informs an orientation where

an initial deployment that is based upon understandings derived from ethnographic work should still be treated as revisable, such that 'emergent practices' that begin to form around the technology can then be further supported through an ongoing process of refinements (Nicolini 2013; Ventä-Olkkonen et al. 2017).

One of the key terms that gets used in this context is '**appropriation**'. According to Dourish (2003) "appropriation is the process by which people adopt and adapt technologies, fitting them into their working practices" and he emphasizes that "understanding appropriation is … critical to the success of technology deployment". This has led to a design movement that is focused upon what are termed 'appropriable technologies', and various researchers, including Dourish, have examined what features of design might best facilitate appropriation. A key point here is that the orientation from this perspective is not just towards ensuring a deployed technology is going to fit with existing practices, but that it will be incorporated into people's 'systems of meaning' (Dourish 2003) so that it can become just another accepted part of how things get done. Possible variations in this orientation were noted by Poole and De Sanctis (1990) who posed a question as to whether the goal was to have a technology appropriated by users exactly according to designers' intent, or whether appropriation could also incorporate the adoption of 'specific structural features' to meet their own, not previously envisaged ends. Allowing for the latter case, in particular, is advocated by many parties (Folcher 2003; Jung et al. 2008; Mackay 1990). In this vein, Tchounikine (2017) suggests that "designing for appropriation consists of intentionally providing means that are likely to enable users to adapt the system to the effective usages they develop" (see also Salovaara (2007) who makes a very similar argument regarding the design and deployment of communication technologies). Dix (2007) has also argued that it is important for designers to provide "elements for which users can add their own meanings". Here there is an orientation towards 'exposing people's intentions' and then supporting the realisation of those intentions, rather than 'controlling' them. An adjunct orientation to this view is that deployed designs should possess 'flexible, substitutable and reclaimable attributes' to facilitate people's creative repurposing of technologies to better suit their own ends (Maestri and Wakkary 2011). Some take this even further and argue that deployed technologies should come with resources that will enable them to personalize them because this will increase the likelihood of their acceptance (Blom and Monk 2003; Sung et al. 2009).

A more pragmatic and organizationally-oriented proposition that nonetheless acknowledges this view that at least a part of the work of appropriation is down to users themselves to accomplish, and that this is what designers deploying technology should be supporting, is the notion of designing for '**tailorability**' (Keshav 2013; Trigg and Bødker 1994), or '**configurability**' (Balka and Wagner 2006). Here the focus is upon the fact that users often inhabit a complex ecology of systems and shared practices. Integrating new technologies within this ecology is pointed to as an increasingly important challenge and the suggestion is that the best way to support appropriation is to provide users with resources whereby they can 'tailor' or 'configure' a deployed technology to fit their specific social and organisational set of circumstances. A key aspect of this argument is that a preliminary step to

literal technological configurability is one of social configuration, where existing social arrangements may need to be revised in certain ways in order to enable a new technology to fit. Thus, an important aspect of deployment is the discovery of how the introduction of a new technology may ramify for existing practices. This then entails due consideration of just what may need to be changed to enable things to work, with it being just as possible that it will be certain existing practices that will need adaptation (Balka and Wagner 2006; Bardram and Bossen 2005). Alongside of this, there is a view that deployment needs to come with an expectation that how to make the technology fit is something that may involve an ongoing discussion between 'local' and 'system' developers. In this case what may be needed as much as anything else is the sharing of relevant technological and organisational knowledge, rather than just instructions regarding how to undertake specific kinds of technical fix (Trigg and Bødker 1994). A somewhat distinct view that nonetheless resonates with this interest in providing for discussion, is that deployments ultimately fail because system developers are very poor at communicating what a technology might actually be able to deliver in use (Cockton 2004). On this basis, the proposed orientation to deployment amounts to one of properly establishing a means for articulating value propositions alongside of the deployment itself. A more extreme version of this relates to the huge literature regarding the integration of technology into teaching practice (see. for example, Bauer and Kenton 2005; Christensen 2002; Ertmer 2005; Ertmer et al. 2012; Harris et al. 2009; Kim et al. 2013; Pierson 2001). The perceived issue here is that there is an apparent reluctance on the part of teachers to integrate computing technology into their everyday practice. Deployment orientations are thus centred round how to provide teachers with the proper motivation to adopt the technology.

Another related view is that, as understanding what might allow for appropriation to happen effectively is an ongoing topic of research, a way to proceed might be to deploy technologies and study their appropriation or otherwise to learn more about the process. Bossen and Dalsgaard (2005) strongly advocated this line after being involved in the failed implementation of a knowledge management system where, ostensibly, much had been done to try and design it to fit with local practice. Their position on the need to study appropriation itself is grounded in the observation that the deployment in question had failed because of a mismatch in understanding between those implementing the system and the workers themselves regarding the concept of 'knowledge'. More than this, they argued that the only way to understand how this ramified was to appreciate that design is an ongoing process that stretches far into the integration of deployed technology and that you can't design something and then simply expect to be able to 'throw it over the wall'. Instead, how to make a technology 'appropriable' is something that has to be figured out in significant measure after the technology has already been deployed. For some, the key moment to focus on for the appropriation of deployed technologies is the actual point where a technology is fully handed over from the developers to those who are intended to use it. The orientation in this context is towards providing adequate resources *around the technology* to support its subsequent use with regard to things such as

maintenance, configuration, and training (Khan and Kajko-Mattsson 2010). In some contexts, studying how a technology is appropriated alongside of the process of actually deploying it has become a relatively standard way of proceeding (see, for instance, Stein et al. 2017).

In the sphere of **creative appropriation** and **everyday design** users are themselves expected to play a very active role in making a deployed technology fit for longer-term use, and part of the design focus is upon how to facilitate this (Wakkary and Tanenbaum 2009). As a strategy to help designers understand what they might need to consider when designing for appropriation of this kind, Desjardins and Wakkary (2013) have suggested looking at existing ordinary design practices to see what people themselves orient to when designing things for their own use. To this end, they looked at ordinary everyday design in domestic and hobbyist contexts and argued that in these kinds of design practices it is the 'meaning of the practice' itself that matters most. On the basis of this they suggested specifically designing to support people in the pursuit of 'foundational, aesthetic, and aspirational goals' where deployed technologies might need to, on the one-hand, allow for people to themselves experiment with how the technology might be used, or on the other hand, allow for more or less immediate use in a variety of different ways.

So far, then, we have seen a set of 'blending in' orientations that subsume things such as: making the system fit with actual practice; causing minimal disruption; making the technology at home; involving the users in the design; treating the deployment as revisable; designing for appropriation; designing the technology to fit with people's existing systems of meaning; allowing the users to shape the technology to their own interests; designing the technology to enable users to shape it to their own interests; providing flexible and substitutable attributes; providing for personalization; designing for tailorability; designing for configurability; communicating and negotiating with users; articulating the value of the technology; motivating the adoption of the technology; figuring out how to make it fit as you go along; providing additional resources around the technology; and facilitating experimentation and discovery of use. In the next section we will see how another set of orientations to deployment have evolved around the notion of putting prototypes in the wild as a means of discovering what needs to be done to make something that might fit.

2.1.2 Deployment as 'Test'

In the above section we noted that many research endeavours have the ultimate goal of deploying technology in the wild in ways that are minimally disruptive and designed to encourage technology appropriation. However, many design-oriented projects are phased across a number of iterations and sometimes technologies are deployed in a relatively rough-and-ready state in order to uncover the ways in which refinements might be best directed. This is not necessarily distinct from the above and the end-goal may still be to end up with something that is appropriated in minimally disruptive ways. However, test deployments can sometimes serve other ends as well.

One particular orientation towards deployments can be to actively use them to test the viability of existing **design assumptions**, with an expectation that this can then lead to further, iterative refinements (see, for instance, Ko et al. 2011). A key feature of this orientation is that there is no expectation that users will necessarily like the deployed technology and want to use it in the first instance. Elbaum and Hardojo (2004), noting how often software engineers may make 'inaccurate assumptions', suggest similarly that every software deployment should be used as a 'source of information', with 'field data' being continually cultivated to inform further design. However, the kind of field data they have in mind here is essentially log data, which they take to be indicative of user behaviour in various ways. Kevic et al. (2017) also suggest something along similar lines in the development and deployment of actual products. They advocate a process of 'continuous deployment', where refinements are passed to a subset of existing users of the product to assess their response so that, if necessary, they can undertake further modifications before implementing the changes in the full production environment. Once again there is an orientation here to it being okay to deploy relatively unfinished technologies if the goal is to use how people respond to that as a resource to engage in refinement.

For many, a key word in the above set of propositions is '**iterative**'. The core notion is that initial designs should be made—perhaps on the basis of prior research that informs what those designs might look like (ethnographic or otherwise) (see, for instance, Kinch and Højlund 2013), they should be deployed, user feedback should indicate where the design succeeds or fails, re-design should take place, another deployment should follow to cultivate further feedback, and so on, until something like a finished design is completed (or the project/funding comes to an end). Some of the early work in CSCW where ethnography was actively incorporated into the design process was articulated along these lines (see COMIC 1994). The notion of 'test-deployments' to conduct evaluation and derive requirements in an ongoing cycle can be found throughout the systems design and HCI literature, across all sorts of domains and putative designs, often accompanied by propositions that each deployment is about 'validation' and the testing of different 'perspectives' or 'functionalities' (e.g. Gabrielli et al. 2011; Kinch and Højlund 2013; Lauwers et al. 2009; Muller et al. 2014; Rosner and Ryokai 2009). Note how there are several assumptions made to sustain this kind of orientation: (i) that deployment of the technology should happen in the real-world settings in which it is intended to be used (i.e. 'in the wild'), and not in a laboratory or otherwise contrived setting, and assessment or evaluation of the technology should happen in that setting as well; (ii) that the deployment will provide you with insight as to how to make the next iteration 'better'; (iii) that each deployed version will be 'better' than the last. A common corollary is that there will be a point reached where the iterations can stop and people will be able to use the technology in an 'un-facilitated' way (e.g. Rosner and Ryokai 2009). Sometimes iterative deployments are also presented as a way of encouraging people to live with an evolving design, play a part in the shaping of it, and become 'habituated' to its

presence (e.g. Kinch and Højlund 2013). This can be seen to resonate with some of the discussion around appropriation mentioned in the previous section.

Some researchers have sounded a cautionary note about presuming that one can deploy not yet fully formed or under-articulated designs in the wild in the hope that it can be refined in due course, because what is initially delivered can be fateful for how other versions are subsequently oriented to. Mackay (1990), for instance, when examining the work of software engineers in customizing an organization's software for local use, made the following observation:

> Software manufacturers should also consider the impact of delivering a poorly-conceived set of default values when the first version of the software is shipped. Unlike many features that can be fixed in subsequent updates, decisions that affect individual patterns of use are likely to have long-term effects. (Mackay 1990, 220)

Another orientation that has arisen in CSCW in recent years, which is very tightly related to the notion of iterative deployments discussed above, can be found in the idea of '**design case studies**' (Wulf et al. 2011). Wulf et al. argue that design case studies should ideally be organised in three 'phases'. The first phase (in ways strongly resonant of other approaches mentioned above) involves a broadly ethnographic investigation of existing social practices in the domain where an intervention is planned, with a particular focus on the use of existing tools, media, and software. In the second phase an ICT artifact of some kind is designed and the actual design process itself is documented, including the reasoning associated with the design and the involvement of any other possibly relevant stakeholders. In the third phase the ICT artifact is introduced and the process whereby it is deployed, the extent to which it is appropriated, and any processes of re-design are also documented. The documentation of the overall study is then used as a resource for further design interventions in an ongoing fashion. Many of the basic orientations towards achieving appropriation and learning through deployment that we have already seen are similarly present here. The novelty in this approach is the insistence upon actually building an active record of what is done and then using that as a resource for the next overall project. Thus, there is a sense in which the whole enterprise within which the actual deployment is embedded is oriented to as a kind of test from which learning can be extracted and built upon in future project (as opposed to individual deployment) cycles.

