Designing for a Relationship Other than Use

Janet Kelly

Designing for a Relationship Other than Use

PhD Dissertation

Author: Janet Kelly

Supervisor: Associate Professor Ben Matthews

Sønderborg Participatory Innovation Research Centre (SPIRE).
University of Southern Denmark.

SPIRE is a strategic research unit were six university disciplines collaborate with a theatre group and industrial partners to develop a unique approach to user driven innovation. Integrating perspectives from Design Anthropology, innovation Management, Interaction Analysis, Interaction Design, marketing and User Centred Design with the change management competence of Dacapo, our centre investigates how people innovate with users to advance innovation theory and develop new methods for industrial practice.

Abstract

A well-designed artefact is of little value if it never reaches the hands of a user. Several other factors must also be in place before a person will have the need, desire and opportunity to begin to use a design. The field of design has become highly sophisticated in its approach to user involvement in order to produce better designs. However the quality of a design outcome can only take it so far towards ensuring it will actually enter the hands of potential users. This is especially true in the medical domain where the use of a medical device is determined not by consumer choice, but by the progression of a medical condition. In this situation, becoming a user may significantly compromise a persons sense of identity but delaying use beyond a certain point can have serious consequences for their health and wellbeing. Design has an important role here by addressing what happens before people begin to use a device. By turning the attention of design to finding opportunities to diminish the impact of use on people's sense of identity, and creating more favourable circumstances for people to become users, a greater number of people could be encouraged to begin using medical devices at thepoint where it will give them the most medical benefit.

This dissertation presents a sustained investigation into how design can respond to what happens before people become users. It consists of five papers in which the notion of 'pre-users' is introduced to describe people who are not yet users of medical devices, but are in position to be so now, or in the future, due to a progressive medical condition. It goes on to illustrate the contribution pre-users can make to design as part of project run in collaboration with two medical device manufacturers, and shows how design and innovation processes that focus on user involvement can be adapted to involve people who represent pre-users in design.

As part of this dissertation the key characteristics of a pre-user driven design process are outlined. This includes demonstrating that a pre-user driven process requires a shift in mindset from directly trying to solve problems or meet needs, to identifying opportunities to indirectly influence whether or not people will become users. It also shows how focusing on pre-use lends itself to having multiple design outcomes that 'complement' each other.

A key characteristic of pre-user participation is identified as a need for sensitivity towards the pre-users relationship with the project objective. Approaches to accommodate this are proposed, including two strategies of indirect enquiry. These are exploring controversy through abstraction and combining controversy with recognisability, which can be employed to explore potentially controversial issues in a sensitive and non- confrontational manner.

This dissertation makes two additional contributions as a consequence of the investigation into pre-use. The first is identifying that the momentary displacement of use as the focus for design in order to identify other important relationships, could in general be a useful approach

for design. The second contribution is a methodological one, describing how artefacts that embody analytical understandings, but are designed to provoke responses in an open-ended manner, can serve as exploratory research tools for design.

Overall this dissertation contributes to design research by outlining how the concepts of pre-use and pre-users can be useful for design. This includes describing how user driven approaches to design can be adapted for a pre-user driven process and what needs to be taken into consideration when organising pre-user participation. In it provides two extra contributions, firstly about the benefits of momentarily displacing use as the focus of design, and secondly how artefacts and design concepts can serve as exploratory tools in a design research process. For industry, the approach outlined in this dissertation is of interest to any companies whose product uptake is similarly affected by issues that are indirectly related to the quality of the product itself.

Acknowledgements

Writing this dissertation has been fun and inspiring, but also a challenge that has taken me places I might never have believed I could go before. There are many people I could not have done this without.

First and foremost I am grateful for the serendipity of having been able to take much of this journey together with Ditte Nissen Storgaard. From an S-train in Måløv to the heights of the Chrysler Building it has been an adventure, and there is no one else I would rather have done it with.

I am also very grateful for the good fortune of having Ben Matthews as a supervisor. Someone told me when I started this endeavor that by the end I would have outgrown my supervisor (it may have even have been you Ben). However I still think you are one of the most intelligent, kind and all round great people I have ever met. It has been a privilege and I am going to miss those late night Skype meetings from half way around the world.

I would also very much like to thank all the people at the SPIRE centre, Novo Nordisk and Oticon who have been involved in the project. At SPIRE in particular, Jacob Buur for all your support and for setting up the project in the first place, and also Stephan Wensveen for being a great sparring partner, co-author and shadow supervisor. At Novo Nordisk everyone at department 272 who provided me with a home and looked after me for nearly four years, I will miss you all very much. I would especially like to thank my industrial supervisor Arne Stjernholm Madsen for your constant encouragement and Gitte Johanssen for always keeping an eye on me. At Oticon my thanks goes to all the former members of CDT and the Eriksholm research centre who were with us along the way. In particular I am grateful to Graham Naylor for your kindness and support. A very special thanks goes to Gitte Engelund for unwavering enthusiasm and commitment to the project.

In addition I would like to thank Eva Brandt, Thomas Binder and everyone else from the Co-design Cluster at The Royal Danish Academy of Fine Arts - School of Design for having me stay for a wonderful year.

I am also very grateful to my friends and family who have been there all the way through. With special thanks to Iben Vinsteen and Elise Søgaard who have been with me for much of the thick and thin, Jens Pedersen, Rosemary Cunningham and my sister Bridget Kelly for moral support and proofreading, and everyone at DSR who provided a welcome respite from my studies whenever I needed it.

Contents

1.Introduction

The intended use of a product or service is a defining factor in its creation. *"In designing and developing an artefact, some model is needed of the anticipated user, the ways in which the artefact will be used and of the social and technical context in which use will take place"* (Stewart & Williams, 2005). In other words the notion of intended use is central to bringing a particular design into being. It is not surprising then that the concepts of use and the user are a main focus for design. Yet products and services exist in complex contexts, in which use relations only represent a portion of the possible relations that will influence and be influenced by the product or service. For example when someone starts to use hearing aids it will not only affect them, but also their partners who they communicate regularly with, the people who they have conversations with at work or at a party, and the hearing care professional who makes a living out of selling and fitting the devices. Furthermore it will have an impact on people they encounter who will need to consider using hearing aids themselves in future. These people will have an opportunity to learn about hearing aids through that user and come to associate that particular person with the technology. These are all people who are essentially on the periphery of use and although they do not have the direct relationship to the design that a user has, they can still be influenced by the design and conversely have a significant impact on how that design is adopted and adapted in the world. Considering these relationships, even though they do not define a design under development in the same way as the notions of use and users

do, also has the potential to provide relevant and important input for design.

The notion of 'pre-users' describes one of these groups of people who have a tangential relation to use that is of interest to design. It was invented in the context of an innovation project with two companies active in the medical device domain, in order to describe people who are not yet users of medical devices - specifically hearing aids and insulin injection devices - but may be able to medically benefit from them, now or in the future. Throughout the course of the project the notions of 'pre-user' and 'pre-use' emerged as useful conceptual tools for exploring and designing for the contextual conditions that allow for use, which include experiences with healthcare systems, relationships to the medical conditions and preconceptions about the technology. In this dissertation I present a sustained investigation into how these concepts can contribute to design using this project as a case, and show how user-centred and participatory design principles were adapted to involve people who represent 'pre-users' in design. The dissertation consists of five papers, which report on design driven explorations into innovating with the 'pre-users' of medical devices. The original papers are:

[P1] Kelly, J. & Matthews, B. (2010). Taking transition into account: designing with pre-users of medical devices. In Proceedings of the 11th Biennial Participatory Design Conference (pp. 71–80). New York, NY, USA: ACM.

[P2] Kelly, J. (2012). Crafting 'Solvable' Problems in the Design Process. In Rodgers, Paul (Ed) Articulating Design Thinking. Libri, Faringdon.

[P3] Kelly, J. (2013) Designing Artefacts that Enquire with Sensitivity. In Proceedings of IASDR2013, Tokyo. Available at http://design-cu.jp/iasdr2013/papers/1124-1b.pdf.

[P4] Kelly, J. & Wensveen, S. (2013) Designing to Bring the Field to the Showroom through Open-ended Provocation. Accepted for the International Journal of Design.

[P5] Kelly, J. & Matthews, B. (2013). Displacing Use. Accepted for Design Studies.

Unedited reprints of the papers are included as they originally appeared, but they have been reformatted to fit the layout of this text. Henceforth in this introduction I will use [P1]-[P5] when referring to these publications. These papers are each published in different venues with slightly different intended audiences ranging from those interested in design thinking to participatory design and innovation; all five are relevant to constructive design research audiences. [P1]- [P4] are presented in order of when the main case material they present occurred in the chronology of the project, while [P5] represents a reflection on the project as a whole and some the broader implications of this thesis. In the rest of this chapter the concepts of 'use' and 'the user' in design are discussed, and how 'pre-use' relates to these. Chapter 2 introduces the project background and presents the approach that was taken to exploring

how design and innovation processes that focus on user involvement could be adapted to incorporate 'pre-users' of technologies. Then in chapter 3 research findings are presented, including the distinguishing aspects of working with a pre-user driven design process, as well as some additional conceptual and methodological implications that have arisen from this research.

1.1 Literature Review: how users and other people have been conceptualised in design.

In design approaches that have an interest in involving people who will use or be affected by the design, these people are conceptualised in many different ways. The concepts refer not only to who is considered relevant to involve in design processes, but what is expected to result from their involvement and the role they will have, essentially helping to shape how the designers conceive of the potential human relationship with a design under development. Although the term 'user' is often the most common way to describe people in design, even this is deployed quite heterogeneously across the different fields.

User-centred design (UCD) as an approach first emerged in the 1980s in response to what was seen as a lack of understanding of the human element in the design of new technologies, which resulted in the significant failure of several designs (Abras et al 2004). Norman and Draper coined the term UCD in their book User Centred System Design; New Perspectives on Human-Computer Interaction (1986), where they outline an approach to user centred systems design. In their approach 'users' were conceived as people with rational goals and intentions to be achieved through the design, which existed in their mind and related to their needs. They argued that user should be understood in terms of their needs and that these should be a central focus for designers.

"But user-centred design emphasizes that the purpose of the system is to serve the user, not to use a specific technology, not to be an elegant piece of programming. The needs of the users should dominate the design of the interface, and the needs of the interface should dominate the design of the rest of the system" (Norman 1986 p.61).

Norman suggests that a central aim of the approach is to match what systems are designed to do to the explicit intentions of users, *"The existence of the two gulfs points out a critical requirement for the design of the interface: to bridge the gap between goals and system."* (ibid p.45) and that in order to achieve this aim development teams needed expertise in technology, users and the tasks users were trying to achieve.

"It takes at least three kinds of special knowledge to design an interface: first, knowledge of design, of programming and of the technology; second, knowledge of people, of the principles of mental computation, of communication, and of interaction; and third, expert knowledge of the task that is to be accomplished" (ibid p.60).

However Norman argues that this expertise should be provided by either especially trained interface specialists, or by the inclusion of psychologists in design teams, ignoring the

possibility that people who represent users themselves may be able to act as experts both in how they think and interact, as well as in the tasks they perform.

Although revolutionary in many senses, this early work in UCD has been critiqued for not going as far as to explicitly promote the inclusion of people who could represent users in the design process (Marti & Bannon 2009, Gulliksen et al 2003). In this manner it contrasts sharply with the approach of participatory design (PD) that emerged in Scandinavia in the 1970s and '80s. In PD, the people who could end up using a design were not just included as subjects to be understood in projects, but actually involved as collaborators (Buur & Matthews 2008). The first PD research was motivated by political concerns about disenfranchisement of workers as computer systems technologies began to be adopted by industry. The participation of workers in systems design was therefore seen as a way to democratise the development of new technologies, not only in order to create technologies that better suited the needs and skills of workers but actually to empower them (often through trade unions) to have a say over the introduction of new technologies in the workplace.

"Researchers who were concerned that only the interests of management were being served by the design and introduction of new technologies established relations with trade unions. The intention was to build up technical and organizational competence among workers and shop stewards in order to strengthen their position at the bargaining table." (Kensing &Blomberg 1998 p.170).

Originally the participants in PD projects were the people whose work would be affected by the introduction of a new technology. In literature they were often referred to interchangeably as 'users' and 'workers', indicating the relevance of both the techno-centric relationship with the design under development, and the persons role in the organisational setting in which the technology would be embedded (see Kensing and Blomberg p.168 footnote). Worker empowerment was one core argument for the participatory approach but there was also a strong belief that just as importantly, their involvement would result in a better outcome. Participation, as Ehn argued, was also be able to make an important contribution to the creative design process as a way a to inspire and validate better designs.

"However, the political reason for involving end users in the design process, and for emphasizing their qualifications and participation as resources for democratic control and changes, is only one side of the coin. The other is the role of skill and participation in design as a creative and communicative process." (Ehn 1988 p.23)

According to Ehn the emphasis then for design teams was instead of becoming experts in end users, to develop processes and methods that would allow the end users themselves to be the experts.

"I claim the importance of rethinking the design process to include structures through which

ordinary people at their workplace more democratically can promote their own interests. I also claim the importance of rethinking the use of descriptions in design, and of developing new design methods that enable users of new or changed computer artifacts to anticipate their future use situation, and to express all their practical competence in designing their future." (Ehn 1988 p.23)

In contrast to the early conceptions of UCD, in the early PD projects end users were brought in as collaborators, with the expectation that their participation would both empower them and contribute to the development of better design outcomes.

Over time UCD approaches have transformed somewhat and with this so has the way people are conceptualised in them. Firstly there has been a shift in understanding users as rational beings and with conscious goals who should be understood purely in terms of their needs, to more holistic understandings that take into account people as emotional beings (Norman 2005). Additionally user involvement has become a central characteristic of UCD, and many of the approaches now described as such bear little resemblance to Norman and Draper's (1986) original description. Gulliksen et al (2003) argue that the term UCD has actually become so broad as to be almost meaningless, but Karat (1997) suggests this can been seen as an advantage.

"I suggest we consider UCD an adequate label under which to continue to gather our knowledge of how to develop usable systems. It captures a commitment the usability community supports—that you must involve users in system design—while leaving fairly open how this is accomplished" (ibid p.38). With this definition it could be argued that PD approaches might now also fall under the label of UCD. However UCD approaches still do not have the ethical agenda of PD (Carroll 1996) and additionally not all UCD is participatory, as user involvement can range from full collaboration, to users being involved as subjects to be studied with little or no influence over design decisions (Marti & Bannon 2009).

Furthermore, as the field of PD has matured it has also transformed. Notably there has been an increased acceptance that participation should extend not just to end users, but to all those who will be significantly impacted upon by a design under development. *"Participatory design has the moral and pragmatic tenet of including those who will be most affected by a design into the design process"* (Segalowitz & Brereton 2009). This has led to a diversification in the kinds of people who have been invited to participate in projects. For example in some projects participants from several levels of the organisation may take part in the design process, in addition to the workers who will be the end users of the technology (Kensing and Blomberg 1998, see Kensing et al 1998 for example). Additionally as PD has spread beyond the work place, it has become more complex to define who specifically the end users will be. Forr example, in the healthcare projects patients and caregivers, as well as different

kinds of healthcare professionals, all represent some kind of user of a single design (see Dawe 2007, Ballegaard et al 2008, Mønsted & Onarheim 2010, Wu et al 2008,). Therefore, while the concept of the end-user is still a central one, other concepts have been brought in to describe the broader range of people who are being invited to participate. *"Usually these different roles take their starting point in perceived users of a finished system and then extend to representatives, key stakeholders and/or decision makers"* (Bergvall-Kåreborn & Ståhlbrost 2008). In contemporary PD practice the range of people now considered relevant to participate extends far beyond those that can be captured by the notion of the end-users. Therefore broader concepts such as 'stakeholders' are often employed in order to account for those people who may significantly influence or be influenced by a design under development, but do not necessarily represent users.

The field of participatory innovation has to take a starting point in the traditions of PD, but conceptualises people slightly differently as a result of the change of focus from design to innovation. In their proposal for an approach to participatory innovation, Buur and Matthews (2008) argue that such projects should involve an ongoing collaboration between the people that innovations are intended to address and people within the organisation that is attempting to innovate.

"A participatory innovation project, as we see it, is a dedicated activity that takes people's practices and needs as a starting point to generate business opportunities in the form of products and services. The opportunities are developed through an ongoing collaboration between the people that they address (users), and the people who are in charge of their realisation (company developers)" (ibid p.268).

Users here are not users of an existing technology, or even potential users of a planned technology, but people who needs and practices might provide an opportunity for innovation. Additionally equal importance is placed on the role of company developers in the process, those people in the organisation who will have an influence on or drive innovation. Buur and Matthews argue that innovation can be generated through supporting collaboration between these two groups and suggest one of the purposes of participatory innovation is, *"to generate knowledge about users/customers in a format that inspires company employees to reflect on product, producer role and company identity,"* (ibid p.268). In participatory innovation users are conceived of as people whose needs and practices could provide opportunities for innovation, while additionally company employees/developers are conceived as people with motivations and understandings that have an influence on the organisation's ability to innovate. Both these groups are considered important for innovation.

User centred design (UCD), participatory design (PD) and participatory innovation each conceptualise people in different ways, based on their epistemological background and

focus. These concepts shape who is considered relevant to involve in design (and innovation) processes, their role in those processes, and what is expected to result from their involvement. Crucially they shape the focus of projects; delineating whose needs, practices and interests the outcomes will attempt to address. The notion of 'pre-users' is a way of creating another kind of focus, one that brings people who are not yet users of an existing technology, but are on a trajectory to become so due to a progressive medical condition, into design and innovation processes. Like users in participatory innovation, it refers to people whose needs and practices might provide an opportunity for innovation, however the aim of a pre-user driven process is to alter a relationship with an existing technology as opposed to innovating a new one. Following in the traditions of PD, pre-users are also conceived as collaborators as opposed to subjects to be studied, but the nature of this collaboration has to change as many people who are covered by the notion of pre-users do not want to believe that they may one day become users of a medical technology, and therefore do not identify themselves with the concept. 'Pre-users' should be seen as supplementary to the notion of 'users' that is a central focus for several fields of design, and is intended to operate in tandem with it.

1.2 Pre-user in relation to the concept of the user.

As the pre-user does not exist without the concept of the user, it is important to be clear on what that concept is (and is not) in design. Use is one kind of relationship that can exist between people and technologies, and the term 'user' denotes a person who is engaged in this kind of relationship. People become users in connection to the deployment of a technology for a purpose and it is what is going on in this connection that is of interest to the designers of the technology. However, particularly in the early days of UCD, there had been a tendency to focus on the characteristics of users themselves, rather than the connection between them and the technology, turning them into a subject to be studied and modelled.

"Users were to be studied, questioned, observed, and their performance on tasks measured. Psychologists could thus come to know the cognitive and behavioral capabilities of the generic user, and this information could be put to use by the design team, who could take into account some of the capabilities of the human subject in their designs." (Marti and Bannon 2009).

The danger of this approach is that users begin to be conceptualised as a component of the design, with material and functional qualities that need to be accounted for, rather than as people who will establish a relationship with and create value through a design. The result is what Redström (2006) describes as 'user design', a where designers begin to dictate what the user should be like and what they should do, with no guarantee that the any real person will be able or willing to fulfil that role (Akrich 1992).

"User-centred design then risks becoming a kind of user design. It is user design in the sense that it is design where the processes through which people turn into users are in focus and where the explicit aim is to work with the results of this process, i.e., how use and user should turn out." (Redström 2006 p.129).

It is important then to recognise that design's interest in people as users, should centre on the relation between them and the design under development, not on how the users themselves should be.

"The "object-centric" view on product design focused on product characteristics. The "subject-centric" view, in turn, started from the user's characteristics. Conceptually, both these approaches are inadequate. Product functionality is a phenomenon that exists as a relation between the product and its user. The phenomenon of use, therefore, needs to be conceptualized as a relation between the user and the artefact, where the user and the functionality of the artefact mutually construct each other," (Tuomi 2003 p.22).

Technologies are only useful in relation to people and people only exist as users in relation to technologies. Bringing people into design processes to represent users is a way to explore what might happen in the relation between them and technology under development. Yet although designers can influence this through the design, they cannot actually dictate how the relation will be when a technology begins to be used in context.

Use is also not the only kind of relationship that people can have with technologies, products and services. 'User' is essentially a very functional and rationally oriented idea of a person and suggests someone who is being solely defined by his or her relationship to a technology and what it does.

"People, not users, inhabit the world. As a person turns to an object, inviting it to be a part of her lifeworld, making it hers, she might decide to start using it for some purpose; and as she begins to use the object, she becomes a 'user'" (Redström 2006 p. 129)

People do not identify themselves primarily as users, but rather momentarily become one when they turn to a technology to fulfil a purpose. 'User' therefore more accurately describes a temporary role people may have in relation to a technology, rather than encompassing a holistic idea of the human. People who use technologies may relate to them in many other ways than actual 'use', for example if a person owns an antique watch, they may use its function to tell the time, but the way they feel about it sentimentally, how they enjoy it aesthetically, and what they try to communicate about themselves with it, are very different ways of relating to it than when they use it for a functional purpose.

Additionally people also encounter artefacts and are affected by them without choice or deliberate purpose. For example, if a pedestrian is hit by a car, its design may significantly affect them even though they could not be considered a user of the vehicle. In this sense the notion of the 'user' can be seen as quite a narrow concept that obscures other diverse types of relations that can emerge between people and designed artefacts. There have therefore been attempts in design to introduce and promote alternative notions that encompass a more holistic view of people, including concepts such as 'human centred design' e.g. as codified in ISO 13407. However a cursory review of contemporary design literature quickly confirms that the concept of the user remains prevalent. One way of explaining this might be that although there are multitudes of ways of relating to a technology, the use relation is still the primary reason (at least in product and interaction design) for bringing a design into being. Broader terms such as 'human' and 'people' are much more vague and do not indicate the specific forms of the relations between people and artefacts. The concept of the user however describes a particular techno-centric relation and design is after all primarily interested in how technologies should be created.

The disscussion of use and users also obscures a great deal of the complexity of how people

are being conceived in design processes, particularly in relation to temporality (Redström 2008). As there cannot actually be users of things that do not yet exist, the term is actually being used to describe potential or future users. The idea of the user shapes the design development and allows people to be brought into the process to help explore what future relations with artefacts could be, but these people are not yet users, rather people who might be likely to use the outcome of the design process when it is created. Wilkie argues that users can be seen as being created along with the technologies that are under development, *"users are assembled along with the new technologies whose design they resource, as well as with the new configurations of socio-cultural life they bring into view"* (Wilkie 2011 p.317). Notions of what users might be like frame people to allow them to become a resource for design, so they can for example take part in workshops or user studies; while at the same time notions of potential technologies and potential use practices are emerging. There is always essentially an inherent transition towards use in design; as a design process develops, the possibility of people being able to become users moves closer. This transition towards an imaginary future is intrinsic to design processes, as designs also do not fully exist during the design process, but are moving towards becoming complete. Thus users remain imaginary representations until there is something there for them to actually use.

Even when the design has been finished and the outcome has been produced, this does not automatically mean that users of it will begin to exist. There are many other factors that play a role in bringing people and technologies together that extend far beyond the concerns that are specifically dealt with during the design process. Although aspects of affordability, accessibility and desirability are considered during development processes, ultimately things like transport infrastructures, economic situations and individuals' sense of necessity or desire for something, cannot be controlled through the design. For a person to become a user certain conditions must occur to create a context that allows for use, conditions that are often unrelated or indirectly related, to the design of the product, service or technology itself. Take for example injection devices for diabetes drugs; for a person to become a user of these there are several prerequisite circumstances that must occur. Firstly a person needs to actually have diabetes and be diagnosed, the health care system they have access to must also permit and distribute the device, their doctor has to be willing to prescribe it, and they have to be willing both to take their doctor's advice and begin using the device. These are contextual conditions that range from legal structures, to physiology, to interpersonal relationships; all of which play a part in determining whether or not use will occur. These contextual conditions are particularly crucial to use in the medical domain, where the decision to use a device is based on the progression of a medical condition rather than questions of desirability, and where becoming a user of the device can have a profound impact on people's sense of identity. In this

area the influence of the design of the device itself may be entirely obscured by these other factors on which use is dependant.

While these contextual conditions may not be greatly affected by the design of the device, by looking for other ways to influence them new opportunities for design can emerge. The conditions of the context of use can be altered through other kinds of carefully considered interventions, in a way that makes it more favourable for people to become users. The notion of pre-use is a way of putting the focus of design onto the circumstances that are prerequisite to use, further to and outwith designing for the use. The notion of pre-users conceptualises people who are in a position to be influenced by contextual conditions to become users, now or in the future. Specifically in the case of the pre-users of medical devices, these are people who are on a trajectory towards use due to a progressive medical condition. Like use, pre-use also conceptualises a relation between people and technologies (including products and services), however in the case of pre-use this is an indirect relation that is being mediated by other artefacts and people, such as doctors and diagnostic technologies. Also like users, there is no guarantee that pre-users will ever become users, as while the technologies may actually exist with pre-use, the circumstances that will allow for their use may not. In the next chapter I will describe a project in which a constructive design research approach has been used in the cases of the hearing aids and injection devices to investigate pre-use in order to identify how the prerequisite contextual conditions that allow for use can be designed for.

Conceptualising pre-use

Originally when the project was framed the two companies' who sponsored it did so because they were interested in identifying and overcoming barriers that were preventing people from becoming users of their devices. With purely this agenda, 'pre-users' sounds very similar to the concepts of 'non-users' and 'potential users', who are typically people who have chosen not to become users of a particular product, but could potential be persuaded to become users. This also implies that the interest in them is also more of a marketing one than a design one; making an existing product seem more desirable in order to make people want to use it. Relating specifically to having a medical condition does differentiate the concept of pre-users slightly from the non and potential users of a commercial product, as these are products that no one wants, but may need at some point in the future. The issue at stake for people is not about consumer choice, but that they will need to use devices they would otherwise choose to avoid, as their medical condition develops. However the definition of 'pre-users' as being people who are not users of the devices but may be able to medically benefit from them now or in the future, is problematic in several ways. Firstly defining these devices as something people need involves certain assumptions, namely that the medical perspective should be prioritised above other perspectives when it comes to deciding what people can benefit from and what something being beneficial actually means. The term itself, 'pre-use' nicely captures the temporal dimension in that the potential of transition is a key aspect of the situation. However it also implies that becoming a user in the future is somehow inevitable for people (which is something that cannot be known with any certainty).

Recognising these problematic aspects, we decided to redefine the concept of pre-use in a slightly different way. Instead of focusing on the relation to the technologies themselves, we used pre-use to describe practices that are relevant to the technologies' continuing absences or potential introduction. Pre-user, like user, can be understood in terms of a conceptual tool for designers and the companies, framing people that are in a situation that was relevant and of interest for design and innovation in the companies. Although it still refers to those people who were not yet users of the companies' devices, but could medically benefit from them now or in the future, the function of the concept pre-users came to conceptualise practices and people to allow them to become a resource for design.

 It would also then have been possible to make a very broad framing for pre-users which included almost anyone who did not use the devices, as with both conditions most people have the potential to develop them in future. In other words we could have framed the majority of the global population as pre-users. However, based on the reasoning that people who had the conditions were more likely to become users and also would have a different relation to

the devices as treatments, people with the conditions who did not yet use the devices became the central focus of the study. Pre-use was therefore defined initially by the absence of a technology in a setting where the 'medical' condition to which the technology is intended to apply is present.

As we had defined pre-use as the practices that are relevant to the technologies' continuing absence or potential introduction, we had to try and discover what these practices might be. What we found was that the medical devices bring to the foreground different aspects of the medical condition, while obscuring others. When a treatment was made into an option it changed the relationship people had with their condition; for example when hearing aids are made an option, hearing problems can become an issue about the deterioration of the individual's body, instead of being about poor acoustics or another person's unclear annunciation. However the devices are just one of many treatment options and several other factors also take part in how both the conditions and treatments are understood. These factors include diagnostic and assessment practices, interactions with healthcare professionals, interactions with other people connected with the conditions such as users, as well as alternative practices of handling the conditions. The devices are part of a complex network of practices that play a role in how people understand the condition both as something they have and something that is treatable. It is the practices in these networks that relate to the devices' continuing absences or potential introduction that constitute the practices of pre-use, as we have framed them in this project.

2.Pursuing the Research Agenda

The investigation of 'pre use' was undertaken during the course of a four year industrial research project. The project, Innovating with Pre-Users of Medical Devices, was a collaboration between two Danish medical device manufacturers, Novo Nordisk AS and Oticon AS, in addition to the SPIRE research centre for Participatory Innovation. The project involved two PhD candidates, my colleague Ditte Nissen Storgaard, who is from an Anthropological background and myself, with a Product Design background working closely together on much of the research. The project was initiated because both these companies perceived they had a similar problem in that a large proportion of their potential market, people diagnosed with the medical conditions whose health and wellbeing could benefit from using these treatment devices, are reluctant to begin doing so. For research this posed an interesting question as to how user driven design and innovation processes be adapted to incorporate these 'pre-users' of technologies.

The basic focus of this project was then to study and engage pre-users of medical devices in two cases of Participatory Innovation (Buur & Matthews 2008); that of insulin injection with

Novo Nordisk and of hearing aids with Oticon. For type 2 diabetes pre-user refers to people who were diagnosed with the condition but were not yet users of insulin, as people are unlikely to be aware they have diabetes before they are officially diagnosed. While the pre-users of hearing aids referred to people who were in some way aware they had a problem, whether or not they had an official diagnosis, as it is a condition people may have for many years before they seek professional help for it (Engelund 2006). Both diabetes and hearing impairment are long-term chronic medical conditions that cannot be cured. In the first case, reluctance and delay to initiating insulin increases the risk of severe health complications later on, while in the second case, reluctance to accept and use hearing aids severely impedes participation in social life and may lead to early retirement from the work force. In both cases the crucial issue relates to expediting patients' access to a medical device.

In the original project framing, which was written in collaboration with the companies, the aim was to create an understanding of the barriers inherent in the transition from pre-user to user and to develop methods that successfully involve pre-users in innovation processes in order to uncover new product development and business opportunities. The intention was also to develop an understanding of the motivations for delay for these two groups in the adoption of the technologies, and learn how to engage pre-users in participatory design and innovation processes in order to develop design solutions that cater for their specific relationship to the treatment and technology. In addition this included exploring the challenges faced by the industrial companies in innovating offerings of value both to themselves and the pre-users, while operating within the constraints of healthcare systems and institutions. Addressing these aims involved exploring the research question of 'how design and innovation processes that focus on user involvement could be adapted to incorporate 'pre-users' of technologies and what kinds of design opportunities would be brought into view by doing this?'

Novo Nordisk

Novo Nordisk is a global healthcare company and the world's largest manufacturer of insulin; the company's main focus is on diabetes care. With headquarters in Denmark, Novo Nordisk markets its products in more than 180 countries (www.novonordisk.com/about_us). Its largest market is the USA which accounted for 34 % of global sales in 2012, (Ibid). In addition to insulin, since 2009 Novo Nordisk has also produced another kind of injectable diabetes treatment, a GLP1 drug, under the brand name Victoza®, which in 2012 accounted for approximately 68% of the total GLP1 market. These drugs are the company's main business area, but they also design and produce pen-like injection devices for their drugs. The first of these, the NovoPen ™, was launched in 1985 and since then devices have become an competitive aspect of product sales. The NovoPen and its successors have been recognised as an exemplarily designed product for use (Jordan 2002), with the most recent non-disposable version of the pen receiving a Red Dot design award in 2012. It is within the Device Research and Development area of the company that this project has been based.

Oticon

Oticon is one of the world's three largest hearing aid manufacturers. With headquarters in Denmark, it is a member of the William Demant group, which specialises in hearing care technologies. Like Novo Nordisk, the USA is the groups largest market, with   North America accounting for 68% of revenue in 2010 (William Demant Group Annual Report 2010). In addition to hearing devices, Oticon provides material and tools to guide and assist the professionals dealing with their products, and the people using the devices. Oticon was responsible for the world's first fully digital hearing device, the world's first fully automatic hearing device and world's first hearing device with artificial intelligence (ibid); their Intiga device won both the Danish Design Award 2012 for Industrial design, business-to-consumer and the People's Choice Award 2012 (www.ddc.dk). The project has been mainly based at Oticon's research center, Eriksholm.

Note :I mention these awards and recognitions here to highlight that while it is often possible to blame poor product design for a products' lack of desirability, here that is not necessarily the case.

Condition profile: Type 2 Diabetes

There are 371 million people in the world with diabetes, at least 90% of these are type 2 diabetes (www.idf.org/types-diabetes). In 2012 there were 4.8 million deaths due to diabetes. (IDF Diabetes Atlas 2012). Type 2 diabetes is characterised by insulin resistance and relative insulin resistance (www.idf.org/types-diabetes), which in turn leads to high levels of sugar (glucose) in the blood which can damage and functionally impair a number of organs, most significantly the cardio-vascular system. In addition to increased mortality, poorly controlled diabetes can lead to a number of medical complications including kidney damage, increased risk of cardio-vascular events, blindness, nerve damage and increased risk of infection leading to amputation. Type 2 is often referred to as a lifestyle disease and is often but not always linked to obesity, causing insulin resistance which leads to elevated blood sugar levels. The condition is often but not always linked to obesity and being overweight, and usually occurs in older adults, with most people developing it after the age of 40- although due to the growth in obesity, an increasing amount of younger people are developing the condition.

There are many factors involved in the treatment of type 2 diabetes; in addition to medication, lifestyle changes including increased exercise, weight loss and a diabetes friendly diet are also considered to be a critical part of the treatment. In the early stages of the condition, most people can be treated in several effective ways

with lifestyle changes and various forms of medications. Typically people will start on oral medications, while insulin is often considered a last resort when other medications fail to work. Due to this people often consider initiating insulin to mean they have failed in the management of their condition. The condition is actually progressive and if someone lives long enough they will eventually need to be treated with insulin injections no matter how well they have looked after themselves. Using insulin increases the risk of hypoglycaemic events, where the blood sugar level drops to a dangerously low level that can result in coma and death. There is also evidence showing that an unnecessary delay in insulin treatment initiation is likely to result in increased risk of serious future complications related to the disease including reduced life expectancy and compromised quality of life (Goodall et al 2009), but despite this research shows that there is still a reluctance amongst health care providers (HCP's) and people with type 2 diabetes to initiate insulin (Peyrot et al 2005).

Condition profile: hearing loss

In 2005 there were over 31 million people with hearing loss worldwide, most of which were age related (Kochkin 2005). Age related hearing loss is a gradually developing condition that can take many years to progress. Age-related hearing loss is caused by the degradation of some of the receptors in the inner ear that detect different frequencies of sound. When receptors in the frequencies in the range of human speech are damaged, which they commonly are, it becomes harder for people to distinguish the sounds of letters within words which makes verbal communication increasingly difficult (Worsoe and Elberling 2006), which can have serious personal and social consequences for people. A 2006 Danish study indicated that people with hearing problems have a degraded experience in their working lives, which may be decisive in whether or not they take early retirement (Christensen 2006) and more significantly recent studies have also made a comprehensive link between hearing loss and the onset of dementia (Lin et al 2011) as well as generally diminished cognitive abilities (Lin 2011).

