Chapter 8
Design Research: Methodological Innovation Through Messiness

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Abstract The third wave of Human Computer Interaction (HCI) involves more ubiquitous and embedded forms of computing. Making these useful, usable and even delightful for people needs design research. The more technologies become enmeshed in our lives and the more dependent upon them we become, the more essential it is that they are simple for everyone to use and they do not let us down in those annoying ways we have become used to tolerating. Embedding computing into more and more of the objects and environments we interact with makes them less visible but more ubiquitous, making their usability essential but challenging at the same time. Design research is a mechanism which can help researchers, programmers and designers to understand how to create better twenty-first century computing systems and environments. This chapter discusses how design research can contribute to allowing third wave HCI to benefit the lives of all citizens rather than frustrate them.

8.1 Design Research

The third wave of Human Computer Interaction (HCI) involves more ubiquitous and embedded forms of computing. Making these useful, usable and even delightful for people needs design research. The more technologies become enmeshed in our lives and the more dependent upon them we become, the more essential it is that they are simple for everyone to use and they do not let us down in those annoying ways we have become used to tolerating. Imagine that you cannot enter your smart home because you mistyped the password too many times and now you are literally locked out, or your Google Home device does not understand your accent, leading to a constant battle to communicate with your own light switches and power sockets that was never an issue for previous generations. Embedding computing into more
and more of the objects and environments we interact with makes them less visible but more ubiquitous, making their usability essential but challenging at the same time.

This chapter discusses how design research can contribute to allowing third wave HCI to benefit the lives of all citizens rather than frustrate them. Design research is a mechanism which can help researchers, programmers and designers to understand how to create better twenty-first century computing systems and environments. This has been acknowledged in the field of Information Systems (IS), where there has been increasing focus on design in IS research (Gregor 2006) and IS has been seen as partially a “design science” (Hevner et al. 2004: 76). Let us be clear, by design research we do not mean design practice, which happens in many disciplines from fashion to architecture to user experience (UX) and beyond, and generally is about generating solutions to defined briefs or problems. By design research we mean work intended to produce new knowledge, which should benefit designers by generating new ways to use and apply technologies, providing information about users and their opinions, activities and interactions with the world and the technologies surrounding them, and developing frameworks and exemplars to be used to design in better ways.

Design research has been around as a discipline since not long after World War 2, and has a somewhat controversial background in terms of how it is defined and what is included as design research as well as what it should focus on. A good history which spells out the transition from “design science” to “design methods” to “design research” and beyond is provided by Bayazit (2004). However, more useful for our purposes is to understand how design research can contribute to HCI. Frayling (1993) split design research, by then a maturing field, into the three categories of research by/through design, research into design and research for design. Here we will briefly discuss these distinctions as we believe they are useful for explaining how design research contributes to HCI (and other disciplines).

Research for design is research (generally using various other research methods, although it could also utilise a design process) that contributes to the design field, and the knowledge that designers can use to make better designs. Much Human Factors and HCI research actually falls into this category, as does a lot of design research which is focussed in these areas, including many of the examples we will discuss in this chapter.

Research by or through design means research which uses a design process or elements of design methods to generate new knowledge. There has been a substantial amount of debate into whether design practice can be research and where the dividing line between the two is (see for a good overview Durling and Niedderer (2007)). From our perspective, although the debate is still regenerated at times, it has been substantially resolved due to the forced clarity of thinking about what elements of designing constitute research which has been brought into being by the imposition of research assessment exercises in the university sector. For example, the Australian ERA (Excellence in Research Australia) has forced universities and research institutions to define what outputs by design academics (and other creatives such as visual artists, creative writers and film-makers) can be defined as
research and what cannot. To do this the concept of research which is generally applied to a PhD has been applied – does it generate new knowledge which is accessible for others to apply and use? Design can thus be a research method used to generate knowledge about technologies, users, systems, or designing itself, or it can be a process used to generate a new product, interface, building, system, etc. If the knowledge generated through this process is new and can be shown to make a unique contribution, it is research. If it simply addresses a design brief and produces a new or re-designed product or interface without making a unique contribution to knowledge, it is not.

Research into design continues to follow on from the work on design science and design methods in understanding what designing is and how it is done. Recently this has also included what Cross has termed “designerly ways of knowing” (Cross 2006). Research into design is less relevant for this chapter, although these decades of work into what is special about designing and how designers can contribute to making things, systems, decisions and more has helped to create understanding about the field. This body of work may have contributed to the fairly widespread acceptance of “design thinking” in all sorts of fields in recent years, as well as the understanding that design research can contribute to HCI and other fields.

Thus, despite the controversy around Fielding’s categories, in general researchers have continued to conduct research and build the field in all three areas. In this chapter, we will discuss design research which relates to HCI and this overwhelmingly falls into the categories for design and by/through design. Before describing specific examples in these two categories, we will discuss an issue that applies to much of design research – messiness.