Of course, one of the core technological rationales for undertaking a series of deployments of growing sophistication is the development of **prototypes**. Prototypes can begin their lives as something really quite crude (though, as Soute et al. (2013) point out, this depends somewhat upon the domain). As with iterative development, the notion is that there will be a move from early prototypes with relatively restricted functionality, through to something fully functional that is in some sense proximate to what a finished product might look like. Here the key distinction from something like iterative development is the sense of the prototype being a working model. Often its early form already expresses many of the core ideas, rather than this being something that might be uncovered over time. However, at the same time, the expectation is that this phase of development will not be about completion. Even the most effective of

prototypes assume that there will be some other, subsequent body of work necessary to arrive at something that has the characteristics of a working product. Thus, Jones et al. (2007) suggest that the purpose of a prototype is to 'evaluate and communicate a good idea' so as to get a better understanding of what is really needed (see also Brereton et al. 2015; Soro et al. 2016). They also note that typical user evaluations of prototypes are very often at some remove from the real world. Thus, prototypes may offer little more than being able to distinguish between what is 'good' or 'bad' or as a means of 'getting one's ideas straight'. Taking these issues seriously, some have advocated making the communication process between designers and users more actively bi-directional, with both parties working through the implications and viability of the prototyped technology together (Kim et al. 2016). Jones et al. (op. cit.) draw attention, too, to the distinction between research understandings of what a prototype might be and understandings in industry where, essentially, each version of a product is oriented to as a prototype for the next product to be developed. Thus, the argument is that deployment of a research prototype is about trying to get at some fundamental kind of insight, whilst in industry the job is just about examining whether the features work.

Other potential reasons for deploying a prototype include: understanding what kinds of modes of interaction future deployments will need to support for the particular environment in which the deployment is taking place (Brereton et al. 2015); and more broadly understanding how future deployments will need to be conducted so as to keep participants on-board (Brereton et al. 2015; Soro et al. 2016). In relation to this, note that some researchers have also engaged in recurrent deployments of relatively stable technologies in order to establish specifically what an appropriate deployment protocol would look like for the environment in question (e.g. Finnegan et al. 2017). Some have even taken deployment as a topic of study in its own right (e.g. Unkelos-Shpigel and Hadar 2013).

Odom et al. (2016) somewhat extend upon the traditional sense of a prototype by suggesting that the original understanding is limited in an HCI context where technologies in progress will now often be subjected to extended deployments in the wild. They propose instead the notion of a '**research product**', which should be possessed of four 'interrelated qualities': 'inquiry-driven, finish, fit, and independent'. 'Inquiry-driven' refers, fairly evidently, to the sense of the technology being there to support some kind of research inquiry and around which different research questions might be formulated. 'Finish' is more interesting. Here they suggest that the kind of engagement people have with a research product 'is predicated on *what it is* as opposed to what it *might become*'. With regard to 'fit', the suggestion is that, along similar lines to many of the deployment objectives we have discussed so far, the goal is to have people living with it and experiencing its use over time. Here, however, there is once again a slight nuance in that they suggest that, in order to also meet the requirement of a research product enabling investigation of a research question, there is a need to 'balance the delicate threshold between being neither too familiar nor too strange'. The notion of 'independent' is where a 'research product' moves most evidently away from being a prototype. In this case:

> … a research product operates effectively when it is freely deployable in the field for an extended duration. This means that from technical, material, and design perspectives an artifact can be lived with for a long duration in everyday conditions without the intervention of a researcher. (Odom et al. 2016)

We shall be returning to this particular point in our subsequent examination of some actual deployments, because this is a particularly challenging objective to meet in practice. The principal distinctions in orientation we can pull out of all this are: (a) A recognition in the deployment itself that people will themselves orient to the technology as being whatever it is, rather than investing effort in 'making excuses for it' on the grounds of whatever the researchers are ultimately trying to accomplish with it. This is an important point that resonates strongly with the argument I shall be presenting in due course. (b) Trying to make something that, when it is deployed, will not involve researchers then having to come back and mess with it.

A somewhat distinctive approach to prototyping that nonetheless shares some features with it is the use of what have been termed '**technology probes**'. Hutchinson et al. (2003) express the notion of technology probes in the following way:

> a particular type of probe that combines the social science goal of collecting information about the use and the users of the technology in a real-world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and designers to think of new kinds of technology to support their needs and desires.

In practice, in the wild deployments of technology probes involve providing participants with one or more different technologies—often off-the-shelf or of very rudimentary design—and letting the participants live with them and use them over a certain period of time in order to get more information about the setting and the sorts of technologies that might actually be required. A distinctive feature of the orientation here is that, whilst the deployed technologies might be considered 'ball-park' technologies, where they are deemed to be something like what might be required, they are not necessarily heavily invested in beyond their capacity to engage or encourage use. There is an implicit understanding that these technologies may be completely displaced by others that are actively designed to be 'fit for purpose'. The point of the probe is to try and discover what 'fit to purpose' technologies ought to look like. Indeed, some have used what they term 'exploratory prototypes' in just this way (Heyer and Brereton 2010) within a broader prototyping lifecycle, with the findings generated from the initial prototype being used to develop a more concrete prototype that might be open to appropriation. Another distinctive feature is the interest in using technology to uncover something about how the setting in which it is deployed is organised (see, for instance, Saslis-Lagoudakis et al. (2006), who deployed a home messaging service to investigate awareness and intimacy in home environments). In this respect, technology probes share some characteristics with deployments where the goal is to breach, which I shall be discussing in more detail below. However, there is no necessary assumption that technology probes will be actively 'disruptive' and, as pointed out above, there is usually a sense of them being something akin to what an appropriate technology ought to look like. Like prototypes, the goal is often just one of opening up a dialogue with users about what a real solution might

entail. Another aspect of technology probes (that they might be said to share with the notion of cultural probes (Gaver et al. 1999) that first gave rise to them) is the view that they should be deployed in multiple settings if they are going to generate useful results by polling what responses they generate in different contexts (see again Saslis-Lagoudakis et al. 2006).

Another approach that might be considered closely related to prototyping is **piloting**. Here the design is deemed potentially unfinished and open to significant revision, but is nonetheless oriented to as a genuine attempt at designing a technology that is crafted to meet the anticipated goals and, thus, deployments of pilots in the wild are usually undertaken with the express goal of engaging in some form of evaluation (see, for instance, Hertzum and Simonsen 2010; Lauwers et al. 2009).

As one moves towards notions of piloting, etc., one begins to enter the realm of evaluation of various kinds. One of the more formal, frequently laboratory-based or, at least, controlled-environment-based approaches to evaluation is **usability testing**, which places it outside of the scope of our considerations here. However, there are a few researchers who advocate usability testing through in the wild deployments (e.g. Rowley 1994, who terms it 'field testing'). A similar set of prescriptive approaches can be found in the notions of **formative** and **summative evaluation**. The concepts of formative and summative evaluation originated in projects designed to bring about changes in educational practice (Scriven 1967). In technology and computing a formative evaluation is one that is undertaken during the course of a technology's development in order to inform the further design and refinement of specific elements. A summative evaluation is one that is undertaken once the technology is (notionally) finished (or at least at the end of that particular development cycle). Here the goal is to evaluate how the technology performs overall, usually with an eye to whether the technology should be taken up and used, productised, sent back for re-design, dropped entirely, etc. (Koenemann-Belliveau et al. 1994). Whilst formative and summative evaluations are also typically conducted in controlled settings, it should be noted that Koenemann-Belliveau et al. (1994) foresaw a need on occasion to engage in 'empirical usability evaluations' where there is a notion of deployment in the wild involved because of the need to capture situated 'critical incidents of use'. An additional small twist on this that trades upon a commonplace technique for eliciting user feedback about in the wild deployments is the notion of **remote evaluation** (see, for instance, Lichtner et al. 2009). Here, diaries are used as a communication tool for users to provide designers with ongoing feedback about a technology and its performance. A further variation on this that aligns itself broadly with the concept of **Living Labs** is the use of an online 'evaluation platform' for deployment in the wild of various technologies (Balog et al. 2014), where software is fed to selected users, who test it in the context of their actual everyday activities and give feedback. The feedback then informs re-design prior to the software being implemented in live production environments. Living Labs (see Eriksson et al. 2006; Bergvall-Kåreborn et al. 2009; Svensson and Eriksson 2009; together with von Hippel 2005; Intille et al. 2005; and Abowd et al. 2000) might be thought of in some ways as mounting to in the wild deployments in that the concept "refers to an R&D methodology where innovations, such as services, products or application enhancements, are *created*

and *validated* in collaborative multi-contextual empirical real-world environments" (Eriksson et al. 2005). However, whilst the idea is dedicated to getting the technology out into the wild, the actual environments within which the stakeholders are brought together and invited to make use of the technology are still, as the use of the word 'labs' implies, controlled and artificial in some respects. This makes it hard to fully justify their inclusion in the panoply of approaches to deployment in the wild.

So, in addition to the 'blending in' orientations that we mentioned in the preceding section we can now include the following: using deployment to test design assumptions; deploying technologies in various stages of refinement with an assumption that findings from each deployment can be used to inform the next one (and make it better); deploying technologies to test prospective approaches and functionalities; deploying technologies to encourage people to participate in the design process; deploying technologies as a means of testing out the deployment process itself; deploying technologies as means of communicating and evaluating research ideas; deploying basic technologies as a means of discovering what effective technologies would ultimately need to look like; deploying technologies to probe the organisation of the deployment setting itself; and deploying technologies to expressly evaluate their features and performance. We are now going to examine a wholly distinct set of concerns where 'blending in' is of much less interest than 'standing out'.

2.2 Standing Out

When it comes to deploying technologies where the goal is to make them stand out and purposefully have users take pause and engage with them in some sense, there are, again, two tightly interrelated concerns. First of all, a technology may be deployed so that it can specifically draw attention to itself and provoke some kind of reaction. Secondly, a technology may be deployed so that it is deliberately disruptive in order to find out something new. In the latter case, the disruption might serve a number of ends. It could be for the purposes of informing future technology development. However, it could just be a vehicle for finding out more about what people do. Evidently these two cases overlap because deliberately noticeable technologies may be made so as to breach some set of local concerns, and, likewise, the pursuit of novelty may be accomplished through a breach. Nonetheless, there is ultimately a difference between making a technology freestanding as an object of focus in its own right and making a technology disruptive as a means to other ends.

2.2.1 Remarkable Computing

The preceding sections need to be set against a quite distinct orientation that can be found in the research literature. Here the interest is not in having the technology blend

into practice and be made at home. Instead there is an emphasis upon making the technology and any associated content/provision highly visible and even potentially provocative.

One whole body of work here relates to deploying technologies with the goal of **provoking discomfort** of some kind. Benford et al. (2012) suggest four different kinds of discomfort that might arise: "visceral, cultural, interactional, and social". The orientation here is towards deploying such technologies for the purposes of delivering "powerful experiences that as a result, may be more entertaining, enlightening or socially bonding for their participants" (op. cit.), or, as they later put it, moving away from 'traditional usability goals' towards 'fostering emotional and aesthetic engagement' (Benford et al. 2013). The consequences for deployment here are putting things out into the wild that actively disconcert people, that are challenging to understand or use, or that deliberately seek to make a virtue out of their limitations. The notion of 'uncomfortable interaction' arose in the context of design related to games, amusement park rides, cultural performances and experiences, and art installations. The specific things that researchers are seeking to uncover through deployments adopting this perspective are possible answers to the following questions: "What are the potential benefits of uncomfortable interaction?; What forms can such interaction take?; How can discomfort be created?; How can it be embedded in an experience?; and, What ethical challenges must be addressed?" (Benford et al. op. cit.). Similar considerations about the potential use of 'uncomfortable systems' were expressed in 2007 by Foucault et al. who deployed an agent-based system in an office, where it gathered information about people in the office by "asking seemingly benign questions', which it then used "to spread false, strange gossip throughout [the] office space". They claimed that "provocative interaction on-line can improve off-line sociability", thereby having "a positive effect on social relationships". However, a somewhat different view was taken by Halbert and Nathan (2015), who, whilst engaging in using a series of interactive tools to make users uncomfortable for the purposes of prompting 'critical reflection', observed that "for contexts in which an uncomfortable reaction is intended, instrumental, or indeed inevitable, we recognize that it is inappropriate to design for a positive or "feel good" experience". Nonetheless, we can note that there are some deployments undertaken where the orientation is clearly towards the generation of a noteworthy response, in this case discomfort.

Deploying technologies that actively **encourage reflection** is a rationale that has been used on a number of occasions. Lee et al. (2014), for instance, report on the deployment of a technology called The Reflexive Printer, that was specifically designed to promote 'technology-mediated reminiscence'. Printing pictures from people's photo albums on a random basis, as halftone or single colour images, the researchers here sought to encourage three kinds of interaction: "exploration of personal memories; interaction within a community; and reflection on rumination". Iivari and Kuutti (2017), seeking a route to move 'critical design' towards the development of deployable technologies, actively specify the kinds of orientations that they think need to be in play. Coming from a participatory design background they make a distinction here between the orientations relevant to designers and to users. One of the objectives they discuss is the deployment of technologies that are designed

to 'provoke and reveal', with both parties promoting the design of things where "the status quo is critically scrutinized, challenged, [and] disturbed" in some way. Another objective they discuss is the deployment of technologies that are designed to 'combat and empower'. Here designers may look to designs that in some sense 'empower' those who might traditionally be viewed as weak, whilst users might seek deployments that empower weaker users to have a more active role in the design process or in some other sense 'combat' potential 'oppressors'. Sometimes the whole point is just to generate discussion. Thus, Holzer et al. (2015a, 2015b) designed and deployed a mobile app that worked out people's share of a restaurant bill according to their income, not simply as an aid to sharing bills, but as a vehicle to provoke debate about income inequality. Overall, in all of these cases, we can note that the orientation is not towards providing something that will simply blend in, but rather to deploy a technology that will, in some sense, stop people in their tracks and ask them to actively think about something.