This kind of hearing loss is incurable, but many of the effects can be ameliorated with the use of hearing aids which can amplify the relevant frequencies of sound in the environment into the hearer's reduced hear-able range. Despite studies that show that nine out of ten users of hearing aids thought their hearing aids improved their quality of life (Kochkin 2005), in both the US and Europe only around one in four people for whom hearing aids could be beneficial actually use them (ibid, Hougaard and Ruf 2011). Studies show that hearing impaired people believe the general public associate hearing loss with being old, as well as being disabled and stupid, and that stigma is a relevant reason for choosing not to wear hearing devices (Pelz et al 2005). Additionally as the onset is gradual, many people may not realise they are losing some of their hearing abilities and they themselves will not be the first to notice their hearing difficulties; rather it is frequently their partner, friends or colleagues who will notice first. This means that it can take a long time for people with a hearing impairment to recognise and accept that they have a problem hearing (Engelund 2006).

2.1 Research approach

In order to investigate this research question a research approach was adopted where the practice of designing was the central means through which knowledge was constructed. This kind of approach is often described as 'research through design', a term coined in a working paper by Christopher Frayling (1993). However in response to several criticisms that this concept, not least the lack of theoretical grounding and guidance for building up a working research practice in Fraylings original paper, Koskinen et al (2011) in their book on design research through practice, have proposed a new term, 'constructive design research', which they use to describe "*design research in which construction- be it product, system, space or media- takes center place and becomes the key means in constructing knowledge*" (ibid p.5). This is a research approach where the deployment of design skills is seen as key to the generation of knowledge. "*When looking at the 1990's it is clear that what people like Tom Djajadiningrat in the Netherlands, Anthony Dunne in England and Simo Säde in Finland did in their doctoral work was solid, theoretically and methodologically informed research that could not have been done without a design background*" (ibid p.6). One example of constructive design research is the iFloor project where an interactive floor built into the main lobby of the city library in Aarhus was designed and developed, and from which two doctoral theses were produced (ibid p.1). In the Innovating with the Pre-users of Medical devices project a similar constructive design research approach has been adopted. The aim has been to discover how design and innovation processes that focus on user involvement can be adapted to incorporate 'pre-users' of technologies and what kinds of design opportunities would be brought into view by doing this.
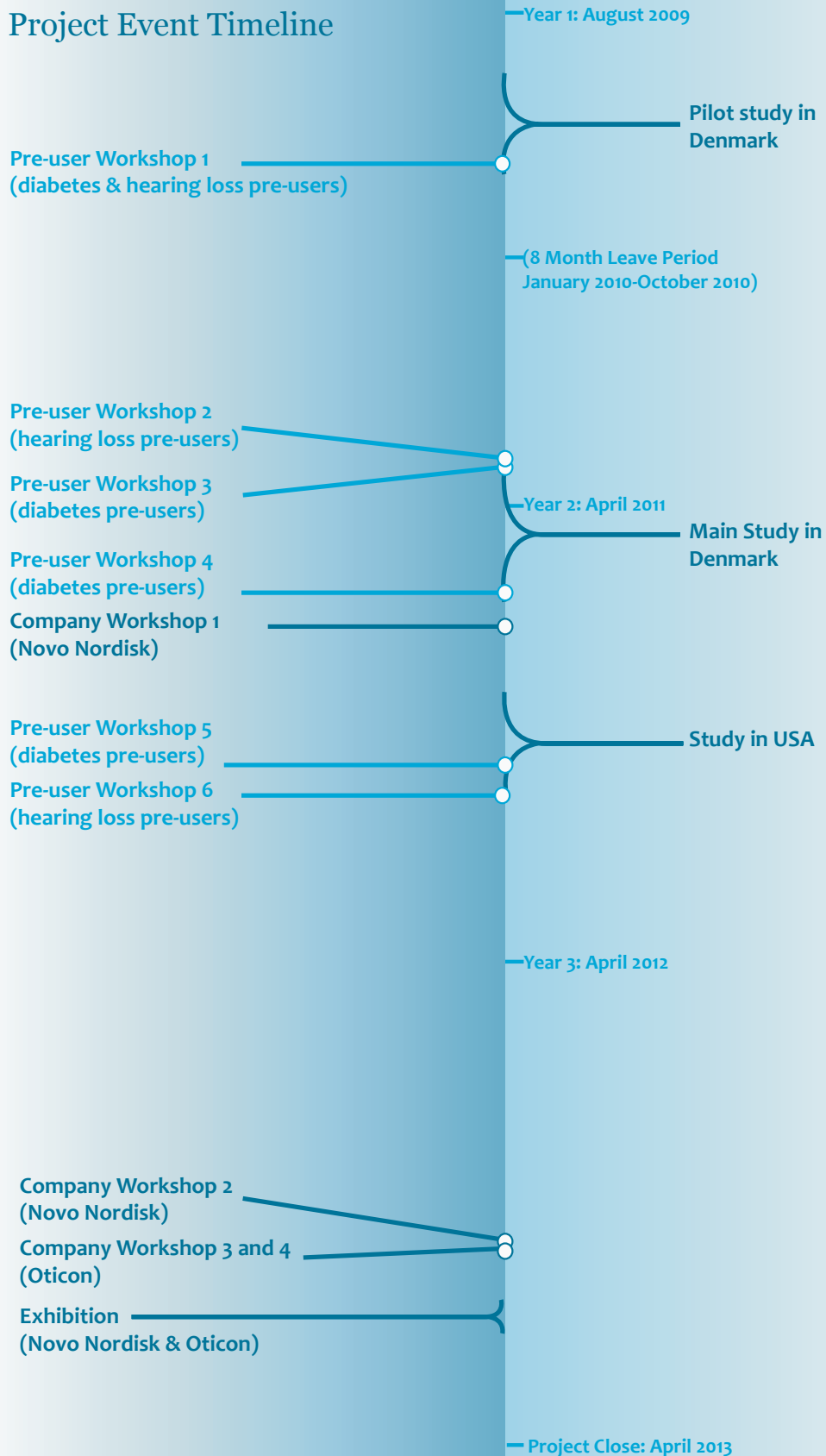
As design research is an emerging field there has been a tendency to adopt methods and approaches from more established fields that are ill suited to the nature of the design setting (Stolterman 2008). In particular attempts to apply scientific standards of rigor, including the principles of falsification and repeatability, have been criticized (ibid, Cross 2001) for failing to appreciate the nature of design practice and the kinds of problems it deals with. As Rittel and Webber (1973) argue, unlike other kinds of problems that are researched in different fields, design problems are 'wicked', which means that amongst other things they have no definitive formulation or solution and therefore cannot be falsified (Buchanan 1992, Gaver 2012). Additionally, design deals with the particular, not the general, so notions of repeatability are difficult to align with design practice, "*Design is about the unique, the particular, or even the ultimate particular. Designers have to address the people and situations at hand, and the desires and needs at hand, while taking into account the limited time and resources at hand.*" (Stolterman 2008 p. 59). Knowledge generation in design research through practice must

accommodate the unique qualities of that practice.

Brandt and Binder (2007) propose that knowledge generation in design research should be considered to involve three parts: firstly the evidencing of a traceable 'genealogy', in other words whom and what the knowledge is intended to address along with the debate and dialogue the research participates in, secondly 'intervention' the alteration of the world through experiments and finally the 'argument' that is generated from this. With this understanding, Dalsgaard (2010) argues validity in design research should be achieved through rigor in terms of multiple and well-documented experiments, clearly articulated, as well as a contestable argument. "*When presenting their findings to the research community, interaction design researchers should strive to make clear the process by which they reach their findings, as indicated by the notion of genealogy, as well as adhering to the notion that the argument presented should be contestable*" (ibid p.202). Validity in constructive design research can be achieved through a traceable process, a rigorous deployment of experiments and clearly articulated arguments, which can also sometimes be embodied in the design outputs.

In order to investigate in a rigorous manner how design and innovation processes that focus on user involvement can be adapted to incorporate 'pre-users' of technologies and what kinds of design opportunities would be brought into view by this, a program of research activities has been developed and conducted. These activities fall roughly into three categories; ethnographic field research, the development of design concepts and artefacts, and the staging of interventions. These research activities were conducted simultaneously over three studies: a pilot study in Denmark, a larger study in Denmark and a three month study in the USA, the latter at the companies' request as it is their largest market. These studies were used to inform each other. In addition to ethnographic fieldwork, throughout these studies design concepts and artefacts were developed, and interventions staged in the form of collaborative design workshops both with pre-users and company representatives, as well as an exhibition within the companies towards the end of the project. The studies were driven by several events (see Project Event Timeline) with periods of analysis and design in between them. In the rest of this chapter I will go through each of these categories of research activities in order to establish their validity, describing what the activities involved, how they were conducted and documented, as well as how they interrelate.

Project Event Timeline

Year 1: August 2009

Pilot study in Denmark

Pre-user Workshop 1 (diabetes & hearing loss pre-users)

(8 Month Leave Period January 2010-October 2010)

Pre-user Workshop 2 (hearing loss pre-users)

Pre-user Workshop 3 (diabetes pre-users)

Year 2: April 2011

Main Study in Denmark

Pre-user Workshop 4 (diabetes pre-users)

Company Workshop 1 (Novo Nordisk)

Pre-user Workshop 5 (diabetes pre-users)

Study in USA

Pre-user Workshop 6 (hearing loss pre-users)

Year 3: April 2012

Company Workshop 2 (Novo Nordisk)

Company Workshop 3 and 4 (Oticon)

Exhibition (Novo Nordisk & Oticon)

Project Close: April 2013

2.2 Ethnographic studies and fieldwork with pre-users

Ethnographic field studies were used in the research as a way of developing an understanding of some of the existing situations and practices that related to pre-use; those practices that could influence the contextual conditions for use. These studies were intended to provide an understanding of the current situation for design from which hypotheses about alternative futures could be developed. I conducted the field work together with my anthropologist colleague Ditte. As our starting point we took the handling of the medical conditions, focusing in particular on what was happening in clinical interaction, where the conditions were discussed between pre-users and health/hearing care professionals. This was based on an assumption that the clinical interaction was where the main decisions about treatments happen; making it a highly important situation in whether or not someone begins to uses the devices. We also chose to complement this focus with an investigation into people's everyday lives, and the everyday practices and situations that relate to the conditions, by visiting pre-users in their homes and conducting interviews with them, as well as inviting some of them to document their experiences with an auto-ethnography kit and conducting participatory observation in related settings (see the fieldwork activities cards on p.26). In total in this project we observed and recorded 23 health/hearing care professionals in action in 77 consultations, and sat in to purely observe several more. Follow up interviews with 31 pre-users were conducted in clinics, 21 pre-users were visited and interviewed in their homes, and auto-ethnography kits were completed by 7 pre-users, with follow up interviews. These interviews and observations were thoroughly documented with audio and video recordings where possible, as well as with field notes.

As the project progressed the approach to these fieldwork activities was refined, informed by the work that had already been completed. Thus the focus of the fieldwork was not only broadened but also evolved as a deeper understanding of the field was gained. For example, during interviews with pre-users of hearing aids in their homes in the pilot study, several informants revealed that their family and partners had played a role in making them aware of the extent of their hearing problems. One informant told us for instance that it was his children who had been the first to tell him he was losing his hearing. During the second study in Denmark we decided to explore this issue further by trying where possible to get couples to interview. During these interviews couples seemed to demonstrate disagreement over the extent to which the hearing loss was problematic, with the partner of the person with hearing loss claiming to find it more problematic than their husband or wife claimed it was.

Fieldwork activities cards

## Participatory observations in clinics

We conducted participatory observations in a total of 15 clinics, including general practitioner health clinics, ear, nose and throat clinics and audiology clinics. We spent 1-3 days in each clinic and sitting in on consultations, recording those between health/hearing care professionals and pre-users. From these we observed how health/hearing care professionals and pre-users communicate about the conditions, how the conditions are assessed, how treatments are discussed and how actions are decided upon within the interaction.

Interviews at pre-users homes.

We interviewed a total of 21 pre-users in their homes at least once, spending 1-2 hours with them. These interviews were used to help understand how pre-users experienced the conditions and their treatments in their everyday lives outside of the clinics. In these interviews we were given a range of narratives from pre-users that covered topics including how they first came to realise they had the condition, the different measures they took to accommodate it in their lives and how they saw the future living with the condition, as well as their opinions about treatments.

Auto-ethnography kits
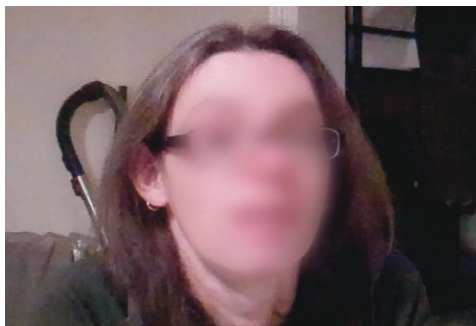
The auto-ethnography kits were handed out to pre-users in the USA who we had already interviewed, three with hearing loss and four with diabetes. Both kits included a task where the pre-user had to interview someone close to them about their condition and a task where they had to track an aspect of their condition, while with hearing loss, the problems they were having and with diabetes their perceived blood sugar level throughout one day. The kits created a detailed picture of how the conditions were experienced in people's daily lives and relationships.

Observations in other settings

We wanted to extend our understanding of the conditions to other settings where they are made relevant. This proved to be very difficult with hearing loss as there are few settings where this kind of hearing loss is dealt with outside clinics. With the diabetes we attended an educational course, and took part in participatory observation in a cookery class there. From this we were able to observe how diabetes was addressed as a lifestyle issue, outside a medical context.

Developing a hypothesis from this that hearing loss played a role in relationship dynamics in couples, when we gave informants who participated in the final study an auto-ethnography kit, we included a task in which we asked people with hearing loss to video interview someone close to them about it and then interviewed them about their reflections on this afterwards. What in particular became evident from this was that the informants with hearing loss had not been aware of the extent to which it was causing other people problems before the exercise. For example one informant who interviewed the carers that stayed with her to help her look after her elderly mother, was surprised to discover they actually avoided talking to her because of her hearing loss, " *I also interviewed a second care giver, who told me something very startling – she told me, because of my hearing loss, she hesitates to talk to me – because she thinks it bothers me when I have to ask her to repeat things, so it prevents – it is an impediment for her even talking to me. I did not realize it had that kind of effect – that it would prevent somebody from talking to me.*" This activity in turn led us to understand that hearing problems are potentially linked to other communication problems in relationships and that a person with hearing loss maybe unaware of the extent to which it is problematic for other people.

The evolution of the fieldwork approach was not only informed by findings from the ongoing field studies, but also from the artefact development and intervention staging happening in parallel. For example in Pre-user Workshop 1 which we conducted towards the end of the pilot study we introduced a series of concepts that were meant to be provocative, called critical artefacts which were based on measuring technologies (see table 1). They included one concept for the diabetes domain; a plate that would use colour to indicate the healthiness of the food on it for someone with diabetes by changing colour, and intended to represent an alternative to measuring blood sugar after eating. The reaction of the participants was at first dismissive, with one suggesting the concept was "*for babies*", but then the same participant went on to suggest that the idea might be useful for people who had just been diagnosed with the condition. This led to a hypothesis that the practice of measuring blood sugar plays a role in people developing a sense of expertise in their condition. We therefore put further focus on this in our fieldwork by including an activity in the auto-ethnography kit asking people with diabetes to chart what they believed their blood sugar was during the course of a day and explain why, as well as looking at other ways people gained expertise in their conditions, such as participating in cooking classes that were being run for people with diabetes. Overall while conducting the fieldwork research we meticulously documented the activities and repeatedly returned to the field as our understanding developed in order to deepen our knowledge of the themes and issues we had identified, and interrogate our emerging hypotheses in order to establish their soundness.

Notes on a Collaboration between Design and Anthropology

A close collaboration between design and the analytical discipline of anthropology has both dominated, and defined much of this project and the notion that the generative discipline of design involves its' own particular form of analysis has been an underlying aspect of how it has been approached. The employment of anthropology, or more specifically the field research methods of ethnography that belong to the discipline, is now well established as part of user centred and participatory design processes. Still there is much debate as to precisely what should be the relationship between the two disciplines and how ethnography should be integrated within design projects. According to Dourish for example, the value of ethnography to design that it reveals a way of looking at the world, "*the value of ethnography then is in the models it provides and the way of thinking it supports*"(Dourish 2006, p.549), that the point of ethnography is to provide an analytical perspective that creates a particular way of reflecting on what is going on. Crabtree & Rodden (2002) on the other hand argue that ethnography should assume an exploratory role in technological innovation, "*the aim is to explore the sociality of novel design spaces opened up through the deployment of radical technology configurations in real world situations of use,*" (Ibid, p.71). They argue that ethnography can be a means to explore what happens when experimental technology designs are introduced into real world contexts, while Buur and Sitorus have gone as far as to deploy ethnographic material as a tool to provoke deeper reflection on the technologies under development, "*Rather than convey findings in a rational argument, we have experimented with formats where the role of ethnography is to provoke engineers to reframe their perceptions of new designs,*" (Buur and Sitorus, 2007 p.14).

A critical issue regarding the integration of ethnography and design is that, as Blomberg et al argue, they come from very different traditions and have different objectives (Blomberg et al 1993). While ethnography is a way to understand practice, design ultimately seeks to alter it. In the developing field of design anthropology there is an increasing interest in how collaborations between the two disciplines can be mutually supportive of their distinct objectives. Halse (2008), suggests that the disciplines of design and anthropology can resource each other, that anthropology can be a kind of design as it in a sense designs new ways of seeing, "*I have asked of the reader to think of anthropology as if it were a special form of design, based on the idea of the ethnographer as a special kind of reinventor and reshuffler of realities*"(ibid p.208) and conversely that the tangible creations of design can serve as means for the formation of these new perspectives, "*that playful design interventions work to open new ways of conceiving the world, and that the concrete techniques for doing*

this are a potential resource for anthropology"(ibid p.208). This suggests a working practice where the two disciplines are integrated and mutually support each other.

Closer to Halse's suggestion, we have approached this project with the perspective that both anthropology and design can make their own particular way of understanding available as a resource for the other. This project has involved a close collaboration between design and anthropology where representatives of the two disciplines have attempted to work together and utilise the other's skills in order to further their separate research agendas; mine focused on opportunities for design, while my anthropologist colleague Ditte was interested in collecting data to support the writing of an anthropological analysis. On a practical level this meant, collaborating on parts of the project that could contribute to both agendas. The planning and most the fieldwork and design activities was something we did together, and through our discussions before, during and after these activities we were able to share and influence each other's understandings. This was a way of working where we each maintained our disciplinary role, with me taking main responsibility for the generation of concepts and artefacts, and Ditte taking main responsibility for conducting thorough fieldwork. Together we were able to generate hybrid outcomes, an understanding of the field that was relevant to design and design interventions that could be used to better understand the field. We held frequent conversations as we were sitting and working together as well as during the work we did together out in the field. These conversations were used to direct each other's analytical gaze; where Ditte as an anthropologist would suggest ways of looking beyond the obvious in what was going on in the field and in the data. I in turn would look for what could be interesting for design and try and draw the attention there. Here ethnography was not conducted purely to serve the purposes of design, nor design interventions applied purely to give the anthropologist a new way of seeing the field, but instead we have built on each other's skills and practices in order to achieve our own disciplinary objectives. I believe that this way of collaborating has successfully pushed the design agenda much further than if I had been working alone.

2.3 The development of design concepts and artefacts.

Throughout the project artefacts and concepts were designed and developed in order to explore how the developing understandings of pre-use could contribute to design and what design opportunities could be identified through focusing on pre-use. The artefacts were developed in response to the hypotheses that were emerging from the fieldwork about current practices, but also embodied hypotheses about what future practices might be like. The design development process, including concept sketches, scenarios and annotations about the design decisions were carefully documented in sketchbooks (see figure 1) and with photographs. The concepts were then brought back to pre-users and company representatives in the form of models, prototypes and visualisations, which were often part of workshop activities and other forms of intervention. Throughout the project themes were continuously revisited and iteratively developed in line with the developing understanding of the practices and issues at stake for pre-users.

One example of a theme that was prominent throughout the project and thoroughly explored through the development of design concepts was 'the assessment and measurement of the conditions' (see table 2). This was a theme that emerged early in the process based on insights from the fieldwork that measuring the conditions, either in the form of hearing tests for people with hearing loss or blood sugar measuring for people with diabetes, was an intrinsic and seemingly problematic part of people's experiences of them. The early fieldwork seemed to imply that people found the abstract nature of these measurements of their bodies in the form of numbers, difficult to relate to in their everyday lives. In the Pre-user Workshop 1 towards the end of the first study, the concepts designed for the critical artefacts activity were based on this theme. Although these were not meant to be realistic responses, the concepts explored how measuring in relation to the conditions could be externalised from the body, in order to relate it more directly to the things people were doing. For example a concept for people with hearing loss was an app that would show which conversations in a room would be easiest to hear. The theme of assessment and measurement was then explored further for the Design Thinking Research Symposium Paper where concepts were developed that included an app for the hearing loss side that would visualise the sound environment to show people the amount of sounds they were not hearing.

In the third study in the USA the theme was further explored with a concept for an alternative way of measuring hearing loss by recording the frequency of problems, this was explored and tested by incorporating it into an activity in the Auto-ethnography kit. Then the

theme was used to develop concepts that were incorporated into artefacts for activities in the Pre-user Workshops 5 and 6. On the hearing loss side for example, also inspired by the insight from the fieldwork that hearing loss was linked to communication problems in relationships, a concept for a reflection tool was developed. The Whose Problem Game involved asking the participants to assess how problematic their hearing loss was for both them and other people, in specific situations. This idea was then refined further and presented as a concept for a reflection and dialogue tool in the exhibition that was held within the organisations. This example is one of over several key themes that were continuously iterated on throughout the project, being returned to and significantly developed further between three to fives times each.
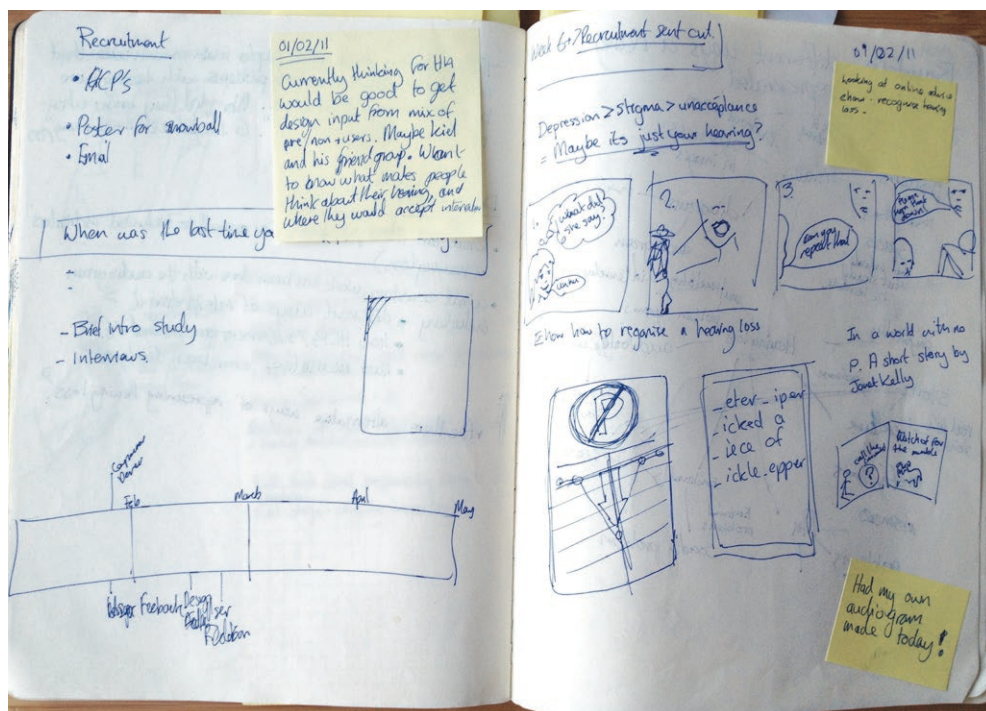
Figure 1: Annotated sketchbook page

Table 1: the development of the critical artefacts

Pre-user Workshop 1

Pre-use Domain: hearing loss and type 2 diabetes.
Purpose: Introduce discussion about technologies in a sensitive manner.
Artefact Intent: Obviously unrealistic, ranged from uncontroversial to very controversial, based on measuring technologies.
Main Topics of Responses: consequences of making the condition visible, non-relevance of measuring to the expert user, technologies as an alternative to current practices of handling and interpreting the condition.

Pre-user Workshop 4

Pre-use domain: type 2 diabetes.
Aim: Introduce discussion about controversies around treatments.
Artefact Intent: Embody controversy by combining a desirable aspect with an undesirable one; explore themes of convenience, naturalness, presence of condition in daily life.
Main topics covered by responses: safety of treatment, reliability of technology, convenience, interpreting the need to treat, stigma.

Pre-user Workshop 5

Pre-use domain: type 2 diabetes.
Aim: Introduce discussion about relating measurements to life practices.
Artefact Intent: Possibly realistic in the future, embody different ways of relating to blood sugar measurements, including having it as a constant presence, linking it food and linking it to future risk.
Main topics covered by responses: non-relevance of measuring to the expert user, the acceptability of scare tactics, futility of relating to risk.

Pre-user Workshop 6

Pre-use domain: hearing loss.
Aim: Explore perceptions of hearing aids.
Artefact Intent: Represent realistic but unfamiliar technologies to the participants. Embody different technological possibilities for hearing solutions including function, cost, convenience, stigma and visibility. A real hearing aid was also introduced during the session.
Main topics covered by responses: stigma, convenience, attractiveness and making hearing loss visible.
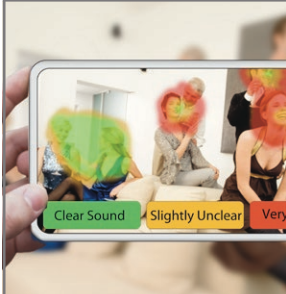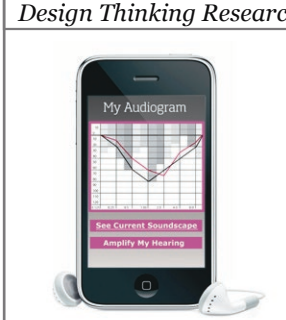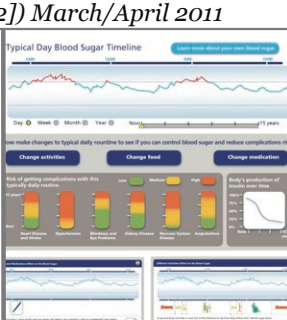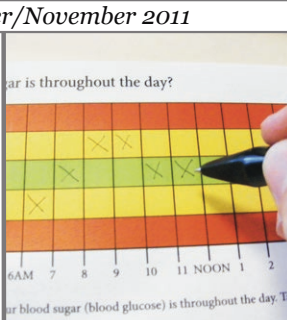
2.4 Interventions with pre-users and within the organisations.

Many of these artefacts were deployed as part of a series of ongoing interventions that were staged throughout the project, mainly taking the form of workshops. In total we conducted six of these workshops with pre-users, plus four additional workshops within the organisations and an exhibition that served also as a deliverable to them. Additionally, the auto-ethnography kits, which were deployed as part of the fieldwork with pre-users, served a double purpose as an experimental intervention. Many of these interventions had an exploratory nature and were intended to inspire unexpected responses, rather than just testing the hypotheses and design ideas that were emerging. They left room for the participants to bring entirely new perspectives to the material and ideas that were being presented as well as experimenting with ways to provoke novel practices and behaviours. All the interventions were documented with video and audio recordings, along with photographs of the images generated for and as part of them.

In the workshops a range of different activities and methods were used to stage these interventions, some of which were used consistently over the period and evolved along with it. One of these was the Critical Artefacts method that was used in four of the workshops with pre-users (Pre-user Workshops 1,4,5 and 6), across all three studies. This is based on the approach of Critical Artefacts Methodology (Bowen 2009a, Bowen 2009b), which was inspired by the critical design tradition and uses provocative design concepts to foster innovation in co-design activities. The method was adapted as a way of provoking reflection on specific aspects of treating and living with the medical conditions, in order to explore and test emerging hypotheses, such as the hypothesis that measuring the condition influenced how people understood the conditions and therefore that changing the way it was measured would change the way people understood it. At the same time the activity provided a platform for introducing potentially sensitive issues in an indirect way, so as to avoid confronting the participants with them, by embodying them in the form of artefacts. Table 1 gives an overview of how the critical artefacts method was adapted and developed throughout the project including the different intended purposes of the workshops, the intent behind the artefacts and what topics were actually covered by the responses they provoked. We continued with this method throughout the project as it proved to be a good way of introducing a sensitive issue in an indirect way that provoked further reflection and discussion amongst the participants.

Other experimental activities that were staged in the workshops included ones that centred on co-analysis. For example in Workshop 4, we used a co-analysis method called A-frames (Clark 2007) where pre-users with diabetes type 2 were given stories on a folded piece of

Table 2: The development of artefacts exploring the theme of measurement

Hearing Loss	**Type 2 Diabetes**
Pre-user Workshop (pilot study) (see[P1]and[P2]) November 2009	

Critical Artefacts: These concepts tried to explore hearing measurement as something external to the body, the concepts involved measuring the acoustic environment and communicating it in ways that ranged from discreet to public.

Critical Artefacts: These concepts tried to explore measuring blood sugar as something external to the body, the concepts involved measuring the affect food would have on blood sugar and communicating it in ways that ranged from discreet to public.

Design Thinking Research Symposium Paper (see [P2]) March/April 2011

My Audiogram: This concept explored a way to make it easier to relate the real life experience of hearing loss in situations where it caused problems to the audiogram, the main medical diagnostic tool used to assess hearing loss.

Making Sense of Blood Sugar: This concept explored a way to help people understand how blood sugar levels can be controlled by the different parameters of medication, exercise and food, and how these relate to the long term risks.

Auto-ethnography Kits (in the USA) (see [P3]) October/November 2011

Daily Problems Chart: This task in the kit explored how measuring the frequency of hearing problems experienced could be an alternative way to assess hearing loss.

The Blood Sugar Chart: This task explored how people perceive their blood sugar changes over the course of a day and tracking this changes the way they thought about it.

Pre-user Workshop (in the USA)(see [P3]) November/December 2011

The Whose Problem Game: This concept explored how hearing loss could be assessed by how problematic it was both for the person with hearing loss and their communication partners.

Critical Artefacts (Risk Predictor, Blood Sugar Watch, Food Scanner): These concepts explored a range of different ways measuring technologies could mediate between actions taken to treat the disease and the consequences.

The Exhibition within the Organisations (see [P4]) November/December 2012

Shared Assessment Leaflet: This concept explored how assessing how problematic hearing loss is both for the person with hearing loss and their communication partners, could be used to create reflection and dialogue.
ACT on Diabetes: This

concept explored how it would be if, rather than getting a numerical reading when measuring blood sugar, people with diabetes were given a suggestion as to how they should act on it.

paper that had come from fieldwork activities conducted with informants who were not at the workshop, the A-frames, and asked to identify key themes and group them (see figure 2). This activity not only provided a new perspective on the material, but also gave an insight into how the informants interpreted the behaviour of people in a similar situation to themselves. Later in the project in Pre-user Workshop 5, another co-analysis activity was conducted with people with diabetes. This time we wanted to explore the theme of people's ideas and pre-conceptions about insulin so we asked them to sort and prioritise statements about insulin, which had come from the fieldwork, in terms of which they found most concerning. This activity gave us further insights into people's relationship with the prospect of using insulin, such as that people were concerned about beginning to use it because they were afraid it would not work and they would have no other options. The activity was not just intended to be co-analysis, but also to explore a potential design direction by experimenting with practices of encouraging people to articulate their concerns about becomeing a user of the drug. Using the statements as prompts the participants were very quickly able to prioritise their concerns, which suggested the format could be adapted to be concept for a tool used by healthcare professionals to ensure that they were addressing the most important concerns when they discussed insulin with their patients. In a similar way the tasks in the auto-ethnography kits were also an experiment with encouraging self-reflection on the impact of the two conditions in order to explore this as a design direction, as well as being combined with self-documentation in order to further the fieldwork investigation.

Within the organisations the workshops mainly focused on disseminating the knowledge that was being generated and ideating on the themes and design directions being generated with methods like Doll Scenarios (Halse et al 2010). The main intervention within the organisations was the final exhibition, which consisted of a collection of design concepts, along with stories from the fieldwork. The artefacts in the exhibition were intended to provoke reflection on the issues at stake as well as to communicate findings. Opening and closing events were held in order to get feedback from selected visitors and an exhibit was included where visitors could leave comments in order to not only gain an insight into the organisations response but to make that response part of the exhibition. One example of an exhibit is the 'Revealable Hearing Aids', which presented a design for hearing devices that would make communication a shared responsibility by lighting up whenever the person with hearing loss needed extra help to hear. This concept was in contrast to the ideology of the entire hearing aid industry that hearing aids should be as invisible as possible and elicited a range of responses from the company representatives ranging from the very positive "*I think the idea is brilliant!*", to immediate rejection "*sorry- everybody has some degree of vanity. Would you seriously use this yourself,*" which gave further insight into the extent to which certain ideas were ingrained

within the organisations. In addition to the postcards, the discussion and questions from the opening and closing session were documented with video and photographs.

As Brandt and Binder (2007) suggest, these interventions were used as experiments to further examine and interrogate themes and hypotheses from the fieldwork, as well as to investigate potential design directions. They provided a platform for the deployment of artefacts and design concepts that had been developed as part of the project, both with pre-users and within the two organisations that sponsored the project. Interventions were a way of eliciting insights both about the current and potential future practices, that otherwise might have remained hidden. As part of these interventions, processes and methods for pre-user involvement were implemented and tested, and potential design opportunities were iteratively explored.

Figure 2: A-frames activity

3. Research Contributions

The central contribution of this dissertation is the conceptualisation, exploration, investigation, and critical assessment of pre-user driven design. As part of this contribution the temporary removal of the focus of design from use is identified as having the potential to be a general strategy for design. This contribution incorporates novel methods for the deployment of artefacts in an explorative and analytical role, which have been generated and evaluated in the course of undertaking a pre-user driven design process. In chapter 1 I described how the concept of pre-use relates to current discussions on the notions of use and the user in design, and in chapter 2 I explored the research agenda. This chapter goes on to describe some of the details of this contribution, indicating how the five papers included in this dissertation elaborate the different aspects. I outline the distinguishing aspects of a pre-use driven design process and show how the particular characteristics of pre-user participation can be accommodated in design and innovation processes. I then go on to discuss the broader impact and potential benefits of temporarily removing focus from the user in design, before finally setting out an argument for the use of artefacts in an exploratory role in constructive design research projects.

3.1 The characteristics of a pre-user driven process.

A pre-user driven process requires a shift in mindset away from looking for opportunities to directly solve problems or meet needs, towards looking for opportunities to indirectly influence a situation through a variety of means. The practices of interest when looking at pre-use are not a coherent set. Instead pre-use is interested in a multitude of dispersed but interrelated practices that can influence whether or not people will become users of the medical devices. These are what I have previously described in this thesis as the contextual conditions that play a part in determining whether or not use will occur. Very few of them can be identified as directly causing or preventing people becoming users, and none can be singled out as the main barrier to use; yet all can affect use. As a result of this it is not possible to 'solve' the problem of pre-use, in the sense that there is no singular problem space to be addressed. However the contextual conditions can be influenced through identifying opportunities to alter individual practices. This means that a pre-user driven design process has to be approached with an aim to influence a situation, rather than to provide a definitive solution.