8.2 The Messiness of Design Research

Design research puts people first, not technology. Good design research is about understanding people in relation to their use of technologies, not the other way around. Introduction of design research methods to HCI has over time resulted in new models of collaboration between design researchers and HCI researchers, with one recurring message that design research as a creative methodology is inherently messy. A unique contribution design research has made to HCI is in development of new methods and approaches, which are not used elsewhere (Forlizzi et al. 2008:20), although design researchers often use established methods, too, as we discuss below. Design research brings with it processes and methods that span quantitative methods, traditional social sciences and visual research. Such transdisciplinary design research projects often struggle to strike a balance between rigid, structured and systematic approaches to research and the inherently open, unstructured, and intuitive methods that characterise design practice and which are necessary to engage with, capture and represent the complex spectrum of the human experience needed in human-centred design. In this, design research can be said to make the research process ‘messy’. While messiness creates a number of challenges in the
process and outcomes associated with design research, these arguably could be framed as constraints or as opportunities to explore a novel direction or application.

Forlizzi et al. have developed a model that evaluates the contribution of design research to HCI against four criteria, including Process, Innovation, Relevance and Extensibility (2008:22). Importantly, Forlizzi et al. have argued for the value of design research in HCI not on the grounds of proximity to scientific validity and precision in measuring the usability of the final design but on the basis of its opposite. That is, rather than made replicable, the design process is made explicit and design decisions understandable; rather than made measurable, outcomes are made accessible and relevant. While their model is a useful step towards a value proposition for design research in HCI, it does not yet fully respond to the contribution design research makes to the research and integration of human experience with the research and design process, across research by/through and for design.

Understanding and authentically representing human experience for the purposes of designing better systems, products and experiences – the core aim of design research – relies on researchers’ ability to identify the right mix of methods to aid in understanding non-verbal, interpretative and intuitive subjective experiences of people. Such an approach prioritises people in the research process by developing an understanding of people and human experience, beyond the frame of “user”. In doing so it aims to understand, access and represent the complexity of the human experience in a more holistic way, something Glaccardi and Karana have termed a situational whole (2015). Such an approach, while adding to the representational complexity, has been agued to provide a necessary “counterpoint to the reductionist approach favoured by the scientists and engineers.” (Forlizzi et al. 2008:19).

In the context of technology design and technology use, consideration of human experience helps facilitate a shift towards understanding technology itself as experience (McCarthy and Wright 2005). Conducting research in a more holistic way, by drawing methodological approaches from design practice as well as using more established methods commonly employed in other disciplines, adds multiple levels of complexity to the research process. This brings with it degrees of ambiguity and subjectivity that are difficult to rationalise within a scientific research paradigm, yet form critical elements of design practice. It is this messiness that necessitates a critical engagement with questions such as the role of the researcher, knowledge, evaluation and validation of outputs, and ultimately questions of what constitutes rigour in an essentially non-scientific approach.

Design research is comfortable with uncertainty. It opens up the research process to new possibilities but creates an indeterminability of the final output. The design process is a journey into the unknown and design researchers are comfortable with navigating that journey – e.g. starting it without knowing for sure where it will end or what the stops along the way will be. In other words, design researchers can deal with messiness and even see it as a necessary part of the process of understanding people, their needs and how to best meet them. Messiness allows more potential solutions to problems if you dare to go where it is potentially uncomfortable, appears disorganised and chaotic but is full of rich information. People are complex
and their experiences are ‘messy’ in nature; this means that understanding people’s experiences is full of complex interdependencies. In addition, constant change in how technology affects everyday life has an important impact on how people understand products, systems, interfaces, places, technologies, and environments. People’s experiences are constantly being redefined and challenged every time a new technology is implemented in their daily lives. The focus on people as the ‘experts on their experiences’ (Visser et al. 2005) has taken central stage in many of the design methods aiming at knowledge development, idea generation and concept development (Sanders and Stappers 2012: 23). For design research, the benefits of messiness can be manifest by attending to a number methodological concerns. First, the re-negotiation of the relationship between structured and uncertain open-ended methods provides a way of framing messiness within the design of a study. Second, there is a need to foreground and question the role of expertise and expert knowledge, to establish an epistemological perspective. Finally, focusing on meaning-making/Generating generates new frames of reference and can unsettle existing structures and the predictable outcomes.

8.2.1 Messiness and Structure

Experience is by definition pre-linguistic, and generally unstructured. It is through sense-making, which may involve feelings, expression and cognition, that we give experience structure and form (McCarthy and Wright 2005). Experience is thus highly subjective, contextual and ambiguous. Looking at this from the lens of the irreducibility of the human experience (McCarthy and Wright 2005:267), it could be said that more traditional HCI methods, based in science and focusing on quantifiable measures of effectiveness, are limited in scope to undertake research outside the fixed parameters of science and engineering methods. On the other hand, the subjectivity of the human experience leads to greater ambiguity, which in turn creates messiness by unsettling existing structures. Meaning, or sense-making, when framed within the constructivist approaches as an individual’s ability to make sense of ambiguous situations, reframes existing structures, constructs or models as a given, or as “natural”; yet they are often emergent and are a result of sense-making or resolving an otherwise ambiguous situation as understandable. The absence of an apparent structure in much design research leaves more room within the research process for accommodating fluidity and multiplicity of representational possibilities. Additionally, open-ended processes are often messy and they lead to an indeterminable output (Zelenko 2012).