A number of researchers have sought to encourage overt engagement in broadly similar, if less manifestly challenging ways. Gaver et al. (2003) and Morrison et al. (2007), for instance, expressed an interest in promoting '**ambiguity**' (which Benford et al. (2012) propose, of course, as a possible trigger for discomfort). Mostly these designs are deployed in the context of interactive art installations, which already implies a certain orientation being brought to them by other designers and prospective users. Here the deployments are geared towards inviting users to play and experiment with the technology, with the outcomes then being potentially surprising and open to **interpretation** (Morrison et al. op. cit.; Sengers and Gaver 2006). In notable juxtaposition to the preceding orientations we have discussed, evaluation of technology in this context is not focused upon potential usefulness or openness to appropriation but rather upon ludic outcomes, where success is measured in terms such as 'fun' or 'stimulation'. Notions like this of **play and fun** have been especially prominent in arguments about deploying technologies that 'break fundamental design rules' and draw attention to themselves in various ways (Blythe et al. 2004; Holzer et al. 2015a, 2015b; Morrison et al. 2011)

Another rationale that is often put forward for the deployment of ludic technologies in the wild is that they can provide a means to **provoke active engagement and interaction**. Blythe et al. (2010) report on the deployment of a ludic system in a residential care home that was intended to encourage 'cross-generational engagement'. A range of 'digital curios' were given to elderly residents alongside the deployment of four different off-the-shelf technologies that sought to promote 'curiosity and playfulness' in a space where different generations could intermingle. A very similar approach was taken to deployment in care homes by Gaver et al. (2011) where a 'Photostroller' was deployed for two months that presented a 'continuous slideshow of photographs' harvested from Flickr, within six set categories that were ongoingly modified. The idea here was that the Photostroller would promote 'ludic engagement' amongst the residents. Fortin et al. (2014) engaged in a 10-week in the wild deployment of an interactive art installation in Montreal that sought to encourage people to engage with it as means of uncovering how people might want to make use of public space technologies. Wouters et al. (2014) also deployed public displays as

a vehicle for promoting engagement, this time on the facades of people's houses as a means of communicating between households and the neighbourhood, though in their case the focus was more upon how 'playful experiences' might be aligned with a goal of increasing awareness about 'socially relevant topics'. Note generally that in all of these cases there is an orientation towards deploying technologies that will actively draw people to them and encourage engagement with them, and that this engagement will have some kind of social outcome. Clearly this is at some remove from notions of 'blending in'.

Engagement, of course, does not always have to be geared towards some notable social outcome. The purpose of having deployed technologies being actively 'remarkable' and open to comment may well be more focused upon promoting **aesthetic engagements** of various kinds. Fiore et al. (2005), drawing on Dewey (1934), take a pragmatist aesthetic view to these kinds of deployments with the goal being to 'transform' designed materials/technologies into 'works of art' that will promote some kind of 'experience' for the user. This resonates strongly with other notions in the literature regarding using technology to either **'augment' user experience** (McCarthy and Wright 2004), or even provide '**complete experiences**' (Benford et al. 2009). Some researchers have argued (somewhat contentiously) that a similar approach needs to be taken to deployments of technology in the domestic environment, with designs being actively 'remarkable' and encouraging engagement at an aesthetic level (Djajadiningrat et al. 2000; Fogarty et al. 2001; Hallnäs and Redström 2002; Petersen 2004; Petersen et al. 2004). In particular, Petersen (2004) suggests that this is "a possible response to concerns on making future interactive homes too transparent and straightforward".

When it comes to deploying technologies that stand out in some way, we can note a number of distinct orientations that may be brought to bear. These include deploying technologies: that actively disconcert people; that people will find hard to understand or use; that manifestly constrain what people can do in some sense; that provoke some kind of emotional response; that position people in ways that will oblige reflection of some kind or the adoption of a specific stance; that will provoke uncertainty or be open to being understood in a variety of ways; that people will find fun, stimulating or entertaining to use; that demand some kind of engagement; or that will provide some kind of experience, aesthetic or otherwise. In all cases, the goal is to deploy things that people will take notice of and that will require engagement with in their own right, rather than as resources through which other things might be accomplished. In other words, the technology (or its immediate outcomes) will be in some sense remarkable (as in inviting comment or response). In the next section we will look at deployments that, on face value, have the same goals in mind, but where there is an underlying orientation to using the deployment to bring the organized properties of a setting into view. In other words, places where outcomes may seem similar to the ones above, but where those outcomes are of less interest in themselves than what they can tell us about the world.

2.2.2 Deployment as 'Breach'

The preceding section looked at how orientations to deployment can centre on being disruptive to provoke various kinds of responses or encourage different kinds of engagement. However, disruption can also be used to reveal aspects of the social order that would otherwise be difficult to get at. In his original *Studies in Ethnomethodology* (1967) Harold Garfinkel speaks of the difficulty of uncovering the 'seen but unnoticed' background expectations that underlie much of everyday life. Citing Schutz (1962), he points to the need to provide a 'special motive' for these background expectations to be brought into view. He thus engaged in a number of 'breaching experiments', though he is keen to point out that these are not what one might consider experiments in a procedural sense, but rather 'aid's to a sluggish imagination'. So, he sought to "produce and sustain bewilderment, consternation, and confusion; to produce the socially structured affects of anxiety, shame, guilt, and indignation; and to produce disorganized interaction" so as to reveal how "the structures of everyday activities are ordinarily and routinely produced and maintained". He also points out that we trade upon our knowledge of such things in order to be able to see just how it is that we might be able to cause trouble. So, a number of deployments over the years have taken this viewpoint seriously and have sought to deploy technology specifically as a vehicle for obtaining new insights about the way the world works that would otherwise be hard to obtain.

One way of going about this is to deploy technologies that render people expressly **accountable** for their actions in some way. Thus, Schwartz et al. (2013) deployed a system for rendering people's energy consumption visible to others around them in ways that would not ordinarily be possible. As a result, people were obliged to offer up accounts and rationales for their energy consumption practices. Gaver et al. (2015) achieved a somewhat similar outcome, albeit in a more light-hearted and playful fashion, with a deployment called Energy Babble that was "a kind of automated talk-radio that is obsessed with energy and the environment". By installing it in the homes of members of a pre-existing 'energy community' it served to actively bring issues to the fore. We have already noted above how Heyer and Brereton (2010) used 'exploratory prototypes' to probe environments and bring rationales for practice into view.

Poole (2012) goes so far as to actually promote the use of technology deployments as breaching experiments in order to **expose certain phenomena** that are otherwise difficult to uncover. In her case, she was interested in how people handle breakdowns in network provision in their homes. As she points out: "The amount of time between critical incidents with respect to home computing setup, maintenance, and troubleshooting are unpredictable; they could be minutes apart or years apart". She also notes that many breakdowns are treated as not worthy of mention in subsequent reports and interviews. As a result, she actually staged breakdowns and got participants to engage in activities such as installation and maintenance that they never normally undertook, so as to reveal practices and reasoning that were hard to

access in other ways. Through this she was able to expose the rationales whereby the division of labour regarding technical work in people's homes is organized.

In a rather similar vein to the preceding examples, deployments can also be geared towards breaching matters in such a way as to **make specific orientations or understandings visible** that might otherwise remain unarticulated. This is very close to what Poole was trying to do but, in Taylor et al.'s study of a 'cross-cultural digital noticeboard' that they co-designed with an Australian Aboriginal community (2017), the approach was much less disruptive and less inclined to 'force' things into view. Much of the information that could be open to posting on the noticeboard was of a temporal character but, because of the particular understandings of time present in the community, there was also a lot that didn't fit with the design. The presence of the noticeboard provided an opportunity for these understandings of time to be articulated and brought into view.

For Crabtree (2004) deployments operating as breaching experiments are particularly effective for **uncovering opportunities for innovation**. As he notes:

> IT research is often informed by studies of the practices that new technologies are to be embedded in and which they transform in their use. The development of mixed reality, tangible, ambient, ubiquitous, mobile, and wearable computing have seen the emergence of a range of technological innovations that have little or no grounding in current practices, however. Such developments create new practices where none existed before and the challenge for multi-disciplinary research is to adapt to this situation.

In fact, ethnographic studies exploring the use of the kinds of innovations Crabtree is pointing to, often throw up instances of breaching as a matter of course, thereby presenting designers with rich insights about the order they have disrupted that can then be used, as Crabtree suggests, as a further resource for design down the line. Thus, it often turns out that breaching is a *discovered* (as opposed to planned-for) resource for innovation. As an example, in Tolmie et al. (2008) an ethnographic study was undertaken of people playing an SMS-based game where messages from the game server were sent recurrently to people's mobile phones throughout the day, frequently interrupting the course of their ordinary everyday activities. Ethnomethodological analysis of the gameplay in this context showed that interruption handling was shaped by 'its accountability to the various people or 'cohorts' whose concerns participants needed to juggle simultaneously'. These findings were set against existing approaches to interruption handling, leading to an understanding of how a more nuanced understanding interruption-handling might be brought to bear in future design.

So, the final set of orientations presented above reflect approaches where there is an understanding that deployments can be used to: render people specifically accountable for certain actions; expose rationales and understandings that would otherwise remain hidden; provide a vehicle for specific kinds of orientations to be articulated; and to bring about circumstances where new opportunities for innovation can be discovered and recognised. In the remainder of this chapter we will look in detail at a couple of cases where certain kinds of orientation can be seen to underlie approaches to deployment in the wild, to tease out their consequences and examine what kinds of lessons might be drawn from that.

3 Grammars of Deployment

Now central to this section is the view that when you adopt a certain orientation to deploying technology in the wild, that necessarily comes with a certain 'propositional grammar'. This propositional grammar is wrapped up with the fact that when you say you are going to do something, either: (i) it is already a matter of commonsense why you should want to do that; (ii) the articulation of what you are going to do already contains an account for why you are doing it; or (iii) you deliver, as an adjunct to the proposition of what you are going to do, the reasons why you are going to do it. So, to take a very simple example, for case (i), if you are a member of a household, with a set of known routines and responsibilities, you might well just say "I'm going to do that washing-up now", without needing to say very much to anyone about why you are going to do it, because that's something self-evident to the local cohort (what ethnomethodologists term being 'naturally accountable'). For case (ii) you might be doing the washing-up at a time when it's not normally done and say "I'm going to do the washing-up now rather than later", where it's a matter of local knowledge that you're going to be out when the washing-up usually gets done, so there's no need to go into detail, but implicit to what is said is the explanation of why you are going to do it. For case (iii) you might, as a guest in someone's house, say "I feel really guilty. You've fed me supper and I haven't lifted a finger. So you must let me go and do that washing-up". In this case there's no local *expectation* that you will do the washing up, so you deliver an explicit account for going and doing it. Notice in each of these cases how everything trades upon shared bodies of commonsense knowledge and how that pertains to particular people's rights and responsibilities. This is key to what we are going to be talking about.

So, if you say to me, "I am going to put an application on your mobile phone, and it's going to ask you some questions and then share your answers with everyone else in the office", what does that even mean? The issue with deploying in the wild (or in any place really) is that you are not just putting the technology into a neutral space. It has a pre-existing set of understandings and expectations in play and your deployment has to be somehow accountable. And if it's not naturally accountable then you're going to have to provide some kind of an explicit account that can serve as an explanation. In short, you're going to have to do some propositional work of some kind. So, if you tell me you're going to do that to my mobile phone and it's going to have those kinds of outcomes, I'm likely going to have a whole battery of questions, such as: 'How are you going to get it on my phone?'; 'Is it going to run my battery down?'; 'When is it going to ask me these questions?'; 'What sort of questions is it going to ask me?'; 'Is it going to ask me anything personal?'; 'How is it going to share my answers with everyone?'; 'Will they know those are specifically my answers?'; 'What are they going to do with those answers?'; 'And why the hell do you want to do that anyway?'. Of course, as already competent members of society, designers typically come at this with an expectation that these kinds of question will arise. So, most often, the strategy is to already proceed as in case (iii) above by delivering your proposed deployment with a ready-made account. And so, there is the

propositional work. It takes as its starting point what you already know of the world and gets shaped into something that will hopefully say enough for the deployment to happen. Nor is it some kind of a con, where you'll say anything to get them on board. Your explanation is already grounded in what it is you understand yourself about what it is you are going to do. So, the propositional work is also shaped around that understanding.