A pre-user driven process is more open at the outset than those design processes in which users and use contexts have already been identified, in which case some kind of model of anticipated use, and therefore an idea of what is being designed, is already in place (Stewart & Williams 2005). This therefore aligns designing for pre-use with more explorative, open-ended processes where the aim is to identify entirely new ideas for products and services, such as in participatory innovation projects (Halse et al 2010) or in projects which seek to find applications for new technologies (Brereton & Buur 2008, Crabtree 2004). These are processes that are open-ended and exploratory in the sense that there is no model of anticipated use or idea of what the solution will be like at the outset. However they still have specific aims for what these outcomes should achieve, such as improving waste management (Halse et al 2010) or finding applications for ubiquitous computing technologies (Crabtree 2004). What differentiates these open-ended design explorations from a pre-user driven process is that they can develop outcomes that directly address the project aims, even if the form that these responses will take is unknown at the start. In the case of pre-use however, the project aims can usually only be addressed indirectly, through outcomes that respond to an obliquely related issue.

As design generally responds to indeterminate 'wicked problems' (Rittel and Webber 1973), defining and framing the problem that is going to be addressed is a key aspect of the process (Dorst and Cross 2001). Problems are framed through the identification of solutions

(Buchanan 1992), and problem/solution pairings 'co-evolve' as two distinct search spaces that interact over time in the design process (Maher et al 1996). In user driven processes, where a model of anticipated use exists from the outset, there is an already an initial problem framing and an idea of what a solution might look like. This then becomes a starting point for further exploration and development. However in a pre-user driven process, like in other exploratory and open-ended processes, the framing of initial problems through the identification of opportunities and potential solutions is the key activity at the outset. In doing so different models of anticipated use are created, what I describe in [P2] as crafting it into a 'solvable' problem. It is important to note that in a pre-user driven process the problems and solutions being identified must overlap with opportunities to change people's relationship with an existing design (the medical devices).

In [P1] I describe how the initial fieldwork led to the identification that the numerical diagnostic measurements of the conditions could be abstract and difficult for people to relate to. In turn this had the potential to impact people's decision to become a user of the devices as it made it hard for them to understand why they needed to treat the conditions and therefore use the treatment technologies. This was therefore a problem framing that overlapped with the problem of pre-use. In [P2] I go on to describe how this was framed as a 'solvable problem' through the identification of a solution in the form of counselling tools that directly linked the measurements to the experiences and consequences of living with the conditions. This then became a starting point for creating a new model of anticipated use and reframing the pre-user as a potential user of another artefact, in this case the counselling tools. This direction was iteratively developed throughout the project (see for example Making Sense of Blood Sugar' [P2; p.115] 'My Audiogram' [P2: p.116], 'The Insulin Concerns Game [P3; 139-141] and 'Shared Asssessment, Hearing aid Coach, 'Insulin Introduction kit' and the 'Information Underload Service [P4; p170-171]), and although the initial solutions and problem framing were altered and redefined continuously, the overlap with addressing ways to change people's relationship with use was maintained.

As a pre-user driven process is interested in all the circumstances that influence whether or not people become users, it requires designers to consider a multitude of interconnected practices simultaneously. This means looking at the 'ecology' of pre-use (Kaptelinin & Bannon 2012), a notion has been used to promote, "*an understanding of artifacts as "species," whose survival is determined by a dynamically unfolding interaction with other species in their shared natural environment,*" (ibid p.290). In other words, exploring the existing and potential relationships between people and artefacts in the context and how these are influenced by each other. As a consequence of this it becomes more difficult to scope down and isolate individual, separable problems for design to address simply by introducing new

products and systems. Rather than seeking to integrate the outcomes of a pre-user driven process into a single integrated solution, creating outcomes that are more varied and loosely related allows for indirectly connected opportunities to be utilised simultaneously and as complementary to each other. This means a pre-user driven approach lends itself to the generation of multiple responses to different framings of the problem, rather than a single apposite one. This perspective allows design to consider the range of options that can be designed for in a particular context, influencing not just one but several practices through each other.

In the hearing loss domain, for example, hearing aids in themselves frame hearing loss only as a physical problem within the ear, but in context hearing problems are experienced as many different things in different practices. In order to demonstrate how design could respond to these different experiences and practices, four concepts for hearing loss were developed and presented in the final exhibition within the organisations (see [P4]). One of the concepts,'Shared Assessment' (Figure 2.1), responds to how hearing loss is dealt with in relationships and takes the form of a leaflet that provides both parties in the relationships tools to discuss the hearing loss, while another 'Hearing Aid Coach' (Figure 2.2) provides tools to help coach people through using hearing aids for the first time and to help them communicate with their hearing care professional. The third concept 'Revealable Hearing Aids' (Figure 2.3) uses the hearing aids themselves to make communication into a mutual responsibility by allowing the person with hearing loss to indicate to the people around them when they need extra help hearing. The final concept 'Hearing Awareness' (Figure 2.4), is designed to make people aware of their hearing experiences in general by involving a series of interventions that draw attention to the experience of hearing in different spaces. By acknowledging some of the other ways hearing loss can be framed, design can also alter the way it is framed as a physical problem that can be addressed with hearing aids. In other words these concepts create and respond to multiple framings of the problem, and in doing so re-frame the problem to which the original product (hearing aids) responds. Each of these concepts has the potential to alter different aspects of the contextual conditions that allow for the use of hearing aids. While they work independently, they are not alternatives to each other but rather 'design complements', designs that work in parallel and are complementary, but respond to different framings of the problem.

A pre-user driven design process needs to be approached with an aim of identifying and developing opportunities to indirectly influence the contextual conditions for use within a multitude of interconnected but indirectly related practices. One consequence of this is that in a pre-user driven process there should not be a defined idea of what the outcome should be at the outset. This means that compared to early manifestations of user driven processes
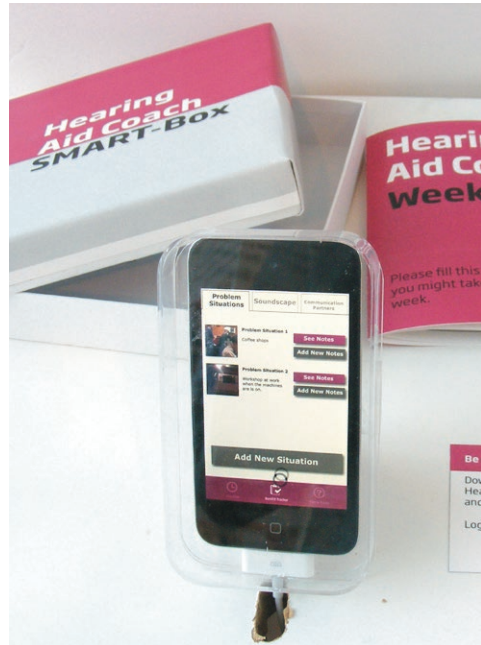
Figure 2.1: Shared Assessment

Figure 2.2: Hearing Aid Coach

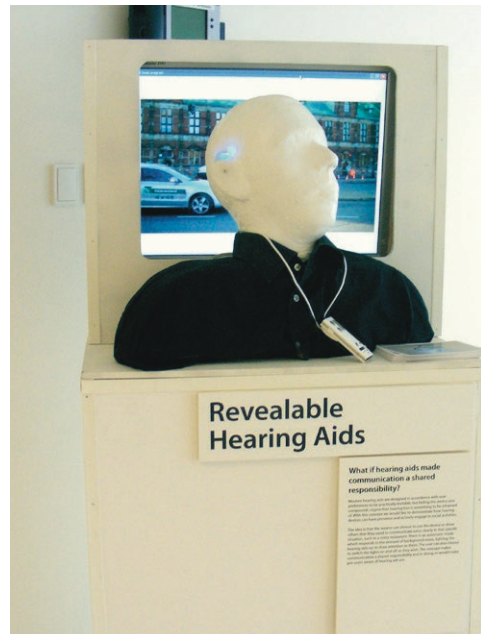*Figure 2.3: Revealable Hearing Aids*

Figure 2.4: Hearing Awareness

such as UCD as Norman (1986) conceived of it or early PD projects (Kensing &Blomberg 1998, Bergvall-Kåreborn & Stahlbrost 2008), where potential users, contexts of use and expected outcomes were identified from the project outset (usually as workers, workplaces and information systems), there is a greater possibility, from the beginning, for what can be explored and the range of outcomes that might emerge. Exploring pre-use is similar to more open-ended approaches that have a mandate to generate opportunities for innovation within a specific domain or context, such as participatory innovation projects (Buur and Matthews 2008). In a pre-user driven process, when identifying and developing potential outcomes in the form of problem/solution pairings, these will be unlikely to be able to address the main aim of the project directly. Instead the problem framings must indirectly overlap with this aim. Additionally as a pre-user driven design process is addressing a multitude of interconnected but indirectly related practices, it becomes more difficult to identify individual, separable problems. Therefore the generation of multiple complementary responses to different framings of the problem in order to influence not just one but several practices through each other, becomes more appropriate.

3.2 Accommodating some of the unique requirements of pre-user participation

Another contribution of this thesis is to establish how pre-user participation should be approached. Following in the traditions of participatory design (PD), pre-users in this project have been conceived of as collaborators. However this collaboration has had to be approached with additional care in order to ensure the pre-users' full and continued participation. The main reason for this is that many people who are covered by the notion of pre-users do not want to believe that they may one day become users, and therefore do not identify themselves with the concept. This means there is an additional need to be sensitive to the participants' relationship with the prospect of becoming a user of the devices when inviting them to participate. In this section I will elaborate on this need for sensitivity and how it can be accommodated.

The experience and nature of participation has long been a concern for PD researchers and practitioners. In early PD projects providing a platform for participation was in itself seen as an automatic benefit to participants, a way to support and protect their rights as workers (Kensing &Blomberg 1998). However as PD has developed the extent to which participants have been able to influence the outcomes of projects has varied (Bergvall-Kåreborn & Stahlbrost 2008), meaning that participation in itself did not automatically equate with an obvious benefit to the participant. Additionally, as PD has moved out of the workplace, challenges that relate to working in contexts that require an increased level of sensitivity have emerged. For example in cases where participants have reduced physical or cognitive abilities, such as when working with individuals with cognitive disabilities and their family caregivers (Dawe 2007) or in a hostel for ex-psychiatric patients (Crabtree et al 2003, Cheverst et al 2005), researchers have needed to develop methods and approaches which are sensitive to the capabilities of those participants. In the case of pre-users this is the need for sensitivity with regards to participants relationship to the project's (and companies') objectives, and what being involved in the project might mean for their sense of identity. In other words, although pre-users are useful to the project agenda they do not identify with it, "*people who, we might say, are interesting, but not interested,*" [P1; p. 74] meaning that understanding their perspective and practices can contribute to design and innovation, but that they do not want to be associated with the prospect of becoming a user.

In addition to practical concerns about the impact of technology on lifestyle and routines, the prospect of beginning to use the technologies is deeply linked to matters of identity. Many pre-users believe becoming a user of the devices would have implications on how other people

would perceive them and also how they see themselves. For people with hearing loss this can be admitting to themselves that their body is getting old and failing, and additionally embarrassing that this might be visible to others. With diabetes many people are under the impression that having to use insulin will mean that they have failed to look after themselves properly and becoming a user is something to be ashamed of. Both these sets of concerns are demonstrated in the ethnographic material analysed and presented in [P1], [P3] and [P4] of this thesis. What this means for design and innovation with pre-users is not necessarily that they will disagree with the project objectives, but rather that many will not want to associate themselves with the prospect of becoming a user and this is therefore why they may not want to believe that they are relevant to the project.

In [P1] I describe one way to address this reluctance to identify with the project objective, by instead making the focus of the design issues pre-users do identify with, which coincide with the interests of the project. While the objective of the project is still to create the conditions that will support people becoming users of the devices, the practices that are explored are those which pre-users themselves find in some sense problematic. For example during interviews in the pilot study in Denmark some of the participating pre-users identified that poor communication with health care professionals was problematic for them and affected the way they treated themselves. Therefore it was possible then to quite openly explore these communication problems and potential solutions with pre-users as they recognised it as a need, while at the same time improving communication with health care professionals was one way to create circumstances that were more conducive for people to become users.

There were other areas where the interests of the project objectives related to issues that could be offensive to pre-users, such as those that would imply that they were destined to become users, or were ignorant of their own condition. Essentially this was because the values of the companies as stakeholders, who had defined the project objectives, clashed with the values of the pre-users as stakeholders, a type of ethical situation that is typical of participatory design practice (Steen 2011). As Iverson et al (2010) argue, values in a participatory design processes should be negotiated through an iterative process of dialogue. However in this case this type of full disclosure of the values and interests that were driving the project, risked compromising the participants' sense of identity and prevent them from participating as experts in their own experiences. As an example, we were interested in exploring the discrepancies between the indigenous perspectives of people with the conditions and the perspectives of healthcare professionals and the healthcare industry. If we had directly expressed our interest in these discrepancies to participants, we could have put them in a position of disadvantage, as it would have forced them to pit their own subjective experiences against the authority of the medical profession. In order to address this strategies of indirect enquiry were developed, which

allowed participants to articulate and express their values without being forced to defend those values against those of the medical profession, or confronting them with prospect of becoming a user. While this meant an additional duty was placed on the project team to responsibly interpret and represent those values within the process[1], it also meant that participants were able to take roles where they remained an authority on the topics being discussed.

There are two different strategies of indirect enquiry that have been used to explore aspects of pre-use in this research. The first, *exploring controversy through abstraction,* uses abstraction to explore issues that may be confrontational to pre-users [P1], such as those that imply that they will become users themselves. In the cases described in [P1], [P2] and[P3], critical artefacts methods (Bowen 2009a) were adapted in order to order to abstract the controversial issues and present them in the form of concepts for provocative and socially unrealistic technologies. Pre-users were then encouraged to speculate on how the technologies related to their condition. As an example, in Pre-user Workshop 5 as described in [P3], three kinds of artefacts were presented as part of the critical artefacts activity (Figure 3). These were intended to embody controversies that related to the how measuring blood sugar affected pre-users understanding of type 2 diabetes and included a concept for a measuring app/ device that scanned food barcodes and predicted the effect eating that food would have on peoples blood sugar. This was intended to provoke reflection on the constant decision making regarding food that is part of treating diabetes in daily life. A concept for a wrist worn blood sugar measuring device, was also developed, that was intended to explore the idea of having a constant presence for a condition that is normally symptomless. Finally, there was a concept for a home blood sugar measuring device that would give a reading of the long term risk of complications from the measurement, which tried to get participants to reflect on how they related to the risks associated with the condition. As is described in [P4], through discussing and assessing the value and flaws of each of these concepts, the workshop participants started to reveal their attitudes and hidden assumptions with regard to these specific aspects of treating the condition.

The second indirect strategy of enquiry, c*ombining controversy with recognisability,* involves merging explorations of the more controversial interests with explorations that are more acceptable and recognisable to the participating pre-users. [P3] describes two different methods that were explored, which disguised concept exploration by combining it with investigative research activities. The first activity was a set of self-document tasks that

---

1   *In this process where the researchers', companies' and participants' agendas were never completely aligned even at the close, the extent to which we, as a project team actually fulfilled this duty to responsibly interpret and represent the participants values remains unfortunately an open and unresolved question.*

Figure 3: Critical Artefacts from Pre-user Workshop 5

were introduced in the context of the study as a design probe/auto-ethnography activity for pre-users with hearing loss (Mattelmäki 2005). At the same time the task explored whether provoking pre-users to reflect further on situations where their hearing loss caused problems, would make them more willing to acknowledge the severity of the problem- a purpose they may not have been willing to accept if it had been presented as such. The second, a board game style activity, was introduced as a format for participation within a workshop context (Brandt 2006), where it was also being tested as a prototype for a pre-user communication tool that could be adapted for a clinical setting, without having to imply to the pre-users that they may not communicate well with their doctors. Both these activities mask a potential confrontational topic with another kind of exploration that was more likely to be acceptable to the participants.

The moral and pragmatic principles of participatory design (PD) mandate the inclusion of those people who will be most affected by a design in the design process (Segalowitz & Brereton 2009). Creating processes and methods that allow the participants to express their expertise has long been a concern of the field (Ehn 1988). However, in PD each project has its own specific context and set of participating stakeholders with their own individual capabilities,

interests and relationships to the project objective. Therefore, as Buur and Matthews (2008) point out, there is no general PD method to facilitate inclusion but rather every PD project involves the development of its own methods in order to accommodate the unique requirements of participation in that project. "*Participatory design projects are typically not the reapplication of a (or "the") participatory design method to a new business context or product domain, but are instead engagements in methods development themselves,*" (ibid p.258). In cases like pre-use, where potential participants may not wish to identify with the implications of participation, developing methods that allow them to participate without being confronted with this is an important requirement. When it is not possible to avoid controversial issues, strategies of indirect enquiry such as those presented here, provide a way to approach these with sensitivity that allows participants to remain the authority in their own experiences.

3.3 The displacement of the user.

While focusing on pre-use is a novel approach because it seeks to indirectly alter the contextual conditions of use rather than the actual practice of use (i.e. wearing hearing aids and injecting insulin), diverting attention from use and users has produced some implications that extend beyond the concept of pre-use itself. Another contribution of this thesis is a proposal that in general it can be useful for design to temporarily displace the user as the centre of the design process and put focus on identifying other potentially important relationships that might exist between people and artefacts in the context that is being looked at. Instead exploring the networks of practices that exist in that context and considering the multiple roles a design could have within it in addition to use, can help designers identify opportunities and important considerations that they may otherwise miss by focusing on use alone.

As was discussed in chapter 1 of this dissertation, the terms 'use' and 'the user' conceptualise a particular kind of relation between people and artefacts (Tuomi 2003). Although these concepts have been critiqued for being overtly techno-centric notions, which potentially obscure many aspects of the relationships that can exist between people and designed artefacts (Grudin 1993, Redström 2008), they remain important and useful conceptual tools for designers. Considering use and users allows designers to explore the specific functional relations that will exist between people and a design under development. When being employed by a competent designer the notion of 'use' will also extend far beyond the functional relationship that the term implies, to cover multiple aspects of the total experience the design can potentially create (Jordan 2008). In addition, 'users' may also cover a range of people who are important to the design, but will not necessarily be the ones who deploy it for a functional purpose (Bergvall-Kareborn & Stahlbrost 2008). However, although the concepts of 'use' and 'users' may be employed by skilled designers to cover a range of ways of relating to designs under development, the terms themselves do little to support this broader meaning. As a result even a skilled designer may miss possible insights and opportunities by focusing on use alone. Grudin (1993) suggests that instead designers could focus where possible on roles such as the professional one people may have when interacting with a design. However this over-specifies a single role as being important to design, implying all that is of interest is the person as a doctor for example, when their other roles as a friend, mother and woman may be equally as relevant. It also does not specify at all the relationship the design will have to the person, removing the conceptual link between the person and the technology.

Pre-use however is a concept that deliberately under-specifies the role of the person, and although it indicates a relationship with the technology, the specific nature of this is left very open. This meant that in this project, as is described in [P5], it was necessary to discover in

the course of the design process the specific relationships between people and artefacts that could be important to design, through exploring the networks of practices in which use was embedded and the multiple roles the devices could have. For example, by looking at the range of practices that were involved in treating the conditions (such as what happened during a doctors appointment), it was identified that the communication relationship between pre-users and health care professionals was important. This led to the development of clinical communication tools as a design response (concepts for these were presented in the exhibition that is described in [P4]). These networks of practices also included those that related to how the conditions can affect interactions with family members, highlighting the importance of the relationship between family members and the conditions, resulting in design concepts for tools for communication with partners and families (also presented in [P4]).

Additionally, looking at these practices from the perspective of considering the multiple roles the artefact could have (conceptualising the artefact as multiple [P5]), led to the identification of further relationships it does and could have that are additional and tangential to use. For example the potential relationship hearing aids could have with the people around the person with hearing loss led us to consider if they could serve as tools to help them identify when that person was having problems hearing. The Revealable Hearing Aids concept that is described in [P4] is an attempt to respond to this relationship. As is further discussed in [P5], considering the artefact as multiple also put emphasis on different kinds of use roles for the design, like the way a nurse might use an injection device to demonstrate how easy it is to inject is a different role from how it is used by a person with diabetes as a means to deliver insulin.

'Use' and 'users' are valuable notions that have provided design with a conceptual means to challenge techno-centric assumptions and complicate stereotyped notions of what people who would be using a design would be like (Marti and Bannon 2009). However, an unwavering focus on use runs the risk of obscuring other issues and relationships that could also be important for design (Grudin 1993, Redström 2008). This is why rather than suggesting the replacement of use with another concept I argue for its momentary displacement, in order to allow other rich and diverse relationships that can exist in addition and tangential to use to become more prominent. Ethnographic field studies have provided a way to draw designs' attention to the complexities of use practices and contexts (Buur and Sitorus 2007). Instead I argue that approaching similar studies with a view to actively exploring the multiple roles artefacts have and the networks of interrelated practices they exist in, can also help designers to be sensitised to the range of possible roles their designs could play in the world, and so uncover new opportunities for design and innovation.

3.4 Artefacts as exploratory research tools.

As a consequence of the sustained investigation into pre-use this thesis is also able to make a methodological contribution about the role of design concepts and artefacts as exploratory research tools. Throughout the course of this research project concepts and artefacts have been developed and deployed as a means of exploring how the notion of pre-use could be useful for design and innovation. From early on in the project, as is described in [P1], [P2,] and [P3], they were used to introduce issues of a sensitive nature to pre-users in an indirect manner through abstraction by using an adapted version of critical artefacts methods, and to indirectly explore potentially controversial new practices in a sensitive manner by combining them with an activity that had a recognisable research purpose. Later in the project as part of the exhibition presented in [P4], design concepts and artefacts were also used to disseminate knowledge and engage the two organisations in the results of the project, as well as to explore their reactions to it. All of these artefacts and concepts were developed to generate insights and provoke unexpected responses rather than just to test ideas and resolve the project findings into concrete solutions.

The role of artefacts as research tools in design is well established as, for example, a means of gathering inspiration or information (Gaver et al 1999, Mattelmäki, T. 2005), formatting participation (Brandt 2006) or inspiring creativity (Bowen 2009a). One of the reasons that deploying artefacts is so valuable to design research is that they do not just respond to the world but can actually alter it in multitude of ways that cannot be predicted. Ehn points out when an artefact is created it becomes capable of *"modifying the space of interaction for its users, ready for unexpected future use, rich in aesthetic and cultural values, opening up for new ways of thinking and behaving"* (Ehn 2008, p.93). What has also been important to the use of artefacts in this project is the understanding that developing a design concept involves a process of analysis and therefore the outcome of that process represents the synthesis of a multitude of insights into what the world is and ideas about how it could be, at a level of complexity that could not easily be articulated through words alone, *"artefacts embody the myriad choices made by their designers with a definiteness and level of detail that would be difficult or impossible to attain in a written (or diagrammatic) account"* (Gaver 2012). As design concepts embody the results of a process of analysis and are capable of altering the world in unexpected ways, they provide a means of both furthering that analytical process and generating of new insights about what the world could be.

In order to encourage the unexpected, many of the artefacts that have been developed

and deployed as part of this research have been deliberately designed to be in some way open-ended (Mattelmakki et al 2011). This is in order to focus on provoking rich responses rather than just an assessment of whether the idea is good or bad. For example the critical artefacts presented in [P1], [P2] and [P3], were intended to be open-ended by being in some way unrealistic and provocative, forcing activity participants to consider the more complex issues of why they found it unrealistic and provocative, and what would have change to make it a feasible context, rather than just considering whether they liked it or not. Similarly the activities presented in [P3] that were developed to explore new practices by combining them with a recognisable research task, centred on the use of an artefact. An example of this is the probe/auto-ethnography kits, which had the purpose of self-documentation but were also a means to explore practices of people reflecting on the extent to which their hearing was causing them problems. These tested what would happen with these new practices and explored the consequences, without putting the focus onto whether or not the artefacts themselves were a good or bad response to the issue [P3]. Finally and most significantly, the exhibition that is presented in [P4], was an attempt to actually hand over insights and ideas from the project to the organisations, in an open ended manner that encouraged developers from both companies to consider how they could apply them to their own work. In addition it was a means of exploring the organisational responses to these insights and ideas. This was achieved through creating a range of concepts that demonstrated how interrelated issues could be addressed in a range of different ways, juxtaposing more viable concepts for the organisations next to quite provocative ones, and presenting these alongside some of the stories from the fieldwork that had inspired their development [P4]. The exhibition demanded that people from the organisations make their own connections between the ideas embodied in the artefacts exhibited and bring their own knowledge to them, allowing them to add their responses to the exhibition. In doing so the exhibition attempted to plot out a landscape of possibilities (Gaver 2012), rather than ultimate solutions to the issues identified in the project.

As Mattelmakki et al. (2011) argue, designing materials to be open to interpretation and appropriation by project participants and stakeholders can be powerful tool for collaborative exploration. In this project the property of design concepts to embody analytical understandings and the designer's ideas about how the world could be (Gaver 2012), was utilised to bring these ideas and understandings back to pre-users and company representatives for further exploration and development. The artefacts were deliberately designed to be slightly but not extremely provocative [P4], so as not to induce outright rejection. This was achieved through balancing the familiar and recognisable with aspects that were judged to be either unexpected or controversial for the participants. The artefacts were also generally presented in collections or sets, in order to encourage comparative responses and explore a landscape of possibilities

as opposed so a singular opportunity. These artefacts were intended to provoke rich and unexpected responses, and their deployment throughout the project was used as a means to extend our understanding of pre-users and the organisations that were involved in the project, as well as to explore and develop potential design directions.

4. Conclusion

Use practices do not exist in isolation, but instead form networks of practices that will influence how a design is adopted and adapted in the world. Therefore focusing on use alone cannot guarantee that the outcome of a design process will ever enter a users hand. In this dissertation I present a case for focusing on pre-use, the factors that can influence whether or not people will become users. I argue that pre-users should be invited to participate in design and innovation processes. I also demonstrated, how opportunities to influence some of the factors that dictate whether or not people will become users can be discovered through a 'pre-user driven process', and how these can be designed in order to create better contextual conditions for use.

I describe how a pre-user driven process requires a shift in mindset from looking for opportunities to directly solve problems or meet needs, to looking for opportunities to indirectly influence the circumstances that encourage or prevent people from becoming users. As a consequence of this I argue that like other open-ended exploratory processes, a pre-user driven process should not be approached with a specific outcome in mind. Instead emphasis is needed at the start of a pre-user driven process on identifying opportunities to addresses problem framings that will indirectly affect the contextual conditions for use, and therefore overlap with the main aim of the design project in some way. Additionally, as a pre-user driven process does not respond to a single practice, but a network of interrelated

practices, I argue that it lends itself to creating multiple outcomes that are interrelated but not interdependent, allowing for indirectly connected opportunities to be utilised simultaneously and as complementary to each other.

This dissertation describes how participation can be approached when involving pre-users in design and innovation. In particular when inviting pre-users to participate it is necessary to be sensitive towards their relationship with the project objective in order to retain them as participants, as many pre-users will not wish to believe that they will one day become a user. In order to accommodate this two approaches are suggested, which are a means to investigate many areas that were of interest to the project objective, while allowing pre-users to participate in a way in which they remained an authority on the topics being discussed. The first approach involves focusing on pre-users' current experience of issues that are also of interest to the project objective, such as aspects of the healthcare system they find problematic. The second approach involves exploring more controversial issues to them by employing strategies of indirect enquiry. One strategy that I suggest is to explore controversy through abstraction, which involves presenting controversial issues in an abstract form that prevents them from being directly confrontational. Another is to combine controversy with recognisability, by merging explorations of the more controversial interests with explorations that are more acceptable and recognisable to the participating pre-users.

As a consequence of the sustained investigation into how focusing on pre-use can contribute to design, two additional contributions have emerged that are also presented in this dissertation. The first is the finding that the momentary displacement of use as the focus for design in order to explore additional relationships that may be important to how the design is adopted and adapted in the world, is a useful approach for design that could extend beyond a pre-user driven process. By exploring the networks of practices that exist in the context that is of interest and considering the multiple roles a design could have within it in addition to use, designers will more easily be able to identify opportunities and important considerations that they might have missed by focusing on use alone. Secondly there is a methodological contribution, which relates to the use of artefacts as exploratory research tools in design. Throughout this project artefacts and design concepts were continuously developed and deployed in order to further explore the issues and hypotheses that were developing from the field. These embodied analytical findings from the fieldwork but were designed to provoke responses in an open-ended manner in order to elicit the unexpected and further the process of analysis.

The contributions of this dissertation further the ongoing discussions in the field of design research that concern which people we should be designing for, and how this should be approached. For industry this dissertation also has implications for any companies in

the medical domain, and potentially in other domains, whose product uptake is similarly affected by issues that are indirectly related to the quality of the product itself. In summary this dissertation contributes to design by outlining how the concepts of pre-use and pre-users can be useful for design, including describing how user driven approaches to design can be adapted for a pre-user driven process and what needs to be taken into consideration when organising pre-user participation. This dissertation also makes two additional contributions, firstly that the momentary displacement of use as the focus of design can in general help draw attention to opportunities that might otherwise have remained invisible, and secondly how artefacts and design concepts can serve as exploratory tools in a design research process.

References

Abras, C., Maloney-krichmar, D., & Preece, J. (2004). User-Centered Design. I In Bainbridge, W. Encyclopedia of Human-Computer Interaction. Thousand Oaks: Sage Publications. Publications.

Akrich, M. (1992). The de-scription of technical objects. I Shaping technology/ building society. MIT Press. pp. 205–224

Ballegaard, S. A., Hansen, T. R., & Kyng, M. (2008, April). Healthcare in everyday life: designing healthcare services for daily life. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 1807-1816). ACM.

Bergvall-Kåreborn, B., & Ståhlbrost, A. (2008). Participatory design: one step back or two steps forward? I Proceedings of the Tenth Anniversary Conference on Participatory Design 2008 pp. 102–111.

Blomberg J, Giacomi J, Mosher, (1993) Ethnographic field methods and their relation to design. in Schuler, D. & Namioka, A. (editors) ,Participatory Design: Principles and Practices, Lawrence Erlbaum Associates. pp.123-155

Bowen, S.J. Critical (2009 a) Artefact Methods: Using Provocative Conceptual Designs With in Participatory Human-Centred Design Workshop. In Proceedings of the Nordic Design Research Conference 2009: Engaging Artifacts.

Bowen SJ. (2009 b). A critical artefact methodology: Using provocative conceptual designs to foster humancentred innovation. PhD dissertation, Sheffield Hallam University 2009.

Brandt, E., & Binder, T. (2007). Experimental design research: genealogy, intervention, argument. International Association of Societies of Design Research, Hong Kong.

Brandt, E. (2006) Designing exploratory design games: a framework for participation in Participatory Design? In Proc. PDC 2006, pp. 57–66.

Brereton, M., & Buur, J. (2008). New challenges for design participation in the era of ubiquitous computing. Co-Design, 4(2), 101-113.

Buchanan R (1992) Wicked Problems in Design Thinking. Design Issues, 8(2), pp.5-21.

Buur, J. & Matthews, B. (2008). Participatory Innovation. International Journal of Innovation Management (ijim), 12(03), pp.255–273.

Buur, J., & Sitorus, L. (2007). Ethnography as Design Provocation. Ethnographic Praxis in Industry Conference Proceedings, 2007(1), pp.146–157.

Carroll, J. M. (1996). Encountering others: Reciprocal openings in participatory design and user-centered design. Human–Computer Interaction, 11(3), 285-290.

Cheverst, K., Rouncefield, M., & Graham, C. (2005). Whose probe is it anyway. In: Workshop on appropriate methods for design in complex and sensitive settings. OzCHI,

Christensen, V. T., (2006) Hard of Hearing. The Danish national Institute of Social Research, Copenhagen.

Clark, B (2007) Design as Sociopolitical Navigation. PhD Dissertation. University of Southern Denmark.

Crabtree, A. (2004). Design in the absence of practice: breaching experiments. I Proceedings of the 5th conference on Designing interactive systems: processes, practices, methods, and techniques pp. 59–68.

Crabtree, A., Hemmings, T., Rodden, T., Bb, N. N., Cheverst, K., Clarke, K., & Hughes, J. (2003). Designing with care: Adapting cultural probes to inform design in sensitive settings. ERGONOMICS SOCIETY OF AUSTRALIA, 2003, pp.4–13.

Crabtree, A., & Rodden, T. (2002). Ethnography and design. In Proc International Workshop on "Interpretive" Approaches to Information Systems and Computing Research (pp. 70-74). Cambridge, MA, USA: ACM.

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

Dalsgaard, P. (2010) Research in and through design: an interaction design research approach, Proceedings of the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction, November 22-26, 2010, Brisbane, Australia

Dawe M. (2007) Let me show you what I want: engaging individuals with cognitive disabilities and their families in design. Proc CHI'07 extended abstracts on Human factors in computing systems. , pp. 2177-2182.

Dorst, K., & Cross, N. (2001). Creativity in the design process: co-evolution of problem–solution. Design studies, 22(5), 425-437.

Dourish, P.(2006). Implications for design, in: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, Montréal, Québec, Canada, pp. 541–550.

Ehn, P. (1988). Work-oriented design of computer artifacts (Doctoral dissertation, Umeå University).

Ehn, P. (2008, October). Participation in design things. In Proceedings of the Tenth Anniversary Conference on Participatory Design 2008 (pp. 92-101). Indiana University.

Engelund, G. (2006). "Time for Hearing" - Recognising Process for the Individual: A Grounded Theory. Det Humanistiske Fakultet, Københavns Universitet.

Frayling, C. (1993). Research in art and design. London: Royal College of Art.

Gaver, W, Dunne, A., & Pacenti, E,. (1999) Design: Cultural probes, Interactions, Vol 6, Issue 1, Jan/Feb 1999 pp. 21–29

Gaver, W. (2012). What should we expect from research through design?, in: Proceedings of

the 2012 ACM Annual Conference on Human Factors in Computing Systems, CHI '12. ACM, New York, NY, USA, pp. 937–946.

Goodall G, Sarpong EM, Hayes C, Valentine WJ. (2009) The consequences of delaying insulin initiation in UK type 2 diabetes patients failing oral hyperglycaemic agents: a modelling study. BMC endocrine disorders.

Grudin, J. (1993). Interface: an evolving concept. Communications of the ACM, 36(4), 110–119. doi:10.1145/255950.153585

Gulliksen, J., Göransson, B., Boivie, I., Blomkvist, S., Persson, J., & Cajander, Å. (2003). Key principles for user-centred systems design. Behaviour and Information Technology, 22(6), 397-409.

Halse, J. (2008). Design Anthropology: Borderland Experiments with Participation. the IT University of Copenhagen, March 2008.

Halse, J., Brandt, E., Clark, B., & Binder, T. (2010). Rehearsing the future. Danish Design School Press. Copenhagen.

Hougaard S, Ruf S.(2011) EuroTrak I: A consumer survey about hearing aids in Germany, France and the UK. Hearing Review.;18(2) pp.12-28.