There are, however, advantages to intentionally unsettling structural coherence in order to generate new possibilities outside established design conventions and in favour of greater ‘in-situ’ responsiveness to participant response. Indeed, reliance on pre-existing frameworks comes at the cost of a creative response, which, by definition, falls outside of a predetermined structure. In the context of technology and interface design, such an approach limits the emergence of unintended findings:
“Defaulting to design conventions in an attempt to guarantee technology uptake shuts down any unintended uses, resulting also in the negative framing of interaction outside an established structure as erroneous rather than intentional” (Zelenko 2012: 100). To remove constraints is to challenge predetermined processes and open them up to renegotiation.

8.2.2 Expertise

Opening research processes to greater input from participants – including where such contribution may lead to a redesign of a research artefact – opens the role of research expertise and expert knowledge up to re-negotiation. Open processes have the potential to, on the one hand, create opportunities for shared control over the resulting outputs and, on the other, a struggle for control over the process as it is unfolding. Necessarily, knowledge of researchers and participants are curated to be interwoven, as is the case in co-design and joint analysis techniques. Where the research methods are centred on the core of human experience and where participants are the sources of this experience, they enter a position of greater knowledge over most effective method for their sense-making of that experience. This involves new ways of articulating, representing and communicating their experience to researchers, adapting research artefacts where needed. At one end of the spectrum, the expertise of participants may be accessed but applied by designers (e.g. experiments, interviews or observational studies), but at the other, participants in participatory design may contribute their ideas and expertise throughout the research and design process.

8.2.3 Sense-Making and Meaning-Making

In general meaning-making can be understood as the process by which we use language and form to give expression to experience and to create self-awareness. In this paper we refer to meaning-making as that part of experience which requires sense-making and understanding in order to engage with the world meaningfully. This involves extending design of research processes that consider specificity of one’s local context or situation, promoting a high degree of responsiveness to a unique individual experience or life circumstance. The term sense-making has been used in multiple fields from organisation studies (Weick 1995) to HCI (Russell et al. 2009). McCarthy and Wright (2005) have argued for linking sense-making, subjectivity and agency with HCI). This suggests the importance of research methods that foreground the experience of the “user” – and thus recognise the limits of existing structures, conventions and practices associated with questions of usability with a predictable unambiguous process and outcome.
Sense-making is described as a metacognitive process by which we construct narratives to understand ambiguous, new or unrecognised experiences. It is these stories, expressions, of experience that open-ended (unstructured) design methods aim to illicit, without imposing the worldviews or frames of reference of the researcher. Thus, outputs from design research are highly contingent upon the individual subjective experience of the participants. The following case studies and examples each explore the role of messiness within design research. Each contains questions about how structure, expert knowledge and sense-making are addressed and influence research methodologies.

8.3 Examples of Methodologies and Approaches Used in Design Research

This section contains case studies and examples of design research used in a variety of design research projects, both for and through design, by the authors and others. The section is arranged to firstly cover a range research for design examples before moving onto examples and a larger case study of research by/through design. These examples are intended to illustrate how design research can contribute to HCI and also to compare the various approaches. Design research approaches employed to understand people’s needs and experiences has been catalogued and categorised in various ways (Kumar 2012; Sanders and Stappers 2012). Sanders and Stappers (2012) map out several methods and cluster them into four different dimensions: Design-led (e.g. design process) and Research-led (e.g. Usability, Contextual Enquiry); Expert (e.g. user centred design) and Participatory (e.g. generative tools) mindsets. Different methods are positioned into each of these different dimensions.

Participatory design methods and generative research focus on facilitating people in taking part in a design process while eliciting insights and ideas on a given situation (research through design). On the other hand, the methods that have been developed the longest and used the most in HCI include methods also used in applied psychology, anthropology, sociology, and engineering. These methods are the ones that we describe here as research for design, and which focus on contributing to knowledge while helping designers design products that better meet the needs of users. Although some methods we include as part of design research (such as experiments, interviews, observations, etc.) are also used widely in social and physical sciences, design researchers generally approach them quite differently. For example, experiments are generally designed based on research questions rather than hypotheses, and analysis (such as coding of audio and/or visual data) is often based on coding schemes that grow out of the data itself (commonly in conjunction with established literature), rather than categories decided a-priori, as would be more usual in hard sciences, psychology or some traditional HCI experiments.
8.3.1 Research for Design Methods

Research for design methods often follow a reasonably traditional approach to data collection, analysis and interpretation of findings, with a view to developing principles that can then be applied to interfaces, products and services. Methods for data collection involve – but are not restricted to – verbal protocols, observations, interviews, cognitive analysis, usability testing, applied ethnography, visual representation of concepts, contextual enquiry, among others. These methods can be experiment-based or ethnography-based, in the field or in a lab, and are generally guided by research questions (although some experiment-based studies may occasionally use hypotheses instead of research questions). The rigor of the methods relies on triangulation of research methods, replicability of methodology, and/or generalisation of findings.

In experiment-based research methods, the researcher is the expert and translates the data collected from users into interpretations or findings, in the process tidying some of the inherent messiness present in the typically rich and noisy data set. To this end, researchers are assisted with a variety of tools and methods, such as thematic coding analysis, visual and observational analysis, and the use of specialised software (such as Noldus Observer to code video-recorded observations, or ATLAS.ti to code still images and text). In ethnography-based research methods, the researcher can sometimes adopt the role of participant observer and immerse themselves in the research context. Ethnographic methods, such as participant observation, field work and oral histories are commonly combined with qualitative research approaches such as semi-structured interviews, oral histories, and document analysis. Often a Grounded Theory approach, with the use of software for thematic or content analysis, is employed to assist the data analysis process.