Now, propositions come with a grammar. They are, of course, endlessly mutable and, as Wittgenstein once made so evident, to assume that any form of words is fixedly propositional or anything else is a dangerous (and ultimately doomed) gambit. However, nonetheless, your proposition regarding what you are going to do has to be somehow recognisable as that. In short, if you are going to deliver an account, it has to be seen to be an account or you're in trouble. Of course, you might well ask, so what makes a proposition recognisable as such? And how do you know if it's adequate for what it is you want to do? But therein lies the rub, of course. So, in the following two cases, we're going to be looking at how deployments in the wild can come with these propositional grammars attached, and how the application of those grammars can actually pan out in terms of what actually gets deployed and how it is engaged with. In the first of the two cases I shall be examining issues with how researchers themselves might understand the grammar of what a deployment will be about. In the second case, I shall be looking at how, whilst researchers themselves might be relatively clear about the grammar of a deployment, this is no guarantee that it will be oriented to that way by participants in the wild. Indeed, the grammar of the deployment can itself promote engagement that is quite at odds with what researchers themselves assume a deployment to be about.

3.1 Test Case (1)—Blending In and the Disappearing Computer[1]

In the early days of computer design the principal emphasis was squarely upon playing up the, at the time, remarkable character of computing technology, both in terms of the machines themselves and in terms of what they could do. Their new-found importance in life and their capacity to change the world and everything we do within it was seen as something to be either vaunted and played up to the maximum, or as something to dread and contain. In either scenario the machine was centre stage and in the spotlight.

As a prelude to his own interest in 'invisible' computing, all of this moved Mark Weiser, one of the more visionary researchers then working at Xerox's PARC laboratories, to comment in 1994 that:

[1]Much of the argument presented in this section originally appeared in a paper entitled 'Unremarkable Computing' presented at the ACM's conference on human factors in computer systems (CHI) in 2002 (Tolmie et al. 2002).

> For thirty years most interface design, and most computer design, has been headed down the path of the "dramatic" machine. Its highest ideal is to make a computer so exciting, so wonderful, so interesting, that we never want to be without it.

From the workplace, to leisure domains and travel, to the home, much of the emphasis thus far had been upon systems that demanded attention and invited comment.

However, Weiser was in the vanguard of a quite distinct approach to computing, with technology ubiquitously spread throughout the environment in ways that would allow it to, in his view, simply 'disappear':

> The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it. (Weiser 1991)

This concern with 'disappearing' computing was not primarily about aesthetics but rather about how computing might be made to become wholly 'natural' in use and so to-hand it would never be reflected upon:

> A less-travelled path I call the "invisible"; its highest ideal is to make a computer so imbedded, so fitting, so natural, that we use it without even thinking about it. (Weiser 1994)

The vision expressed by Weiser inspired a whole generation of research programmes and deployments, most notably in the field of ubiquitous computing. One place it was particularly taken up was in a major European Community funded initiative at the beginning of the 21st century called 'The Disappearing Computer'. Strongly echoing Weiser's comments from over a decade before, the vision behind this initiative was described in the following terms:

> … the computer, as we currently know it, will be replaced by a new generation of technologies, moving computing off the desktop and ultimately integrating it with real world objects and everyday environments. Computing thus becomes an inseparable part of our everyday activities while simultaneously disappearing into the background. It becomes a ubiquitous utility taking on a role similar to electricity: an enabling but invisible and pervasive medium revealing its functionality on request in an unobtrusive way and supporting people's everyday activities. (Streitz et al. 2007a, b)

'The Disappearing Computer' initiative was profoundly influential at the time, leading to research and deployments in areas such as the augmentation of physical artefacts (Luff et al. 2007), design for domestic environments (Lindquist et al. 2007), and the creation of what might be called 'smart spaces' (Streitz et al. 2007a, b).

It is worth considering for a moment what kinds of deployments this kind of design agenda might lead to. In the years following Weiser's invitation to the 'invisible' the principal focus fell more and more upon quite literally trying to make computers disappear from sight. So, for many industrial design companies (e.g. Philips Research 2001) the interest was in how to make devices smaller and neater, with fewer wires and more seamlessly integrated into the surrounding environment. Figure 1 featured in the description of a research project from the time that was focused upon ambient computing (Philips Research, op. cit.). In the associated text a contrast was made between the left-hand image, which is supposed to illustrate the current world, and the right-hand image, which is supposed to be illustrative of the future.

Fig. 1 "All sorts of computing devices will disappear into the background of our everyday lives" (Philips Research 2001)

Clearly this image is trying to convey an interest in the *perceptual* visibility or invisibility of computing and how it might literally be made to 'disappear'. So, deployments of technology that is "invisible in use" would entail, in this view, something like implementing computational technology that is so small it can no longer be readily seen in the environment. This was a common proposition at the time: the development of computing that is quite literally 'invisible and embedded' and thus to look actively for ways in which to *hide* it from view. The following relates to the deployment of a suite of active tools designed to support children engaged in storytelling:

> The use of cards and slides goes in the direction of possibly incorporating mnemonic units into physical objects, and using them in a spatial dimension (possibly to transport them and reuse them in another space-time frame). Information handling is enlarged in spatial terms, and is consequently no longer limited to a central processing unit. The instruments seem to us to be headed in the same direction of distributed creation, the creation and recording space being integrated into the context of handling and constructing natural objects from the children's physical world. These points seemingly indicate a movement towards invisible technology, where any central processing unit stays out of sight and out of mind for its users. (Decortis and Rizzo 2002)

This kind of proposition was also a particularly strong component of the early approaches to ambient computing (see Weiser and Brown 1996), where the goal was to design systems that provided information that would never ordinarily cross beyond a user's peripheral awareness:

> Bits flowing through the wires of a computer network are ordinarily invisible. But a radically new tool shows those bits through motion, sound, and even touch. It communicates both light and heavy network traffic. Its output is so beautifully integrated with human information processing that one does not even need to be looking at it or near it to take advantage of its peripheral clues. It takes no space on your existing computer screen, and in fact does not use or contain a computer at all. It uses no software, only a few dollars in hardware, and can be shared by many people at the same time. It is called the "Dangling String"… Created by artist Natalie Jeremijenko, the "Dangling String" is an 8 foot piece of plastic spaghetti that hangs from a small electric motor mounted in the ceiling. The motor is electrically connected to a nearby Ethernet cable, so that each bit of information that goes past causes a tiny twitch

> of the motor. A very busy network causes a madly whirling string with a characteristic noise; a quiet network causes only a small twitch every few seconds. Placed in an unused corner of a hallway, the long string is visible and audible from many offices without being obtrusive.

Interestingly, the idea incorporates both notions of moving computing off of the screen and into the environment, but also ideas of making some aspects of the digital domain that are usually 'invisible', i.e. network traffic, 'visible'. In another paragraph the paper makes some further propositions regarding the perceptual aspects of ambient computing, this time regarding what might count as being 'peripheral':

> We use "periphery" to name what we are attuned to without attending to explicitly. Ordinarily when driving our attention is centered on the road, the radio, our passenger, but not the noise of the engine. But an unusual noise is noticed immediately, showing that we were attuned to the noise in the periphery, and could come quickly to attend to it… It should be clear that what we mean by the periphery is anything but on the fringe or unimportant. What is in the periphery at one moment may in the next moment come to be at the center of our attention and so be crucial. (Weiser and Brown 1996)

At the same time a veritable battery of research projects appeared where much effort was devoted to trying to find ways in which to effectively embed computers and computing capability in various kinds of ordinary objects such as tables (Gaver et al. 2004), cups (Gellersen et al. 1999), chairs (Streitz et al. 1998), ornaments (Frohlich and Murphy 2000), and even picture frames:

> We are designing a "digital family portrait" that creates a visualization of a person's day at home from available sensor information. From general measurements of activity to indications of the weather, the portrait attempts to capture the observations that would naturally occur to someone living in the same home. Leveraging a familiar household object, the picture frame, our current design populates the frame with iconic imagery summarizing 28 days of daily, household life. (Mynatt et al. 2000)

Closely related to this notion of embedding computation within artefacts, but in certain respects distinct, is the notion of *augmenting* artefacts. The distinction here relates not simply to adding computation to the artefact in order to somehow more efficaciously or richly accomplish things it is already used for, e.g. the display of pictures. Instead the idea is to extend the range of actions that might be accomplished with the object:

> We have used the MediaCup in colleague awareness applications. In a study of Ambient Telepresence, MediaCups and other devices in an office environment were used to track everyday activity, which was then communicated to a remote workplace where it was rendered as subtle background noise, to promote a sense of remote presence in a non-obtrusive way. In another colleague awareness application the MediaCup was used in conjunction with other environment based sensors to log user activity for production of a kind of comic strip of recent activity, accessible to co- workers. (Gellersen et al. 1999)

Broadly speaking then, the proposition in play with all of these ideas is that technology might be deployed that puts the computing elements almost or completely perceptually out of view, often within familiar objects, but with an end in mind of somehow adapting or shifting the semantics of an object's use, so that it might convey, again by perceptual means, something different or new.

Now, the notion of computing 'disappearing' into the background demands an understanding of what it might take to make such a thing happen. All of the above deployments are founded upon an assumption that making computers 'disappear' is a matter of physical visibility and perception.

One of the things Weiser was particularly driving at in his notion of the 'invisible' was the 'weaving' of computing into the background such that it became a part of 'the fabric of everyday life'. In other words, instead of computing being special, remarkable, or 'dramatic', the goal was to make it completely mundane. And we can see that, nowadays, the larger part of everyday life computing has, indeed, become something completely taken for granted and mundane.

Here, for instance, a pre-existing routine for buying clothes has become an ordinary activity online, so much so that the stranger thing would be to ask why they should be buying their clothes in this way:

> … When I'm looking for something- For example, if I'm looking for a dress for something good then there's certain sites that I know, that's where I'm going to- And it's nothing to do with catalogues, I just know I will find something there. Then I will go and look at those. It depends whether I see something I like or not. If I like it enough I will go for it straight away. Because I know the shops. I used to shop actually in their shops, so I know how their stuff fits and, you know, what sort of look I'm going for and all the rest of it. (Tolmie et al. 2013)

In another example we can see how computing technology can be used without need for account in circumstances that would once have been served by pen and paper in a similar way:

> If somebody wants to give me a phone number or an email address I don't get out a bit of paper and a pen anymore I can just write it straight on my phone which I find much more practical. Coz it's something I always have on me. (Tolmie et al. 2013)

And in the following we see how the unremarked presence of computing technology in everyday life has become even more pronounced with the advent of smartphones which can be played with as a background activity in a huge variety of different circumstances without anyone thinking to pay any special attention to their use:

> Facebook and twitter I go on every day. Facebook I maybe go to three times a day on the phone. It's pretty much the first thing I do when I wake up, is go on Facebook and Twitter. While I'm still in bed in the morning, before I get up properly, around lunchtime, and again in the evening. Often when I'm waiting downstairs to watch stuff and messing around with my phone I'll be looking at Facebook and Twitter. It's a general fill in activity. Facebook on the machine [now] I pretty much only use for the games, because I can't play them from my phone. Twitter I don't much like using on my computer. I much prefer the app on the phone What was done on Facebook on my laptop before is now almost completely displaced to my phone… Since I've had the phone I've been a lot more active on both Facebook and Twitter. (Tolmie et al. 2013)

However, Weiser's concern, and a continuing concern of the ubiquitous computing community, was not about a serendipitous proliferation of devices to the point where they might become mundane simply because they are so routinely encountered, but rather about building in (or at least providing for) mundaneity *by design*.

Let us examine how Weiser's 1994 suggestion that computers might be made 'invisible' *in practice* might work as a grammatical proposition. What people might treat as invisible as a matter of practice is critical here. People can talk about things being invisible in all sorts of different ways. The question is: what does it take for things to be understood to be invisible *in practice*, or talked about as being invisible *in practice*, or oriented to as invisible *in practice* in the first place? Is this really something that is all about perceptual availability such that things that can't be seen or heard or smelled or touched or tasted will automatically blend into the background and disappear? Or should we be looking to something other than physical apprehension[2] when it comes to things disappearing *in use*?