International Diabetes Federation. IDF Diabetes Atlas, 1st and 5th (2012 update) edns. Brussels, Belgium: International Diabetes Federation, 2000, 2011 and 2012 Available from www.idf.org/diabetesatlas/

ISO 13407. (1999), Human-centered design processes for interactive system (Geneve: International Organization for Standardization)

Iversen, O. S., Halskov, K., & Leong, T. W. (2010, November). Rekindling values in participatory design. In Proceedings of the 11th Biennial Participatory Design Conference

Jordan, P.W.(2000). Designing Pleasurable Products: An Introduction to the New Human Factors. Taylor & Francis Group.

Kaptelinin, V., & Bannon, L. J. (2012). Interaction design beyond the product: Creating technology-enhanced activity spaces. Human–Computer Interaction, 27(3), 277-309.

Karat, J. (1997). Evolving the scope of user-centered design. Communications of the ACM, 40(7), 33-38.

Kensing, F., & Blomberg, J. (1998). Participatory Design: Issues and Concerns. Computer Supported Cooperative Work, 7(3-4), pp. 167–185.

Kensing, F., Simonsen, J., & Bødker, K. (1998). Participatory design at a radio station. Computer Supported Cooperative Work (CSCW), 7(3-4), 243-271.

Kochkin S. (2005). MarkeTrak VII: Hearing loss population tops 31 million people. Hearing Review, 12(7) pp.16–29.

Koskinen, I., Zimmerman, J., Binder, T., Redström, J., Wensveen, S., (2011). Constructive

Design Research: Design Research Through Practice. Morgan Kaufmann, Boston.

Lin, F.R., 2011. Hearing Loss and Cognition Among Older Adults in the United States. J Gerontol A Biol Sci Med Sci 66A, 1131–1136.

Lin, F.R., Metter, E.J., O'Brien, R.J., Resnick, S.M., Zonderman, A.B., Ferrucci, L., 2011. Hearing Loss and Incident Dementia. Arch Neurol 68,pp. 214–220.

Maher, M.L., Poon, J. & Boulanger, S., (1996) Formalising Design Exploration As Co-Evolution: A Combined Gene Approach. in J S Gero and F Sudweeks.Advances in formal design methods for CAD, Chapman and Hall, London.

Marti, P., Bannon, L.J., 2009. Exploring User-Centred Design in Practice: Some Caveats. Knowledge, Technology & Policy 22, pp.7–15.

Mattelmäki, T. (2005) Applying probes – from inspirational notes to collaborative insights. CoDesign. 1, pp.83-102.

Mattelmäki, T., Brandt, E., & Vaajakallio, K. (2011). On designing open-ended interpretations for collaborative design exploration. CoDesign, 7(02), 79-93.

Mønsted, T., & Onarheim, B. (2010, November). Segmentation of Users in PD for Healthcare. In Proceedings of the 11th Biennial Participatory Design Conference (pp. 159-162). ACM.

Norman, D. A. (1986). Cognitive engineering. In User Centered System Design; New Perspectives on Human-Computer Interaction. L. Erlbaum Assoc. Inc., Hillsdale, NJ, USA (pp.31-61).

Norman, D. A. & Draper, S.W. (1986). User Centered System Design; New Perspectives on Human-Computer Interaction. L. Erlbaum Assoc. Inc., Hillsdale, NJ, USA.

Norman, D. A. (2005). Emotional design: Why we love (or hate) everyday things. Basic books.

Pelz,C. Meis, M. Schick, A. Raabe, T. (2005) The stigma of hearing impairment –strategies to improve the acceptance of hearing aids. In proceedings of the 50th International Congress of Hearing Aid Acousticians

Peyrot, M., Rubin, R.R., Lauritzen, T., Skovlund, S.E., Snoek, F.J., Matthews, D.R., Landgraf, R., Kleinebreil, L., (2005). Resistance to Insulin Therapy Among Patients and Providers Results of the cross-national Diabetes Attitudes, Wishes, and Needs (DAWN) study. Diabetes Care 28, . 2673–2679.

Redström, J. (2006). Towards user design? On the shift from object to user as the subject of design. Design Studies 27, pp.123–139.

Redström, J. (2008). RE:Definitions of use. Design Studies 29, 410–423.

Rittel, H. and Webber, M. (1973) Dilemmas in a General Theory of Planning, Policy Sciences 4, 155–169.

Segalowitz, M., & Brereton, M. (2009, November). An examination of the knowledge barriers in participatory design and the prospects for embedded research. In Proceedings of the 21st

Annual Conference of the Australian Computer-Human Interaction Special Interest Group: Design: Open 24/7 (pp. 337-340). ACM.

Steen, M. (2011). Upon opening the black box of participatory design and finding it filled with ethics, in 'Nordic Design Research Conference. Making Design Matter', Helsinki, Finland.

Stewart, J. and Williams, R. (2005) .The Wrong Trousers? Beyond the Design Fallacy: Social Learning and the User. User Involvement in Innovation Processes. Strategies and Limitations from a Socio-Technical Perspective, Edited by Harald Rohracher, Profil-Verlag. Munich pp.195-221

Stolterman, E. (2008). The nature of design practice and implications for interaction design research. International Journal of Design, 2(1), 55-65.

Tuomi, I. (2005). Beyond User-Centric Models of Product Creation, in: Haddon, L., Mante, E., Sapio, B., Kommonen, K.-H., Fortunati, L., Kant, A. (Eds.), Everyday Innovators. Springer-Verlag, Berlin/Heidelberg, pp. 21–38.

Wilkie, A. (2011). Regimes of Design, Logics of Users. Athenea Digital 11, 317–334.

William Demant Group Annual Report 2011 http://files.shareholder.com/downloads/ABEA4C7PH1/2378102434x0x546717/9b8727d2-f733-43fa 93c57a30e28e9aef/Annual_ Report_2011.pdf Accessed at 20-03-2012 12.48 ECT

Worsoe, K., Elberling, C. (2006). Fading Sounds: About Hearing and Hearing Aids. Oticon Foundation.

Wu, M., Richards, B., & Baecker, R. (2004, July). Participatory design with individuals who have amnesia. In Proceedings of the eighth conference on Participatory design: Artful integration: interweaving media, materials and practices-Volume 1 (pp. 214-223). ACM.

www.ddc.dk/danishdesignaward2012/vinder/industrieltdesign-btc/intiga accessed 11-02-2013 11.01 ECT

www.idf.org/types-diabetes accessed 11-02-2013 14:12 ECT

www.novonordisk.com/about_us/default.asp accessed 11-02-2013 at 10.32 ECT

www.oticon.com/about/our-group/facts/about-oticon.aspx#market 11-02-2013 at 10.02 ECT

Publications

Taking Transition into Account: Designing with Pre-users of Medical Devices

Janet Kelly and Ben Matthews

Abstract

Participation in design has typically focused on involving those who use, will use, or who represent the users of the products in development. In this paper we discuss our experiences designing with 'pre-users'—people who have a relationship to the technology other than as a user or potential user of the product. We present a case study that documents how we worked with pre-users of two different types of medical technologies: hearing aids and insulin injection devices. Pre-users are people who do not currently use these products, but who are in a life situation for which these technologies may be prescribed sometime in the future, judging by their current medical condition. This paper distinguishes pre-users from other types of users commonly involved in participatory design. We exemplify how they can contribute to design activities through the case. We discuss relevant methods for their involvement and list some of their contributions to design, concluding with a discussion of how the objectives of participation might need adjustment when involving pre-users in design processes.

Author Keywords

pre-user, transition, design, user participation, methods

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

The notion of 'the user' of products and systems has undergone several evolutions over the past couple decades. For instance, one move away from the idea of the user emerged out of an appreciation that technologies are not merely used, and use is not an end in itself. Technologies are not developed to support users, but to support what people want and need to do. In contrast to 'user-centred design', terms such as 'work-oriented design' (Ehn 1989) and 'activity-centred design' (Norman 1999) sought to place the tasks, projects and aims of people's lives as the focus of design, rather than the person per se. Both 'work-oriented design' and 'activity-centred design' are recognitions of the fact that technology and its use are embedded in complex networks of socially organised relations. Both are movements away from the idea of designing for the person, as if the person is a stand-alone cognitive universe—a relatively stable bundle of dispositions, attitudes, values, routines and preferences that are simply there waiting to be deployed. Understanding precisely how people as agents are situated in various and variable contexts that serve as the agents' resources for determining the purpose, sense, meaning, appropriateness etc. of actions has been at the foundation of this important shift in design thinking.

Additionally, for some scholars the shift from the term 'user-centred design', prevalent in the 1980s, to 'human-centred design' e.g. as codified in ISO 13407, was a purposeful move away from a narrow and instrumental conception of a person's relation to a product as one being solely of use. It was a recognition that products and people have many more relationships than artefact-user; people may encounter products in other respects e.g., in how they are disposed of, or in how they noisily interrupt a meeting or film. There is a range of design-relevant intersections of people and products that are not easily captured by a notion of person-as-user.

Yet in spite of these developments, the concept of the user is still prevalent in design discourse, and continues to be valuable in a number of respects. Companies continue to organise their product development work to meet user needs, user feedback is sought on prototypes in development, user insights are considered invaluable, and use context is investigated in order to ensure the successful deployments of products, systems and services. And generally speaking, the majority of the methods introduced in participatory design and related fields have been developed primarily with the involvement of the users of the technology itself in mind, bracketing the broader scope and possibilities of person-product relationships.

In this paper, we report on our first hand experience of some of the challenges faced when participating in the design of new technologies with people who have a relationship to a technology other than as its 'user'. We have done this in the course of a joint industrial project

where two different medical/assistive technologies were in view. In this paper, we will refer to the people involved as 'pre-users' of the technologies in question.

Of course, participation in design projects with people who are not, and are not likely to be, the users of the eventual system is not something intrinsically new to participatory design (PD). In the early and most influential PD projects, large-scale collaborative design was conducted in conjunction with constituencies, not just users. To take one characteristic example of this early PD work, in the DEMOS project (Ehn 1989), collaboration was closest with trade unions and their representatives. PD was mobilised in an environment in which there already existed a socially-organised constituency whose mandate it was to safeguard the interests of the employee (who was in this case the intended user of the computer technologies under development). In such conditions, it is prudent for PD to work alongside the existing social-organisational structures that are already present, rather than have designers enter the scene as a third (or fourth or fifth) party.

Over the years, as PD has gradually infiltrated other arenas than its original concerns with the computerisation of industrial workplaces, and as computational technologies have been steadily incorporated into more and more (previously mundane) artefacts, the contexts within which PD projects are done have also changed significantly. For example, it is frequently the case that there are no organised constituencies analogous to employers or trade unions in relation to new technologies under development. In community development contexts, for instance, technology becomes a part of the means of creating and organising temporary social constituencies, rather than being the principal object or outcome of people's participation in design (see, e.g. Brereton & Buur 2008, Segalowitz & Brereton 2009). New technologies are increasingly not simply commercial or industrial, public or private, but can simultaneously be medical, domestic, personal, communal, recreational and educational. 'Single' products can traverse many of these established boundaries. And in such cases, it is rare that there exists a socially organised constituency with which to engage participation in design.

This state of affairs becomes more delicate when considering the issue of power, and its relation to the ideals of PD. Naturally, in the absence of the involvement of organised constituencies in PD, there can often be little 'power' to the willing participation of users in design. That is, without some other (external) collective leverage, users' actual authority over the products in development is greatly restricted. Although they can participate and potentially contribute to the form, function and interaction of the technology, their autonomy over the process is limited; particularly if the strongest, most definitive action they can take relative to the project is merely to withdraw their participation. Participation, as Beck (2002) reminds us, is not to be confused with power.

Our particular project with personal medical technologies shares this particular set of

conditions, where there are no comparable existing constituencies of users, employers or other 'official' organisation. As we will describe, it is further complicated by the fact that these technologies are typically not purchased, but prescribed by medical experts.

The Idea Of 'Pre-Users' Of Medical Devices

In PD, users, potential users and their representatives have been the traditional focus of designers' efforts at organising participation. The emphases on skill (Ehn 1989, 1992) for instance, reflected the vital recognition that workers possessed local knowledge (and especially know-how) that developers needed to try to support rather than supplant with the introduction of new systems. Not only did potential users have an obvious personal stake in the development of the technologies in question, they also had a clear contribution to bring to the table. In this sense, participants in PD have typically been interested participants (in a dual sense of 'interested'). The central issue we are exploring in this paper concerns our initial efforts to organise participatory design with people who, we might say, are interesting, but not interested, in the above senses. That is, they are people who currently do not see themselves as having an interested stake in the development of these future technologies, nor do they bring a particular or expertise or knowledge base that the technology must necessarily address in its use. Furthermore, they are not even people who are guaranteed to use the technology in the future (in contrast to 'potential users'). Rather, they are what we refer to as 'pre-users': people who are currently in a position in their life circumstances that current users were once in, prior to becoming users. Although this description is a little convoluted when formulated like this, we hope it will take on a clearer sense through the discussion and examples that follow.

Our research is being conducted in conjunction with two companies who produce medical devices: Novo Nordisk who produce insulin injection devices and Oticon who produce hearing aids. In this paper we present our efforts to conduct a user-centred, participatory design process with the pre-users of these medical technologies. In these contexts, pre-users of hearing aids are people who suffer from a hearing loss that is causing recognisable problems in their lives, but who do not yet have a hearing aid. The pre-users of insulin injection devices are diagnosed type 2 diabetics who are not yet using insulin. It is noteworthy that in both these cases the path to becoming a user of these technologies is not defined by market choice, but by the onset of a physical condition, and the eventual prescription or recommendation of the technology by a medical professional.

Age-related hearing loss is a gradual condition that progresses over a long period of time. People may have this type of hearing loss for several years before they begin to experience any problems related to it. It is often the case that they themselves will not be the first to notice their hearing difficulties; rather it is frequently their partner, friends or colleagues (Engelund 2006). Age-related hearing loss is caused by the degradation of some of the receptors in the

inner ear that detect different frequencies of sound, and often those in the range of human speech. This kind of hearing loss is incurable, but many of the effects can be ameliorated with the use of hearing aids which can amplify the relevant frequencies of sound in the environment into the hearer's reduced hear-able range. In a US study, nine out of ten users of hearing aids said their hearing aids improve their quality of life (Kochkin 2005). Despite this, in the US only one in four people for whom hearing aids could be beneficial actually use them. In Europe the figures are about the same—on average it is about one in four or five (Kochkin 2005). A 2006 Danish study indicates that people with hearing problems have a degraded experience in their working lives, which may be decisive in whether or not they take early retirement (Christensen 2006).

Diabetes type 2 to is a similarly progressive condition. In this case, the body is unable to produce enough insulin or is unable to respond properly to it to be able to convert glucose (sugar) in the blood into energy that cells can use. The prolonged demand for more insulin produces strain on the pancreas (the organ that produces insulin) which can eventually cause it to cease insulin production. There are 285 million people in the world with type 2 diabetes, a number that is expected to grow to 439 million by 2030 (www.diabetesatlas.org). Type 2 diabetes can lead to the damage and functional impairment of a number of organs, most significantly the cardio-vascular system. It is potentially fatal, and other effects include blindness and loss of circulation to the limbs. In its early stages the condition can be treated in several effective ways, but as it progresses sufferers eventually need to be treated with insulin injections. A study in the UK showed that type 2 diabetes patients are at increased risk of a large number of related complications due to an unnecessary delay in insulin treatment initiation; the failure to promptly begin insulin therapy is likely to result in needlessly reduced life expectancy and compromised quality of life (Goodall, Sarpong Hayes & Valentine 2009).

Such circumstances make pre-users something quite distinct from potential users. 'Pre-users' is, for us, a working term that attempts to capture the extent to which these persons are at a particular temporal position in a transitional process that is neither of their choice nor in their control. Other terms, such as 'potential user' or 'non user', though literally applicable to this group of people, often carry free-market connotations that are not comparable in this case. Non-users are typically people who choose not to buy or use a product, perhaps because they have no desire or need for it. Potential users may yet be swayed. Naturally, PD processes often involve potential users. PD, as it is now practiced, is frequently employed as something more akin to a method than a radical design movement. New product development in industrial and commercial ventures that have little to do with workplace democracy now employ PD in order to make better products, and in such cases it is frequently the potential users of products or technologies who are involved in participation (e.g Sanders & Stappers 2008). While potential

users, like pre-users, may be in the situation where they do not have a strong stake or interest in the product under development, they also have little or nothing to lose. For potential users, the product is not a threat for instance, nor is it a looming spectre on their horizon. In contrast for pre-users, use is not an option, it is a prospect, and not necessarily a pleasant one. Pre-users find themselves on a trajectory not of their choosing that appears to be heading towards use.

So this particular context—medical devices and chronic conditions—carries with it a number of distinctive challenges. The magnitude of the life issues of the participants that are relevant to the technology under consideration obviously requires sensitive consideration. As we will show, for some participants the technology and what it symbolised was perceived as highly threatening, and in a way that differs to the comparable threats to workers' livelihood introduced by the computerisation of workplaces. When a participant fears the very prospect of a daily reliance on insulin, for instance, the form, function and interaction of the injection technology (the aspects typically of principal interest to the design team) pale in significance compared to the simple fact of living with a chronic and serious condition. Secondly, the possession and use of these devices is not by choice but by prescription. Furthermore, the use of medical technologies that are prescribed to patients/clients also carries institutional significance that differs to technologies used in workplace or domestic settings; the user's autonomy to use (or not) the technology in medical cases is seen in terms of their compliance with 'doctors' orders', not simply a matter of personal choice (as might be the case with domestic or commercial technologies) or possibly insubordination (in the case of mandated workplace technologies). Such medical technologies are embedded in different social-institutional structures (health systems, consultations, reduced access, control, and autonomy over treatment and decisions) that create a unique set of circumstances for the prospects of use. Pre-users do not have, or belong to, a constituency that would otherwise have much say over the form, function, success or otherwise of a new product. (And while ordinary potential users of technology may not have a constituency of their own either, their collective actions can determine how or whether a technology becomes successful, since their relationship to the resultant product is one of market choice.) All of this bears on the potential roles and contributions of pre-users to the design of new hearing aids and insulin injection devices.

Still, by enabling the pre-users of insulin injection devices and hearing aids to participate in a commercial design and development process, opportunities are created to better appreciate the circumstances and conditions that they experience prior to use. And there are several motivations for involving 'pre-users' rather than (just) users. As we have suggested above, in both of these cases (hearing aids and insulin devices), there are large numbers of people who could potentially benefit from these technologies but for a variety of reasons do not yet

use them. In both cases there are significant barriers to becoming users, including the fear of social stigmatisation and the difficult personal acknowledgement of having a permanently debilitating (or difficult-to-manage) health condition. Clearly, pre-users contribute a different perspective on these technologies and barriers to their use that existing users cannot provide. Furthermore, both Novo Nordisk and Oticon already have a history of involving users in various technology development initiatives; for both these companies the potential of better understanding pre-users offered the promise of better aligning the technologies they develop to the ways they are perceived prior to prescription. One aspect of principal interest to the project is to understand the transition to use; this is something that, again, pre-users have a very different perspective on than users.

Relevant Methods

For us (the authors) as researchers, the opportunity of designing with and for people who have never used such a treatment technology offered a compelling research challenge. Unlike users, pre-users cannot enter a design project and assume a role of expert in use or domain-specific knowledge such as work procedures. The nature of their participation in co-design activities and events must necessarily be different — unlike users, there is no existing use context, and their relationship to the technologies is indirect and is likely to be a sensitive issue for them to face. Additionally, one must consider what their role is to be in the process, as they cannot assume the role of expert as user or in use context. As we hope to show, they can provide an important perspective on pre-use perceptions of the technologies, on the systems (e.g. public health) which support the transition to use, or more broadly as experts in the lived experience of their particular stage in a the condition's development, each of which also has a bearing on design.

Other authors have encountered related challenges in their own work. For instance, on some design occasions there exists no prior socially-organised context to study or involve in the design process (Crabtree 2004). In the context of mobile gaming, Crabtree deployed technological prototypes as 'breaching experiments' in order to reveal the contours of social order in this domain that could not have been uncovered by conventional fieldwork or user involvement. Similarly, one of the original dialectics of the PD program related to the tension between tradition and transcendence (Ehn 1989): whether, and how, new products should integrate into an existing organisation of work practices versus leveraging the possibilities afforded by new technologies to reinvent and change for the better aspects of work practice. In design, there is always the potential (and promise) of transcending the current situation in certain respects. As others have noted, design (unlike analysis) cannot be data-driven (Sharrock & Anderson 1994). Furthermore, the discourse encompassing 'the user' in design has significantly evolved in recent years to the point that the very idea of a use context available to the design team prior to the deployment of a working technology has been unsettled (Redström 2006, 2009). Design just is the creation and introduction of new contexts. In consideration of cases such as these, the role of users participating in design as experts in an existing context is clearly not the only role they can or should play in design.

Furthermore, others have also documented many of the challenges encountered when working with participatory design processes in contexts that require an increased level of sensitivity. Dawe's (2007) work, for example, has developed design methods for assistive technologies with and for individuals with cognitive disabilities and their family caregivers; or the adaptation of probes to be used in a hostel for ex-psychiatric patients (Cheverst, Rouncefield

& Graham, 2005). Still in these cases the need for sensitivity specifically relates to the extent to which the participants' physical or cognitive abilities may prevent them participating as equals in a design process. The difference with pre-users is that the sensitivity required here is with regard to their relationship with the particular technologies under development.

The Case

The case we present here involved pre-users of both hearing aids and insulin injection devices. This case is an initial component of a federally-funded research collaboration between the SPIRE Centre for Participatory Innovation, Novo Nordisk and Oticon. It involves two industrial PhD researchers from the academic disciplines of design anthropology and user-centred design. The aim of the larger project is to develop an understanding of the barriers that serve to prevent people becoming users in the cases of these two medical devices, and to develop methods that successfully involve pre-users in innovation processes. The intention behind this initial exploratory study was to provide an introduction to the research domains and to develop familiarity with the field.

The specific goals of this study were to initiate design collaboration with pre-users, and to develop methods and design ideas to inform the larger study. This was done in two stages. The first consisted of a field study which involved interviews with three pre-users of insulin treatment and two of hearing aids, interviews with four health care professionals (two general practice doctors (GP's) and two ear, nose and throat specialists (ENT's)), and sit-in observations of several clinical interactions with pre-users in both settings. The interviews and the consultations were video-recorded, and field notes were taken during the sessions. The second stage consisted of a co-design workshop with four of the pre-users who had been interviewed.

Figure 1: Interview with a type 2 diabetic in her home .

The field study

Five pre-users were involved in the study, and in four out of the five cases we also gained permission to visit them in their homes. These interviews focused on understanding how they experienced their condition now, how the condition had developed up to this point, how they had become aware of it, their experience with health services in relation to the condition, their perception of treatment options and their expectations for the future, as well as general questions relating to their lives and lifestyles

The health care professionals involved in the study were recruited by letter from addresses listed on Danish health care databases. We visited them in their clinics and were able to interview both the GP's, and one of the ENT's. These interviews focused on how they approached treating patients with the condition, what their experience of people at this stage in their condition was, their attitude towards the treatment technologies, what they felt their role was in this process and what they expected to change in the future with regard to the conditions. We also had the opportunity to observe and video record seven pre-user hearing consultations with one ENT, whose clinic we spent a day in, and a total of three pre-user diabetic consultations with the two GP's.

Figure 2: Observing a clinical interaction at an ENT clinic in Denmark

The co-design workshop

The co-design workshop that followed the field study was aimed at developing and iterating methods that could be used to involve pre-users in the process. It was important to be sensitive

about bringing the two different groups of pre-users together for the reason that they may not have been able to relate to each other's conditions. However, it was also an opportunity to discover the extent to which there might be commonalities between their experiences as pre-users of medical devices, also to highlight the differences in attitude towards the technologies of those people who lived with the prospect of that technology in their future and those who did not.

Four pre-users (two from each domain) participated in the workshop. The first activity was based on a timeline. We asked the participants to write down four instances that they felt were most significant in the development of their condition so far, place them on a timeline and explain them to the rest of the group. We then asked them to do the same for events in their future: the next significant event they expected to happen, and what they expected the biggest change for them would be in ten years' time. Our intention was to find out where they perceived themselves in the process of their condition and to gain an insight into their hopes, fears and perceptions of the future.

Figure 3: Co-design workshop .

The second activity was based on the 'critical artefacts' methodology, an approach inspired by the critical design tradition that uses provocative design concepts to foster innovation as part of a human centred process (Bowen 2009). In this activity, we presented six provocative design concepts based on deliberately unrealistic technologies, and asked the participants to discuss the positive and negative aspects of their use in specific situations. The intention

here was to encourage the participants to generate a creative input for the project, and also to speculate on the way they saw technologies relating to their condition. Our decision to use this method was based on trying to find a sensitive way to introduce technologies to the participants without confronting them with them. Additionally, we were conscious of the fact that the treatment technologies themselves, since we had learned that these technologies were seen as threatening by some pre-users. Instead, the critical artefacts were based on technologies that could be used to measure factors that affect the pre-users' conditions. (On reflection, this seems to have been overcautious; basing the artefacts on the actual treatment technologies appears that it would have been a way to produce a more fruitful discussion about them without being overly confrontational.)

Emerging Themes From The Case

As this exploratory study was planned and executed over a relatively short period of time, we conducted our fieldwork and analysis simultaneously, with each informing the other. From this case, several design-relevant themes emerged that spanned both groups of pre-users.

Measuring the condition

One theme that appeared relevant to both conditions is the apparent discrepancy between how the condition is assessed technically, usually by tests that result in numerical values, and the qualitative, sensory, personal experience of the condition—along with the problems it raised across various aspects of life. For example, a technical hearing loss is assessed with a hearing test that results in an audiogram, a chart that maps out a patient's hearing thresholds, plotting frequencies of sound against the amplitude (in decibels) at which they can be heard. But hearing is experienced as a problem for the sufferer most commonly in social situations, which are also dependant on the environment (acoustic properties of a room, background noise levels and frequencies, direction of sound sources relative to the hearer, etc.) as well as the specific characteristics of the person's hearing loss. Both of the ENT's involved in the study felt that it was important not only to establish diagnostically that their patients had a technical hearing loss, but that they were also experiencing enough noticeable problems in their lives to motivate them to use a hearing aid, prior to recommending one.

With regard to diabetes, numeric values (specifically those of the sufferers' blood sugar, blood pressure and cholesterol) are not only used to diagnose the disease, but to constantly assess how well the patient is managing the condition. We spoke to one diabetic pre-user who found it so difficult when her blood sugar levels would go up and she did not understand why, that she would stop monitoring her blood sugar for a time. "Then I will stop measuring – I get the feeling: No, I do not want to be confronted with it... To be confronted with these numbers that just go up and down – I can not handle that at all." The technical evaluation of her condition also affects her on a deeply emotional level as she felt she was in some way being judged by the numbers.

This theme of measurement emerged at a number of other points during the ethnographic study, which was one of the reasons we decided to base our development of the critical artefacts on it for the co-design workshop. For this we chose to present concepts that would externalise the measurements involved in the two conditions: presenting to the diabetics artefacts that would be used to measure 'healthiness' of their food rather than their blood—e.g., plates that changed colour to indicate how good the food that had been placed on top would be for them. For hearing loss sufferers the critical artefacts represented technologies that would measure

the acoustic quality of the environment they were in as opposed to their hearing, e.g. a device that could indicate to them which conversations occurring in a crowded room they would be likely to hear most clearly.

Figure 4: The critical artefact plate that indicates how healthy the food is with a three colour system.
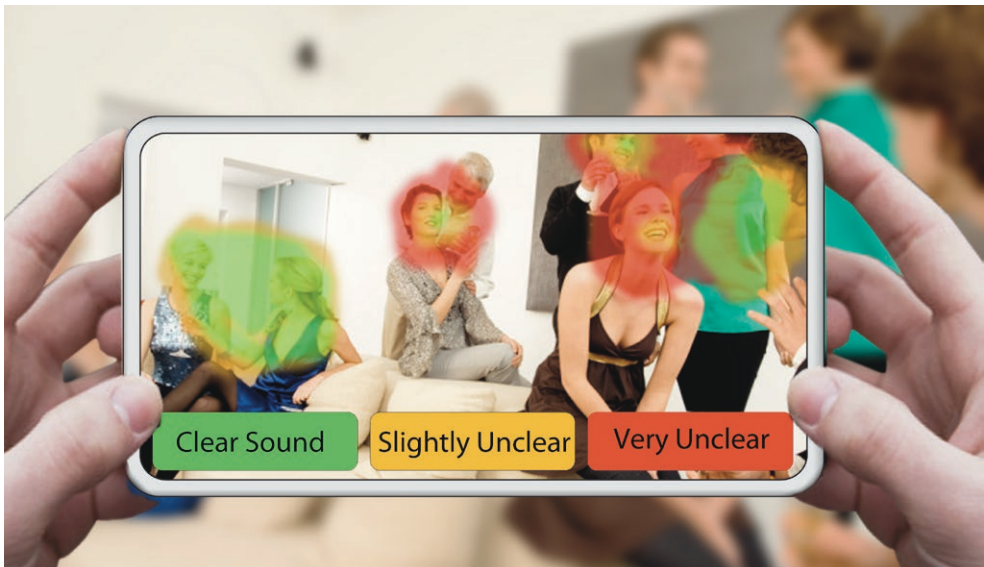

Figure 5: The critical-artefact device that indicates by colour where sound is clearest in a room.

Interestingly, the diabetics were very open to the idea of this as a replacement for regular blood sugar measurement, which is a painful experience, but were very much against the idea that these measurements might be visible to other people. The hearing loss sufferers, for whom confrontation or exposure to technical measurement is an infrequent aspect of their condition, saw little point in being able to assess the acoustic quality of their environments. However, they saw the functional potential of this being inbuilt into hearing aids which would then be able to automatically respond to it.

Strategies for maintaining a 'normal' life

Across both conditions, pre-users described strategies they employed to maintain what they felt was a normal or good quality of life despite their condition. For the hearing loss sufferers this mainly involved slight changes they had to make when speaking with people, such as sitting closer and facing them directly. One of the hearing pre-users, Karsten, also had noticed a change in his enjoyment of music over several years which he attributed to his hearing loss and partially to compensate for this he bought a surround sound system for his home.

For the diabetics having to change their diet and watch what they ate seemed to significantly threaten what they felt was a good quality of life. One even expressed that when she was first introduced to the kinds of food it was recommended she ate, that she thought that she would die, but that she later found ways to cook healthy food in ways that she could still enjoy it, e.g. using herbs and spices to make it more 'interesting'. Food also proved to be a particularly

Figure 6: One interviewee shows where she hides her pills from view.

problematic issue for the diabetics when it came to maintaining a normal social life, in that they often had to rely on their friends being aware of their diabetes when they offered them food, or not noticing that they avoided eating certain foods they had been served. One strategy some of the pre-users employed was to eat before going out, but some of the people we spoke to admitted that in these kinds of social situations, they often chose not to comply with the recommendations for their diet.

Maintaining a normal life in these cases is not just about being able to do the same things they did before they developed the condition but also about feeling 'normal'. This issue came up particularly for one of the diabetics we spoke to with regard to the several medications that she had to take. Mona was adamant that she did not want to feel like a patient; the pills she had to take were one of the things that made her feel this way. "I am maybe a little crazy, but I do not want to have the pills on my table, because it reminds me that I am a patient, and I do not want to be a patient – I do not want anything in my kitchen to remind me…" She did not avoid taking the medications but tried to minimise the impact they made on her daily life.

Communication in the clinical meeting

Before we began the fieldwork we had hypothesised that clinical meetings with health care professionals were significant to these two groups' experiences as pre-users, particularly since this is a point when most of the aspects of their treatment were decided. Within these meetings we observed that treatment decisions proved to be much more complex than the healthcare professional simply making a diagnosis and prescribing a treatment. For both conditions these clinical meetings rather seemed to display a process of co-decision making, where the professional's treatment suggestions were dependant on the patient's willingness to accept them. For example, as we have previously mentioned, the ENT's involved in our study wanted first to establish that a patient with a hearing loss would be willing to use a hearing aid before recommending one. Similarly in the regular check up meetings between diabetics and their GP's, the decision to change treatments was as much dependant on how happy the patients were with how they were currently managing with their current treatment as it was on the doctor's prognosis.

The result was that these consultations involved a complex interaction played out in a relatively short period of time. In both cases the longest a consultation lasted was 20 minutes, and these consultations were often marred by communication problems. It is apparent for both groups that these problems can have a significant impact on treatment of the condition and the pre-users' experience of the quality of care. In the Danish system, patients are able to get free hearing aids from the government once an ENT has confirmed they have a sufficiently serious hearing loss. One example of the communication problems encountered during

clinical meetings with the ENT's was that in several of the fifteen-minute consultations which we observed that also included diagnosis, nearly half the time was being spent by the ENT trying to explain where the patient could go to get the hearing aid and how it would be paid for, a task often made more difficult by the patient's hearing loss. The ENT then very little time remaining to explain how the hearing aids might actually be able to help the patient or what difficulties they could expect when adjusting to wearing them.

For diabetes these communication difficulties are exacerbated by the complexity of the condition which has many different aspects that have to be constantly monitored and can be treated in various ways, e.g. with medication or lifestyle changes, and often both simultaneously. It is also an issue that diabetes treatment is not aimed solely at alleviating symptoms, which many suffers do not significantly experience, but at preventing potential future problems such as blindness and loss of circulation. One GP we spoke to expressed a concern that he found it difficult to make patients to understand that they were being treated for the risk of what the disease could do, particularly has he did not want to frighten them. "I think we need tools for communication of this risk, and for these situations when you are not changing a disease but you are changing a risk factor. It is not vey well understood and I don't think we have good tools for handling that". Serious difficulties emerged for him in trying to motivate patients to look after themselves now to prevent the possibility of developing future complications.

Preconceptions about becoming a user

Being in a position where the prospect of becoming a user of the technology was more prevalent than for most 'non-using' people of other technologies, the pre-users we spoke to had many ideas about what the experience of being a user would be like. These ideas about what use would be like and what role it would play in their lives seemed to play a central role in how they consider the transition to becoming users.

For the diabetics the idea of starting to use insulin had very negative connotations, beyond just the discomfort of having to inject. Involved in our pilot was Marie, a woman who had Type 2 Diabetes, who felt that it was likely she would one day be using insulin, an idea that terrified her. Both during the interview with her and the timeline exercise in the co-design workshop Marie expressed her fear of having to use insulin treatment, "it's the most scary picture that I can get. When I am taking insulin it is the end of everything." Marie's expression that insulin treatment would somehow be the 'end' was a statement we heard from others as well. Additionally, some of the pre-users we spoke to were under the impression that starting insulin treatment would mean that they had failed to manage their condition rather than it being the result of progressive condition. There also seemed to be a common perception

that was insulin treatment was initiated it was not possible to come off it; one pre-user we interviewed, Mona, had been temporarily put on insulin treatment when she was in hospital after having suffered a stroke. "I was very afraid of it, because I thought – when I have to get insulin once, it will be for the rest of my life. I did not know they could do it for a period of time... I was more shocked about having insulin then about having the stroke." The pre-conceptions of what insulin treatment actually is cause pre-users to live in fear of it.