Experiment-based design research methods follow a rigorous scientific method-like approach where findings can help inform evidence-based decision making in the design process, can be critically evaluated, and can provide a platform from which to add to the existing base of knowledge or to support an innovation. An example of this approach is Evidence Based Design (EBD), which has been applied to healthcare Design Research and more specifically to environmental design research in healthcare settings (Zborowsky and Bunker-Hellmich 2010). Here, the messy nature of the design research problem was identified as human errors leading to reduced patient safety in healthcare facilities, errors involving medical professionals, the patients, the health care processes, social interactions, and the facilities. A complex matrix of problems led to architects, designers and the medical community engaging in collaborative research work that aimed to deliver theory that contributes to inform decision making towards design interventions as well as theoretical frameworks to inform best practice in the design of healthcare facilities.

Observation-based methods are very common across much of Design Research, as observation is such a valuable tool when seeking to understand people’s activities and their use of all sorts of designed objects, environments and services. Hence we have used observation across many projects, both research *through* and *for* design.
However, we need to position observation in terms of what relationship it might have with frameworks such as ethnography, as observation is often strongly linked with ethnography. Ethnography is a research methodology that has its roots in the anthropological study of non-western cultures (Lazar et al. 2017). Borrowed from the social sciences, ethnomethodology, an ethnographic fieldwork-based research approach, has been employed in the context of HCI and Design Research to understand peoples’ behaviour and culture (peoples’ practices, feelings, and experiences) and their interactions with the designed world in the context of their everyday lives (Button 2003). The use of ethnomethodology in HCI has been traced back to Xerox PARC in the early 1980s, when computers moved from laboratory settings to everyday people’s contexts (Blomberg et al. 2009) and developers needed to understand users’ requirements. This research approach has developed further and intersects with Participatory Design, Action research, and Generative Design Research, initially described as Critical Design (Plowman 2003). It may also involve an empowerment research agenda, where participatory action research undertakes a critical stance where the researchers’ ultimate goal is to facilitate or support collaborative social change (Barab et al. 2004).

Showcasing different methods that aim to contribute with research for design (knowledge that designers can use to make better designs), there follow four exemplars of design research studies that have employed these kinds of research approaches. Here we discuss the methods employed, the messy nature of the research problem, and the outcomes.

Example 1: Understanding human experience through visual representation of concepts

To support designers’ engagement with users’ experience as an essential component of the design process, a study was conducted to investigate the influence of human experience on users’ and designers’ differing concepts of products (Chamorro-Koc et al. 2008). Human experience is a complex fabric of elements that comprises many different factors in a person’s life, including episodic and tacit knowledge, knowledge from seeing and doing, emotions, memories, etc. Thematic coding of people’s visual representations of concepts, alongside the transcribed verbal protocols of the sessions, was employed to uncover the experiential and contextual component of people’s understanding of product use. Individual sessions were conducted with designers and non-designers who were asked to draw their idea of everyday products as a process undertaken to reveal concepts emerging from visuals and to identify emerging relationships between people’s individual experience and their understanding of a product’s use. Retrospective interviews were employed immediately after participants finished the drawing task to gather their explanation of the concepts in the drawing. Figure 8.1 shows exemplars from visual representations of a user’s (left) and a designer’s (right) concepts of a blender. Here it can be seen that the user’s drawing shows several features of a blender described by name, and also that the user has provided some more explanation of what the product and its parts are. In this study it was inferred from the verbal protocol that the user drew a blender she probably owns or uses. Differently, the designer’s drawing shows
three different blenders, and names and functionality of their different parts. His drawings suggest attributes such as soft grips; moreover, drawings show the relationships between the parts. It seems that the designer knew details of this type of product and drew features from memory, but his drawings do not reveal experience of using one particular product but experience of designing similar products.

The approach to the use of visual representations together with retrospective interviews in this study, and the use of a thematic analysis, led to understanding of elements from peoples’ experiential knowledge. Based on the evidence of relationships identified between peoples’ experiences and their understanding of a product’s use, the interpretation of findings converted those causal relationships into design principles to assist the design of product usability by informing designers about the specific aspects of human experience that trigger people’s understanding of products and product usage.

Example 2: Intuitive interaction research

Design research conducted by Blackler and colleagues (Blackler and Popovic, 2015a, b; Blackler et al. 2010) has established a definition of intuitive interaction and built theory around it through a series of experiments. Initial studies comprised experiments to establish an understanding of what intuitive use is by using observation of people with different levels of age and experience using various actual interfaces and products. Experiments were designed and carefully controlled to allow for rigorous statistical analysis so that we could confidently state what contributes to intuitive use and whether differences exist between various groups. Over 18 years of research into intuitive interaction by various researchers on four different continents using a variety of products, interfaces and experiment designs has shown that prior experience is the leading contributor to intuitive interaction (Blackler et al. 2010; Fischer et al. 2014; Hurtienne and Blessing 2007; Hurtienne and Israel 2007; Mohs et al. 2006; O’Brien et al. 2008). Almost all of this work has been conducted using fairly quantitative methods – experiments which compare different groups of people or interfaces for levels of intuitive use, analysed using standard statistical
methods – but including methods such as observation (video-recorded and coded), verbal protocols and scenario setting (where participants are given a fictional scenario within which they complete set tasks with products or interfaces, be they actual products or prototypes). Figure 8.2 shows a typical lab set-up for such experiments. In these experiments, variables such as the time and/or number of steps required for optimal completion of the tasks, number of correct uses and intuitive uses were calculated and compared.