Let us take a look at the following example, captured during an ethnographic study of a freelance language translator working at home:

> The translator in question, whom we shall call Lucie for the purposes of reference, lived in a small 3-bedroomed house with her 2 children, a boy aged 12 and a girl aged 10. Lucie had stopped doing translation work in an agency the previous year so as to 'go it alone' at home. To facilitate this she had converted one corner of her living room into an office. Freelance translation work is typically paid by the word. Lucie therefore routinely started work early in the morning before her children had got up. This way she could get a certain amount done without any kind of interruption. The following notes come from observations of one such early morning session. Lucie had been working at her desk since about six o'clock, translating from English into French a text describing a new dieting aid. When she began her children were asleep upstairs but over the course of the observations their morning routine was initiated through a series of commonplace but significant events.
>
> **Instance 1**:
>
> *Lucie flicks through some printed sheets on her desk and comments on how the table of contents doesn't match the text. She returns to the electronic document and continues to translate the next title, saying out loud a segment. It is 7:00 a.m. and an alarm clock goes off in a child's room upstairs that she shows no reaction to and continues to key in as before. When she has completed that section of text she switches her monitor off and says 'it's been an hour'. She pushes in the leaf to her desk, stretches, then leans on the ledge under her monitor resting on her elbows, her hands to her cheeks, drinking coffee. Once she has finished her coffee she goes into the hall to call upstairs to the children: «Bonjour mon gros doudou, Bonjour mon lapin…».* (Fig. 2)

One of the first things to ask about this example is what it is about it that might give an ethnographer reason to suggest that an alarm clock going off was '[shown] no reaction to'? Well something that *is* clear here is that, for the ethnographer at least, the alarm clock going off is something that *is* taken to be remarkable. Particular note is made of it in the fieldnotes as a local phenomenon of possible relevance. However, at the same time the translator takes the very same thing to be completely *unremarkable*. This very fact that she doesn't make anything of it is just exactly what gives a witnessing party such as an ethnographer, who is 'not specifically competent in all of the routine features of the setting', the right to observe as purely a matter of commonsense reasoning that the translator 'showed no reaction to it'.

---

[2]There are a wide variety of possible discussions that might be had about what many disciplines routinely refer to as 'perception' or 'apprehension' actually turn upon. Here we are wholly concerned with the notion of 'invisibility *in use*' but for a deeper discussion of this issue the reader might usefully turn to a 1989 paper by Coulter and Parsons entitled '*The Praxiology of perception*'.

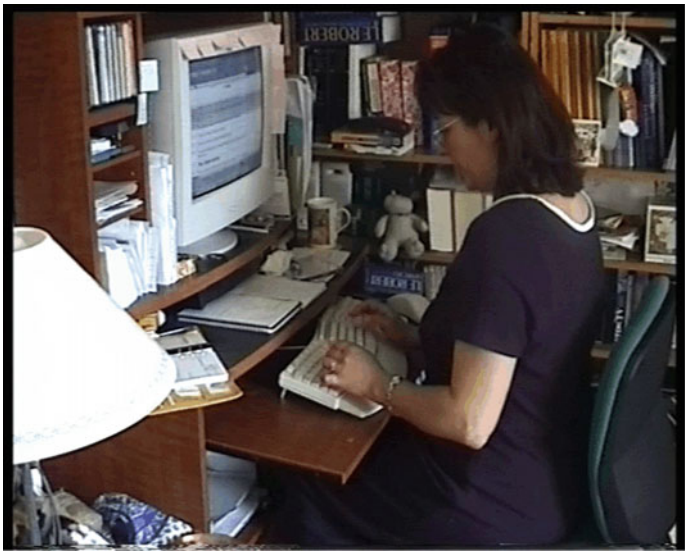

Fig. 2 An inaudible alarm? Or inaudible in use?

There are some matters of method to unpick here regarding the workings of remarkability and unremarkability. So something that is worth doing, even though at first sight it may seem perverse, is to consider some of the plausible things that could have happened but didn't. One such thing is that the translator did not mark out the alarm going off as something *unusual* by saying something like 'whatever is that?'. At the same time, she did not orient to it as something known but still notable by saying something along the lines of 'damn, that alarm is going off again!'. Remark could also have been devoted to how it was significant with regard to some other consideration, perhaps by saying something like 'oh, is that the time already?'—but it wasn't. What you get instead here is her displaying an orientation to the alarm going off as it being something that is completely *unremarkable*: the occurrence demands no kind of comment or display of interest that would suggest it has any greater significance than any of the other background stuff going on. The meat of the matter here, from a methodological point of view, is that although the alarm going off was apparently handled without any particular reflection, the most important thing about it is that she 'manifestly *did not* mark out her interest in the occurrence' (Tolmie 2011). It is this that provides for the sense of it being a thing that is wholly routine at that time of day and in that particular household. In fact, the very act of remarking upon some feature of the ordinary routine as though it is somehow special is itself remarkable and would need accounting for in some way, Thus:

> To show any evident interest is to make the matter intelligible in some other way. By not marking out the alarm in some way makes it clear that there is nothing inherent in it's going off that obliges her to treat it as something worthy of note or in need of some comment. (Tolmie 2011)

Of course, inspection of the example shows that things do not quite end there. Whilst the alarm clock going off may have been 'invisible' in use for the translator, it was certainly still taken to be implicative. However, its implicativeness resides in the further pursuance of the everyday routine, where the very fact that things are pursued that way is itself taken to be unremarkable. So, it's not as if the alarm going off has no import. On the contrary, it was full of import for the translator's children. Furthermore, the fact that its going off is something that is available to all parties means that, should the children neglect to recognise the proper and routine import of the alarm going off, then the translator is able to immediately call them to account for such neglect.

> … whilst the alarm may have been unremarkable, it was still a resource that was used by members of the family with many other things turning upon it because it was one of the principal devices used to initiate the morning routine. (Tolmie 2011)

So, here's another thing, whilst the translator might have been held to account for her manifest interest in the significance of the alarm going off, she could, without equal need for account have taken very definite interest in its *failure* to go off. If it were to get to a quarter past seven and she hadn't heard it going off yet she might very reasonably pause to mark that out.

What all of this shows is that perceptual invisibility and invisibility in use are not at all the same kind of thing. Taking alarm clocks as an example, they are, by design, perceptually demanding devices. Yet, in the context of an everyday routine they can, for users, simply disappear from view. And this is not because they have somehow been made smaller or quieter or only an ambient feature of the background but rather because, in the context of how they work as a resource within the daily routine, to treat them as somehow dramatic or exceptional would defeat the very sense of how they are used. And, as we further noted, the very absence of an alarm, a situation devoid of perceptual content, might well be oriented to as something worthy of remark.

What all of this suggests when it comes to design and to the deployment of technology is that augmenting ordinary, familiar objects in the home with new kinds of computational possibilities under the assumption that you can simply hide the computation away within what is already there and thus make it somehow less visible does not really capture what invisible in use might amount to in practice. So, building and deploying computing that disappears or that is invisible on the basis of increasingly levels of miniaturization such that devices might become less and less perceptually visible in no ways addresses invisibility from the point of view of interaction. This is not to say such matters can play no part, but it is a mistake to make these a primary focus when invisibility in use turns upon something else: how machines are embedded in everyday routines. Indeed, the very fact that such augmentation can lead to a *change* in the ordinary understandings of objects is something that is just as likely to lead to them becoming more remarkable as not. Something that is apparently hidden from view but which nonetheless demands various forms of interaction for its management may, if anything, be more remarkable, more disruptive and in need of account.

Now, the thing is, from a conventional perspective upon perception it would usually be reasoned that alarms are quite specifically designed to be both noticed and attended to, yet clearly in actual human practice there is something else going on whereby it could actually very well be the case that the act of noticing and attending to an alarm might be the thing that proves to be remarkable rather than the alarm itself. What this serves to reveal is that there is a very real risk of confusion in conventional reasoning about how one should design for visibility or invisibility that presumes that it is the perceptual character of some device that provides for how well it might or might not fade into the background, whereas what we can clearly see is that it is the orientations of people themselves that will serve to make things remarkable or unremarkable. So, the presumption that you can simply design invisibility into a device is not completely tenable.

As we noted in our original discussion of the above material, things can be 'perceptually available yet practically invisible-in-use' (Tolmie et al. 2002). But at the same time, 'things can be perceptually absent yet quite specifically marked out'. What matters then is not 'perceptual character' so much as *significance* for other matters of local reasoning.

Where the above discussion has taken us is to a point where hopefully the reader will now be able to recognise that the key challenge for design here is how to build and deploy machines such that they are able to be *made mundane* by their users. It should also by now be obvious that this is a tough challenge because it's not as if you could hope to provide a machine with a generic set of features such that, by their very nature, they would ensure the machine slipped right into the background without anyone ever even noticing that it was there. So it is that what is being proposed grammatically in the notion of 'invisibility in use' has led to some potential blind alleys in design and deployment over the years because a commonsense assumption regarding what invisibility might amount to has overridden any close attention to the latter part of the clause: '*in use*'.

3.2 Test Case (2)—Standing Out and the Video Window

We are now going to look at something of a contrasting example to the one above. In a short article published in 2005, Bill Gaver described how he spent a period of time living with a very simple system he installed in his home called 'The Video Window'. The system was constructed out of two basic parts that were linked together: (a) a waterproof 'bulletcam' that was mounted on a mast fixed to the wall just outside of his bedroom window, and (b) a flat screen monitor that was installed in his bedroom. The whole point of the system was unashamedly ludic and Gaver makes much of its aesthetic qualities, though he also notes it had aspects that were of practical utility, particularly providing them with an indication of the weather before they had even got out of bed in the morning. Gaver also points to some lessons to be derived from this original deployment, which include: the extent of 'ludic pleasure' that can be derived from even very basic technologies, with constraints even possibly contributing to

their aesthetic quality; the ludic qualities to be gained from providing a new view on one's existing environment; the extent to which apparent flaws, such as camera motion and water on the lens, can provide information in aesthetically engaging ways; and the possibilities that exist to combine utility with 'ludic engagement and aesthetic pleasure'. It is also pertinent to point out that Gaver adds at the end of his list of lessons "Tinkering is enjoyable, but maintenance is a chore." We want to look at this example because the point of the deployment is not to have something that necessarily blends in, though in Gaver's own home it evidently did become an accepted part of their environment. On the contrary, the point is to have something that gives a new view on the world; that makes aspects of your ordinary environment suddenly available to you in novel and remarkable ways. This is not something that wants to disappear, it is something that wants to celebrate difference and present it to you.

In 2006 we were ourselves involved in a shared research activity that involved, amongst other things, a new installation of 'The Video Window' in somebody else's home (see Tolmie and Crabtree 2008). The rather modest ambition of this deployment was to explore the outcome of placing 'ludic' rather than utilitarian technologies in homes, which were designed to encourage engagement at the level of curiosity, pleasure and play instead of being there to 'do' something in particular (Gaver and Martin 2000; Gaver 2001). And, to this extent, it can be claimed that this deployment was a success. However, as we reported in our original paper the deployment actually provoked a number of extremely interesting and illuminating reactions on the part of the householders that neatly revealed the true nature of the challenges confronting people seeking to deploy research technologies in people's homes.

Like Gaver's original deployment, the technology was constructed out of two basic parts that were linked together: a 'bullet cam' mounted on a pole and fixed, in this case, to the balcony; and a flat screen monitor in a custom made wooden frame that was positioned in the dining room where the inhabitants might encounter it on a regular basis (see Fig. 1). It should be noted in addition that both devices ran off of mains power and it was expected that they would be left on continuously (Fig. 3).

The deployment site here was the home of 'Julia' and 'Ron', a middle-aged couple who lived in a large Victorian house with a view of the seaside. Ron was a high school teacher and Julia worked as an administrator at a local university. The house was situated in a seaside town in the south of England with good views of the sea from one side of the house, including the balcony. The installation took place in July 2006 and the technology remained there until September 2006.

A pre-installation visit took place prior to the actual installation during which members of the research team considered where the external camera might be positioned. Initially they considered putting it on the roof of the house, but eventually settled on attaching it to the balcony. This made it easier for the research team to run cables downstairs to the internal display. Originally the research team had also wanted the monitor window to be placed so that it was oriented in the same direction as the camera and the householders had even cleared space for it. However, as this involved fixing a large mounting bracket to a wall with very visible screws it was decided that it would be easier to place it on a shelf in the dining room instead, even

Fig. 3 The video window: a camera on a pole and a bespoke monitor

though this meant it would now be facing a different way. Over the course of the deployment, maintenance of the Video Window fell to the members of the research team rather than the householders, even though Julia and Ron might have handled some of the troubles themselves.