Although the hearing loss sufferers generally had a more positive view of what it would mean to be a user of hearing aids compared to the diabetics view of insulin, hearers still seemed to have many preconceptions that did not align particularly well with the 'experts'. We spoke to one pre-user who had had some business dealings with hearing aid companies before and was in many respects quite well informed about the technology, but he had strong opinions about the significance of having a hearing aid. He believed that in order to guarantee his satisfaction with a hearing aid he would have to get the most modern, expensive and technologically sophisticated aid, where he would also be able to adjust the settings himself. "It should be in such a way that you have a hearing aid and you can adjust, experiment with yourself....so you can fine tune it all the time....I think that's important." This stood in contrast to the healthcare professionals' understanding of what the technology is able to do, as although there are digital hearing aids that can have several settings and volume control, they typically only permit the main adjustments to be done by an audiologist. These kinds of misalignment in perceptions can also cause people to invest in technologies that may ultimately turn out to be unsatisfactory or unsuitable for their needs.

Opening Pre-User Design Spaces

Our work thus far with pre-users suggests that consideration of their specific circumstances can be beneficial in design and innovation processes. The study has highlighted that those who are potentially transitioning to become users have a different set of concerns and considerations that may be relevant to the design of that technology, and the products and services that surround it, than those experienced by the users of (or other interested parties to) that technology. It has also served to identify innovation areas for this group, and throughout the course of the pilot we began to perceive several instances in which design interventions could work to affect the experiences of our participants. Yet it is evident from our work that while we can study their lives and practices easily enough, the development of a design process that allows for sustained participation of this group at all stages, and their empowerment within that process in the spirit of participatory design, presents additional challenges.

As we have mentioned, existing methods and formats to study and involve users will not unilaterally apply here, though many are adaptable for use in this context. What we have learnt from our work so far is that the key characteristic that differs between working with these pre-users and the actual users of the technologies is the sensitivity that needs to be deployed with regard to the area of design interest. When users are ordinarily involved in design and innovation processes, their role is often defined by their specialist knowledge of the domain and use context that the designers/developers do not possess. The kinds of contributions they can make to such processes are clear and have been well-documented in PD, CSCW and cognate fields; the kinds of questions they can address for the purposes of design are readily apparent. Here, where the participants may not be able to identify themselves in any relation at all to the technologies of interest to us means that they may find being directly asked to participate in their design irrelevant to them, confusing and in some situations offensive (this particularly so in cases like ours where the process of transitioning to using these technologies is one that is tightly coupled to the individual's own identity). Nor were we (as designers) certain of just how they might contribute prior to engaging them in design.

Yet through the study we have been able to identify several areas where pre-users can make a unique and valuable contribution to design and innovation and where we believe their sustained participation in these processes could be beneficial. As with all PD methods must be matched to intended outcome and in this case taking additional account of the participant characteristics. We have therefore begun to generate hypotheses for potential approaches based on four areas of opportunities for design interventions that emerged from the study. We present these below.

Facilitating the process of becoming a user

In the cases we have been looking at, the process of becoming a user involves much more than just going in to a store and picking a product off the shelf. Difficulties navigating the systems and services involved in acquiring a technology and learning how use it can prevent or hinder the transition to becoming a user. In both of these cases, the decisions taken to become 'a user' are necessarily negotiated and agreed in professional consultations. As such, we cannot separate pre-users' impressions of, and interactions with, the medical system from their perceptions of 'the product'. Because of this complexity, we see the potential for some very simple steps that could be taken to make a more transparent process for the pre-user, such as providing tools and materials to guide them through the process. We speculate that for this purpose, a more traditional PD approach (where the participant adopts the role of expert in the situation of interest) is useful, providing that the design objective is to improve the experience of these systems and services in themselves (rather than to streamline them to expedite people's transition to becoming users, for instance). One opportunity that could be particularly interesting for our case would be bring together health care professionals and those that we have called pre-users together to ideate on, develop and refine tools that can be used in the clinical meeting to create a common language that both groups can use to communicate easier and with fewer misunderstandings.

Changing perceptions and improving information about use

Due to the nature of pre-users' relationship to these medical devices, their perceptions of these products and technologies are based on portrayal rather than practice. Here we see an important design potential in better aligning pre-users' and HCPs knowledge and expectations of the technologies, the health systems in which they participate, and each others' expectations, in order to better enable both parties to anticipate the ways in which transitioning to use will impact upon their lives. This is not about merely making friendlier devices, but about making clear the implications of adopting and using a particular technology to people other than those who are currently using it, something that is equally applicable to the health care professionals' perceptions of pre-users. HCPs assumptions about how a patient feels towards and may be able to cope with the initiation of use, appear to be significant factors in treatment decisions that are negotiated in consultations. This area of design interest provides a greater challenge to participation as essentially we are asking people to help us find ways to change their own perceptions and ideas, implying these are in need of change. One approach to do this could be using methods similar to the critical artefacts, where aspects of the technology could be isolated and abstracted so as not to be overtly confrontational. Such an approach could be one way to provoke discussions that can identify what people's perceptions presently are

and from where they have originated. A more transparent alternative could be to bring some of these different groups together (HCPs and pre-users), creating a format for participation where these different perceptions can come to the surface and begin to be addressed. The difficulty for the PD practitioner here, however, becomes how to facilitate such a session so that the 'voice of medicine' does not dominate the 'voice of the lifeworld' (Mishler 1984)—i.e. that this remains a space of mutual education, not just patient education. An approach with less potential for direct confrontation between the participants might be to bring pre-users together with actual users in a similar setting. In each of these possibilities, however, we see the opportunity for stakeholders to challenge each others' perceptions through the interaction, with the potential that this begins a process of change. Creating spaces for the possibility of airing such conflicting perspectives may reveal further opportunities to address the formation of these perceptions through design on a broader scale (c.f. Gregory, 2003). Here we suggest that participation itself can become a vital part of the solution.

Creating alternatives to use

Additionally pre-user involvement is a way of identifying needs and opportunities that are created when the use of a technology has not been, or is yet to be adopted. Our study participants described and demonstrated several strategies that they employed to manage their circumstances, and in a sense to compensate for non-use. Here the design space that opens is developing new ways to support these strategies and develop new ones. This could serve as an alternative to 'becoming a user' of the technologies we have had in view. Here again, methods similar to the critical artefacts might be effective in proposing alternative technology possibilities to provoke discussion and critical reflection. With careful consideration of their set-up, breaching experiments, role playing scenarios and similar 'futuring' methods (e.g. vision workshops) could play a role in exploring this design space. This approach plays somewhere between the development of new technologies that create new practices, and the development of new practices that imply (and ultimately create) new technologies.

Improving use

Finally, although this study has seemed to indicate that we cannot simply ask pre-users to suggest improvements to a technology that might make them more inclined to use it, they may still have a role to play in improving the ultimate experience of use. One interesting aspect that emerged from the co-design workshop was the pre-users' descriptions of what they expected that technology would actually be able to do for them. These expectations, though not always in accordance with the medical experts', could be seed the generation of design specifications. We speculate that it might also be fruitful to see what pre-users, who have this

peculiar relationship to the technology that is not constrained by their actual experiences of use, could contribute creatively to ideation sessions. This is something we are continuing to explore in current work.

Conclusion

In this paper we have introduced the concept of pre-users, in particular with regard to medical devices. Pre-users are neither users nor potential users; their relationship to the development of these products is slightly more complex. Yet despite not having a direct relationship to the technologies under development, involving pre-users in design can be of benefit to the companies that produce the products, the health system in which they are located and most importantly to the pre-users themselves. However, in certain respects, pre-user participation must differ in approach to other forms of stakeholder participation, and there are several aspects that must be taken into account.

As we argued, one such aspect is that pre-users have no constituency to represent them, and they may have no interest in the development of the technology. As we have found, however, this does not prevent them from participating and contributing to the project. Sensitivity to the life issues that for pre-users are implicated by the products being designed is clearly of paramount importance—as we found with one of our participants who was determined not to end up a user. Proposing a scenario which forced her to consider using the product outright could be confrontational and destructive.

We have suggested that one approach to pre-user participation is to create a focus on areas that are of current salience to them, i.e. not specifically looking at the technologies themselves but pre-users' close experiences with the healthcare system as they are now encountering it. At points when it is interesting or necessary to broach subjects which may be in some way confrontational, methods that abstract the issues for discussion, such as the critical artefacts, may be useful. With regard to empowerment, participation in itself may be part of the solution, in that by participating, pre-users are brought together with other pre-users, users, and healthcare professionals in a setting where they have a contribution of equal value to make. This may also serve as the beginnings a means of creating some form of temporary constituency (c.f. Segalowitz & Brereton 2009), and can also serve as a means of addressing some of the issues uncovered such as patient education and healthcare professionals' perceptions of pre-users, as it has in this study.

Inviting pre-users to participate in design requires sensitivity towards their own existing perceptions of, and relationships with, the technologies, and must be carefully balanced with the intent and objectives of the project. If the only power that pre-users have in the process is the right to withdraw their participation, then respecting the way they choose to participate, and what they choose to participate in, is of the utmost importance. What this study has highlighted, however, are several areas of design interest that are inadequately addressable through the involvement of other stakeholders or constituencies. Understanding the process

of transitioning to use, aligning perceptions and information between the medical fraternity and pre-users, and creating alternatives to use, are design spaces that have been opened through the participation of pre-users in design.

Acknowledgments

References

Beck EE. P for political - participation is not enough. Scandinavian Journal of Information Systems, 2002, 14:77-92.

Bowen SJ. A critical artefact methodology: Using provocative conceptual designs to foster humancentred innovation. PhD dissertation, Sheffield Hallam University, 2009.

Brereton M, and Buur J. New challenges for design participation in the era of ubiquitous computing. CoDesign: International Journal of CoCreation in Design and the Arts, 2008, 4(2):101-113.

Christensen VT. Hard of Hearing. The Danish national Institute of Social Research, Copenhagen, 2006.

Crabtree A. Design in the absence of practice: breaching experiments. Proc. DIS2004. ACM Press. 2004, 59-68.

Dawe M. Let me show you what I want: engaging individuals with cognitive disabilities and their families in design. Proc CHI'07 extended abstracts on Human factors in computing systems. 2007, 2177-2182.

Ehn P. Work oriented design of computer artifacts. Stockholm: Arbetslivscentrum. 1989.

Ehn P. Scandinavian design: on participation and skill. In: Participatory design: principles and practices. Erlbaum. 1993, 41-78.

Engelund G. Time for hearing - recognising process for the individual: a grounded theory. PhD dissertation, Det Humanistiske Fakultet, Københavns Universitet, 2006.

Goodall G, Sarpong EM, Hayes C, Valentine WJ. The consequences of delaying insulin initiation in UK type 2 diabetes patients failing oral hyperglycaemic agents: a modelling study. BMC endocrine disorders 2009, 9:19.

Graham C, Cheverst K, and Rouncefield M. Whose probe is it anyway. In: Workshop on appropriate methods for design in complex and sensitive settings. OzCHI, 2005.

Gregory J. Scandinavian approaches to participatory design. International Journal of Engineering Education 2003, 19(1):62–74.

Kochkin S. MarkeTrak VII: Hearing loss population tops 31 million people. Hearing Review 2005, 12(7):16–29.

Kochkin S. MarkeTrak VII: Customer satisfaction with hearing instruments in the digital age. The Hearing Journal 2005, 58(9):30-43.

Mishler EG. The discourse of medicine. Greenwood Publishing Group, 1984.

Norman DA. Human-centered design considered harmful. Interactions 2005, 12(4):14-19.

Redström J. Towards user design? On the shift from object to user as the subject of design. Design Studies 2006, 27(2):123-139.

Redström J. RE: Definitions of use. Design Studies 2008, 29(4):410–423.

Sanders, EBN, Stappers PJ. Co-creation and the new landscapes of design. CoDesign 2008, 4(1):5–18.

Segalowitz M, and Brereton M. An examination of the knowledge barriers in participatory design and the prospects for embedded research. Proc. of the 21st Annual Conference of the Australian Computer-Human Interaction Special Interest
Group: Design: Open 24/7. ACM Press. 200, 337-340

Sharrock WW, Anderson RJ. The user as a scenic feature of the design space. Design Studies 1994, 15(1):5-18.

your hearing

Quieter

.00   2.0   4.0

The S-tø_ to _ø_e?

probl
in b
rest
los

Hearing loss can
you in unexpected
like making you mo
tired at work becaus
have to concentra
to hear collegue

mumbling, or
t you can't
aying?

w loud a frequency of sound v
n hear it. The area above the lin
nd below the line is what yo

ar.
ear.

diogram app for iphone a
your audiogram agianst

Crafting 'Solvable' Problems In The Design Process

Janet Kelly

Abstract

This paper is an attempt to explicate how a 'wicked' problem, is addressed in a design process in order to construct it in such a way as to be 'solvable'. I will show that in this example how aspects of the problem space were selected in a way to allow a corresponding solution space to be defined- and show how both this problem space and solution space then evolved through design exploration. The case presented is in fact two design projects, which were run in parallel, performed on behalf of two medical device manufacturers. In this case, in order to respond to the varied and sometimes contradictory interests of the various stakeholders, the design problem which defined the starting point for exploration was crafted from aspects of the problem space where these interests in some way overlapped. The resulting proposals are concepts that aim, not to surpass conventional expectations, but to change them to be better aligned with the actual experience of using the technologies.

Introduction

The concept of 'wicked problems' was introduced by Rittel in the 1960's [1] to describe a societal class of problems, differentiated from the problems being addressed by of the natural sciences. Unlike the 'tame' problems of the natural sciences which "are definable and separable and may have solutions that are findable", 'wicked problems' are ill- formulated, involve information that is confusing, have many stakeholders with conflicting values, with unforeseeable consequences, and although are addressable, are not solvable "Social problems are never solved. At best they are only re-solved- over and over again." [2] This idea has resonated within the design community as it recognises issues at the very core of much of design practice. As Buchanan points out regarding the first published report of the idea, that the description wicked problems as was in fact an "amusing description of what confronts designers in every new situation." [1]

The 'wicked problems' approach was outlined by Rittel and Webber in their 1973 paper regarding the professional practice of planning, where they outlined ten properties of wicked problems- highlighting their indeterminate nature. Later Buchanan offered an explanation as to why design problems specifically are so wicked, arguing that this is because there is no subject matter particular to design, leaving the designer both free and obliged, to define their own."Design problems are 'indeterminate' and 'wicked' because design has no special subject matter of its own apart from what a designer conceives it to be. The subject matter of design is potentially universal in scope, because design thinking may be applied to any area of human experience. But in the process of application, the designer must discover or invent a particular subject out of the problems and issues of specific circumstance"[1]. Design is not confined by any one way of doing things, but can consider any possible path in order to make a transformation, leaving us with a potentially infinite number of possibilities as of how to respond to any given task.

In contrast to classical problem solving models which suggest first the clear definition of a problem followed by the search for a solution, due to their indeterminate nature 'wicked problems' become defined through the forming of a solution, the response determining which elements the problem it is addressing will be comprised of. "To find the problem is thus the same thing as finding the solution; the problem can't be defined until the solution has been found. The formulation of a wicked problem is the problem! The process of formulating the problem and of conceiving a solution (or re-solution) are identical, since every specification of the problem is a specification of the direction in which a treatment is considered."[2] Creative design involves an exploration of both problem and solution, and this interdependency between the development of them has become intrinsic to how we currently understand

design practice; acknowledging that design exploration is as much about finding problem as solutions; as Cross describes it, "Defining and framing the design problem is therefore a key aspect of creativity." [3] Problem formulation is part of the creative design process- we construct a problem out of aspects of the circumstances we are trying to transform, in order to make them solvable.

Mayer presented a model of this exploration process as a form of 'co-evolution' [4], in which the problem and the solution spaces are two distinct search spaces that interact over time, and where the problem leads to the solution, but in turn the proposed solution can refocus the problem, meaning that designers define what to change (the problem) and also how to go about it (the solution) in parallel, developing and refining them through constant iterations in search of an apposite concept [5]. "Creative design involves a period of exploration in which problem and solution spaces are evolving and unstable until (temporarily) fixed by an emergent bridge which identifies a problem-solution pairing"[6], this exploration phase involving both searching for solutions and potentially solvable problems until they can be matched together. There is a subtle difference then between the problems that our overall goals derive from in most projects and the ones we formulate to solve. The initial and underlying problems that project goals derive from, except in the most trivial of design cases as Buchannan points out [1], are usually those that can be considered wicked problems, ill-defined and unsolvable; while the design problems we formulate through our exploration, must be defined sufficiently in order for solutions, no matter how tentative, to present themselves .

Although these problem may evolve beyond recognition throughout the process of exploring of problem- solution pairs, it is necessary to formulate that initial 'solvable' problem from a unsolvable wicked one, in the first place- without the designers skill to do this, the exploration would have no starting point to evolve from. Steve Harfield argues in the cases of architectural design that he is studying, the architects do this by formulating an architectural or design problem based their own personal views of what constitutes appropriate designerly problems[7], in addition to the problem in the brief, "By imposing upon the problem-as-given their views, positions and preferences, architects construct the problems they seek to solve while at the same time defining and limiting the solution possibilities available to them." In the case I present here I will attempt to demonstrate that in the case of a user-driven process such as this how I chose and defined a 'solvable' designerely problem, attempting to take into account stakeholder perspectives as well as my own views as a designer.

The Case

This design project has been done as part of a research project that is sponsored by two medical devices companies, Novo Nordisk who produce injection devices for diabetes drugs, and Oticon who produce hearing aids. The project was initiated because both these companies perceived they had a similar problem in that a large proportion of their potential market, people diagnosed with the medical conditions whose health and well being could benefit from using these treatment devices, are reluctant to begin doing so. In this project we are referring to this group as 'pre-users' of medical devices [8] The initial aim of this research project has been twofold, firstly to identify, what are the reasons that prevent people from becoming users, and secondly to involve the device pre-users in order to develop outcomes that facilitate the transition from pre-user to user. Both these conditions are complex and progressive, making it difficult for people suffering from them to understand what it exactly is they are being treated for. The project group includes myself, a designer, and an anthropologist. The brief for this task asks for designs that surpass conventional expectations, but what I would like to present here is a case where I attempt to develop design responses that change conventional expectations, to be better aligned with the actual experience of using the technologies, demonstrating how this became one of the main objectives of the process. Through presenting this case I will also try to demonstrate how the problem I attempt to address is typical of Rittels 'wicked problem' concept, an explicate how I as a designer try to tackle this, in particular on the practice involved in constructing a problem formulation in order to create outcomes of that respond to a range of different stakeholder interests. For practical reasons this case involves two similar design projects, one for each of the company sponsors, which were run simultaneously.

The main project goal in this case derives from the commercial interests of the two companies that are sponsoring it. Both hearing loss and diabetes type 2 are conditions that are becoming increasingly more common with an aging population. These medical conditions can have a significant affect on peoples, health, well being and social life, as well as their ability to stay independent as they grow older, but fortunately there already exist medical technologies to treat them which are easily available across the developed world, and that can allow people with the conditions to achieve a high quality of life. Type 2 diabetes can be treated in many ways, one of the most effective being insulin injection treatment and hearing aids have been show to significantly ameliorate many of the problems of hearing loss. The issue both companies have is that they believe they have a large untapped market, as despite the medical benefits of the technologies they produce, many people delay the uptake of these treatments long past the point the where it would be medically beneficial to them. Their goal in initiating the research project that this case is from, in collaboration with the SPIRE Centre

for Participatory Innovation at the University of Southern Denmark, has been to see what could be learnt from people who have the conditions but were not yet using the devices, who had not yet held them in their hands, and innovate with them in order to 'solve' this (the companies) problem.

Although the goals driving the project are commercial, is not possible to separate them from the two healthcare issues to which they are associated. There are 285 million people worldwide with type 2 diabetes [9]; a figure which is increasing rapidly. It is a gradually developing condition that is characterized by insulin resistance and relative insulin deficiency, this in turn causes high blood sugar (glucose) levels, and although it is often preventable through lifestyle changes, once developed it must be treated to control blood sugar levels, as sustained high sugar levels will eventually lead to tissue damage, often resulting in serious complications. This tissue damage can occur in many organ systems, but it is the kidneys, eyes, nerves and vascular tree (blood vessels), which manifest the most significant, and sometimes fatal, diabetes complications. Diabetes is ranked among the leading causes of blindness, renal failure and lower limb amputation in most developed countries. Diabetes is also now one of the leading causes of death, largely because of a markedly increased risk of coronary heart disease and stroke (cardiovascular disease). In Addition to the human suffering that diabetes-related complications cause, their economic costs are huge [10]. Studies show that failure to promptly begin insulin therapy when it becomes necessary is likely to result in needlessly reduced life expectancy and compromised quality of life [11].

Although the consequences of hearing loss may not be as dramatic as diabetes, the condition can still have drastic effect of the lives of those have it and the people around them. There are 31 million with hearing loss world wide, many of which are age related [12]. Similarly to diabetes, gradual hearing loss is an incurable condition, but most of the effects of it can be ameliorated with hearing aids. Hearing impairment has been associated with depression [13] and social withdrawal, and can be damaging to personal relationships as if affects communication. It is also show to have a significantly detrimental affect on work experience and the workforce, with people with hearing loss being significantly more likely to report a sick leave, almost exclusively due to stress related complaints , in addition a Danish study has also linked hearing loss, with likelihood to take early retirement.[14] yet despite a very high satisfaction amongst people who use them only one in four people who could benefit from a hearing aid actually use them in the developed world[15]. From a medical perspective these both hearing aids and insulin injection devices have significant benefits, and although they will not cure either condition, are able to help prevent some of their worst consequences. Yet despite this the healthcare problems have not been 'solved', the wickedness remains, as people who are supposed to be able to be benefit from these treatments do not.

The circumstances of this 'wicked' problem are thoroughly confusing when considered only with this rational, which is why gaining an insight into the rational of the potential users of these devices was important. We chose to take a user (or in our case pre-user) driven approach to design in this project, and most of the work presented in this case is based on a pilot study we conducted in Autumn 2009, and follow up events in Spring 2011, following a period of leave from the project. In the pilot project we interviewed 2 people with hearing loss but no hearing aids, and 3 people with type 2 diabetes not yet on insulin treatment, in their homes, and invited 2 of each group to a co-design workshop. In addition to this, based on a hypothesis that the clinical interaction between doctor and patient was important to the decision to adopt the devices, we visited 2 general practitioner doctors and 2 ear nose and throat doctors, for interviews and recorded consultations between them and patients with the condition [8]. After the project leave we were able to go back to one of the people with diabetes for a follow up workshop, and we also revisited one of the people with hearing loss, who had since acquired hearing aids, but he was joined in the workshop by his wife who also had a hearing loss but was resisting getting hearing aids.

Formulating A 'Solvable' Problem

Insights in to the problem

Our initial interviews involved going to visit each of the pre-users in their homes and conducting and hour and a half semi-structured interviews with them focusing on the condition and the way it affected their daily lives. Additionally we conducted semi-structured with the health care professionals (HCPs) focusing on their experience of treating these patients and introducing the treatment technologies to them, and recorded consultations where the treatment of the conditions were discussed. One of the conclusions we were able to draw from these were that the perceived benefits offered by the technologies, were being weighted up against recognised problems the conditions created in peoples lives, and interpretations of how these might develop in future and for the people who suffered from these conditions, the treatments as 'solutions' to the medical problem were seemingly more problematic than the conditions themselves.

This was partly because the symptoms of the conditions were not necessarily immediately felt by those with them. In the case of type two diabetes most people experience very few symptoms, the condition is treated to prevent long term damage to the body and to lower the risk of events such as heart attacks, but in general before these complications emerge there are few things to indicate a person is sick and afterwards it is often too late. As one GP we talked to explained, it is challenging to explain to people that we treat diabetes for the risks of complications in the future as people do not feel sick now so they are not addressing immediately felt problems. While gradual hearing loss is a condition which normally develops over many years and so many people may not even be aware they have it for a very long time. It is often the case that they themselves will not be the first to notice their hearing difficulties; rather it is frequently their partner, friends or colleagues [16].As one of our participants expressed" I do not notice what I don't hear," which also meant that when people did recognise they had a hearing loss, they did not necessarily recognise it as a problem that was affecting them significantly to do something about. One ENT explained to us that people often came in because someone else wanted them to and in these cases he was reluctant to offer hearing aids, as from his experience these people were less likely to use hearing them.

The participants in our study did not feel that the conditions were necessarily causing them any problems in their daily lives, but felt that the treatments would. For people with diabetes, taking insulin was presented more as a symptom of the disease than a treatment, a point in the progression of the disease that suddenly meant it became serious, one of our participants, Marie, explained to her taking insulin "means it is now serious, no going back", and even that taking insulin would mean there was nothing more that could be done "when I

start taking insulin it means the end of my life". While with the hearing loss the concern was related to the stigma of having the condition, a participant, Ole, expressed concern that in people saw the hearing aid they would think, "that poor old man, he can't hear," the concern was that the hearing aid would make the condition more evident, rather than alleviating the symptoms.

Reluctance to adopt use of the treatment technologies was not explicitly related to problems with the design of the devices them, but people associated the treatments with the problems of having the conditions and not as being the solutions to them. With type 2 diabetes the treatment is mainly to prevent future complications, rather than current symptoms. While with gradual hearing loss, it can be hard for people suffering from the condition to differentiate between problems cause by their environment, and those caused by the condition; additionally many of the consequences (tiredness, social isolation) can seem completely unrelated. In both cases people did not feel like they were experiencing problems in their everyday lives that were caused by the conditions, and the treatment would actually be more problematic. This insight gave a greater transparency to the nature of the problem the project goal was deriving from but did not tame it.

Finding a problem that seemed 'solvable

The stakeholders' conflicting values, particularly as to what constituted as to being the problem in these circumstances, is a significant aspect of the 'wickedness' of these problems and to me it appeared that finding a way to align these would be a way to respond to this. I considered that if I could make the consequences of not treating the conditions clearer to the pre-users, and by doing so transform their expectations of the becoming a user of the technologies from a problem into a solution, the project goal could be met. Yet I still was not able to easily search or recognise interesting responses from this formulation alone. It was still too broad and indeterminate to focus on how it could be resolved with concrete solution concepts, so I began to look for a way to formulate a more defined problem taking into account this aspect of the problem.

I became interested in one phenomenon that we noticed during our analysis of our ethnographic data, which was that numbers and measurements were referred to frequently when discussing both conditions. Both of the conditions are essential defined by a number, diagnosed by measuring blood sugar levels or hearing threshold, which if it is above a certain cut off point, means it is technically the condition and for the participants our study, the relationship with these numbers and measurement could be problematic in different ways. For those with diabetes sometimes rises in blood sugar did not seem to relate easily to what they were eating and doing, "Flødeboller (marshmallow filled cake- when I eat that in the

evening then in the morning I have a very high blood sugar. That is hard for me to understand because flødeboller are very easy to digest. If I eat drops (candy) or anything in the evening , it is not very high in the morning, then I have offset it." In addition to this, for some there were no physical symptoms. "I don't feel it. I never do, I never feel any different when its low or high". The abstract and confusing nature of these readings could also have a profound affect on an emotional level, "Then I will stop measuring – I get the feeling: No, I do not want to be confronted with it... To be confronted with these numbers that just go up and down – I can not handle that at all." The emotional impact seemed to be caused by measurement not just being related to the condition itself, but also to being judged as a good patient.

While it seemed that one problem with hearing loss was the discrepancy between the subjective experience of it and the abstract technicality of the diagnosis. Many of our study participants had expressed a suspicion that the problems could actually be being caused by environmental factors- they felt they could hear clearly in some situations but not in others the problems were often equated with the environment, or that other people were "mumbling". Being officially diagnosed did little to help allay the suspicions or clarify that problems were actually linked to the hearing loss. When tested the measurements of their hearing levels were recorded on an audiogram from which the hearing care professional obtains the information they need to decide on a treatment [17]. None of our participants who had had a hearing test could explain to us what their diagram meant in terms of their experience of hearing and from our observations ENT's trying to explain to patients their hearing loss it was evident it was not easy to understand - one patient we observed for example though the decibel scale indicated an age ranges at first. People found it hard to relate the loss of some frequencies as indicated on the audiogram to the hearing problems they were having, causing them to doubt the need for treatment.

Our study participants found it hard to relate to the abstract nature this measurement to any problems which in turn appeared to be one of the reasons they found it hard to accept the need to treat it. Measurement and numbers were in fact closely linked to both the experience of the condition and many of the strategies for handling it. This aspect of the problem was connected to others and could actually meet the companies' goal for the project - if the numbers could be easier related to the experiences and consequences of the conditions, it could make people understand the need to treat the conditions better and therefore more willing to adopt the technologies earlier. I recognised potential bridges between this problem formulation and solution concepts that had began to emerge and felt this would be a productive area to explore further, a component of the overall wicked problem that was potentially 'solvable'.

Figure 1. ENT explains audiogram to a patient.

Evolving the Problem Through Solutions

Critical Artefacts

Finding ways to make the numbers and measurements involved relate better to the experience of the condition presented itself as a designerely [7]problem as it gave me a defined and limited subject matter to work with but also allowed me to begin conceiving of potential solutions. The first concepts generated were not conceived as potentially realizable design solutions though, but instead as exploratory tools to enquire further into the problematic aspects of the condition with the pre-users. This method was based on Critical Artefacts Methods [18] which are inspired by the Critical Design, the idea of which is to use provocative design concepts to generate critical reflection from stakeholders as part of a design process, not as the outcome of it. "The critical artefacts produced serve the role of 'probes' within human-centred design activity - tools for exploring problem contexts and generating needs-focussed product ideas. The critical artefacts are instrumental in developing better "answers" (ibid). We developed critical artefacts, 3 based around hearing loss and 3 based around type 2 diabetes and measurement technologies, and presented them in a workshop with pre-user representatives from both disease areas, 2 of each.

The idea behind the concepts was that rather than measuring the condition, they would measure aspects of the environment that affected the experience of the condition; technologies that indicated how easy it was to hear in an environment, and technologies that indicated how healthy food was. The concepts all varied in the level of privacy they allowed for example one
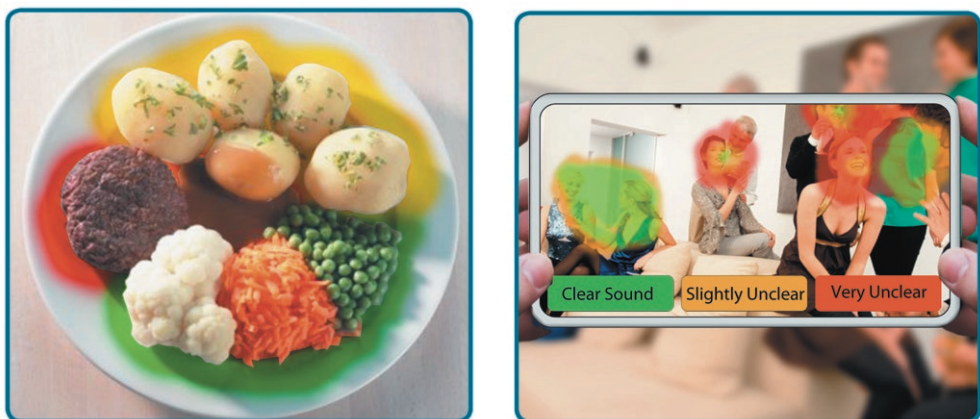

Figure 2 & 3 Critical artifacts- NutriScan Visual and Soundscape Info

concept for the diabetes was a plate that would change colour depending on the healthiness of it, while another was a discreet key ring sized device they would 'scan' the food. In the activity we presented the devices along with a situation, for example a dinner party, and asked the participants to describe how they might use the concepts in that situation.

The discussion in the workshop brought to the surface many of the participants' attitudes towards technologies role in handling their condition, and what they felt was acceptable from it. For the participants with diabetes the artefacts provoked reflection on the role numbers and measurements as indicator of success, showing how well you are controlling it and also what it meant to add a social element by making this visible to others One participant, for example, discussed how she would try to cheat if she had to use an artefact like the plates; she felt that it would show how unhealthy the food she was eating was, which would be in someway shameful and not something she was willing to make explicitly visible to others.

Participant- The idea that other people could see what I put on my plate, I don't think that's a good idea. I would cheat…. if I could.
Facilitator- Cheat? Do you have any idea how?
Particpant- No…..but I sure I would cheat. The green area would be so big on my plate, I would find some way (using hands to indicate rearranging food)

It also prompted reflection on the how the numbers and need to measure could be representative of your knowledge about the condition, as another participant was quick to label the same idea as was childish, "that's for babies", but it then occurred to her that it could have a role for people who were newly diagnosed, when they were just starting to learn about managing their condition, highlighting the role of measurement as an existing tool to learn how to control the diabetes through diet.

The reflection the hearing loss concepts provoked was focused more on how, or if, being able to understand what was causing the communication problems in social situations would help to deal with the situation better. A participants who in a previous interview had discussed how at parties he would feel excluded because he could not hear what was going on, that he would often pretend to understand what was going on as a way of coping, but when he considered the use of this concept he explained that he did not think it would guide him at all, he would still go to the people he wanted to talk with, not the ones which he could hear best. This reflect eventually prompted both participants with hearing loss to discuss the advantages of having such a technology as a feature in a hearing aid, that would automatically adjust itself to the situation so they would not have to adapt their behaviour in these social situations. The artefact effectively made explicit the role of hearing loss coping mechanisms in changing

behaviour in social situations, which had caused the alternative of hearing aids to appear in a more positive light.

Figure 4. Pre-User Critical Artifacts Workshop

The Second Workshop

After this initial exploration I began looking ways in which solving this problem could also addressing the overall project goal, making the numbers easier to relate to the experiences and consequences of the conditions in order make people understand the need to treat the conditions better; or more specifically the benefits of the treatments. For the diabetes, the insight from the critical artefacts workshop about to the role of measurement in learning how to control the condition with diet, made me consider how learning about insulin treatment and other aspects of the condition could be approached in a similar way and began exploring ways to communicate how changing the three main treatment parameters, diet, exercise and medication, affected blood sugar numbers over time, as a way of relating the treatment of the condition to the way it affected peoples bodies. While with the hearing loss case, the workshop had indicated that making the affects of the hearing loss explicit in real situations could make wearing hearing aids seem like a more positive option, so I began looking at concepts to inspired by the 'Audiogram of Everyday Sounds' a tool that is used for counselling on hearing loss in audiological consultations [19], that involved using patients own audiograms to visually

indicate the sounds that they weren't able to hear in real situations.