In the case of the intuitive interaction work worldwide, use of quantitative analysis is common. It has led to results that help us to understand the complex fabric of people’s past experience and how it influences their familiarity with products and interfaces and the way they intuitively interact with them. This is now informing designers’ practice in a classic research for design scenario. Although this is probably the least messy example given here, it was still approached with a greater level of uncertainty than many other classically-designed experiments. At the start we did not know what we would find and included various potential variables in the design of earlier experiments so that we could investigate several possible options for what was causing the phenomena.

Research through design has also been used as part of this work in order to test the use of tools developed to improve intuitive interaction. Designers or researchers designed new interfaces using the tools developed based on previous experiments, and then used further experiments to test whether the new interfaces were any more intuitive (e.g. Blackler et al. 2014; Fischer et al. 2015; Hurtienne et al. 2015). Results from these experiments have suggested that implementing tools intended to assist in design of intuitive interfaces can lead to significantly more correct, intuitive uses and significantly higher familiarity scores as well as increased user satisfaction or perception of intuitiveness.

Example 3: Novice and expert use of specialised knowledge in security related tasks

For the regular passenger or visitor at airports, security screening is an ordinary and routine task. However, there is a multitude of knowledge required from airport employees to carry out this routine task. Swann et al. (2014) conducted a study
around airport security screeners to understand design implications for interface design. The problem with security screening involves people making sense of the images on the screen in order to action a security related decision-making process. The research, conducted in the field at an international airport in Australia, delved into investigating expertise and the types of knowledge used by airport security screeners, and applied a multi method approach incorporating eye tracking, observation, concurrent verbal protocol and interviews. The study identified that novice and expert security screeners primarily access perceptual knowledge and experience that imposes little difficulty during routine situations. During non-routine situations, however, experience was found to be a determining factor for effective interactions and problem solving. Findings demonstrated that experts used strategic knowledge and a structured use of interface functions integrated into efficient problem solving sequences. Comparatively, novices experienced more knowledge limitations and uncertainty, resulting in interaction breakdowns. These breakdowns were characterised by trial and error interaction sequences, which resulted in a lengthier security screening process. The study led to an understanding of relationships between visual and physical interface interactions and their integration into problem solving sequences.

As part of the study, participants (security screeners) were asked to use eye tracking technology (Tobii glasses) to capture their visual attention on the screening machine. This was later analysed with the use of specialised software for qualitative analysis (Noldus Observer) by implementing coding heuristics informed by eye tracking research to code visual behaviour and infer the knowledge base of the screeners. An example of the analysis is shown in Fig. 8.3; here it can be seen how problem solving sequences can be resolved quickly, indicated by short sequences (Fig. 8.3, bottom), or they can be more extensive, involving a number of shifts between different behaviours (Fig. 8.3, top).

Example 4: Actor-network research and the analysis of complex socio-technical situations

Described as a notion of an heterogeneous network that brings together human, nonhuman, social and technical elements to comprehend complex situations (Law 1992), Actor-network theory (ANT) approach has become more common in design research due to its ability to deal with human and non-human elements simultaneously by considering them symmetrically, as being equally able to influence a situation. The use of actor network research in design takes the perspective that in certain situations ‘things’ can have as much as or more power than people, and is helpful in understanding how a new thing can change an existing situation if everything else remains, initially, the same. This perspective was applied by Kraal et al. (2011) in the study of doctors and nurses’ interactions in a pre-surgical medical consultation procedure with technology, which presented an area of investigation where social relationships, context of use, procedural interactions, and people-
Technology interactions are some of the factors constituting complex sociotechnical situations. The study employed a research frame based on aspects of actor-network theory: ‘interressment’, ‘enrollment’, ‘points of passage’ and the ‘trial of strength’. This research frame was used to analyse a medical consultation context where it is considered how the traditional patient-doctor consult could change with innovative technology in two different situations: face-to-face consultation, and a remote tele-health consultation. In this study, a prototype of a digital stethoscope was tested in the context in which it is used. Ten tests using the prototype digital stethoscope were video recorded in a hospital setting in experimental conditions. Noldus The Observer XT behavioural analysis software was employed to assist the data analysis of the video-recorded observations, coding the activities of the doctors, nurses and patients. The use of the actor network research frame identified aspects in the telehealth consultation that could be carried out in similar manner to the face-to-face consultation. By showing which aspects of an existing situation are the most important the research frame can also be used to consider the successful integration of artefacts that are yet-to-be designed into an existing situation. Actor network theory applied in this kind of study demonstrates that the design of an artefact is not enough to ensure successful use; but it is the design of the situation in which the artefact is used that contributes to the success of the artefact.