Something that is core to our interest here is how deployments may come with a propositional grammar that is so utterly embedded in assumptions made, even researchers may take it for granted. Something to note in particular is that this propositional grammar is not just present in the things that are openly articulated. It is also present in what people assume they may or may not do. What I want to do in this section is examine some of the key components of this unexplicated grammar and do some of the work of explicating it. This, in turn, will serve as a basis for some of the lessons it is worth taking away from all of this.

3.2.1 Who Has the Right to Do What?

Something immediately visible in the video window deployment was the sense in which the people in whose home the technology was being deployed were orienting to the whole experience as something that was being done to them, albeit in a relatively positive fashion, rather than something they were having done for themselves. This became visible in a number of different ways.

So, one of the things I noted above was that decisions about the actual placement of the technology were, whilst negotiated with the householders, largely driven by the concerns of the research team. A comment we made at the time was that, even if people have not decided where they going to put technology they have purchased for themselves when it first comes through the door, the routine assumption is that

it will fall to them to make decisions about where they are going to put it, not some external party.

The following conversation between the research team (Terry, Phil and Natalie) and one of the householders (Julia) demonstrates the ease with which the householder was willing to cede her rights about placement decisions to the research team, and even to go out of her way to facilitate it:

Terry: Shall we decide where we're going to put it?
Phil: Yeah. Erm I …
Natalie: She was expecting it to go here (points at wall in dining room).
Phil: Yeah, actually, it's time we talked to her because – sorry, Julia?
Dave: Julia? Julia?
Julia: What?
Dave: Can Phil just have a word about where they're going to put it? The screen?
Julia: Oh yeah.
Phil: So to mount it on the wall – which is, I know what we discussed, we really have to put this mounting bracket in, which means putting four big screws in the wall. And we thought …
Julia: Yeah, it can go on the shelf.
Phil: It might be less destructive. Either on that shelf or the one up there.
Julia starts to clear items off the shelf.

One cannot imagine people relinquishing their rights regarding the placement of technology they have purchased with anything like the same degree of passivity. What is clear here is that once people orient to a deployment as being about 'doing research', this provides a to-hand account for setting aside any of the usual assumptions that might be made regarding rights and obligations if the installation of the technology was part of an ordinary service-to-client transaction. An issue to be aware of here is that the ease with which people take up this orientation makes visible a strong tension between research deployments and the ways in which they might be seen to be representative of how people appropriate other stuff that they bring into their homes under their own auspices.

3.2.2 What Is It for?

Another feature of how the deployment of the video window was articulated was the absence of any clear directive regarding what the inhabitants might choose to do with it. This was for good reason. The research team wanted the householders to discover their own meanings in the technology. However, it was also clear that the householders wanted to arrive at some kind of account for the purpose of the technology, regardless of any ludic concerns shared by the research team. Here, then, is part of an email that Julia sent to the research team:

> Alec, the camera has swung round so it points more easterly over the gardens (and down a bit I think), rather than straight down to the sea. Does this matter? I had the idea the angle was specially chosen but perhaps not.

Yet, when visitors came to the home, Julia's standard account for it was along the lines of: "it's just for fun, something to enjoy".

What is unusual about all of this in terms of how technology might ordinarily find its way into people's homes and lives is that here it has been incorporated into their environment without them having any clear idea what its real purpose might be or how it might be expected to behave. People do not routinely bring into their homes technologies like this and, once again, the license for them having done so and for living with their uncertainties about its nature is that it is 'something to do with research'.

The issue with such a technology, as we pointed out in our original discussion of the video window, is that, when people orient to deployed technologies as '*devices of research'* rather than ordinary household products, this ensures that their orientation to that deployment is quite distinct from how they would ordinarily orient to new stuff being brought into the home. This, of course, may not be viewed to be a problem, but it does need to be recognised in how people's engagement with the deployment is discussed and analysed.

3.2.3 Who Owns the Technology?

A third issue of note here is how grammar of deployment can impact on orientations to ownership. Ownership is not just about possession, it's about who is responsible for maintaining and fixing things when troubles arise. One of the striking things about the video window deployment was the way in which the household members *set aside* any sense of responsibility for keeping the technology in good working order, beyond notifying the research team that there were problems.

This setting aside appeared to be grounded once again in the orientation the householders had towards the equipment being part of a research exercise. As a matter of local reasoning, the basis upon which the technology was being accommodated in their house was as a 'test' or a 'trial', but there was no sense in which they understood the technology to be their own. As we commented at the time:

> They have not gone out and chosen and bought it. There is no manufacturer manual and no informal network of support from others with similar appliances. Someone else who is presumed to know everything necessary about it has brought it into their home and if it breaks there are important ways in which it is 'not their problem'. (Tolmie and Crabtree 2008)

This being the case, maintaining and fixing the technology took on a particular set of nuances that would be alien to the upkeep of something they considered to be their own.

So, one thing that happened was that, when troubles arose, the householders apologized to the research team for 'bothering' them when they made contact. Julia elaborated on this at the time by saying:

> It's just annoying 'cause I mean, you know, you have to ring somebody up. I feel I'm annoying you lot and then you have to come round, so I have to be there, so - I mean, you know, it's a bit of a pain.

A further dimension to this, visible in the remarks above, is that notifying and being around to help the research team with fixing the technology is oriented to as a *favour* to them, not as a means of upholding one's contractual rights. As is demonstrated by the following comment from one of the research team to Ron, it was clear that this orientation was also something shared by the research team themselves:

> No but seriously you are free to say – you're very free to say "look it's not working, we're not enjoying it, take it out".

The question of whose job it was to fix the technology brings the whole question of ownership particularly to the fore. There was a recurrent problem where the display would indicate that it was not receiving any signal from the camera. It was upon this topic that Ron made their orientation to the deployment especially explicit:

> I mean if it was mine and I kept getting the no signal thing I suppose I might get a bit frustrated and worried about that. But I knew, as I said, that it was a kind of improvised set up and actually not mine, you know, not my responsibility to fix it, so I didn't mind that.

This hands-off attitude and detachment from the operability of the Video Window once again underscores how the householders viewed the deployment as something that was 'being done to them' and in which there was therefore no need for them to get actively involved.

3.2.4 Making It Remarkable

As we mentioned at the beginning of this section and in Sect. 2.2.1 above, there is an important sense in which the researchers deploying the video window wanted it to be engaged with as something notable and remarkable and provocative of discussion on those grounds. This was at least a part of the rationale underlying the research team's resistance to pre-specifying what it might be used for. Perhaps the most important test of how successfully the propositional grammar of the deployment worked in this case, then, is the extent to which it was oriented to as something remarkable and worthy of comment.

It is worth noting in relation to this that the householders were encouraged to keep a diary. The strangeness of this as a practice is illuminating. Here is what Ron had to say on the matter:

> I mean, what I like I suppose, when you live with something like this and it's here all the time, what I like is the routineness of it - I like to see the trees move, I like to see the vegetation - you know, the kind of things that I'd otherwise be standing at the kitchen window watching. Or you know, watching from upstairs. But I mean, that's the sort of satisfaction of it for me. Which is not erm – I mean it is worth recording but you'd only record it once, you know what I mean, it doesn't, it isn't something that changes day by day.

What this emphasises is the way in which the workings of things in people's homes are, as a matter of course considered unremarkable and 'unworthy of report'. This being the case, the very pursuit of such record-keeping practices would appear to make the technology and its behaviour remarkable and anything other than just

another part of the home. However, what is being oriented to as remarkable and challenging here is not the technology itself, but rather the practice of creating a record about it, so it's the business of research that is being reasoned about in these terms. The following remark is especially telling in that case:

Dave: Do you find yourself talking about it much with Julia?
Ron: Erm, we talk about it. We talk about it to other people.

Thus, what the deployment and research strategy actually provoked here is that both Julia and Ron were engaged in formulating accounts that might render a putatively alien technology ordinarily *remarkable to other people*, researchers included. But what of themselves?

4 Making One's Way in the Wild

One of the things that will have become apparent over the course of this chapter is the sheer variety of ways in which researchers might go about deploying technology in the wild. And clearly there are almost as many ways of orienting to those deployments and what they are trying to accomplish. Something I have strongly indicated is the extent to which those orientations might be fateful for how the actual deployment unfolds. This, of course, is not really news. Many researchers who have engaged in the practical deployment of technology have experienced the full force of this observation. Something I have also pointed to is the importance of recognising that the users of the technology will bring their own orientations to bear. This is, of course, familiar to many as well. However, the scope for user orientations to differ from researcher orientations is wide and, as a consequence, so is the scope for these orientations to be actively at odds, as I have shown in the worked through examples. Most particularly, there are issues to contend with at the level in which a deployment is oriented to as having a propositional 'grammatical'.

However, the propositional grammar attached to a deployment trades upon local understandings and local accountabilities that are not always reflected upon when a deployment is conceived of and pursued. Thus, it can be that, whilst the accounts given and organisation of a deployment might seem to propose unproblematically how it should be reasoned about, very different orientations to a deployment might unfold.

So, we saw how a misunderstanding about what 'invisibility in use' might amount to in practice could, in principle, lead to deployments where the technologies are anything but invisible for the inhabitants of the environments where they are deployed. We also saw that it is extremely easy to invite an orientation to a deployment as being about research, which has a whole set of concomitant grammatical outcomes that can undermine other things the research is trying to accomplish.

In short, designers may orient to where they are deploying a technology as being 'in the wild', but those who are engaging with a deployment don't understand themselves to be in the wild. They are in their homes, their offices, on the street, in the bus, or

whatever, with all of the ordinary and routine practices that inhabit such settings being in play. However, if you were to invite them to a laboratory to undertake a series of experiments under conditions they have no prior understanding of, or certainty about what expectations to bring to bear, then they might well start to feel they were venturing into the wild.

Acknowledgements The research reported in this chapter was originally funded by the EPRSC *Equator IRC*, www.equator.ac.uk and the EC's Disappearing Computing programme, IST FET 2000 26,360, as part of the project MIME (Multiple Intimate Media Environments). My thanks also go to my original co-authors for the papers this chapter is built upon: Andy Crabtree, James Pycock, Tim Diggins, Allan Maclean and Alain Karsenty. Additional thanks to Jon O'Brien, Graham Button, Marge Eldridge, Bill Gaver, Geraldine Fitzpatrick and Mark Stringer. My thanks most especially to Alan Chamberlain for his remarkable forbearance.

References

Abowd, G. D., Atkeson, C. G., Bobick, A. F., Essa, I. A., MacIntyre, B., Mynatt, E. D., & Starner, T. E. (2000). Living laboratories: The future computing environments group at the Georgia Institute of Technology. In *Conference on Human Factors in Computing Systems (CHI 2000)*, The Hague, Netherlands, April 1–6, 2000.

Aune, M. (1996). The computer in everyday life: Patterns of domestication of a new technology. *Making Technology Our Own, 1996,* 91–120.

Balka, E., & Wagner, I. (2006). Making things work: Dimensions of configurability as appropriation work. In *Proceedings of CSCW'06* (pp. 229–238). ACM.

Balog, K., Kelly, L., & Schuth, A. (2014). Head first: Living labs for ad-hoc search evaluation. In *Proceedings of the 23rd ACM International Conference on Conference on Information and Knowledge Management* (pp. 1815–1818). ACM.

Bardram, J. E., & Bossen, C. (2005). Mobility work: The spatial dimension of collaboration at a hospital. *Journal of Computer Supported Cooperative Work, 14*, 131–160.

Bauer, J., & Kenton, J. (2005). Toward technology integration in the schools: Why it isn't happening. *Journal of Technology and Teacher Education, 13*(4), 519.

Benford, S., Giannachi, G., Koleva, B., & Rodden, T. (2009). From interaction to trajectories: Designing coherent journeys through user experiences. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 709–718). ACM.

Benford, S., Greenhalgh, C., Giannachi, G., Walker, B., Marshall, J., & Rodden, T. (2012). Uncomfortable interactions. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'12)*, May 2012, ACM, Austin, Texas.

Benford, S., Greenhalgh, C., Giannachi, G., Walker, B., Marshall, J., & Rodden, T. (2013). Uncomfortable user experience. *Communications of the ACM, 56*(9), 66–73.

Bergvall-Kåreborn, B., Holst, M., & Ståhlbröst, A. (2009). Concept design with a living lab approach. In *Proceedings of Hawaii International Conference on Systems Science (HICSS'42)*, Big Island, Hawaii, January 5–8, 2009.

Berker, T., Hartmann, M., & Punie, Y. (2005). *Domestication of media and technology*. UK: McGraw-Hill Education.

Blom, J. O., & Monk, A. F. (2003). Theory of personalization of appearance: Why users personalize their pcs and mobile phones. *Human-Computer Interaction, 18*(3), 193–228.

Blythe, M., Overbeeke, K., Monk, A., & Wright, P. (2004). *Funology: From usability to enjoyment*. Dordrecht, The Netherlands: Kluwer.