In order to explore and test these ideas further with the pre-users we organised two more co-design workshops, one with a participant with diabetes from the first workshop, and another with a participant first workshop with hearing loss, who had started using hearing aids since the first workshop, and his wife who also had a hearing loss. In these workshops we started by presenting a pre-user scenario, which we followed with an activity which involved trying to get the participants to forge the links between the measurements and their experiences of the conditions. For the diabetes this was presenting a graph showing changes in blood sugar over a day, and asking the participant to match cards with meals and activities on them, to the peaks and troughs, and with the hearing loss we presented an blank audiogram, which we the participants should fill in, and try and identify where the sounds they had problems with should be placed on it. Finally we then presented concept proposals, which the participants critiqued and made development suggestions for.
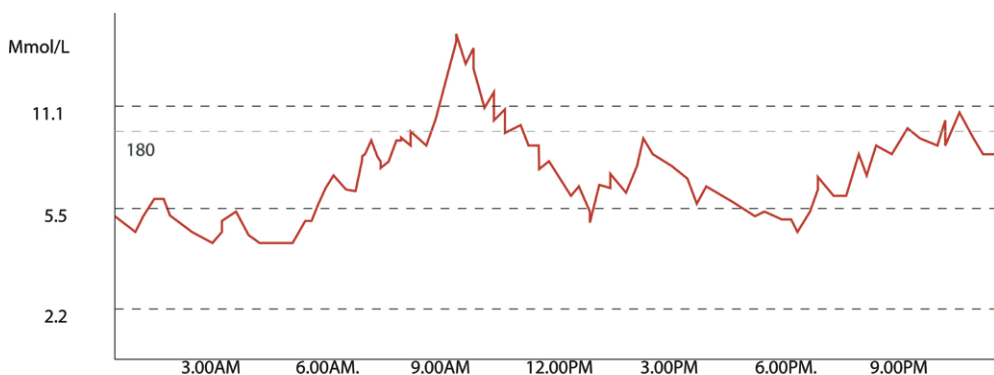

Figure 5. Blood Sugar Chart fromt Type 2 Diabetes Workshop

In the blood sugar graph activity in the diabetes workshop, the participant was quickly able to make connections between the changes in blood sugar on the graph and the food and exercise images, but struggled to relate the medication options to changes in blood sugar over the day. She really did not seem to need a tool to help her understand the daily changes in blood sugar, but when we discussed the concept afterwards, she discussed the importance of understanding the long term risks, which put the focus on communicating this, and also medications role in preventing them. The participants in the hearing loss workshop, found the audiogram activity more challenging, in particular, trying to identify where sounds they had difficulty hearing would be on the chart, even just trying to work out whether something was a high or low frequency was hard, for example bike tyres on gravel was one sound that

was particularly difficult to classify. Although they thought it was interesting to be able to be able to see what you don't hear currently, but that it would be even better if you could hear the difference.

Figure 6. Audiogram Activity from hearing loss workshop.

The Current Design Proposals

The workshops revealed new aspects to the problems, the importance of understanding the long term risk with the diabetes and being able to hear the difference hearing aids could make in real life situations- so based on this the responses evolved further. The current response for the Type 2 diabetes disease area is a concept for an online educational tool 'Making Sense of Blood Sugar', that helps people how food, activities and different medications affect blood sugar, and also indicates the long term risks involved in maintaining high blood sugar. The
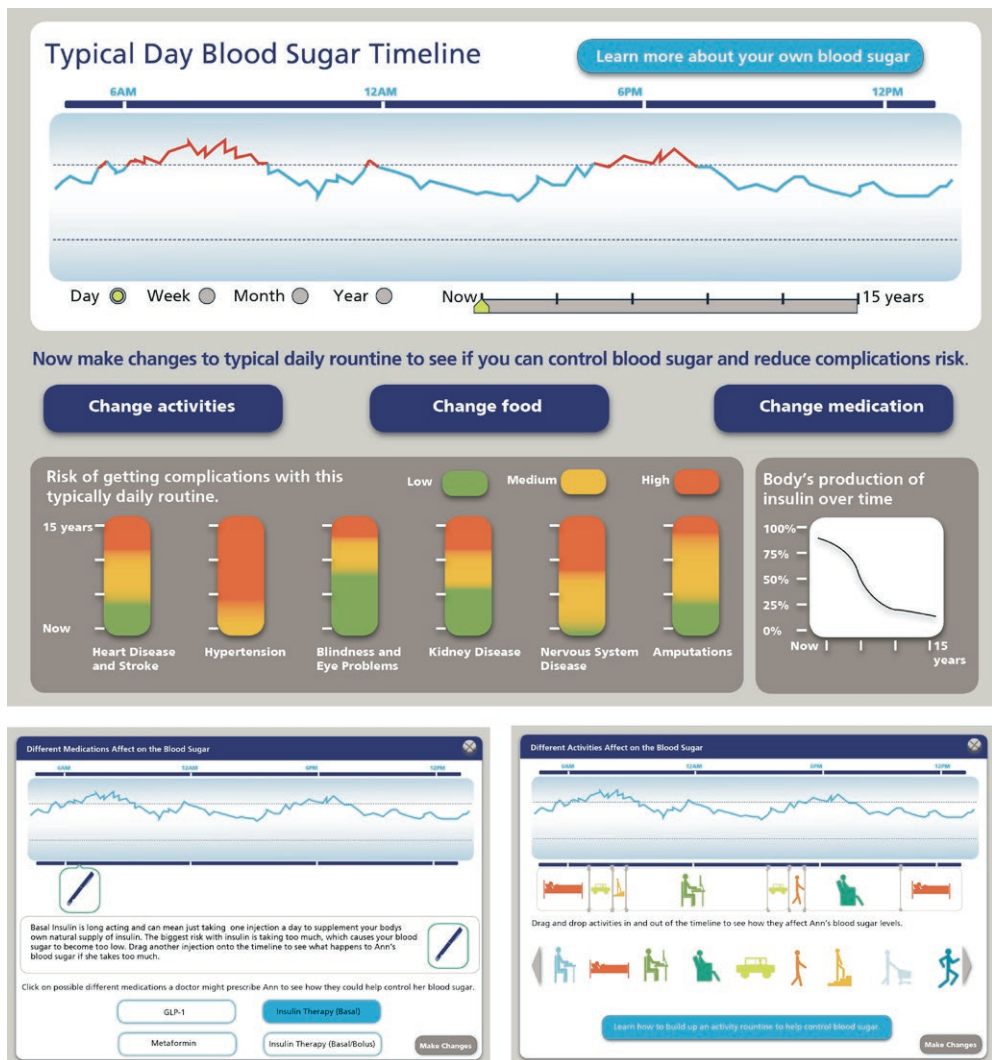

Figure 7. Making Sense of Blood Sugar interface.

concept involves a website, where people with diabetes can learn about how blood sugar levels can be controlled by the different parameters of medication, exercise and food. By experimenting with changing different aspects of an avatar's daily routine, people can see to what extent these affect the avatars blood sugar graph over a day, and in then how these kinds of numbers would affect the risk of getting long term complications. The idea is the tool could be developed as part of a training program for people who are newly diagnosed with the condition, but also could be used by doctors to help explain in treatment plans to patients, to help them understand the objectives and relate the treatment to positive consequences for themselves. It seeks to help people learn how to manage their condition better, but also to show how different medications, especially insulin help to lower and control blood sugar, and why this is worth doing

While the proposal for the hearing loss area, is 'My Audiogram', a concept for a service package that could be provided to hearing care professionals by Oticon. It includes a range of tools that can be given to people who have been newly diagnosed with a hearing loss, to help them relate their hearing loss to the problems they are having, and learn what hearing aids could do to help them hear. These tools centre around the audiogram and the main aim of the concept is to give people ways to connect the abstract numbers that are shown on their
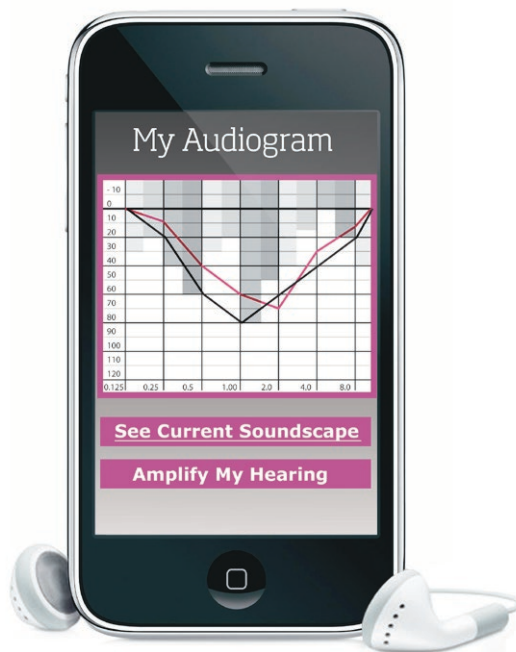

Figure 8. My Audiogram Smart Phone App.

audiogram to the real life situations where they experience problems with their hearing by converting electronic audiograms into self-counselling tools. It would include a smart phone application that would allow people to compare readings of the sounds in their environment to their audiogram, to help them understand how their hearing-loss might affect their experiences; then they would be able to convert their phone into a hearing aid, using the phones own microphone and headset, to be able to hear the difference instantaneously. It seeks to demonstrate to people how hearing aids could help them by demonstrating it in real life situations both visually and with audio.

Although these concepts could represent ways to resolve the main problem the project goals derive from, there are questions that require further exploration, not least would people be motivated to use them and how great an influence would it have on reducing people's reluctance to use the technologies. Prototyping and taking them back to people may help give an indication, but only deployment in the specific circumstances for which it they are intended will be able to give a true picture of their potential. On reflection what is most interesting about the hearing concept, I believe, is that it allows people who are having hearing problems to test different situations out to see if a hearing aid would help, which creates another formulation of the problem- and with that indicates another range of potential solutions that could be explored further. Similarly, what becomes interesting about the diabetes concept is how actions now, IE initiating insulin, can be linked to preserving health in the future, and there may be many other ways to do this. These are not the final concepts, but simply the current matching of problem and solution; as the project is not yet complete, and based on the current rate of evolution, it is likely both problem formulation and solution will change significantly in the search for the apposite concepts.

Conclusion

In this paper I have attempted to explicate how problems are constructed as part of a user driven design process. The given problem in this case is representative of the class of social problems covered by Rittel's 'wicked problem' concept, and was addressed through a creative design process where problem formulation and solutions evolved together, but before this was possible I first had to formulate a problem that was in some way 'solvable' problem. I have tried to demonstrate that a user driven process such as the one presented here, designers seek to construct such problems, that both account for different stakeholder perspectives and their own views on what makes a 'designerly' problem, in other words a problem that is not only 'solvable', but 'solvable' in a way that creates an experience of value.

In this case, even after gaining deeper insights into the nature of this 'wicked' problem, that the project goals had derived from, I did not find it possible to explore potential solutions easily, without creating a problem formulation that was more defined. I chose to respond to a problem that was both different and part of the main problem the project goals, formulated from different aspects of it where stakeholder interests could be aligned. The choice of this problem was based both on the information I had available to me about the problem space and my experience and instincts as a designer as to what could constitute a 'solvable' problem. Once having arrived at a problem that I was able to conceive of solutions for, it was by no means fixed, but instead served as a starting point which changed significantly as solution concept generation revealed more aspects of the problem space.

I have tried to demonstrate that in this process there is a difference between the indeterminate, unsolvable, 'wicked' problems which project goals derive from and the 'design problems' that are constructed as part of the process. Here 'design problems' are those which are crafted from aspects of the specific circumstances in order to temporarily create greater determinacy in design processes and therefore give focus to the exploration allowing for potential solutions to become recognisable. I suggest that as designers we formulate these problems as tools that allow us to respond with design ideas; to making them defined sufficiently to be able to recognise what a solution might look like and in order to begin exploring further through the co-evolution of solutions. We deliberately formulate these problems in a way that allows us to partially tame them just enough to begin to identify solutions, but with a flexibility to redefine problem and solution space again and again, until an apposite concept emerges as a resolution. By doing so we are discovering and inventing the particular subject matter in which we will work with and I believe it is one of designers' key professional skills drawing both on their own experience and on the information they have available to them about the problem space, to be able to craft 'solvable' problems.

References

1. Rittel H and Webber M (1973) Dilemmas in a General Theory of Planning, Policy Sciences, Vol. 4, pp. 155–169.

2. Buchanan R (1992) Wicked Problems in Design Thinking. Design Issues, 8(2), pp.5-21.

3. Dorst, K. & Cross, N (2001) Creativity in the design process: co-evolution of problem-solution. Design Studies, 22(5), pp.425-437.

4. Maher, M.L., Poon, J. & Boulanger, S., (1996) Formalising Design Exploration As Co-Evolution: A Combined Gene Approach. in J S Gero and F Sudweeks.Advances in formal design methods for CAD, Chapman and Hall, London.

5. Nigel, C. (1997) Descriptive models of creative design: application to an example. Design Studies, 18(4), pp.427-440.

6. Kruger C. & Cross N (2006) Solution driven versus problem driven design: strategies and outcomes. Design Studies, 27(5), pp.527-548.

7. Harfield, S (2007). On design `problematization': Theorising differences in designed outcomes. Design Studies, 28(2), pp.159-173.

8. Kelly J. & Matthews B (2010). Taking transition into account: designing with pre-users of medical devices. In Proceedings of the 11th Biennial Participatory Design Conference. PDC'10. New York, NY, USA: ACM, p. 71–80.

9. Diabetes-Diabetes Atlas. Available at: http://www.diabetesatlas.org/content/diabetes [Accessed May 9, 2011]

10. What is Diabetes- Diabetes Atlas Available at: http://www.diabetesatlas.org/content/what-is-diabetes [Accessed May 2, 2011]

11. Goodall G, Sarpong EM, Hayes C, Valentine WJ. The consequences of delaying insulin initiation in UK type 2 diabetes patients failing oral hyperglycaemic agents: a modelling study. BMC endocrine disorders 2009.

12. Kochkin S. 2005. MarkeTrak VII: Hearing loss population tops 31 million people. Hearing Review, 12(7):16–29.

13. Stephens D, Kramer S (2009)Living with Hearing Difficulties: The process of enablement, Wiley

14. Christensen VT. (2006) Hard of Hearing. The Danish national Institute of Social Research, Copenhagen.

15. Kochkin S. 2005. MarkeTrak VII: Customer satisfaction with hearing instruments in the digital age. The Hearing Journal, 58(9):30-43.

16. Engelund G. (2006) Time for hearing - recognising process for the individual: a grounded theory. PhD dissertation, Det Humanistiske Fakultet, Københavns Universitet.

17. Vogel, D, McCarthy P, Bratt G, Brewer C(2007)Communicative Disorders Review Volume 1, Number 2, pp. 81–94

18. Bowen, S.J. & Chamberlain, P.M., (2008) Engaging the Ageing: Designing Artefacts to Provoke Dialogue. In P. Langdon, J. Clarkson, & P. Robinson, eds. Designing Inclusive Futures. London: Springer London, pp. 35-44.

19. Anon(2010), Maximizing the Patient Counseling Experience with PC-based Audiometry The Hearing Review, Available at: http://www.hearingreview.com/issues/articles/2010-10_03.asp

Enquiring with Artefacts in a Sensitive Context.

Janet Kelly

Abstract

This paper presents a study of the use of material artefacts where they have been used to enquire into a context which requires an additional sensitivity because of the participants' relationship towards the project objective. Firstly some general principles for what artefacts 'do' in design enquiries are outlined. Then several examples are presented from a constructive design research project where artefacts have been specifically designed and deployed in order to indirectly introduce and enquire into some issues that might in some way be confrontational to the project participants. The motivations and intent behind the design of the different artefacts are explained, as is how they were deployed both as a method for enquiry and as an intervention. The paper concludes by discussing considerations and strategies for using material artefacts to enquiry with sensitivity, for the sake of design.

1.Introduction

In User-Centred and Participatory design processes, which focus on people, the research aspect usually includes involving important stakeholders and potential end-users, and attempting to understand their needs and behaviours. In these cases, as opposed to design processes which are more focused on exploring the limitations and possibilities of technologies, the aim is to try and discover an outcome that will provide value within a particular context of human activity. In order to do this, design practitioners have for many years looked to the social sciences, with their professional skills to document and analyse human behaviours in order to understand these needs and behaviours better. The approach of ethnography, and the particular set of fieldwork methods that it entails, has proven to be particularly popular with designers, but essentially design and ethnography come from very different traditions and have different objectives [2] While ethnography is an approach that can be used when seeking to understand practice, this is does not provide all that designers who ultimately seek to alter it, may need. In order to fill in the gaps, designers have also been developing many of their own methods for enquiry.

One of the main things that distinguish the methods designers use for enquiry from those traditional in the social sciences is the central role materials artefacts play. The world of the artificial is the designers' own traditional area of expertise, but it is more than just familiarity that has brought designers to this form of enquiry. Bringing in physical objects and representations of objects creates a different dynamic and different focus in projects. Objects can also be applied in a multitude of different ways and are implicated in the creation of several kinds of knowledge. In this paper I will begin by outlining some of the different ways artefacts have been shown to contribute to enquiry in design processes, before using some examples from my own work to elaborate on some considerations for adapting artefacts to enquire for the purpose of design in a sensitive context.

2. What Artefacts do in Design Enquiries

Enquiry through the deployment of artefacts is a central characteristic of a constructive design research approach [12]. This approach is based on the kind of creative design research practice that is coming out of the tradition of art and design schools, that explores the relationships between people and the physical world through "design experiments" carried out as part of the research. The Field Programme of constructive design research is interested in, "how people and communities understand things around design, make sense of them, talk about them, and live with them," (ibid pp.69) in other words how design relates to real world context. In this area of research, several authors have elaborated on several different ways artefacts can contribute to design enquiries and design processes, on different levels.

Gaver et al's [9] cultural probes for example, have been a highly influential design enquiry approach that was originally developed to generate inspiration from current practices. Cultural probes is a method that uses a package of engaging objects, maps, postcards, and other materials, that are sent out into the field to be modified and then returned to the designers. In the original project they were deployed to establish a conversation with elderly people in diverse communities, and were designed to try and provoke inspirational responses. In this project they were not explicitly analysed but use to develop a series of design concepts, tailored for the communities the elderly people were from. "They provided us with a rich and varied set of materials that both inspired our designs and let us ground them in the detailed textures of the local cultures." (Ibid pp29)

Although the original concept of probes was to intended to generate material to be used as a source of inspiration for designers, the idea of probes, artefacts that could be sent out to document in some way, has become widely influential and has been adapted in many ways [14] . Other forms of probes include informational probes [4] which were used to collect accounts of the ordinary details of the participant's lives in sensitive settings, empathy probes [10] which experimented with finding new points of view through engaging the participants emotions and domestic probes (ibid) that were deployed in domestic setting, and the materials from which were analysed systematically to produces descriptive models, as well as being used in participatory design workshops to inspire designs.

There are also technology probes, which are notable in that they have actually been deployed to enquire through intervention, using semi-functional experimental prototypes that provoke people to reflect on their experiences and aspirations through disruption [17]. Technology probes do more than document current practice in different ways, they also seek

to alter it. They resemble Mogensen's concept of provotypes [15], where provocation is applied through concrete experiences in order to create new practices on the basis on current ones. As Mogensen suggests, artefacts can be used as a bridge between investigation and analysis, to reveal hidden assumptions about current practice, by getting, "participants to experience current practice in new ways by doing it in alternative ways" (ibid pp20), making visible aspects of current experience that may have become invisible, by means of creating a shared vision of an alternative reality.

Critical Artefacts Methodology developed by Bowen [1] is another approach that involves similar aims. Inspired by critical design, it uses critical concepts embodied by designed objects to encourage creativity in co-design processes. Bowen's methodology involves designers expressing their current understanding of a design situation though conceptual design concerns that are then brought back to stakeholders' to provoke reflection on alternative possibilities [ibid]. Methods that employ artefacts can utilize the ability of design to give form to concepts [12] and 'provoke' through suggesting alternatives to current practices.

All artefacts used in design enquiry that suggest or create alternative practices, can also create knowledge about those potential practices. Even when artefacts are not the final outcome of the design process, they have the same qualities, becoming as Ehn argues, both devices and "things" capable of 'modifying the space of interaction for its users, ready for unexpected future use, rich in aesthetic and cultural values, opening up for new ways of thinking and behaving' [7], (pp.93) According to Latour, physical objects have an agency of their own, [13] which manifests both in their materiality and in their intended, and unintended, functionality. Although they may embody ideas, artefacts always leave room for multiple interpretations [18] and their designers will never be able to fully predict or prescribe how they will be interpreted in the world [16], but it is precisely this unexpected aspect that allows artefacts that are deployed in design processes to become tools to explore new practices. More than just testing an idea, deployment of artefacts allows designer to begin to explore their actual consequences for current practice, if and how they transform and what form that transformation can take.

Finally and a little differently, artefacts can be a means of bringing people into the design processes and giving them a role that allows them to participate. In Scandinavian Participatory design, since the early days and the cardboard computers of the Utopia project [8] designers have been creating mock-ups to that, by acting as props in enacting shared visions of future practices with stakeholders at. Mock-ups are a way of making a future technology tangible and actionable, but with a low-fidelity materiality they are also able to be easily understandable and yet still open to adaptation by any of the participants involved, no matter what their level of technical skills were [6].Methods based on the games metaphor have also often been used as a basis for mutual learning between designers and users. Brandt[3]suggests what exploratory

design games offer are a valuable framework for organising participation, where the various skills and interests of the different participants can be employed in order to explore design opportunities collaboratively. She highlights the necessity of having tangible game pieces, as well as the importance of the use of rules, in order to support the participants in making design moves. 'The importance of game materials is to create a common ground that everybody can relate to' [3]. Artefacts create something to orient towards that can be understood on some level by all participants because of their tangibility.

3.1 The Case: Designing in a Sensitive Context

The case I will present in this part of the paper describes the design of artefacts for enquiry in response to the specific constraints of the project context in which they were deployed. The Pre-users of Medical Devices project is a sponsored by two medical device companies, Novo Nordisk who produce insulin injection devices treating diabetes and Oticon who produce hearing aids. The idea behind this collaboration has been to both create an in depth analytical understanding of why people with certain medical conditions (gradual hearing loss and people with 2 diabetes) delay becoming users of medical devices (hearing aids and insulin injection devices respectively) which could ultimately benefit their health and well-being, and to create design concepts to help overcome this delay.

One of the key characteristics of operating design projects in the medical domain is the importance of sensitivity. While in other cases [4, 5] the need for sensitivity often relates to the extent to which the participants' physical or cognitive abilities may prevent them participating as equals in a design process, in the case presented here the need for sensitivity stems from the participants relationship with the particular technologies under development [11]. People with these two medical conditions often may not wish to see themselves as potential users of these devices, because of the implications this has to their sense of identity. In the case of hearing loss this may be because people believe having to wear hearing aids implies that their hearing loss is worse than they feel it is and makes them seem old. While in the case of people with type 2 diabetes, many believe having to inject insulin means that they have failed to treat their condition well by other means, such as diet and exercise, because insulin is often associated with being the last resort as a treatment. The project objective was to see if it would be possible to overcome these beliefs, but in order to do so we had to develop methods that accounted for any lack of sympathy these people may have had with this objective.

As part of this research we have conducted studies with people from both condition areas in Denmark and the USA at the request of the two companies involved. These have been exploratory studies due to the challenges of designing in this complex and sensitive context (ibid) and have involved ethnographic field work, including interviews with pre-users and health and hearing care professionals, and recording and observing in the clinical setting. In this paper I will present work that was done in the New York area in the Autumn of 2011. There are three different kinds of artefacts that I present here: the first set of artefacts were design and deployed as part of the study involving people with hearing loss who were not yet using hearing aids and the second two sets of artefacts as part of the study involving with

people with diabetes type 2 who were not yet users of injection devices.

Figure 1. The Hearing Loss Self Documentation Kit

3.2 Self-Documentation as a Way of Generating and Exploring New Practices

With regard to hearing loss, one of the initial insights we had gained from ethnographic fieldwork was that one reason people delayed getting hearing aids was that they had difficulty believing their hearing loss was causing them significant problems. Hearing loss often manifests as a communication problem rather than a physical problem of hearing, which means can be easier to assign environmental factors such as room acoustics or someone mumbling as the cause. It can also be much more problematic for the people close to the person with the hearing loss, as they are the ones that may notice breakdowns in communication more. We wanted to explore if making people reflect more the problems they experienced from hearing loss could change their attitudes to getting hearing aids, but also thought confronting out study participants with this objective would be offensive as it would imply we thought they were ignorant about their own experiences.

In order to explore this design direction we decided we could introduce it indirectly and combine it with a task that was intended to also intended help document peoples everyday life experience of hearing loss, as it emerged over time. We therefore created design probe style auto-ethnography kits with a dual purpose, firstly to get people to document how hearing problems occurred in their everyday lives, but also to encourage them to reflect on how problematic those hearing problems actually were. We asked three of the participants in our study who had identified themselves as having a hearing problem, but had not yet acquired hearing aids to complete a kit with three activities in it. The participants had around one week to complete the tasks in the kit, after which we came back and interviewed them about it. What follows is a presentation and analysis of some of the kit contents as artefacts for enquiry.

One of the tasks in the kit was called the 'Daily Problems Chart', it was a small credit card sized chart, which folded out and was clipped together with a small sized pen. It consisted of a grid with a list of possible problems caused by hearing loss down one side and the hour of the day along the other axis, the participants were asked, during the course of one day, to put a mark in the box if any of these things happen for the hour it happened .The idea of the chart was to understand how hearing problems occurred in their daily lives, how extensive were they and how frequently they noticed them, it was also to explore if recording the problems could be a new practice that would make them more aware of the extent of the problem.

Only two of the three participants completed the 'Daily Problems Chart', which suggested

the task was too inconvenient for the third participant, who said in the follow up interview he hadn't been able to find the time for it. Of the two that did complete it, their responses indicated that they were surprised by their observations of themselves and that frequency of the situations they recorded was far more than expected. One noted that although she was aware that these situations were occurring, she had not been aware of the extent "I found the exercise, writing down the number of times I'm inconvenienced was also a surprise because even if I am aware that I have to ask people to repeat things – it can be a surprise how many times a day", she knew what kind of hearing problems she was having but had become accustomed to them so was not really conscious of how much they were impinging on her daily life. This was actually exactly the kind of response we were hoping the chart would generate, as we wanted to see if we could get the participants to reflect in a new way on their problem. In the follow up interviews the chart also served to help the participants explain further the way they experience their hearing loss, as they were able to refer to the specific instances it documented which suggests it also worked quite well for documenting current practice.

The kit also included a small video camera, and one of the tasks, the 'Interview Task,' asked the participants' to interview someone close to them about their hearing problems; giving them a set of suggested questions for them to use. The idea of this was to probe the

Figure 2. Wife being interviewed by her husband about his hearing loss.

social aspect of hearing loss, and to explore if the practice of interviewing others who may be affected by their hearing loss, encouraged them to reflect on the way their hearing loss affected the people around them, effecting in any way their decision to seek help.

The follow up interviews suggested that the 'Interview Task' seemed to have had a big impact on all the participants as they had not necessarily been aware of the extent to which their hearing loss was problematic to others before completing it. One of the participants interviewed the care workers who were with her several hours a day, helping her look after her sick mother, and was surprised to learn from one of them how she was reacting to her hearing problems, " I also interviewed a second care giver, who told me something very startling – she told me, because of my hearing loss, she hesitates to talk to me – because she thinks it bothers me when I have to ask her to repeat things, so it prevents – it is an impediment for her even talking to me. I did not realize it had that kind of effect – that it would prevent somebody from talking to me." She had previously only thought about her hearing loss in terms of how it affected her and had not really been aware that it was affecting the people around her to the extent that it changed their behaviour.

The wife of one of the participants even re-appropriated the task, asking to interview him after he had interviewed her, in order to bring up a potentially sensitive topic with him about how hearing loss was affecting their relationship.

> WIFE: so did what I describe seem to be what you experience?
>
> HUSB: I think it is an accurate description, although I think you are probably being kind, I think there is probably a greater frequency of times in which you've said something to me if I am in the other side of the apartment and I haven't done-I am not even aware that you actually spoke.
>
> WIFE: so I just assume that it's your natural inclination to ignore me
>
> HUSB: (laughing) he-he well that's- that would be causing a p-problem in our marriage cause it's not. I'd-I never ignore you

The participant with hearing loss had not previously been aware of how his wife was interpreting his behaviour, even though he had been aware that his hearing loss may have been causing her problems, and that this could even be affecting their relationship.

This re-appropriation of the task clearly documented an instance where a hearing problems become relationship problems. It also created new kind of practice for this couple, that of using the video camera as a mediator in their negotiations around hearing loss. In a later interview the same participant explained how his about his hearing loss had changed, "my thinking about this has been developed, my first thoughts about it would focus on my physical disability, but it is true that in the development of this (the study), I am thinking more about the function in a relationship." Before being asked to complete the tasks he had

only considered his hearing loss as a personal problem, but had been forced to reflect on the implications it had for his relationship with his wife because of the study. For the design agenda, this instance helped to reveal that giving spouses tools to communicate about hearing loss could also be a way of changing attitudes about getting hearing aids.

The kits had multiple role in the study, firstly to explore new practices by created an intervention that forced the participants to reflect on their hearing loss in a range of ways. This intervention both tested this hypothesis that having to reflect would make people with hearing loss more aware of the problem, but also generated new practices, some of which were even unexpected even by its' designers, such as the re-appropriation of the interview task by the participant's wife. As the kit was also about to investigating new practices, this intervention was able to be accepted by the participant in the context of the project as a self-documentation task. The kit additionally created a format for organising participation which actually empowered the participant, turning them into the researcher. In particular the inclusion of the video camera in the kit, with its flexible functionality allowed the participants to appropriate and adapt the task in their own way.

3.3 Making Visible Hidden Aspects of Current Practice in the Guise of Exploring New Ones

The next two set of artefacts were created for the study that involved people with type 2 diabetes and were deployed in a workshop we held in the US. One of the insights from the ethnographic study we had done with people with diabetes was that the blood sugar measuring practices associated with the condition had an impact on how people understood the condition and its' treatments. We wanted to further explore how different ways of measuring might change these understandings, but once again we did not want to confront them with the suggestion that their current understandings were wrong. In a previous part of our study [11] we had experimented with co-design activities based on Critical Artefact Methodology [1]. Although this approach was initially intended to provoke creativity during co-design sessions, we had found it useful for broaching sensitive topics regarding the need for treatment technologies, through the abstraction and re-representation of specific aspects of treating and living with the medical conditions. We decided to adapt the method, to create artefacts that were intended to embody different meanings that blood sugar measurement could have, and how it related to living with the condition daily and in the long term.

In the workshop which we conducted with four people with type 2 diabetes, we presented three mock-ups of technologies that were meant to represent different ways that measuring technologies could mediate between the actions taken to treat the disease and the consequences of it. The mocks ups were low-fidelity, made in white card with a printed graphical interface stuck on, and the intention was that these would serve as props when the participants discussed their potential uses. These were presented to the participants along with a short use scenario in PowerPoint. We used the persona of a person with type 2 diabetes who was struggling to motivate herself to treat the condition, and asked the participants to rate the concepts as to which would be most useful to her, pick one in pairs (they were banned from choosing the same object) and then create a short dialogue where they should try and persuade her of the benefits of the device. The workshop was video recorded and the discussions transcribed and analysed.

The first concept, the 'Food Scanner' represented a device/application that could scan food barcodes and estimate how much, how quickly and for how long blood sugar levels will rise from fasting level for people with diabetes and was intended to provoke reflection on the constant decision making regarding food that is part of treating diabetes in daily life, and

explore new practices that might be instigated from knowing what the effect food would have on their blood sugar in advance. The second concept, the 'Blood Sugar Watch', represented a watch like device that could read blood sugar levels continuously, indicating if this is in the target range, too high or too low with a coloured scale. The Blood Sugar Watch was intended to represent a different way of thinking about blood sugar, with more intuitive communication than abstract numbers, and to explore the idea of having a constant presence for the condition, which is normally symptomless. Finally the 'Risk Predictor' concept represented a home kit for blood sugar measuring that would allow people to see what their risk was of developing complications from diabetes such as blindness, heart disease, amputation and death, over time. . The idea behind this concept was to get the participants to reflect on how they related to the risks associated with the condition.

In the actual workshop the artefacts were not taken up as props to enact scenarios as we had hoped. Instead the participants began to evaluate the artefacts as potential future products. In doing so they began to compare their current practices to the new ones the artefacts implied and divulged a lot about their attitudes to measuring blood sugar and the different meanings it had to them. For example some of them saw themselves as an expert in their own treatment, they wanted to make it clear that they understood their own body and therefore did not need an external reference in the form of a blood sugar measurement. With regard to the 'Blood Sugar Watch' concept, one participant suggested that it could not tell him anything he did not already know, "I would wear it if I felt I needed it but me personally I'm under control I know what I do and what I can't do and I do it- I might not need something like that", he showed that he felt like he understood his the condition so well and did not actually feel the need to rely on blood sugar measuring technologies to understand what was happening in his body. Similarly the reactions to the 'Food Scanner', suggested the participants thought it would only be useful to people who were newly diagnosed with the condition and not for people like them who had had it for a while. These reactions suggested the participants felt that blood sugar measuring was something you did to learn about the condition, but not to assess its progress.

It also became apparent that any kind of external measurement was always open for interpretation and even up for negotiation. They reflected on whether they believed it would be possible to relate the responses from the devices to behaviours, for example one participant suggested that rather than being informative seeing your blood sugar rise after eating on the 'Blood Sugar Watch' would be a flaw because you would have to interpret yourself why it was happening, "you'd have to judge to, it goes up and you know you just ate so that's why it's up", which implied that he thought that high blood sugar was not a problem as long as it could be accounted for. Another related the 'Risk Predictor' to his own eye doctors advice, implying that as you cannot predict a diabetes related complication will happen for certain, the information

Figure 3. (From left to right) The 'Food Scanner', the 'Blood Sugar Watch' and the 'Risk Predictor'

would not be valuable, "my eye doctor that I go to once a year regularly and he's shocked that there is no diabetic retinopathy, when it was going up and down up and down for those 9 years, and he's shocked….so you can tell somebody they'll go blind in 2 years but it probably won't be accurate", this suggest that he felt that as the complications of diabetes were a risk but not a guarantee, knowing the risk was high did not make a difference.

The 'Food Scanner', the 'Blood Sugar Watch' and the 'Risk Predictor' did not explore new practice in the way that was originally intended, possibly both due to their lack of functionality and the construction of the task associated with them. They also created a different kind of participation than was originally intended, that of critical consumers, rather than players in an enactment of new practices. Still, they did succeed in helping making bridges between investigation and analysis, as through their evaluations and critiques of the artefacts as products, the participants' revealed aspects of their attitudes towards measurements as part of treating their diabetes that may otherwise have remained hidden. The artefacts indirectly introduced different aspect of measuring and assessing blood sugar in order to uncover the workshop participants' attitudes.

3.4 Combining Exploring New Practices with Formats for Participation

Another insight that had come out of the fieldwork was that for people with type 2 diabetes, insulin as a treatment was something they had heard about it, but knew very knew facts relating to and had many misconceptions about. Our observations suggested many doctors were not aware that the patients had limited or misinformation about the drug; and often did not address the patients real concerns when insulin was introduced as a treatment option. We wanted to investigate formats for communication tools based on the subject of insulin, but did not want to suggest to pre-users that their assumptions about insulin were wrong. Instead we took inspiration from Brandt's [3] work on using design games and created a board game like artefact that would work as a format for creating participation in workshops but was also another kind of design probe, a way of exploring a format for quickly identifying concerns that could then be adapted into a communication tool for health care professionals

In the same workshop with people with type 2 diabetes in the US, we deployed the 'insulin concerns game' which, like the auto-ethnography kits, both acted as an intervention that explored new practices and enquired into themes. The 'Insulin Concerns Game' consisted of a board and playing pieces on which were written different concerns that had heard during our interview and observations, such as " RISK OF PUTTING ON WEIGHT", "THAT IT WOULD BE FOR THE REST OF MY LIFE", "I DON'T KNOW WHAT IT WOULD DO TO MY BODY" and "IT'S NOT GOOD TO BE ON MEDICINE- IT HAS SIDE EFFECTS". There were also two blank pieces per player on which they were asked to write their own concerns. The players were then asked to take turns place the concern on the board indicating to what extent it was a big or small concern for them and account for their placement. The board was fold out and had bright blocks of colour reminiscent of traditional board games, with hexagonal pieces.