**Fig. 8.3** Detail of problem solving sequences showing long (top) and short (bottom) interaction sequences
8.3.2 Action Research and Design

Action research is a research approach that is commonly attributed to Kurt Lewin, a social psychologist who coined the term in 1944 (Adelman 1993), and emerged as a research strategy to address questions regarding the relationship between theory and practice. Thus it involves a blurring of boundaries between action and research, and is described as a “process concerned with developing practical knowing in pursuit of worthwhile human purposes, grounded in a participatory world view.” (Grundy 1982: 353) The predominant purpose of action research is to affect change. Research is typically conducted in reflective cycles resulting in change in the research subjects, organisations or societies where the research is conducted (Dick 2000). This approach starkly contrasts with research approaches that promote researchers as disengaged and objective entities aiming to reproduce repeatable results. The closely related concept of participatory action research further highlights the role of participants as co-researchers and as well as the deep embedding of researchers in the communities and workplaces studied.

While action research has been applied in the context of HCI, its scope is significantly broader than interface design, or even design in general. Action research has gained traction in the contexts of education research, public health, civic engagement and organisational development (Bradbury 2015). In the context of this book chapter we will look at potential overlaps between action research, design research and its inherent notion of ‘messiness’ and the benefits that can be derived from approaching problems through these different methodological lenses. We will initially discuss the relationship between participatory action research and participatory design and then widen the discussion to consider action research and design research more broadly.

8.3.2.1 Participatory Action Research and Participatory Design

Greenbaum and Loi (2012) situate participatory action research and participatory design on a spectrum of research traditions that are concerned with research “by, for and with, people who will benefit from it” (pp. 81). Participatory Design (see Sect 3.1) has a strong social agenda born out of its Scandinavian roots in the 1970’s that centred on the active involvement of workers in organisational change, learning processes, the design of ICT systems and more broadly, democratic practices (Greenbaum and Kyng 1991; Bodker et al. 1987). Participatory Design is rooted in a design tradition. Through the interaction with and the participation of people it aims to understand the context of design, identify problems and design goals and design outcomes (Halskov and Hansen 2015). How to design with and for participants is the central tenet of Participatory Design. The involvement and co-contribution of participants in the research process plays an equally important role in Participatory Action Research. However, Participatory Action Research tends to be generally more outcome-focused, reflecting and improving research practices.
with the explicit goal to affect positive change for those involved. Participatory Design, by contrast, can be seen to be broadly more *product-focussed*, iteratively designing a solution that best addresses the identified design goals and matches the design context.

Foth and Axup (2006) discuss similarities and differences between these two research approaches based on a set of case studies. They compare the design of a social network for backpackers, using a participatory design approach, to the study of social networks of urban residents, using an action research approach. The study on social information sharing between backpackers used a range of participatory design approaches. The first iteration of the study consisted of an observational study that included shadowing a group of six backpackers while they undertook activities in the city of Brisbane, Australia. Results were recorded using notes, photographs and participant-collected audio recordings. The second iteration introduced design props in the shape of foam mobile prototypes which backpackers took with them and role-played usage scenarios. Results were collected via participants’ feedback on the use of props and play acting and scenario building as part of the exercise. The study of social networks of urban residents begin with a series of case studies using a range of methods including surveys, focus groups, participant observation and interviews, aiming to understand the social fabric of residents and their current use of ICT within their neighbourhood. Participants were involved in a critical reflection of their activities and jointly discussed how to make their apartment complex a better, more liveable place. Strategies for practical activities that would positively impact communication between residents were devised and implemented.

This work further confirms some of the differences between participatory design and participatory action research outlined above, including the difference in goals. The design process is targeted and despite its potential and deliberate messiness, eventually moves research towards a specific set of goals, which are defined as part of the design process. Action research approaches, by contrast, prioritise immersive research that asks participants to critically reflect on their own behaviour in order to affect change. Another important aspect in this context is the scope and transferability of outcomes. Design approaches, by their nature, aim to develop outcomes that have a broad appeal and applicability. Specific groups of participants are almost always representatives of a broader group of people for which a product or service is being designed. For instance, the design of ICT products for a group of backpackers is likely to be transferable to different groups of backpackers in similar contexts. While transferability varies depending on how specific the context is and how representative participants are, it constitutes a fundamental characteristic of design research. Action research approaches, by comparison, are concerned with specific outcomes for the same group of people that are involved in the research. By definition, the process of reflecting on specific conditions, behaviours, and contexts is part of the research process itself. Research outcomes are thus inextricably linked to the group of people participating in the research. Transferability, in the context of action research, is less the transferability of outcomes and becomes more of a reflection on how the process unfolded and how it can be applied to different contexts.
8.3.2.2 Participatory Action Research and Design Research

In addition to the similarities and differences in the involvement of participants, action research and design research more broadly share similarities at a methodological and process level. Swann (2002) identifies the cyclical or iterative nature of both action research and design research as a commonality. Action research is conducted through systematic cycles of planning, acting, observing and reflection (plan – act – observe - reflect) (Kemmis et al. 2013). Design research, in its instantiation of by/through design, similarly implements a cyclical or iterative approach consisting of analysing/understanding people and the context within which they live, work and play, setting design goals, designing artifacts or services at different levels of fidelity and evaluating the application and use of these artifacts/services in relation to the design goals. Both approaches are cyclical, they are reflective and take into account to what extent an iteration/cycle has effected change to fulfil goals, they are systematic and, as we have already established, they are generally participatory.