Blythe, M., Wright, P., Bowers, J., Boucher, A., Jarvis, N., Reynolds, P., & Gaver, B. (2010). Age and experience: Ludic engagement in a residential care setting. In *Proceedings of the 8th ACM Conference on Designing Interactive Systems* (pp. 161–170). ACM.

Bødker, S., & Klokmose, C. N. (2011). The human–artifact model: An activity theoretical approach to artifact ecologies. *Human-Computer Interaction, 26*(4), 315–371.

Bossen, C., & Dalsgaard, P. (2005). Conceptualization and appropriation: The evolving use of a collaborative knowledge management system. In *Proceedings of the 4th Decennial Conference on Critical Computing: Between Sense and Sensibility* (pp. 99–108). ACM.

Brereton, M., Soro, A., Vaisutis, K., & Roe, P. (2015). The messaging kettle: Prototyping connection over a distance between adult children and older parents. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 713–716). ACM.

Carroll, J., Howard, S., Vetere, F., Peck, J., & Murphy, J (2002). Just what do the youth of today want? Technology appropriation by young people. In *Proceedings of the 35th Hawaii International Conference on System Sciences, IEEE*.

Christensen, R. (2002). Effects of technology integration education on the attitudes of teachers and students. *Journal of Research on technology in Education, 34*(4), 411–433.

Cockton, G. (2004). From quality in use to value in the world. In *CHI'04 Extended Abstracts on Human Factors in Computing Systems* (pp. 1287–1290). ACM.

COMIC Deliverable 2.4 (1994). *CSCW Requirements Development*, Esprit Basic Research Project 6225, Lancaster University: Computing Department.

Coulter, J., & Parsons, E. D. (1989). The praxiology of perception: Visual orientations and practical action. *Inquiry, 33,* 251–272.

Crabtree, A. (2004). Design in the absence of practice: Breaching experiments. In *Proceedings of ACM DIS 2004*. Cambridge, MA, USA.

Crabtree, A., Mortier, R., Rodden, T., & Tolmie, P. (2012). Unremarkable networking: The home network as a part of everyday life. In *Proceedings of the Designing Interactive Systems Conference (DIS'12)* (pp. 554–563). New York, NY, USA: ACM.

Decortis, F., & Rizzo, A. (2002, January). New active tools for supporting narrative structures. *Personal Ubiquitous Computer, 6*(5–6), 416–429.

Desjardins, A., & Wakkary, R. (2013). Manifestations of everyday design: Guiding goals and motivations. In *Proceedings of the 9th ACM Conference on Creativity & Cognition* (pp. 253–262). ACM.

Dewey, J. (1934). *Art as experience*. Capricorn.

Dix, A. (2007). Designing for appropriation. In *Proceedings of the British HCI Group Conference* (Vol. 2, pp. 28–30).

Djajadiningrat, J. P., Overbeeke, C. J., & Wensveen, S. A. G. (2000). Augmenting fun and beauty: A Pamphlet. In *Proceedings of DARE'2000* (pp. 131–134). ACM Press.

Dourish, P. (2003). The appropriation of interactive technologies: Some lessons from placeless documents. *Computer Supported Cooperative Work, 12,* 465–490.

Elbaum, S., & Hardojo, M. (2004). An empirical study of profiling strategies for released software and their impact on testing activities. In *ACM SIGSOFT Software Engineering Notes* (Vol. 29(4), pp. 65–75). ACM.

Eriksson, M., Niitamo, V. P., & Kulkki, S. (2005). *State-of-the-art in utilizing Living Labs approach to user-centric ICT innovation-a European approach*. Lulea: Center for Distance-spanning Technology, Sweden, Lulea: Lulea University of Technology.

Eriksson, M., Niitamo, V. P., & Kulkki, S. (2006). Hribernik. State-of-the-art and good practice in the field of living labs. In *Proceedings of the 12th International Conference on Concurrent Enterprising: Innovative Products and Services through Collaborative Networks*, Milan, Italy, June 26–28.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development, 53*(4), 25–39.

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59*(2), 423–435.

Finnigan, S. M., Clear, A. K., Farr-Wharton, G., Ladha, K., & Comber, R. (2017). Augmenting audits: Exploring the role of sensor toolkits in sustainable buildings management. In *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* (Vol. 1(2), p. 10).

Fiore, S., Wright, P., & Edwards, A. (2005). A pragmatist aesthetics approach to the design of a technological artefact. In *Proceedings of the 4th Decennial Conference on Critical Computing: Between Sense and Sensibility* (pp. 129–132). ACM.

Fogarty, J, Forlizzi, J., & Hudson, S. E. (2001). Aesthetic information collages: Generating decorative displays that contain information. In *Proceedings of UIST'01* (pp. 141–150). ACM Press.

Folcher, V. (2003). Appropriating artifacts as instruments: When design-for-use meets design- in-use. *Interacting with Computers, 15*(5), 647–663.

Fortin, C., Neustaedter, C., & Hennessy, K. (2014). The appropriation of a digital speakers corner: Lessons learned from the deployment of mégaphone. In *Proceedings of the 2014 Conference on Designing Interactive Systems* (pp. 955–964). ACM.

Foucault, B., Mentis, H. M., Sengers, P., & Welles, D. (2007). Provoking sociability. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1557–1560). ACM.

Frohlich, D., & Murphy, R. (2000). The memory box. *Personal Technologies, 4*(4), 238–240.

Gabrielli, S., Maimone, R., Marchesoni, M., & Muñoz, J. (2011). BeeParking: An ambient display to induce cooperative parking behavior. In *Proceedings of the 13th International Conference on Multimodal Interfaces* (pp. 295–298). ACM.

Gantt, M. and Nardi, B. A. (1992). Gardeners and Gurus: Patterns of cooperation among CAD users. In *Proceedings of CHI'92* (pp. 107–117). ACM.

Garfinkel, H. (1967). *Studies in ethnomethodology*. Prentice-Hall.

Gaver, W. (2001). Designing for ludic aspects of everyday life. *ERCIM News,* Issue 47. www.ercim.org/publication/Ercim_News/enw47/gaver.html.

Gaver, W. (2005). The video window: My life with a ludic system. In *Proceedings of 3rd International Conference on Appliance Design* (pp. 60–65). Bristol: Springer.

Gaver, W. W., Beaver, J., & Benford, S. (2003). Ambiguity as a resource for design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'03)* (pp. 233–240). ACM.

Gaver, W., Boucher, A., Bowers, J., Blythe, M., Jarvis, N., Cameron, D., et al. (2011). The photostroller: Supporting diverse care home residents in engaging with the world. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1757–1766). ACM.

Gaver, B., Dunne, T., & Pacenti, E. (1999). Design: Cultural probes. *Interactions, 6*(1), 21–29.

Gaver, W., & Martin, H. (2000). Alternatives: Exploring information appliances through conceptual design proposals. In *Proceedings of the 2000 CHI Conference on Human Factors in Computing Systems* (pp. 209–216). The Hague: ACM.

Gaver, W., Michael, M., Kerridge, T., Wilkie, A., Boucher, A., Ovalle, L., & Plummer-Fernandez, M. (2015). Energy babble: Mixing environmentally-oriented internet content to engage community groups. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 1115–1124). ACM.

Gaver, W. et al. (2004). The drift table: Designing for ludic engagement. In *Proceedings of CHI'04* (Design Expo). Vienna: ACM.

Gellersen, H.-W., Beigl, M., & Krull, H (1999). The MediaCup: Awareness technology embedded in a everyday object. In H.-W. Gellersen (Ed.), *Handheld and Ubiquitous Computing, First International Symposium, HUC'99* (pp. 308–310). Karlsruhe, Germany, September 27–29.

Haddon, L. (2003). Domestication and mobile telephony. In J. Katz (Ed.), *Machines that become us: The social context of personal communication technology* (pp. 43–56). New Brunswick, New Jersey: Transaction Publishers.

Halbert, H., & Nathan, L. P. (2015). Designing for discomfort: Supporting critical reflection through interactive tools. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing* (pp. 349–360). ACM.

Hallnäs, L., & Redström, J. (2002, June) From use to presence: On the expressions and aesthetics of everyday computational things. *ACM Transactions on Computer-Human Interaction, 9*(2), 106–124.

Harper, R., Regan, T., & Rouncefield, M. (2006). Taking hold of TV: Learning from the literature. In J. Kjeldskov & J. Paay (Eds.), *Proceedings of the 18th Australia Conference on Computer-Human Interaction: Design: Activities, Artefacts and Environments (OZCHI'06)* (pp. 79–86). New York, NY, USA: ACM.

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education, 41*(4), 393–416.

Hertzum, M., & Simonsen, J. (2010). Effects-driven IT development: An instrument for supporting sustained participatory design. In *Proceedings of the 11th Biennial Participatory Design Conference* (pp. 61–70). ACM.

Heyer, C., & Brereton, M. (2010, August). Design from the everyday: Continuously evolving, embedded exploratory prototypes. In *Proceedings of the 8th ACM Conference on Designing Interactive Systems* (pp. 282–291). ACM.

Holzer, A., Kocher, B., Gillet, D., Bendahan, S., & Fritscher, B. (2015a). DinerRouge: Bringing wealth and income inequality to the table through a provocative UX. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems* (pp. 2187–2192). ACM.

Holzer, A., Vozniuk, A., Govaerts, S., Bloch, H., Benedetto, A., & Gillet, D. (2015b) Uncomfortable yet fun messaging with Chachachat. In *Proceedings of the 2015 Annual Symposium on Computer-Human Interaction in Play* (pp. 547–552). ACM.

Höök, K. (2006). Designing familiar open surfaces. In *Proceedings of NordiCHI 2006* (pp. 242–251). ACM.

Hutchinson, H., Mackay, W., Westerlund, B., Bederson, B. B., Druin, A., Plaisant, C., et al. (2003). Technology probes: Inspiring design for and with families. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 17–24). New York, NY, USA.

Intille, S., Larson, K., Beaudin, J. S., Nawyn, J., Munguia Tapia, E., & Kaushik, P. (2005). A living laboratory for the design and evaluation of ubiquitous computing technologies. In *Conference on Human Factors in Computing Systems, CHI'05 Extended Abstracts on Human Factors in Computing Systems 2005*, Portland, OR, USA, April 02–07.

Iivari, N., & Kuutti, K. (2017, June). Critical design research and information technology: Searching for empowering design. In *Proceedings of the 2017 Conference on Designing Interactive Systems* (pp. 983–993). ACM.

Jones, W., Spool, J., Grudin, J., Bellotti, V., & Czerwinski, M. (2007). Get real!: What's wrong with HCI prototyping and how can we fix it?. In *CHI'07 Extended Abstracts on Human Factors in Computing Systems* (pp. 1913–1916). ACM.

Jung, H., Stolterman, E., Ryan, W., Thompson, T., & Siegel, M. (2008). Toward a framework for ecologies of artifacts: How are digital artifacts interconnected within a personal life? *Proceedings of NordiCHI 2008 Conference on Human–Computer Interaction*. New York, NY: ACM.

Keshav, S. (2013). The challenge of deployment. In *Proceedings of the 2013 ACM MobiCom workshop on Lowest Cost Denominator Networking for Universal Access* (pp. 1–2). ACM.

Kevic, K., Murphy, B., Williams, L., & Beckmann, J. (2017). Characterizing experimentation in continuous deployment: A case study on bing. In *Proceedings of the 39th International Conference on Software Engineering: Software Engineering in Practice Track* (pp. 123–132). IEEE Press.

Khan, A. S., & Kajko-Mattsson, M. (2010). Taxonomy of handover activities. In *Proceedings of the 11th International Conference on Product Focused Software* (pp. 131–134). ACM.

Kim, C. M., Heo, S., Jeong, K. A., & Lim, Y. K. (2016). Formula one: Mobile device supported rapid in-the-wild design and evaluation of interactive prototypes. In *Proceedings of HCI Korea* (pp. 333–338). Hanbit Media, Inc.

Kim, C., Kim, M. K., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education, 29,* 76–85.

Kinch, S., & Højlund, M. K. (2013). Kidkit guides children into alarming atmospheres: Designing for embodied habituation in hospital wards. In *Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces* (pp. 1–10). ACM.

Kirk, D. S., Chatting, D., Yurman, P., & Bichard. J.-A. (2016). Ritual machines I & II: Making technology at home. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI'16)* (pp. 2474–2486). New York, NY, USA: ACM.

Ko, A. J., Lee, M. J., Ferrari, V., Ip, S., & Tran, C. (2011). A case study of post-deployment user feedback triage. In *Proceedings of the 4th International Workshop on Cooperative and Human Aspects of Software Engineering* (pp. 1–8). ACM.