The game worked well as a way of organising participation; the four participants quickly understood the format, and began identifying and committing to their main concerns about insulin. Many of these concerns, as we had anticipated, were misapprehensions that a health care professional could easily address if they were aware of. One participant, for example, assumed it could be painful, aside from the injection, which is not generally a problem associated with insulin, "Of course I could be the body type, I don't know if I am, that once you're on insulin you're in pain and of course the shot is somewhat painful", this suggested that he was afraid of it because he misunderstood what it would do to his body. As they had

been given some pre-written suggestions, the participants also identified some issues which are associated with insulin that they had not been aware of before, "I wouldn't know what the side-affects are, I didn't know it could make you put on weight, I didn't know any of that because I never took it"; weight gain is a real side-effect of insulin, again showing that the participants had very limited information about the drug. The games success in getting the participants to elaborate on their concerns also suggested that it might work well if adapted into a tool for communication between health care professional and patients.

Although we had not anticipated finding out anything significantly new about the participants views of insulin as researchers, we were surprised to gain some new perspectives when the participants elaborated on their reasons for the choice of a particular concern. In particular a concern which was well known to us, that people perceive insulin as a final resort 'the last step on the treatment ladder,' was thrown into a new light when it emerged that some of the participants were afraid insulin actually might not work for them. One participant put that as her main concern, "my diabetes will eventually kill me because if I take insulin and its still not controlled, that's my main concern" , while another expressed a concern about becoming resistant to it. These responses suggested that people were reluctant to try insulin because they were scared it might not be an effective treatment and then there would be nothing else that could be done. This was not a way that we had framed this concern before during our previous analysis of our material, and it highlighted that we had not considered people might doubt that insulin would work as a treatment.

Figure 6. Participants playing the Insulin Concerns Game in a workshop in the USA.

The 'insulin concerns game', following on from the work of Brandt and others, used the recognisable format of the board game to organise participation by assigning the participants the roles of game players, which they easily understood. The activity served to create a form of co-analysis, where the game pieces represented some of our observations from the field and through the participants' responses to these, new framings and ways understanding these emerged. Like the kits, the games were able to be introduced and accepted in the context of the project as a research tool, but additionally served to bridge between the investigation and analysis. Finally the game also explored what new practices for getting people with type 2 diabetes to elaborate on what their concerns were; a format which could be adapted to a different setting such as interactions between patients and health care professionals.

4. Discussion

When designing artefacts to enquire, the project they will be deployed in becomes its own specific and unique context for design, distinct but not separate from the 'real world' context in which the outcome of the design process is eventually intended to be deployed. When designing artefacts for enquiry, the particularities of that context must be accommodated. The artefacts I have presented here were attempts to enquire into a design space in a project context that required sensitivity to participants' feelings towards the project objectives, as these could be confrontational to their sense of identity. The artefacts were designed in order to be able to indirectly introduce the aspects of the project agenda that may have been offensive to the participants. Artefacts and even the methods by which they are deployed cannot be transferred in their entirety from one project to the next. Just as in a 'real world' context, the project context will have its own unique opportunities, challenges and constraints, which the designer should consider. In this case this meant designing the artefacts and their associated tasks in a way that was sensitive to the participants' relationship to the prospect of use with regard to these medical devices.

Creating formats for participation and roles for project participants which they feel comfortable with can be important in any collaborative design project, but is particularly important a situation like this where the project objectives may conflict with the participants' interests and leave them feeling disempowered. Both the artefacts and the tasks together can help create different roles for the participants because they are something understandable and tangible to orient towards. Sometimes the nature of the task and the role that it implies can be made explicit in the artefact, for example with the 'Insulin Concerns Game', the object itself suggested a familiar activity and seemed to have a clear purpose so the task was easily explained and understood. Another option is to give the participants a greater ownership of the project by using artefacts create to give them a means to control the material that is being generated. The tasks in the self-documentation kit did this by making the study participants into researchers of their own lives, while other methods such as low fidelity mock-ups like the cardboard computers, or some of Brandt's design games [3], equip the participants with tools that allow them to take on the role of designers and developers.

Closely related to the roles they create, it is also relevant to consider how the artefacts will be introduced within the project context and in turn what this might make possible. Participants will understand an artefact they encounter as part of the study, in relationship to how they understand the purpose of the study. In the case presented here, this was utilised in order to circumnavigate or disguise a purpose that was potentially confrontational. Both the self-documentation kit and the 'Insulin Concerns Game' disguised a potential confrontational

design interest with another kind of exploration that would probably seem more acceptable to the participants; these artefacts and their associated tasks, combined interests that might have been more controversial with ones that the participants would be more open too. Here introducing an artefact as part of a research task, specific to the project context, was also a way of exploring new practices that could be transferred to other contexts.

Designing artefacts with multiple purposes is one strategy for deploying artefacts for enquiry in a context where it may not be advisable to be completely transparent about what all the objectives of the enquiry are. Another strategy which was followed with the deployment of the critical artefacts was to abstract issues and re-represent as artefacts. This is a way to introduce issues without confronting participants with the interests behind doing so. As product concepts, the participants were able to take on the familiar role of critical consumers, but in the process of doing so still revealing hidden attitudes and assumptions that put current practices into a new light. The advantage of using material artefacts here is that they can embody an issue or an idea in a non-explicit way that allows it to be introducing indirectly as a discussion topic.

Artefacts can be a powerful tool for enquiring in design, both for generating different kinds of material and knowledge, and for structuring participation within projects. Introducing artefacts into contexts of interest is a way to help understand how practices can be transformed through alterations to the material world. Additionally artefacts can be used to both to indirectly broach delicate issues both by re-representing them in the form of design concepts, and also to pursue potentially confrontational objectives by combining different roles and purposes. In a context where the design agenda is potentially controversial, adapting design methods that centre around material artefacts such as probes and design games, can both be a way to approach the controversial issues with sensitivity while generating the knowledge for design.

6. References

[1] Bowen, S.J. (2009) A critical artefact methodology: Using provocative conceptual designs to foster human centred innovation. PhD dissertation, Sheffield Hallam University.

[2] Blomberg J, Giacomi J, (1993) Ethnographic field methods and their relation to design. in Schuler, D. & Namioka, A. (eds) ,Participatory Design: Principles and Practices, Lawrence Erlbaum Associates. pp.123-155

[3] Brandt, E. (2006) Designing exploratory design games: a framework for participation in Participatory Design? In Proceedings of 2006, pp 57–66.

[4] Crabtree, A, Hemmings, T, Rodden, T, Cheverst, K., Clarke, K, Hughes, J. (2003), Designing with care: Adapting cultural probes to inform design in sensitive settings. Ergonomics Society Of Australia pp.4–13.

[5] Dawe M. (2007)Let me show you what I want: engaging individuals with cognitive disabilities and their families in design. Proc CHI'07 , pp. 2177-2182.

[6] Ehn, P. and M. Kyng (1991). Cardboard Computers: Mocking-it-up or hands-on the Future. In Design at work. Edited by Greenbaum and Kyng, Lawrence Erlbaum Associates Publishers: pp. 169-195.

[7] Ehn, P. (2008)Participation in design things. In Proceedings of PDC 2008. pp.92–101.

[8] Floyd, C., Mehl, W., Reisin, F., Schmidt, G., Wolf, G., (1989). Out of scandinavia: alternative approaches to software design and system development. Hum.-Comput. Interact. 4, pp.253–350.

[9] Gaver, B., Dunne, T. & Pacenti, E. (1999). Design: Cultural probes. interactions, vol pp.621–29.

[10] Graham, C. & Rouncefield, M. (2008)Probes and participation. In Proceedings of PDC 2008. pp.194–197

[11] Kelly, J., Matthews, B., (2010). Taking transition into account: designing with pre-users of medical devices, In Proceedings of. PDC 2010. (1993) 71–80.

[12] Koskinen, I. et al.. (2011) Design Research Through Practice: From the Lab, Field, and Showroom, Elsevier.

[13] Latour, B. (2005)Reassembling the Social: An Introduction to Actor-Network-Theory. Oxford University Press.

[14] Mattelmäki, T. (2005) Applying probes – from inspirational notes to collaborative insights. CoDesign. 1, pp. 83-102.

[15] Mogensen, P. (1992). Towards a Provotyping Approach in Systems Development. Scandinavian Journal of Information Systems, Vol. 4.

[16] Redström, J., (2006). Towards user design? On the shift from object to user as the subject of design. Design Studies 27, pp.123–139.

[17] Routarinne, S. and J. Redström (2007) Domestication as Design Intervention. In Proceedings of NORDES,2007.

[18] Sengers, P., & Gaver, B. (2006)Staying open to interpretation: engaging multiple meanings in design and evaluation. In Proceedings of DIS pp. 99–108.

On the exhibition display boards (partially visible):

"I think you are not paying attention when in fact you are just not hearing"

How is hearing loss made into a problem?

Hearing loss is not given, but created as a complex social problem in interactions.

"I think I just had a bad day, when you first diagnosed me..."

Give your feedback, reflect

The aim of...
to offer diff...
on hearing...
So tell...
pers...

Designing to Bring the Field to the Showroom through Open-ended Provocation

Janet Kelly and Stephan Wensveen

Abstract

Engaging formats are required to communicate designerly understandings of field studies to a broader audience within organisations. Here we present a case where the format of an exhibition, consisting of a collection of open-ended provocative design concepts, has been used to disseminate knowledge and engage two medical device manufactures in the results of field studies that involved the pre-users of their devices. We go in to detail with examples as to how the concepts in the exhibition reflect understandings from the field and were designed to provoke new ways of looking at the field. We elaborate on how the exhibition as a whole, rather than presenting ultimate solutions, mapped out a rich and complex landscape for design, and make an initial evaluation of it based on responses from visitors from the organisations. The discussion revolves around what can be achieved through open-ended provocation in this kind of format and what needs to be taken into consideration when designing in this way.

Keywords

Relevance to Design Practice

This paper presents an example of how open-ended provocative design concepts can be used in an exhibition format to communicate designerly understandings of fieldwork.

Introduction

User driven designers and design researchers have found it fruitful for their processes to go out into the field and collaborate with the people who may become the users future designs and other relevant stake holders. However it is rarely possible to take everybody involved in the project into the field and involve them in the research. Findings from fieldwork may need to reach beyond the immediate design team and influence a wider audience within an organisation. In their case for a participatory innovation approach Buur and Matthews argue that such projects should aim to "generate knowledge about users/customers in a format that inspires company employees to reflect on product, producer role and company identity" (Buur, Matthews 2008, p.268). It is not enough to simply communicate fieldwork findings, but the findings must also be communicated in a way that engages and makes them relevant to the audience.

Several authors have explored ways to communicate field study findings in an engaging way in order to generate empathy (Mattelmakki et al 2011), but empathy alone is not enough to foster innovation that creates valuable offerings for users and other stakeholders. In companies who have already adopted a user-driven approach and have a lot of knowledge about their users and potential customers, employees can still find it difficult to apply many insights about users in their work,"it's very interesting, but what can we use it for?" Field study findings also need to be made actionable (Jaffari et al 2011) in an engaging way that allows people in the organisations to understand not only what is going on in the field but also how it can be changed. Furthermore, in a complex context for design, formulating findings into problem statements or a list of implications for design will at best oversimplify the fieldwork and strip the findings of their analytical auspices (Dourish 2006).

As designers are interested in how a current state can be changed into a desired state the field is not just something to be observed and analysed alone, but something which is explored through the act of designing. In constructive design research the act of design and construction itself takes a central place and becomes "the key means in constructing knowledge, "(Koskinen et al. 2011, p5). The value of going out into the field is because it contextualises design, allowing designers and researchers to follow it though society and explore "how people and communities understand things around designs, make sense of them, talk about them and live with them" (ibid, p69). Like anthropologists, constructive design researchers study the material world, but this material world is a combination between the existing and an imaginary world, "a special kind of make believe world, which is partially of their own creation", (ibid, p79). Introducing these imaginings into the lives of people allows them to be followed, but these imaginings can also act as an analytical lens, foregrounding

particular aspects of an existing context and drawing them together in a way that elaborates on how they could be different.

The implication is that design itself can be used as a means to communicate fieldwork and that the understandings developed from ethnographic fieldwork can be represented through an artefact. According to Buur and Sitorus "the product in a sense embodies the ethnography" (Buur and Sitorus 2007, p149). There is a risk however when using this approach out with the original context of again over simplifying the fieldwork findings (Koskinen et al 2011, p97). When the findings are presented in a single design concept it implies there is also a single obvious problem to be solved in the field. This might encourage company employees to evaluate the design concept as a solution, as opposed to reflect on what the issues behind the design and the fieldwork imply for their work and their organisation. Making a collection of significantly different design responses is one way of demonstrating a broader design space. Another way is to encourage deeper reflection by moving the designs beyond being seen as solutions and closer to the domain of Critical Design, where artefacts are used as a way of making people think. Critical Design originates with the work of Dunne and Raby in the 90s and brings conceptual art practice into the world of design. "We hope the work will inspire people and encourage them to see things differently and open up new spaces for discussion", (Parsons, 2009, p145). Through strange, ambiguous and provocative artefacts that cannot be understood as real world design solutions, Critical Design attempts to provoke a different way to see the world.

Critical Design belongs to an alternative to the 'Field' research programme in constructive design research, the 'Showroom'. The Showroom Programme comes out of the tradition of art, as opposed to the Field Programme that comes from the social sciences. Here design becomes a means to conceptualise issues, provoke discussion and highlight controversy. "Showroom is about exposing, debating and reinterpreting problems and issues. Ambiguity and controversy belong to it just as they belong to contemporary art." (Koskinen et all 2011, p103). Research exhibitions are an important means of research communication in the Showroom program. Exhibitions can be considered as "thought experiments" (ibid, p94) that offer a greater freedom than academic writing alone and have been used to bring design research issues to a broader public audience (Kerridge 2009), and to develop discourse around issues such as sustainability (Maze and Redstrom 2008).

This paper presents a case that hybridises these two constructive design research programmes (Koskinen et all 2011), bringing the 'Field' into the 'Showroom'. It is based on an exhibition held within an industrial context that presented a collection of provocative design concepts alongside stories from the field. We chose to create an exhibition as other possible formats such as workshops (see Jaffari et al 2011 for an example) which have been shown to

be very effective have the drawback of only being able to reach a limited number of people, while more easily distributed formats such as books (see Rehearsing the Future Halse et al 2010 for an example) we believe still require a specific interest and commitment to engage with. We wanted to reach people in the broader organisations who had not previously had an interest in the project and the advantage of an exhibition within the company settings was that it allowed many people to encounter it as part their daily working lives, without having to make a specific commitment. The exhibition was intended to communicate fieldwork findings in a provocative and open-ended way that made them actionable to engage the people in the organisations to reflect on the issues and themes that the artefacts embodied.

Provocation and Open-endedness

Provocation is a notion that is often used in relation to Critical Design and the Showroom Programme in design research as a means of changing people's thinking. Although the term provocation has connotations of confrontation, it also has a broader sense that encompasses inciting new thoughts, emotions or behaviour, either positive or negative. Some ways in which other authors have used the term in the Field Programme of constructive design research include attempts to stimulate new practices (Mogensen 1991) and obtain a greater understanding of the context for design (Boer and Donovan 2012), and also to describe the stimulation of novel ideas in co-design processes (Bowen 2009). While being provocative can mean being confrontational and challenging people's expectations and beliefs, it can also means rousing positive emotions such as empathy, stimulating inspiration, or inciting different behaviours and different ways of seeing.

The specific sense in which the exhibition presented in this paper would be provocative was left intentionally ambiguous; the idea was to create a diversity of artefacts where each of them could be received in multiple ways depending on the visitors. This was an acknowledgement of the open-ended nature of the way any kind of material will be appreciated by the viewer, who will always understand the material in a different way from what the presenter anticipated (Mattelmakki et al 2011). Rather than try to limit the possibility for different understandings, Mattelmakki et al have argued that not only should these be recognised, but the different understandings can even be used constructively. "In the open-ended interpretation context this means acknowledging the variety of interpretations, and at best benefiting from them," (Ibid. p.80). In our case the idea was to make it evident that the concepts could be interpreted in different ways, to prevent them from being seen as straightforward solutions and encourage deeper reflection. Additionally allowing these different interpretations to be incorporated into the exhibition by including an exhibit where visitors could post feedback on the other exhibits was a way of creating a greater richness and depth to the discussion around them. This was a way of allowing visitors to see how their own opinion related and differed from others,

moving it beyond an individual interpretation of the material to a more nuanced collective interpretation.

Designing successful provocation is not easy (Bardzell et al 2012), according to Dunne and Raby "a slight strangeness is the key - too weird and they are instantly dismissed, not strange enough and they are absorbed into everyday reality," (Dunne and Raby 2001 p63.). In other words it is necessary to find a balance where the concept is both in some way recognisable and therefore able to be identified with, but still in some way challenging to what is assumed to be normal. Although this makes sense conceptually, crucial to this is sensitivity to what will be perceived as strange or not strange to the recipient of the concepts ideas. What may be provocative in one context will not be at all in other contexts and therefore it is necessary to have some understanding of what will be new and strange to the viewer as well, in this case company employees.

The format of an exhibition was in itself a way of creating a slight strangeness within the industrial context. Proponents of the Showroom Programme have argued for the importance of the subtle difference in the concept of an exhibition as a showroom which suggests commercial roots, as opposed to a gallery which comes from the world of art. The importance of this distinction has been used in reference to exhibitions held in the public domain where the intent has been to engage people in a form of "conceptual consumerism" (Dunne 2005), where art practice's ability to provoke is moved into a larger, more accessible context. Yet in our industrial context, which is completely dominated by commercial practices, maintaining some kind of link with the practices of art is also an opportunity to introduce additional tension that can provoke people to consider what is being presented more deeply. This was why in the end, the presentation of the exhibits ranged from commercial Showroom style, to art gallery and even interactive museum exhibit style.

Finally, presenting ideas in the form of product concepts was a deliberate decision to maintain the balance between the familiar and the strange in this industrial context. The more conceptual and abstract artefacts of Critical Design require a lot of work from viewers to be interpreted and could easily be dismissed in a business context where visitors are expecting something which they are able to apply to their work. While in the public domain, an artefact intended to be provocative and critical in the form of a product concept runs the risk of being treated as a real consumer product (Koskinen et al 2011, p97). It is precisely this aspect, the possibility that the concept could be interpreted as a potential product, which can create engagement and tension in an industrial context. In an industrial setting product concepts speak directly to people's everyday work life, as these are the people who have the influence over what the technologies will actually be like. By presenting fieldwork findings in the form of product concepts, people are encouraged to relate the ideas that the concepts embody to their

own work and engage in reflection over their meanings.

The Case: Pre-user Innovation

The exhibition presented in this paper was held as the concluding event of a PhD project about innovating with pre-users of medical devices. This industrial PhD has been a collaborative project between medical device manufacturers Novo Nordisk who make diabetes treatments including insulin injection devices and Oticon who make hearing aids, and also the SPIRE research centre for Participatory Innovation. It has involved two PhD candidates, one from an Anthropological background and the other from a Product Design background. The project was started because, although they work with very different kinds of medical conditions, both the device manufacturers had a similar problem in that many of the people who could medically benefit from using their treatment devices, delay starting to use them beyond the point where it could begin to have a detrimental effect on their health and wellbeing. The overall project aim therefore was to create an understanding of the barriers inherent in the transition from 'pre-user' to 'user' and to develop methods to involve pre-users in innovation processes in order to uncover new product development and business opportunities for the companies.

Both diabetes and hearing impairment are long-term medical conditions that require constant treatment as they are chronic and cannot be cured. In the first case, the delay of initiating insulin treatment increases the risk of severe complications, such as blindness, heart disease and death later on. In the second case, reluctance to accept and use hearing aids severely impedes participation in social life and may lead to early retirement from the work force. In both cases, the crucial issue relates to overcoming barriers and expediting patients' access to a medical device in a way that would benefit their well-being and quality of life.

In the project 'pre-users' has been defined as something distinct from non-users who have made a choice not to use a technology, and potential users who have chosen not to, but may be swayed. Pre-users are instead defined as people who do not currently use technologies but who are in a life situation in which they may become users of the technologies at some point in the future but due to the progression of a current medical condition. This means that pre-users of hearing aids are people who suffer from a hearing loss that is causing recognisable problems in their lives, but who do not yet have a hearing aid, and the pre-users of insulin injection devices are people diagnosed with Type 2 diabetes who are not yet using insulin/injection treatments.

The project has involved a combination of ethnographically inspired fieldwork and constructive design research. As part of the project the researchers spent time in clinics with both, hearing care professionals and health care professionals, observing and recording their consultations with pre-users. In total 23 professionals were recorded in action in 77 consultations. In

addition to this the researchers made follow-up interviews in clinics with 31 pre-users and visited a further 21 pre-users in their homes from one to three times. Throughout the project a total of 6 exploratory design workshops were held with pre-users, two sets of probe style kits were deployed and several additional workshops were held with company and university employees. During the project the researchers were located within the companies and participating in the daily practices of the organisations.

The Exhibition

The exhibition was held two and a half years into the project, after the fieldwork had been completed. The overall aim of the exhibition was to communicate fieldwork findings to a broader section in the organisations in a way that was engaging and made them relevant to the audience. We wanted to make the fieldwork findings actionable and to inspire people to reflect on the issues and themes that had emerged from the fieldwork, so that they would be able to apply them to their own work practices going forward. It was intended to be provocative and a bit critical in order to give people at the companies a different perspective from that which they currently held, of what the treatments of the conditions are and could be. There were eleven exhibit stands, two presented stories from the field for each domain area (i.e., hearing loss and diabetes, three stories per stand), eight were stands presenting design concepts (four for each domain area) and the final exhibit offered a chance for visitors to comment on the exhibits and incorporate that feedback into the exhibition. It was held over a period of three weeks in four different locations internally, both at Oticon and Novo Nordisk. Representatives from each company were invited to a special guided tour at the opening where they were asked to give feedback along the way. This feedback was then included in a closing presentation on the last day.

The overall idea behind the exhibition came from fieldwork findings about the relationship between the conditions and their treatments. Firstly the fieldwork showed that when a treatment was made into an option it changed the relationship people had with their condition by foregrounding certain aspects of it and back grounding others; for example when hearing aids were made an option, hearing problems could become an issue with the individual's failing body, instead of being about bad acoustics or another person's poor annunciation. Conversely the relationship people had with their condition influenced their attitude towards a treatment option, for example if people felt that they were constantly failing to treat their diabetes well, then injecting insulin could become a symbol of ultimate failure, as opposed to just another treatment option. Therefore the exhibition was intended to both introduce this idea of interdependency between condition and treatment, and suggest that through interventions that changed people's relationships with the conditions and their treatments, different aspects of both could be foregrounded. Presenting a range of concepts was also meant to highlight that in this complex design space, that there is not a single problem to be solved but a multitude of possibilities to reshape the space in different ways.

This exhibition (shown in Figure 1) was both a deliverable to the companies intended to inspire and offer a different way of seeing the world, but was also intended to reveal some of the assumptions and attitudes of the visitors through the reactions they provoked. The

Guests from both companies browse the exhibits during after the closing presentation.

A presentation being given to employees from Novo Nordisk

The exhibit with space for feedback.

Guests from the University of Southern Denmark exploring one of the more interactive exhibits.

concepts developed for this exhibition draw from findings about how these conditions are treated and understood by pre-users, but also on the experience of nearly three years working closely with these two organisations.

In order to communicate both the depth of the issues and themes each design concepts embodied, and the breadth of the considerations involved in the exhibition as a whole, we will first present examples of two of the concept exhibits. The examples describe in detail the themes from the fieldwork that led to the design concepts and use images of the exhibits in order to draw attention to some of the design decisions involved (Gaver 2012). We will then give an overview of the exhibit collection as a whole, highlighting the main themes and relationships between the exhibits, and follow with a preliminary evaluation of the exhibition based on responses.

Concept Example 1: Revealable Hearing Aids

A key theme that came out of the fieldwork in the hearing loss domain and was explored in the Revealable Hearing Aids concept was Self-Stigma. Reluctance to get hearing aids is often attributed to a fear of being stigmatized and we did see evidence of this fear of stigma in our fieldwork as some people were concerned that hearing aids might make them look old and pathetic. For example one of our Danish informants, who we will refer to as Ole, was afraid that people would see him wearing them and think "that poor old man he can't hear." This has also been an issue that the hearing aid industry has tried hard to address for many years and hearing aids have got smaller and more discreet as a result, so much so that it can be hard to notice some models. Ole also explained that he had discovered recently, that someone he knew had worn hearing aids for years without him noticing. "Actually I found out, at this silver anniversary thing, that a young woman we know, well she is around 50, but she had used hearing aids for 15 years, I've never noticed". His comment indicated he seemed to be surprised; both by the technology which he expected to draw more attention to itself, and by the wearer who he had not associated with needing hearing aids because of her age. However, not everyone is afraid that hearing aids will stigmatize them. For example with one of our American informants who we have given the name Alex, when in a workshop he was shown a concept for a visible but modern looking device stated that he would be more likely to wear this than an invisible one, "if I had a hearing aid I would want it to be visible - I am hard of hearing and not trying to hide it". Alex's comment suggests that hiding the hearing aid would mean one was ashamed of the hearing loss, so it can also be argued that making the devices discreet is actually compounding the self-stigma that hearing loss is something people should hide.

Another related theme that was explored in the concept had to do with Identifying with Users. The focus on making the devices smaller and more discrete comes with several other drawbacks, with two things in particular standing out when it comes to encouraging people to become users of them. Firstly because the newer models are relatively unnoticeable, the ones people do see on others

are the larger or older models. One of our American informants described what he thought hearing aids were "those flesh coloured things that you do not want to put into your ears". He had a very clear image of what he thought a hearing aid looked like, which is probably an image many people share. Additionally the discretion of hearing aids can make people less aware of others who are wearing them, which also discourages their uptake. We found that

Hearing aid lit up with a blue light

Oticon streamer with additonal controls

What if hearing aids made communication a shared responsibility?

Modern hearing aids are designed in accordance with user preferences to be practically invisible, but hiding the device also compounds stigma that hearing loss is something to be ashamed of. With this concept we would like to demonstrate how hearing devices can have presence and actively engage in social activities.

The idea is that the wearer can choose to use the device to show ... in that specific ... omatic mode ... e, lighting the hearing aids up to draw attention to them. ... can also choos ... hearing aids up and off as they wish. The concept makes

Exhibit plaque with heading

Revealable Hearing Aids

The exhibit stand, full length from the front.
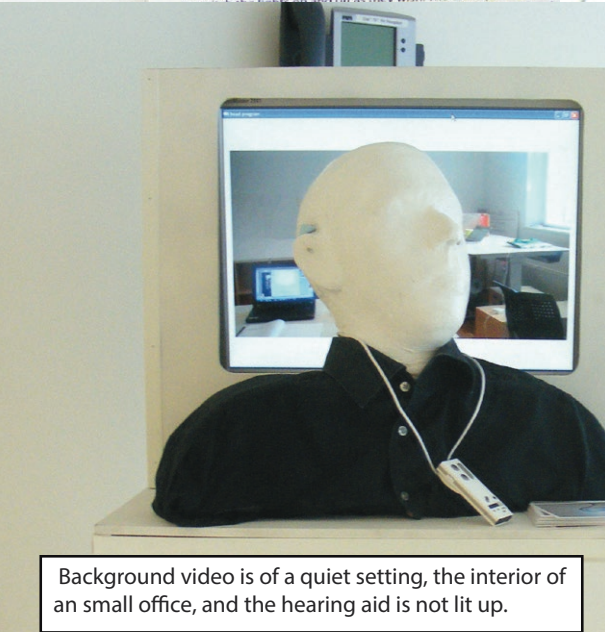
Background video is of a quiet setting, the interior of an small office, and the hearing aid is not lit up.
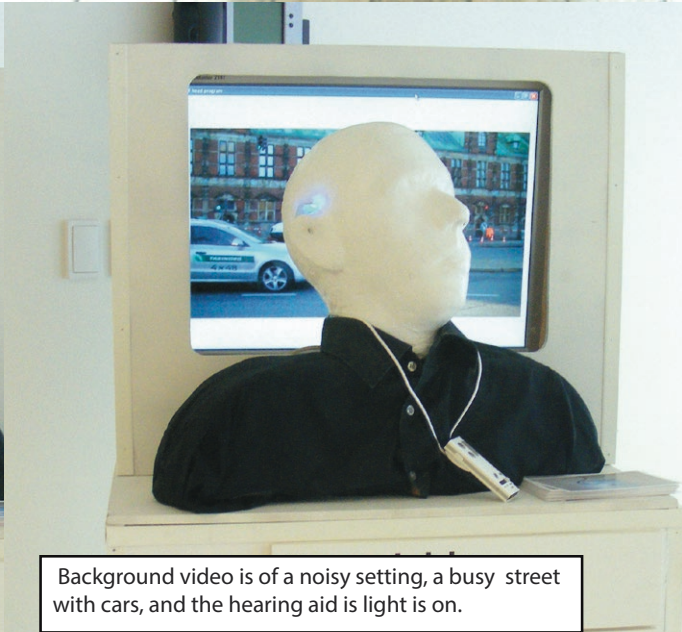
Background video is of a noisy setting, a busy street with cars, and the hearing aid is light is on.

encountering someone that one can identify with, and who is happy wearing hearing aids can be a powerful factor in influencing people's perceptions of hearing aids. As an example we spoke to one Danish woman, who we have given the pseudo name Anna, who was in her thirties and had known she had a hearing loss for many years but resisted getting hearing aids as she did not feel that she was old enough to be wearing them. When Anna met a woman in a similar age she noticed her wearing hearing aids and instigated a discussion over them, after which Anna initiated the process of getting them herself. One way of looking at this is that by making modern hearing aids more visible, it could actually encourage pre-users to become users of them, because pre-users would be more aware of and could identify with the people around them who are users.

Finally the concept also incorporated the theme of Shared Responsibility. Although fear of stigmatization and negative perceptions of the devices are part of the issue, they are not the only reasons why there is reluctance amongst pre-users to get hearing aids. Accepting that there is a need for hearing aids can also be very difficult for some pre-users. This kind of consideration can be seen in the way people sometimes downplay their hearing problems by comparing it to someone who has worse problems, for example an older relative, or by blaming it on environmental factors and other people.

"Right, and I get frustrated …some part of me is thinking; well she's on the other side of the apartment facing away from me she knows my hearing isn't great so why doesn't she turn around and speak louder"

This quote is from an interview between a husband and a wife in the USA. The husband, who has a hearing loss, responds to his wife's comment that she often thinks he is ignoring her, by explaining why he thinks it is her responsibility to make sure he hears her. If hearing aids were proposed as the solution to this problem instead, the responsibility to solve the problem would become entirely his. Hearing aids can mean that the responsibility for communication problems is placed solely on the shoulders of the person with the hearing loss, when previously these problems would have been the responsibility of both parties to solve. This then might suggest that if hearing aids could turn communication back into a shared responsibility, it could make the decision to get them easier for people with hearing loss because they would not have to accept full responsibility for communication problems.

The three different themes from the fieldwork, Self-Stigma, Identifying with Users and Shared Responsibility were drawn together for the Revealable Hearing Aids concept (see Figure 2). This concept for hearing devices allows the wearer to have the devices light up and draw attention to themselves in situations where they needed extra help to hear. The devices would therefore create a presence for themselves and actively engage in social activities. The

idea of the concept was to demonstrate how hearing aids could make communication a shared responsibility and in doing so would make pre-users aware of hearing aid use. The concept was intended to suggest a world where hearing loss is changed from an individual's problem, to a communal responsibility. The idea is that the wearer can choose to use the devices to show others that they need to communicate extra clearly in specific noisy situations, and in those situations the hearing aids would light up. To demonstrate this, a video was playing in the background showing different clips from either noisy places, such as a restaurant or a busy street, or quiet places, such as an empty park or office, while the hearing aids lit up or shut off accordingly. An existing hearing aid Oticon already produces was used to make the model as the concept was intended to make the qualities of these already existing designs more obvious. The colour blue was chosen for the light as it was visible but had a relatively ambiguous meaning in this context. The devices would have an automatic mode which responds to the amount of background noise, lighting the hearing aids up and drawing attention to them: or the user can choose to switch the lights on or off as they wish. To demonstrate this function controls were added to a streamer device that Oticon already produces and this was meant to emphasize that users had control over the visibility of the devices. The devices were presented on a dummy head on a pedestal at head height, so that visitors could find it easier to imagine what meeting someone who wore them might look like. On the pedestal were the exhibit title and a plaque with the concept description with the heading 'What if hearing aids made communication a shared responsibility?' This heading was intended to suggest a world where the meaning of the devices light signal was understood.

Concept Example 2: ACT on Diabetes

An example that responded to the diabetes domain was the ACT on Diabetes concept. One of the key themes behind the concept was the issue of Numbers and Measurement. Measurements are a major part of living with diabetes, the condition is diagnosed by measuring blood sugar and the effectiveness of a treatment routine is also monitored through measuring blood sugar both at home and in the clinic. Often the condition is relatively symptomless when it is being treated and the reason to keep the blood sugar at the target level is because it significantly lowers the risk of serious complications in the future, rather than preventing any immediate consequences. These future risks include blindness, amputation and death. As a result, people with Type 2 diabetes find themselves treating an abstract number and a risk percentage, rather than anything they can feel in their body One participant described the way her body felt gave her no indication about rises and falls in her blood sugar: "I don't feel it. I never do, I never feel any different when it's low or high". We explored the relationship pre-users with Type 2 diabetes had to measuring in several workshops, with a series of artefact concepts (Kelly and Matthews 2010, Kelly 2012). These investigations showed that although blood sugar was abstract, people who had the condition for a while felt they had become expert in understanding it, and knew things like food and exercise would affect their results when they measured. In one workshop in the US with people who had been diagnosed with the condition for several years, a concept for a device was shown. This concept would read barcodes on food and use the information to indicate what effect the food would have on blood sugar. In response, one participant explained that although he thought it would be useful for people who were newly diagnosed, for himself and others in the room it was not relevant: "In the beginning it definitely would be useful..... you could say this food might do this or this food might do that, but for someone like me or everybody here knows the deal so it wouldn't any more". So although abstract numbers define diabetes, experienced patients learn to understand how the things they do in their lives relate to these numbers.

Another related theme was Interpreting the Condition. Despite people's ability to understand what cause changes in their blood sugar levels, studies have shown that frequent monitoring of blood sugar does not necessarily mean people have lower blood sugar and reduce their risk of future complications (Davidson 2005). In the workshops, responses to the artefacts showed that although people understood how various things would affect their blood, this did not mean they felt a need to act on this knowledge. One participant, in a workshop where a concept for a body worn device that would constantly tell you what you blood sugar

level is was presented, pointed out that he felt if a high number could be accounted for, that it did not need to be addressed. "When you sit down and eat a cake, at that moment it will suddenly go right up...but that does not mean you should actually do something because in half an hour it will be ok again". A blood sugar measurement is something that is actually open to interpretation. We witnessed in one consultation a patient even tried to use the number for negotiation with the nurse who was treating him. He argued that because he had maintained his target blood sugar levels, he did not actually have diabetes: "I think I just had a bad day, when you first checked it,". He was not convinced that the measurement that first diagnosed him actually meant he had diabetes. Although people with diabetes may understand what affects their blood sugar levels, the abstract nature of the measurement means that they are able to interpret its meaning in different ways and how they should respond to it, which could imply other forms of assessment might be more successful in getting people to treat their conditions well.