While there are many examples of the applied research approaches in HCI, methodological comparisons specifically between Action Research and Design Research are more commonly found in the interdisciplinary field of Information Systems that considers both the design of technical artifacts and the implementation of these artifacts in organisational contexts (Goldkuhl 2013; Cole et al. 2005). For instance, Cole et al. (2005) suggest that Action Research and Design Research can be effectively combined and suggest a flexible “late binding” approach that allows researchers to defer the decisions as to which methodology to use based on the needs of the specific situation.

8.3.2.3 Action Research and ‘Messiness’

Both Action and Design Research deal with uncertain situations and ‘messiness’ due to the complex nature of humans and their contextual settings, as well as the creative and non-determinate nature of the design process. With regards to Design, Swann (2002) posits: “Design deals in human interactions with artifacts and situations that contain a great deal of uncertainty. Design research is tied to a domain that derives its creative energy from the ambiguities of an intuitive understanding of phenomena” (pp. 51). Action research is comfortable with the ‘messiness’ of humans and their contextual and organisational settings, but in general does not
utilise designerly approaches to address these challenges. This presents both an opportunity and a challenge to effectively link Action Research and Design-based approaches to benefit from designers’ experience of dealing with uncertainty. As a counterpoint to this, Design as a discipline, rather than bestowing a mythical gift on humanity, increasingly faces questions of accountability and the responsibility of designers to the environment (Swann 2002). This trend is reflected within the design community by the reflection of the role that design can play in the context of social responsibility and more broadly design for behaviour change (Niedderer et al. 2017). Action research and its long tradition of reflection and enacting change can make an important methodological and conceptual contribution here.

8.3.3 Co-design/Participatory Design

In developing methods that enable researchers to study individual experience more effectively, the third wave of HCI gives rise to a greater focus on “experience-oriented technologies” (Bodker et al. 1987:26) In this chapter, we have argued that this shift to a focus on individuals and experience-oriented technology design calls for alternative approaches to the process of design that are tolerant of greater ambiguity, uncertainty and accommodating a higher degree of emergence than before. As shown, formalisation of such approaches is still in its early stages (Forlizzi et al. 2008), with limited insights into ways of ensuring rigour across a multitude of experiential, unstructured and highly subjective processes and design artefacts. As mentioned, our aim is to contribute to this debate by showing that such approaches, at the very least, impact the design research process across three key areas. First they require a reconceptualization of the experience of the research process, or its structure, from fixed and measurable towards open-ended. Second, there is a reframing of the role of design and research expertise to include users as experts in their life experience. Finally, there is a focus on the way participants make sense of technology within specific contexts of use.

Perhaps one area that provides a clear context for demonstrated applications of design research to technology design in ways characterised by the third wave is design for eHealth. Applications of participatory and co-design methodologies for innovation in health have over the past 5 years proliferated to the extent that has seen its primacy in innovation acknowledged as part of funding strategy at State Government levels. In the Australian context, “co-design’ and “user-centred design” forms part of a long-term approach to innovation endorsed by local Government as part of the Queensland eHealth Strategy 2016–2026. Beyond commercial applications and research-led collaborations across design and health, this sends an important signal about the focus on people and their experience as core to whole-sector innovation.

The selected case study is from a currently funded Australia Research Council project (involving two of the chapter authors). It focuses on the co-design of a youth help-seeking toolkit for mental health, with young people aged 13–25. Below we
show a series of documented visual examples of participant journey maps created during a participatory design workshop that focused on exploring young people’s pathways of decision making during help-seeking on a mental health topic of concern to them, and evaluation of the usefulness—or otherwise—of technology to their individual help-seeking process. The aims of the activity and the template was to discover the way young people seek information or help with respect to a specific mental-health topic, and identify what they consider as the main steps. This was supported by an open-ended methodology which was designed to visualise where sources of support or barriers are located, and the role technology played in help seeking. Finally, the method included an exploration of the potential role technology could play but currently does not.

The templates designed by the researchers aimed to create a broad, open-ended framework and a shared visual vocabulary which participants could ground within the context of their own lives, creating personal decision-making maps, and enabling rich detail and specifics of their individual journeys to emerge. As shown in Fig. 8.4, the template consisted of a point A at the bottom left corner where participants noted their previously generated topic of concern related to ‘lack of wellbeing’; and Point B representing their desired (or previously experience) positive mental health outcome (also previously generated). To assist with the process of analysing the maps, researchers had devised a set of visual cues—different types of connecting
lines, straight, stepped, dotted – each signifying a degree of difficulty or ease of pursuing a noted action. Straight line signified a step that did not required a lot of effort; stepped line indicated an experience that was very challenging or time-consuming; dotted line represented an ambiguous, unclear path towards the next step. Participants could choose a help-seeking scenario from their past to map.