Koenemann-Belliveau, J., Carroll, J. M., Rosson, M. B., & Singley, M. K. (1994). Comparative usability evaluation: Critical incidents and critical threads. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 245–251). ACM.

Lauwers, T., Nourbakhsh, I., & Hamner, E. (2009). CSbots: Design and deployment of a robot designed for the CS1 classroom. In *ACM SIGCSE Bulletin* (Vol. 41(1), pp. 428–432). ACM.

Lee, H. C., Tsai, W. C., Wang, P. H., Liang, R. H., & Hsu, J. (2014). The reflexive printer: Embodying personal memory for social provocation. In *Proceedings of the 2014 Companion Publication on Designing Interactive Systems* (pp. 97–100). ACM.

Lichtner, V., Kounkou, A. P., Dotan, A., Kooken, J. P., & Maiden, N. A. (2009). An online forum as a user diary for remote workplace evaluation of a work-integrated learning system. In *CHI'09 Extended Abstracts on Human Factors in Computing Systems* (pp. 2955–2970). ACM.

Lindquist, S., Westerlund, B., Sundblad, Y., Tobiasson, H., Beaudouin-Lafon, M., & Mackay, W. (2007). Co-designing communication technology with and for families—Methods, experience, results and impact. In N. Streitz, A. Kameas, & I. Mavrommati (Eds.), *The disappearing computer: Interaction design, system infrastructures and applications for smart environments*. Springer.

Luff, P., Adams, G., Bock, W., Drazin, A., Frohlich, D., Heath, C., et al. (2007). Augmented paper: Developing relationships between digital content and paper. In N. Streitz, A. Kameas, & I. Mavrommati (Eds.), *The disappearing computer: Interaction design, system infrastructures and applications for smart environments*. Springer.

Mackay, W. E. (1990). Patterns of sharing customizable software. In *Proceedings of the 1990 ACM Conference on Computer-Supported Cooperative work* (pp. 209–221). ACM.

Maestri, L., & Wakkary, R. (2011). Understanding repair as a creative process of everyday design. In *Proceedings of the 8th ACM Conference on Creativity and Cognition* (pp. 81–90). ACM.

Marshall, P., Morris, R., Rogers, Y., Kreitmayer, S., & Davies, M. (2011). Rethinking 'multi-user': An in-the-wild study of how groups approach a walk-up-and-use tabletop interface. In *Proceedings of CHI'11* (pp. 3033–3042). ACM.

McCarthy, J., & Wright, P. (2004). *Technology as experience*. Cambridge, Massachusetts, USA: MIT Press.

Morrison, A. J., Mitchell, P., & Brereton, M. (2007). The lens of ludic engagement: Evaluating participation in interactive art installations. In *Proceedings of the 15th ACM international conference on Multimedia* (pp. 509–512). ACM.

Morrison, A., Viller, S., & Mitchell, P. (2011). Building sensitising terms to understand free-play in open-ended interactive art environments. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'11)* (pp. 2335–2344). New York, NY, USA.

Müller, M., Otero, N., Alissandrakis, A., & Milrad, M. (2014). Evaluating usage patterns and adoption of an interactive video installation on public displays in school contexts. In *Proceedings of the 13th International Conference on Mobile and Ubiquitous Multimedia* (pp. 160–169). ACM.

Mynatt, E.D., Essa, I., & Rogers, W., (2000). Increasing the opportunities for aging in place. In *Proceedings on the 2000 Conference on Universal Usability* (pp. 65–71). ACM.

Nicolini, D. (2013). *Practice theory, work, & organization: An introduction*. Oxford: Oxford University Press.

O'Brien, J., Rodden, T., Rouncefield, M., & Hughes, J. (1999, September). At home with the technology: An ethnographic study of a set-top-box trial. *ACM Transactions on Computer-Human Interaction, 6*(3), 282–308.

Odom, W., Wakkary, R., Lim, Y. K., Desjardins, A., Hengeveld, B., & Banks, R. (2016). From research prototype to research product. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (pp. 2549–2561). ACM.

Petersen, M. G. (2004). Remarkable computing: The challenge of designing for the home. In *CHI'04 Extended Abstracts on Human Factors in Computing Systems* (pp. 1445–1448). ACM.

Petersen, M. G., Iversen, O. S., Krogh, P. G., & Ludvigsen, M. (2004). Aesthetic interaction: A pragmatist's aesthetics of interactive systems. In *Proceedings of the 5th Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques* (pp. 269–276). ACM.

Philips Research. (2001). http://www.research.philips.com/generalinfo/special/ambintel/index.htm.

Pierson, M. E. (2001). Technology integration practice as a function of pedagogical expertise. *Journal of Research on Computing in Education, 33*(4), 413–430.

Poole, E. S. (2012). Interacting with infrastructure: A case for breaching experiments in home computing research. In *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work* (pp. 759–768). ACM.

Poole, M., & De Sanctis, G. (1990). Understanding the use of group decision support systems: The theory of adaptive structuration. In Faulk & Steinfield (Eds.), *Organizations and communication technology* (pp. 173–193). Newbury Park: Sage.

Rogers, Y. (2011). Interaction design gone wild: Striving for wild theory. *Interact., 18*(4), 58–62.

Rogers, Y. (2012). *HCI theory: Classical*. Morgan Claypool: Modern and Contemporary.

Rogers, Y., & Bellotti, V. (1997, May). Grounding blue-sky research: How can ethnography help? *Interactions, 4*(3), 58–63.

Rosner, D. K., & Ryokai, K. (2009, October). Reflections on craft: Probing the creative process of everyday knitters. In *Proceedings of the Seventh ACM Conference on Creativity and Cognition* (pp. 195–204). ACM.

Rowley, D. E. (1994). Usability testing in the field: Bringing the laboratory to the user. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 252–257). ACM.

Sacks, H. (1992a). A single instance of a phone-call opening; caller-called, etc. *Lectures on Conversation* (G. Jefferson, Ed.), (Lecture 3, Spring 1972, pp. 542–553). Oxford, Blackwell.

Sacks, H. (1992b). *Lectures on conversation* (G. Jefferson, Ed.). Blackwell.

Salovaara, A. (2007). Appropriation of a MMS-based comic creator: From system functionalities to resources for action. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1117–1126). ACM.

Saslis-Lagoudakis, G., Cheverst, K., Dix, A., Fitton, D., & Rouncefield, M. (2006). Hermes@home: Supporting awareness and intimacy between distant family members. In *Proceedings of the 18th Australia Conference on Computer-Human Interaction: Design: Activities, Artefacts and Environments* (pp. 23–30). ACM.

Schutz, A. (1962). *Collected papers I: The problem of social reality* (M. Natanson, Ed.). The Hague: Martinus Nijhoff.

Schwartz, T., Stevens, G., Ramirez, L., & Wulf, V. (2013, May). Uncovering practices of making energy consumption accountable: A phenomenological inquiry. *ACM Transactions on Computer-Human Interaction, 20*(2), Article 12.

Scriven, M. (1967). The methodology of evaluation. In R. E. Stake (Ed.), *Curriculum evaluation*. Chicago: Rand McNally. American Educational Research Association (monograph series on evaluation, no. 1).

Sengers, P., & Gaver, W. W. (2006). Staying open to interpretation: Engaging multiple meanings in design and evaluation. In *Proceedings of Designing Interactive Systems (DIS'06)* (pp. 99–108). ACM.

Silverstone, R., & Haddon, L. (1996). Design and the domestication of information and communication technologies: Technical change and everyday life. *Communication by design: The politics of information and communication technologies* (pp. 44–74). Oxford: OUP.

Sørensen, K. H. (2006). Domestication: The enactment of technology. *Domestication of media and technology* (p. 46).

Soro, A., Brereton, M., & Roe, P. (2016). Towards an analysis framework of technology habituation by older users. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems* (pp. 1021–1033). ACM.

Soute, I., Lagerström, S., & Markopoulos, P. (2013). Rapid prototyping of outdoor games for children in an iterative design process. In *Proceedings of the 12th International Conference on Interaction Design and Children* (pp. 74–83). ACM.

Stein, M., Meurer, J., Boden, A., & Wulf, V. (2017). Mobility in later life: Appropriation of an integrated transportation platform. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (pp. 5716–5729). ACM.

Streitz, N. A., Geißler, J., & Holmer, T. (1998). Roomware for cooperative buildings: Integrated design of architectural spaces and information spaces. *Cooperative buildings: Integrating information, organization, and architecture* (pp. 4–21). Berlin, Heidelberg: Springer.

Streitz, N., Kameas, A., & Mavrommati, I. (Eds.) (2007a). *The disappearing computer: Interaction design, system infrastructures and applications for smart environments*. Springer.

Streitz, N., Prante, T., Röcker, C., van Alphen, D., Stenzel, R., Magerkurth, C., et al. (2007b). Smart artefacts as affordances for awareness in distributed teams. In N. Streitz, A. Kameas, & I. Mavrommati (Eds.), *The disappearing computer: Interaction design, system infrastructures and applications for smart environments*. Springer.

Sung, J., Grinter, R. E., & Christensen, H. I. (2009). Pimp My Roomba: Designing for personalization. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 193–196). ACM.

Svensson, J., & C. Ihlström Eriksson. (2009). Open innovations in small enterprises—A living lab approach. In *Proceedings of ISPIM 2009*, Vienna, Austria, June 21–24.

Taylor, J. L., Soro, A., Roe, P., Lee Hong, A., & Brereton, M. (2017). Situational when: Designing for time across cultures. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (pp. 6461–6474). ACM.

Tchounikine, P. (2017). Designing for appropriation: A theoretical account. *Human–Computer Interaction*, *32*(4), 155–195.

Tolmie, P. (2011). Uncovering the Unremarkable. In M. H. Szymanski & J. Whalen (Eds.), *Making work visible: Ethnographically grounded case studies of work practice* (pp. 53–73). Cambridge: Cambridge University Press.

Tolmie, P., & Crabtree, A. (2008). Deploying research technology in the home. In *Proceedings of the ACM Conference on Computer Supported Cooperative Work* (pp. 639–648), San Diego, November 2008. ACM.

Tolmie, P., Crabtree, A., Rodden, T., & Benford, S. (2008). Are you watching this film or what? Interruption and the juggling of cohorts. In *Proceedings of the 2008 ACM Conference on Computer Supported Cooperative Work* (pp. 257–266). ACM.

Tolmie, P., Crabtree, A, Akakpo, M., & Rouncefield, M. (2013). *Mapping the domestic digital economy, findings from ethnographic studies of domestic settings, report 1: An overview of the use of digital services in the home*. Horizon Digital Economy Research, The University of Nottingham.

Tolmie, P., Pycock, J., Diggins, T., Maclean, A., & Karsenty, A. (2002). Unremarkable computing. In *Proceedings of the 2002 Conference on Human Factors in Computing Systems* (pp. 399–406). Minneapolis: ACM Press.

Trigg, R. H., & Bødker, S. (1994). From implementation to design: Tailoring and the emergence of systematization in CSCW. In *Proceedings of the 1994 ACM Conference on Computer Supported Cooperative Work* (pp. 45–54). ACM.

Unkelos-Shpigel, N., & Hadar, I. (2013). Mind the gap and find common ground: Empirical research in multiple firms. In *Proceedings of the 1st International Workshop on Conducting Empirical Studies in Industry* (pp. 33–36). IEEE Press.

Ventä-Olkkonen, L., Iivari, N., & Kuutti, K. (2017). Digital technologies in everyday environments: Zooming in and out to children's and their families' smart device practices with public and private screens. In *Proceedings of the European Conference on Cognitive Ergonomics 2017* (pp. 129–136). ACM.

von Hippel, E. (2005). *Democratizing innovation*. Boston: MIT Press.

Wakkary, R., & Tanenbaum, K. (2009). A sustainable identity: The creativity of an everyday designer. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 365–374). ACM.

Weiser, M. (1991). The computer for the 21st century. *Scientific American, 265*(3), 94–104.

Weiser, M. (1994). The world is not a desktop. *ACM Interactions*, 7–8 January 1994.

Weiser, M., & Brown, J. S. (1996, July). Designing calm technology. *PowerGrid Journal,* v1.01. http://powergrid.electriciti.com/1.01.

Wouters, N., Huyghe, J., & Moere, A. V. (2014). StreetTalk: Participative design of situated public displays for urban neighborhood interaction. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational* (pp. 747–756). ACM.

Wulf, V., Rohde, M., Pipek, V., & Stevens, G. (2011). Engaging with practices: Design case studies as a research framework in CSCW. In *Proceedings of the ACM 2011 conference on Computer supported cooperative work* (pp. 505–512). ACM.