To undertake the activity, participants (young people aged 13–15, 16–19 and 20–25) chose an issue of concern from a previously (individually) generated list of topics. Then they placed the topic in the bottom left-hand corner, nominating their desired ‘wellbeing’ outcome at the top right-hand corner. Then, using the visual vocabulary, they mapped their experiences and choices, indicating barriers, enablers and then evaluating the role of technology in relation to these. Each participant created three of these maps for three different issues. Outcomes of this process (Fig. 8.5) showed that the broad framework enabled each participant’s map to be highly individual, revealing rich and unique details about contextual factors impacting help-seeking – whether technology-enabled or where technology was a barrier.

Importantly, this approach took into account the entire context of young people’s lives, including multiple domains: social life, friendships, personal life, family, school, work etc. In this, the activity demonstrates one way of capturing the diversity of multiple participants’ experiences in a holistic, “whole of life” perspective that spans multiple experience domains. This is a key focus of the third wave approach, which Bodker describes as “conceptual thinking that helps us embrace people’s whole lives and transcend the dichotomies between work, rationality, and their nega-
tions.” (Bodker et al. 1987:27). This approach established a method that was partially structured yet open-ended enough to allow for a high degree of interpretation and unique expressions by participants. The researchers iteratively tested prototypes of the templates with people before use in workshops. The resulting method produced far more meaningful responses than traditional structured methods, with each participant providing unique context-specific responses constructed in situ.

This process enabled a messy structure, which was achieved by carefully designing the workshop framework with just enough structure and guidance to prompt rich context-specific responses and open enough to enable non-verbal visual communication of experience. Through use in workshops, the researchers found that it was important to be flexible to accommodate diverse backgrounds, life experiences and preferred modes of expression. As a result, the researchers found it was essential to be open to participant modification of the research artefacts to allow them to express their unique experiences.

Young people used their own lives as the source of the maps, and the open-ended approach necessarily positions young people as experts of their personal journeys. The aim was to respect them as experts of their own experience, of the unique context-specific details impacting their help-seeking decisions, and their articulation of perceived value technology in making these decisions and in relation to ‘what works’ for them. A process such as this foregrounds young people’s voices, giving them control and agency over the resulting artefacts. The help-seeking maps enable multiple opportunities for sense-making and meaning-making. A process that allows participants to make sense of their experience progressively; and, to actively construct meaning. The aim was to create a process that would accommodate multiple contexts relevant and meaningful to multiple participants, which we refer to as context specific. McCarthy and Wright would describe this as “putting felt-life, that is life as lived, sensed and experienced, at the centre of human–computer interaction (HCI)” (2005:262), so as to enable “local, context-rich research”.

Within the shared visual vocabulary, each participant was free to articulate the specifics of their recovery journey, or where participants found the vocabulary limiting they were able to modify it to suit their experience. Each participant created unique maps, providing a glimpse at how they make sense of complex and difficult lived experiences. Such subjectivity, from a scientific perspective, makes validation impossible, but in this context it is the open-ended and subjective nature of the method that is critical in providing new knowledge required to successfully develop designs that are sensitive to the specific context of use. Something that is of the utmost importance when the context of use involves young people’s mental-health and wellbeing. Figure 8.6 shows the map of the whole project and demonstrates how these maps contributed to the design process for the apps that were developed through this project.

This case has been included for its potential to illustrate the ‘messiness’ of the process of researching human experience using visual journey maps. It also shows the way participants are engaged as experts, and highlights the role of meaning-making in the process. It shows that bringing design research into HCI creates a space for intentional messiness that opens new challenges to design researchers and the HCI community.
8.4 Discussion and Conclusion

These very varied examples show the breadth of design research and illustrate the potential it has to contribute to third wave HCI. Design research is applied in a wide range of ways to a wide range of projects and research endeavours. However, these examples have shown that it is essentially focussed on understanding people and ultimately on delivering the best design solutions for the issues that they face.

In this chapter we have argued that design research has made a unique contribution to the 3rd wave of HCI with the development of methods and processes that contribute to the understanding of peoples’ experiences beyond the concept of people as ‘users’. The discussion of research both by/through and for design has highlighted how design researchers have dealt with the messy nature of people’s experiences with technology by understanding technology itself as experience, where methods employed involve processes to work with the complexity of people’s experiences and the ambiguity of the data captured by those processes. The transdisciplinarity of the methods employed in design research is what makes possible a distinctive approach to human-centred design and the understanding of people’s experiences. It achieves this by: adopting messiness in structure through open-ended processes that accommodate for fluidity and indeterminable outputs; the increasingly changing role of expertise and expert knowledge from participants’ and researchers’ input and contribution to the research process; and by meaning-making processes from the participants’ views that generates new frames of reference for understanding research outcomes.

How much messiness is suitable for a particular project and which design research methods are chosen generally depends on the aims of the project and the expertise of the researchers. If a designed outcome is needed then a research through design approach such as participatory design or action research is the best approach to explore. If specific outcomes relating to information or guidelines for design are needed, or an outcome needs to be tested, then methods associated with research for design are available. Not to forget that these approaches can also be combined, as...
demonstrated with the intuitive interaction projects. Each design research method gets messy, although it could be argued that the more participants are involved in the outcome, the messier it will be as the researcher concedes some control. However, the richness of outcomes from design research and the potential to really answer real world research questions is well worth the effort.

References

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