The third main theme related to the concept was the issue of Failure. Blood sugar measuring can actually become a symbol of failure, as people with diabetes struggle to stay constantly in compliance and maintain their target level. One pre-user we interviewed explained how an unexpected measurement could affect her emotionally and demotivate her. "Then I will stop measuring – I get the feeling: No, I do not want to be confronted with it... To be confronted with these numbers that just go up and down – I cannot handle that at all." She felt overwhelmed by the measurement and that the numbers were judging her. As diabetes is a progressive condition that can be treated but not cured by lifestyle changes and will get worse over time no matter how well people treat themselves, this can often cause a sense of failure. As it gets harder and harder to achieve their blood sugar target people can become demotivated as it seems like their past effort has been in vain. Changes in medication, particularly the initiation of insulin which is often only considered when no other treatment will work effectively, can also represent failure and demotivate people. It could then be argued that instead of focusing on targets that people fail to achieve, focus instead on the things they can do to treat their condition. This way people might be more moted, have more energy to make changes in their lifestyles and be less likely to perceive treatment changes, such as the initiation of insulin, as another failure.

ACT on Diabetes (Figure 3) is a concept that draws together these themes of Numbers and Measurement, Interpreting the Condition and Failure. It is about finding other ways to assess success in treating diabetes than just blood sugar number. The blood glucose monitor would be similar to existing devices, but instead of giving a numerical reading of the blood sugar measurement, it would offer people direct suggestions on how to act on their blood glucose levels. The accompanying app records small achievements, through letting people
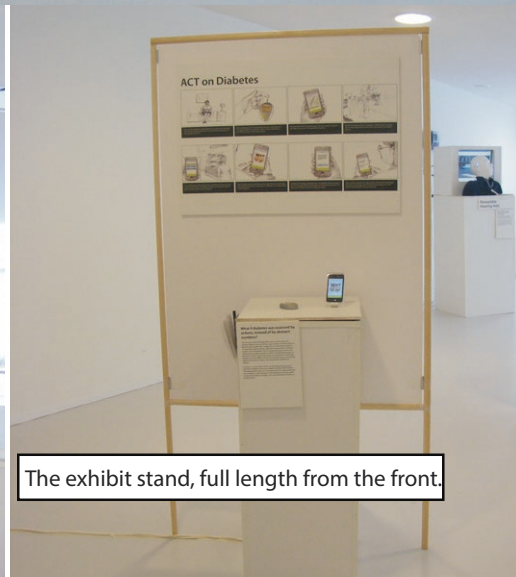
Figure 3: ACT on Diabetes Exhibit

Video of the app running on a smartphone like device (left) and model of the bloodsugar measuring device (right).
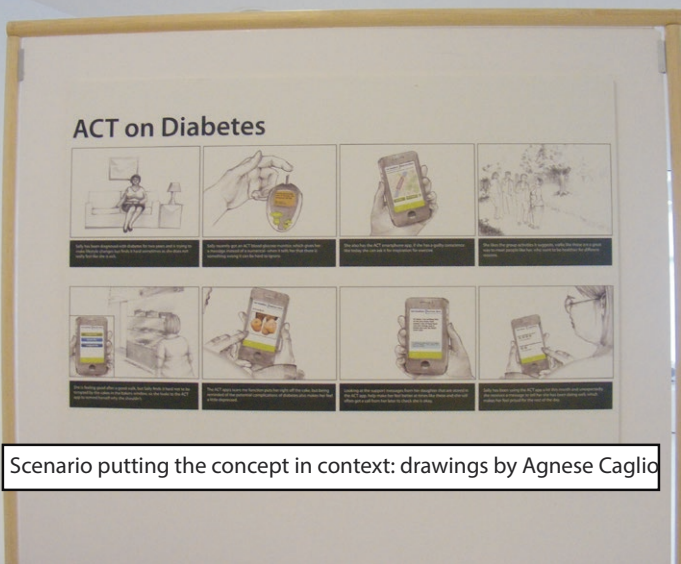
Scenario putting the concept in context: drawings by Agnese Caglio

The exhibit stand, full length from the front.

ask for motivational prompts on demand, then tracking when these are accepted. It would allow people to activate different forms of motivation such as competing against themselves or others, or using family members for support. Notably the app would let people choose to be motivated, offering an alternative way of considering motivation than something that is 'given' to people.

The exhibit included a model of the blood sugar measuring device and a video of the app running on a smartphone, as well as a scenario that put the concept in context and related it to a person. The concept title was above the scenarios and there was a text with the concept description on the podium with the title 'What if diabetes was assessed by action instead of by abstract numbers?' intended to draw attention to an alternative, as opposed to a supplement, to measuring. The app included an option to scare yourself, as relating to the risk of serious complications can be one of the hardest things. Although sometimes the industry tries to avoid the subject of the serious complications of the disease in order not to depress or scare people, some pre-users we spoke to claim they found it useful to be reminded or shocked sometimes,

which is why a very graphic image of amputated feet was used.

The Complete Collection

As a complete collection the exhibits mapped out a broader space for design, where the concepts presented were not to be seen as the ultimate solutions, but points on a complex landscape of possibilities. The idea behind this resembles Gaver's notion of an annotated portfolio (Gaver 2012) where a portfolio of design concepts are annotated and presented together in order to demonstrate the designers way of understanding what design could be within a particular area.

If a single design occupies a point in design space, a collection of designs by the same or associated designers – a portfolio – establishes an area in that space. Comparing different individual items can make clear a domain of design, its relevant dimensions, and the designer's opinion about the relevant places and configurations to adopt on those dimensions (ibid .p944)

Similarly the collection of design concepts in this exhibition was intended to mark out how the field could be understood as a domain for design. The concepts explored the same domain and interrelated themes in different ways in order to demonstrate a way of thinking that people within the organisation might be take with them and apply to their own work. The design considerations for the exhibition revolved around balance, diversity and coherency in order to demonstrate the richness and complexity of the domain.

One of the starting points for deciding to make an exhibition had been a desire to demonstrate how the conditions and their treatments make up design space consisting of a complex network of relations involving various actants. In order to do this an effort was made to make sure the concepts intervened in a range of different sets of relations with different sets of actants. For example the Revealable Hearing Aids concept was a proposed intervention to alter the relation between pre-users and the hearing aids, but did this indirectly by also activating the relations between the hearing aids, users and their communication partners. The ACT on Diabetes concept on the other hand, was proposed as an intervention in how pre-users relate to their condition and does this through their relation to blood sugar measuring devices. Figure 4 is a conceptual representation of how all eight concepts could fit into the network and create new relations between actants. It shows how the complex landscape of possibilities of how a pre-user (in the centre) might become aware of the condition (diabetes in blue, hearing loss in pink) and the treatment devices. The design concepts are points in this landscape targeting the relations between the pre-user and other actants. For example the Revealable Hearing Aids concept was a proposed intervention to alter the relation between the Pre-User and the existing hearing aids (Devices), but did this indirectly by also activating the relations between the Devices, the User and their Communication Partners. The ACT
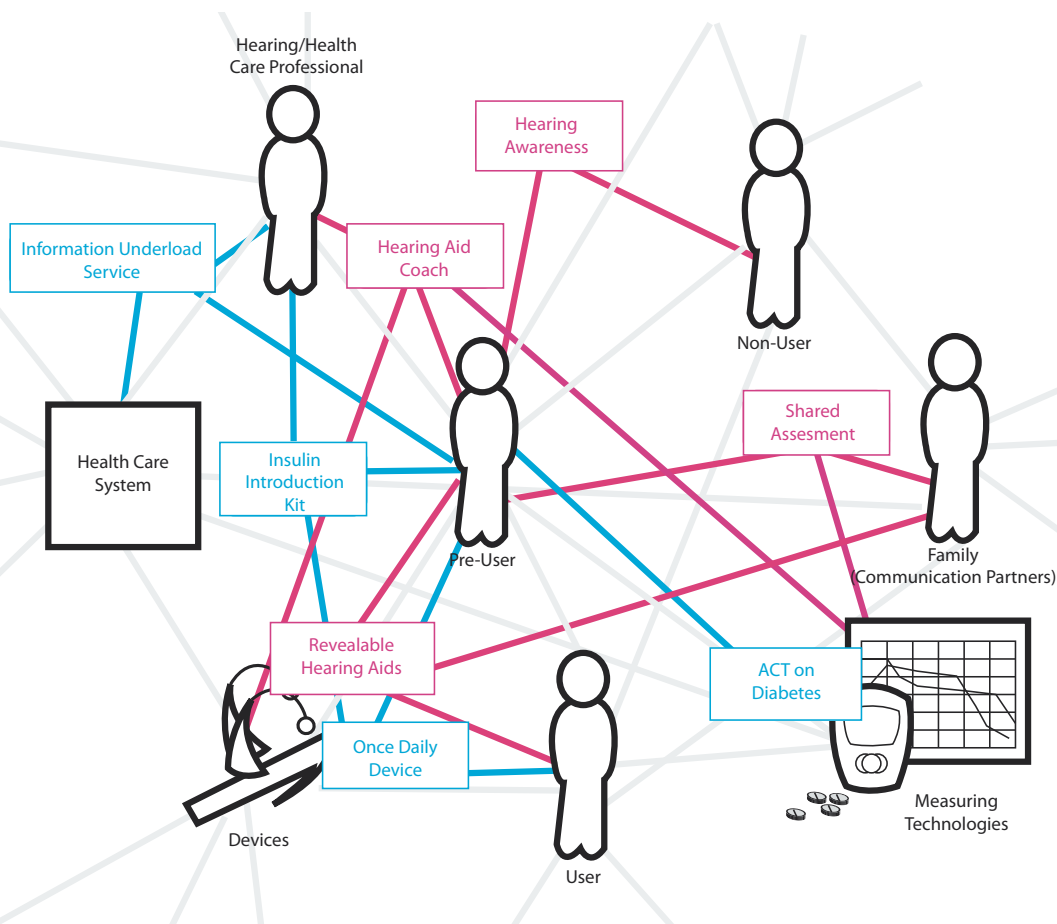
Figure 4: Representation of network of actant relations with concepts.

on Diabetes concept on the other hand, was proposed as an intervention in how a Pre-User relates to their condition through their relation to blood sugar measuring devices (Measuring Technologies).

We also wanted to show that various themes that had emerged from the field could be developed and combined in many different ways resulting in different aspects on the conditions and treatments being foregrounded and back-grounded. Different themes appeared several times throughout the exhibits in order to show this. For example Shared Responsibility theme that was embodied in the Revealable Hearing Aids concept was also explored in a concept called Shared Assessment, a two part leaflet that included tools for reflecting on the impact of hearing loss on others, as well as advice for partners living with someone with hearing loss. The theme of Shared Responsibility was also evident in one of the stories from the field presented on the hearing loss domain stories from field stand, which presents the interview from the USA where the husband with hearing loss is interview his wife, and they are discussing who

is responsible when they have problems communicating. Another example is the theme of Numbers and Measurement, which in addition to relating to the ACT on Diabetes concept relates to two hearing loss concept as well including the Shared Assessment concept and another called the Hearing Aid Coach, which would be an app with counselling tools to be used before and after hearing aid fittings to help people learn to use the devices, and to assess and reflect on the extent to which the devices are is helping them. Additionally the Numbers and Measurement theme was represented in stories from the field on both the diabetes and the hearing loss stands where conversations between healthcare professionals and pre-users discussing the meaning of measurements are presented.

Balance, diversity and coherency were also central considerations in the physical design of the exhibition. Several different formats were used for the concepts. Generally there were two of each (two devices, two applications, two information kits, one service, one set of photographs). The space was laid out so there was no single way to walk through it, no path with a beginning and end, but rather an open landscape with the stand that offered a chance to give feedback in a central position. The format of the exhibits was also diverse and as balanced as possible, (four were boards with small display podiums, two were larger podiums, two were installations set-up with furniture, and the feedback stand along with the two stories from the field stands were full height pillars). Finally a coherency within aspects of the presentation style, graphics and the fidelity of the concepts was maintained to create a sense of a unity that encouraged the exhibition to be read as a complete piece, as opposed to a group of unrelated objects. Maintaining balance within these dimensions was a way to leave the exhibition open for people's own interpretation without forcing direction to how it should be read. It showed richness and variety and was manifested across a range of dimensions including the combinations of themes, different formats, actant relationships and whether the focus was on the condition or the treatment; as well as the existing diversity between the two medical conditions domains.
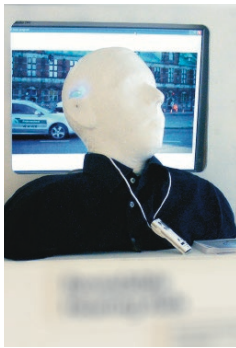
Revealable Hearing Aids

Hearing aids that make communication a shared responsibility by lighting up when the wearer needs extra help to hear.

- Shared Responsibility
- Identifying with users
- Self-Stigma

Hearing Aid Coach

App with counselling tools to be used before and after hearing aid fittings to help people learn to use the devices and reflect on the extent to which it is helping.

- Clinical communication
- Interpreting the condition
- Numbers and measurement

Hearing Loss Data posters

Three stories from the fieldwork showing how the treatment and condition of hearing loss are foregrounded in different ways in interactions.

- Interpreting the condition
- Shared Responsibility
- Clinical communication
- Identifying with users
- Numbers and measurement

Hearing loss

Shared Assessment

A two part leaflet that includes tools for reflecting on the impact of hearing loss on others, as well as advice for partners living with someone with hearing loss.

- Shared Responsibility
- Interpreting the condition
- Numbers and measurement

Introduction and Feedback

Introduction to the project and the exhibition combined with a place to hang and exhibit the feedback postcards

Hearing Awareness

A series of interventions that make hearing as a sense was more present in our lives, FX certification for sound quality and a home décor magazine special acoustic addition.

- Awareness of the condition
- Normalising the condition

Once Daily Device

A device that communicates simplicity of an insulin routine that only involves a once a day injection.
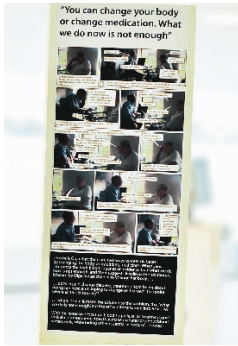
- Insulin concerns
- Manageable/normal life

Insulin Introduction Kit

A kit to help HCP's deal with some of the resistance patient's exhibit when they introduce the idea of insulin/injection to them.

- Clinical communication
- Insulin concerns
- Needle fear

Diabetes Data posters

Three stories from the fieldwork showing how the treatment and condition of type 2 diabetes are foregrounded in different ways in interactions.

- Clinical communication
- Interpreting the condition
- Numbers and measurement
- Insulin concerns
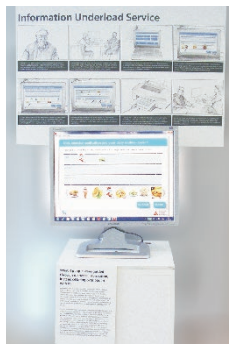- Manageable/normal life

Diabetes

ACT on Diabetes

A Blood Glucose Monitor with accompanying app that offer a way of assessing diabetes by action instead of by abstract numbers.

- Numbers and measurement
- Interpreting the condition
- Failure

Information Underload Service

A service to educate people with type 2 diabetes between visits to their doctor, that breaks up information into manageable pieces and relates it to people's lives.

- Clinical communication
- Manageable/normal life
- Interpreting the condition

Making a Preliminary Evaluation of the Exhibition based on Initial Responses

In order to get initial feedback from the visitors' postcards were placed at each exhibit. These had an image of the exhibit on one side and on the other side the questions, "Did this exhibit offer a different perspective and in what way?" and "What did it make you think of?" were written. These questions where intentionally chosen to be leading in order to provoke strong responses for or against. Under the questions there was a space for comments to be written and visitors could then hang their filled out postcards on the feedback stand where they could be viewed by other visitors. In total 73 postcards were filled out, covering all the exhibits with the exception of the feedback exhibit itself. The majority of the responses came from visitors to the opening presentation, who had been asked especially to fill them in. People who were invited to attend the opening included representatives from corporate strategy, device developers, marketing as well as people working with user insights and education within the organisations. The responses they gave can be used to give some kind of indication of how the exhibition was initially received.

One of the original aims of the exhibition was to inspire visitors to reflect on the issues and themes from the fieldwork it presented and several of the responses indicated it was successful in this. For example one postcard that referred to the ACT on Diabetes concept stated, "I very much like the thoughts about moving away from the numbers, and also in some way turn away from a reactive to a proactive approach- how can we in NN (Novo Nordisk) apply this?". This comment indicates the viewer recognised that the idea behind the concept was interesting and speculated how it could be made relevant. However, some of the postcard responses indicated several of the exhibits were seen rather as completely implemental solutions by some visitors. For example one comment for the Hearing Aid Coach stated "Brilliant, we should do this ASAP". While in other cases people even became engaged in developing the details of the concept further, such as another visitors response to the ACT on Diabetes concept, which was to suggested ideas for additional features it could include like one building on the idea by incorporating the concept of balance "I suggest building on a concept of "balance" combined with suggested steps for improving/ maintaining balance". Even the Hearing Awareness concept, which was probably the concept that was farthest away from the companies' existing offerings, was also taken as being an implementable solution in itself. In particular the idea for a special addition of a special acoustic edition home décor magazine, which in response to one

of the company audiologist (health-care professional specializing in hearing) wrote, " a great idea. Not provocative, just great! I'd buy it right away and recommend it to all my test subjects (hearing impaired) and their adult children!!!" Although these responses which speculate on implementation do suggest that people were found the exhibits engaging and relevant in a way they could apply to their own work which was part of the aim of the exhibition, they do also suggest it was the concepts themselves rather than the fieldwork findings behind them that were sometimes the main focus.

The actual combination of the findings and concepts from the two medical domains seemed to in itself encourage reflection. For example with regard to the issues that were raised by the Hearing Aid Coach concept, one person working with Novo Nordisk recognised that there could be similar issues in the diabetes domain, "Makes me reflect on what the 'parallel' situation in diabetes is- by having it 'mirrored' in the hearing aid world :-) thankyou!". While another person suggested the diabetes Information Underload Service concept could work for hearing loss too, because it could give "a way of contextualising hearing and making the hearing sense relevant for the individual," indicating they not only recognised the issues of contextualising experiences and individual relevance the concept dealt with but also reflected
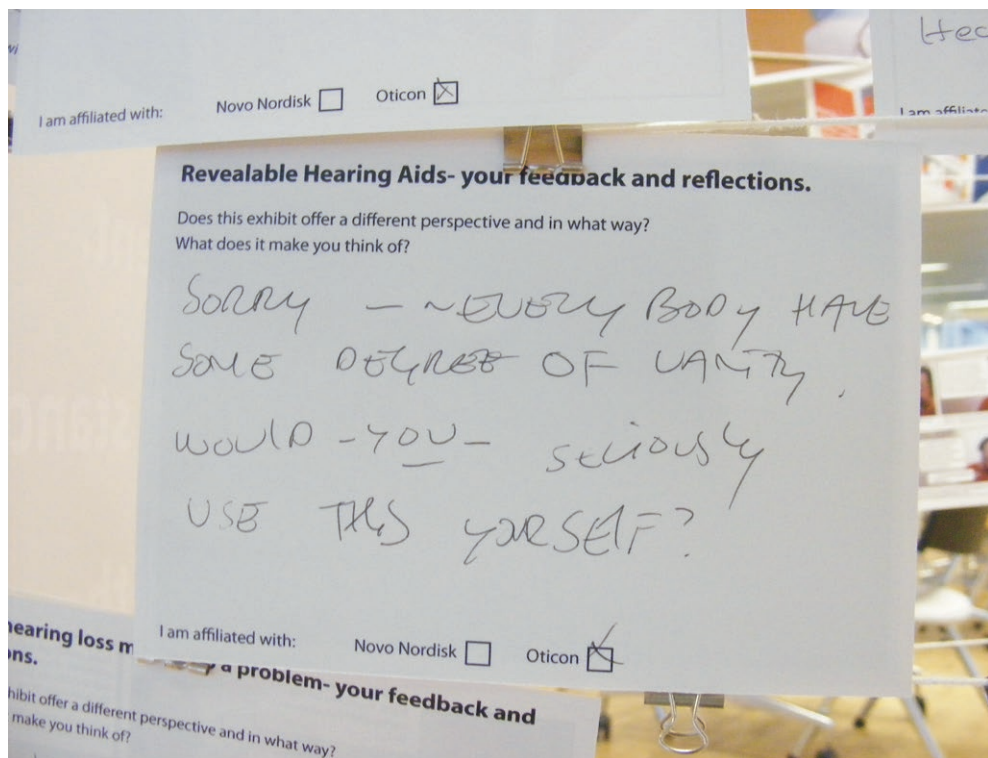

Figure 6: Postcard with response

on how these might also be relevant to address in the other domain. These kind of responses suggested that merging the findings and concepts for both companies together into one exhibition was work well for inspiring ideas. It also allowed people to reflect further on their own domain by making links between the concepts for the other companies' business areas and by making connections with the ideas behind them in new ways.

Furthermore, the exhibition was intended not just to communicate but to provoke. However, based on the postcard responses, only the Revealable Hearing Aids exhibit seems to have been truly provocative in the sense of being confrontational. The responses to this concept indicated that some people had quite a strong emotional response to it even to the extent of being offended, as one person's response implied it was stupid even to consider such an idea because no one would use it, "sorry- everybody has some degree of vanity. Would you seriously use this yourself?" Another expressed dislike of it on the grounds that it would stigmatize people with hearing loss, "I don't like this concept, may stigmatise the hearing impaired person". Yet not everyone had the same reaction, with other comments stating that the idea was excellent and even had the potential to work as an actual solution "I think the idea is brilliant!", "perfect! I think it would work- or provoke a discussion. Start a new fashion". Reactions to this concept were generally either strongly positive or negative suggesting that it touched upon important issues for the visitors and had succeeded in provoking them. As another postcard comment argued, the concept was highlighting an ingrained industry attitude "quite provocative... the "invisible hearing aid" is an industry fetish," it was making visible an assumption that is held across the industry.

Yet the aim of the exhibition was not only to provoke through confrontation, but in the broader sense of the word to provoke people to see the field in a new way. Several of the postcard responses explicitly addressed whether or not the visitor felt they had been shown something new. While many expressed the opinion that a particular exhibit offered a new perspective, there were several instances where another person in the same company expressed a contrary view that the ideas in the exhibit were not new at all in the organisation. For example, one response to the Shared Assessment concept from an Oticon employee was "(does the exhibit offer a different perspective?) Yes it does! It makes me think of the inadequacy of pure tone audiometry- perhaps we should do other tests", suggesting that it had made them see current practice about assessing hearing loss in a new light, but another person from the same company argued it was not new at all and that similar things already exist, "there are a lot of tools for this already". Even the controversial Revealable Hearing Aids concept had one response that claimed that it was an idea that had been considered before, "this is a concept we have discussed earlier on." These differing responses indicate that the exhibits were left open to the viewer's individual interpretation, dependant on the knowledge and values they

brought to it. They also actually reveal information about the companies themselves, showing that ideas and attitudes in the organisations are not unified, but are varying and dispersed.

with Novo Nordisk recognised that there are similar issues in the diabetes domain, "Makes me reflect on what the 'parallel' situation in diabetes is- by having it 'mirrored' in the hearing aid world :-) thankyou!" These kind of responses suggested that merging the findings and concepts for both companies together into one exhibition worked well for inspiring ideas. It also allowed people to reflect further on their own domain by making links between the concepts for the other companies' business areas and by making connections with the ideas behind them in new ways.

Discussion

The Pre-users of Medical Devices exhibition was an attempt to disseminate design knowledge that had been gained in fieldwork throughout organisations in a format that was engaging and caused the companies to "reflect on product, producer role and company identity" (Buur, Matthews 2009). By not just communicating stories from the field, but presenting design concepts too, the exhibition attempted to communicate the kind of knowledge about the field that is constructed through the act of designing. The exhibition was conceived as an interrelated collection that was intended both to communicate an idea of interdependency between condition and treatment in the domains of hearing loss and diabetes, and suggest how design could be used to foreground different aspect of the conditions and their treatments to those aspects that are foregrounded in different ways currently. Open-ended provocation was used as a means to get people to think without attempting to pre-determine how they should react.

Presenting the fieldwork findings in the form of product concepts can be considered to be one way of communicating fieldwork findings in a way where it is not just about communicating knowledge and generating empathy, but actually making the findings actionable, demonstrating different ways that the findings can be applied to product development. Yet there is also a risk with this approach of oversimplifying the issues at stake and that the concepts end up being interpreted as straightforward solutions to problems, rather than making people think and reflect on the issues behind them. In our case, responses to several of the concepts indicated that visitors saw them as viable solutions which could imply that the visitors were not driven to reflect further on the concepts meanings and the findings they embodied. However as the individual concepts are parts of the exhibition as a whole, juxtaposed next to more controversial concepts, it can be argued that the viability of these less controversial concepts added to the diversity and depth communicated by the exhibition as a whole. Presenting a range of concepts, each at different levels of controversy, plots points on a landscape of design possibilities within the field and rather than implying the possibility of single over-simplified solutions, demarcates a complex space that can be altered and communicated but not solved by design.

Another risk of presenting fieldwork findings in the form of design concepts is that much of the thinking behind the concepts, and the issues that have inspired this thinking, can be hidden. In this exhibition there was also a great deal of thought behind each concept, with many understandings and findings from the fieldwork embodied in the ideas. Due to the format of the design concepts, the deeper understandings and finding were probably not possible for the visitors to entirely decode. Showing multiple stories from the fieldwork alongside the

concepts, as well as trying to describe and imply the main themes in the titles and descriptions of each exhibit, is a way of encouraging people to make connections between the concepts and the issues of the field. Additionally, viewers will also bring their own knowledge and ideas of what they find important to the exhibition. In our particular case, most of the people visiting the exhibition were employees at the two companies who were able to bring some of their own knowledge and understanding of the field to the exhibition, and were therefore able to recognise many of the issues at stake in the exhibits. In these situations, giving the viewers that already have a lot of domain knowledge a different perspective on what they already know, may be just as useful for innovation as giving them new knowledge.

Giving people a different perspective also means allowing them to make their own connections between the exhibits and what they know about the field. There is a balance to be achieved between being provocative enough to make people to see things in a new light, and not being so provocative that the ideas are dismissed entirely because they do not relate at all to what people already know. In our case it was probably a good thing that the majority of the concepts were not perceived as provocative in the confrontational sense, as this could have resulted in the visitors dismissing the ideas and exhibition entirely. It was also good to include those few responses that did express a slightly outraged reaction alongside the extremely positive responses to the same concept, as it was a great way to demonstrate the range of ways that the material could be interpreted. The kinds of responses suggest that the exhibition did indeed succeed in provoking people to see things in a different way. The range of responses on single concepts and on the exhibition as a whole also indicates open-endedness, allowing the visitors to interpret meanings based both on the material presented and their own knowledge and understandings.

The format of an exhibition seemed to work well as a way of communicating to a broader audience, but we have little data that can give us an indication of how many people actually saw the exhibition and to what extent they engaging with it. Although the general experiences and the initial responses imply that the exhibition made an immediate impression on those who did visit it, and was provocative and open-ended, real success depends on the longer-term impact it has within the organisations. ¬In order for the exhibition to have contributed to innovation within the organisations it will need to have a long-term impact. While the initial responses indicate the kind of impression the visitor received, it cannot indicate what the people will do with these impressions subsequently. Follow up interviews over time might reveal whether visitors had considered the presented themes and issues well after the visit, whether their views had been significantly changed, or whether they even worked to implement any of the ideas it had inspired. However, much of the impact of the exhibition may not even be traceable in this way. It is hard for people to recognise if this one-off event

had provoked any small enduring change in thinking, and if so whether this thinking has been disseminated effectively into the wider organisation. The exhibition did not present or address one single issue, but was meant to elaborate on a complex entanglement of issues regarding how treatments and conditions are interrelated. If the exhibition does make a successful contribution to innovation within the organisation, by nature, the contribution will be a subtle one.

Acknowledgments

References

1. Bardzell, S., Bardzell, J., Forlizzi, J., Zimmerman, J., & Antanitis, J. (2012). Critical design and critical theory: the challenge of designing for provocation. I Proceedings of the Designing Interactive Systems Conference (s. 288–297). New York, NY, USA: ACM.

2. Boer, L. & Donovan, J. (2012). Provotypes for participatory innovation. I Proceedings of the Designing Interactive Systems Conference (pp. 388–397). New York, NY, USA: ACM.

3. Bowen, S. (2009) Getting it Right: Lessons Learned in Applying a Critical Artefact Approach. In: Undisciplined! Design Research Society Conference 2008, Sheffield Hallam University, Sheffield, UK.

4. Buur, J & Matthews, B. (2008). Participatory Innovation. International Journal of Innovation Management (ijim), 12(03), 255–273.

5. Buur, J., & Sitorus, L. (2007). Ethnography as Design Provocation. Ethnographic Praxis in Industry Conference Proceedings, 2007(1), 146–157.

6. Davidson, M. B. (2005). Counterpoint: Self-Monitoring of Blood Glucose in Type 2 Diabetic Patients not Receiving Insulin A waste of money. Diabetes Care, 28(6), 1531–1533.

7. Dourish, P. (2006). Implications for design. I Proceedings of the SIGCHI conference on Human Factors in computing systems (pp. 541–550). Montréal, Québec, Canada: ACM.

8. Dunne, A. J., & Raby, F. (2001). Design Noir. Springer.

9. Dunne, A. (2005). Hertzian tales: electronic products, aesthetic experience, and critical design. MIT Press.

10. Gaver, W. (2012). What should we expect from research through design? I Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems (s. 937–946). New York, NY, USA: ACM.

11. Halse, J., Brandt, E., Clark, B. and Binder, T. (2010). Rehearsing the future. The Danish Design School Press.

12. Jaffari, S. Boer, L. Buur. (2011)Actionable Ethnography in Participatory Innovation: A Case Study. Proceedings of The 15th World Multi-conference on Systemics, Cybernetics and Informatics. Vol. 3 (pp. 100-106).Orlando, Florida, USA

13. Kelly, J, (2012). Crafting 'Solvable' Problems in the Design Process. In Rodgers, Paul (Ed) Articulating Design Thinking. Libri, Faringdon.

14. Kelly, J., & Matthews, B. (2010). Taking transition into account: designing with pre-users of medical devices. I Proceedings of the 11th Biennial Participatory Design Conference (s. 71–80). New York, NY, USA: ACM. doi:10.1145/1900441.1900452

15. Kerridge, T. (2009) Does speculative design contribute to public engagement. Swiss Design Network Symposium '09. Retrieved February 28th 2013 from www.gold.ac.uk/

media/Does Speculative Design Contribute to Public Engagement of.pdf

16. Koskinen, I., Zimmerman, J., Binder, T., Redström, J., & Wensveen, S. (2012). Design Research through Practice . Boston: Morgan Kaufmann.

17. Mattelmäki, T., Brandt, E., & Vaajakallio, K. (2011). On designing open-ended interpretations for collaborative design exploration. CoDesign, 7(02), 79-93.

18. Mazé R., & Redström J. (2008). Switch! Energy Ecologies in Everyday Life. International Journal of Design, 22(3): 55-70.

19. Mogensen, P. (1992). Towards a Provotyping Approach in Systems Development. Scandinavian Journal of Information Systems, 4, 31–53.

20. Parsons, T. (2009)Thinking: Objects: Contemporary Approaches to Product Design .AVA Publishing; 1 edition
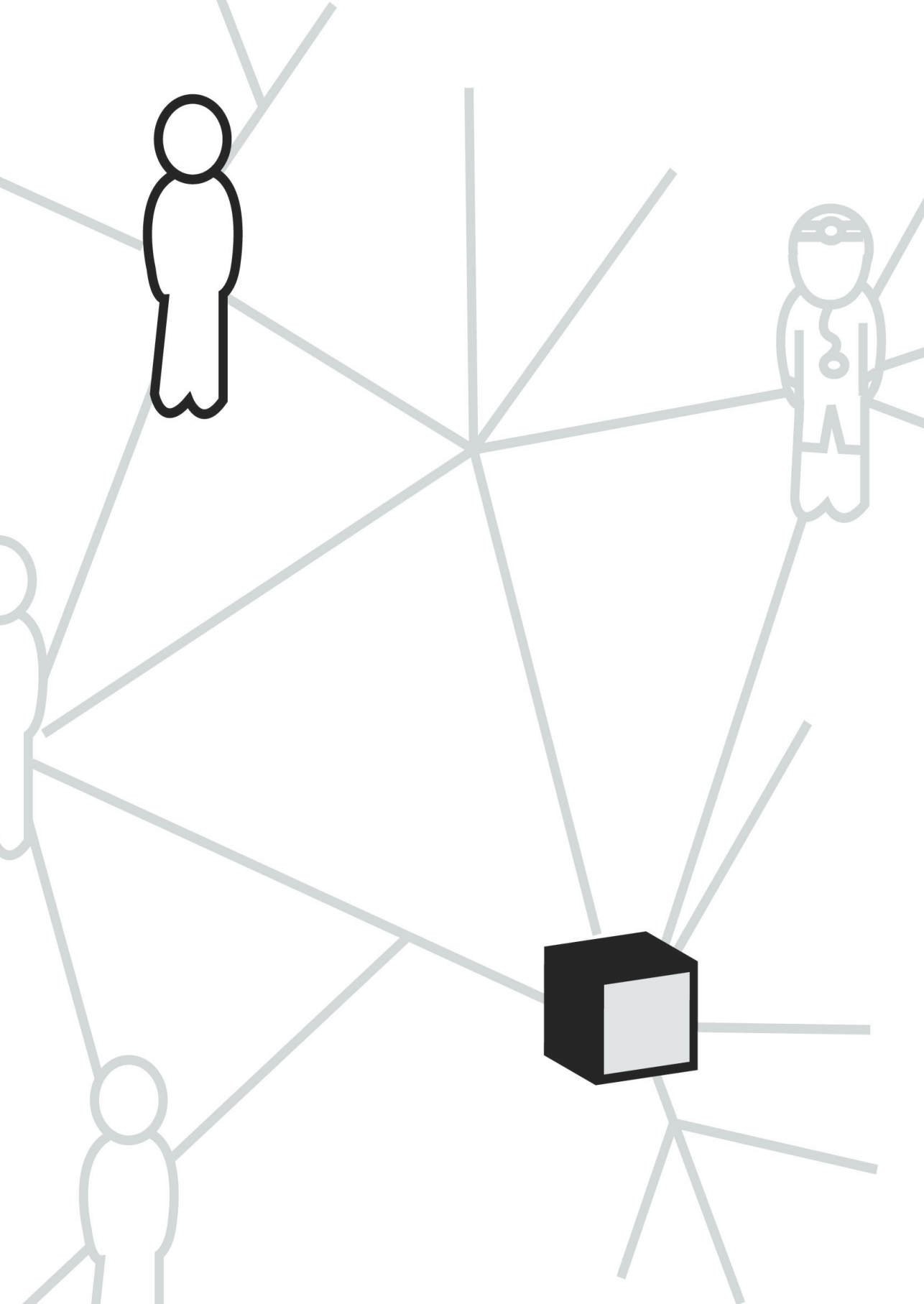
Displacing use: exploring alternative relationships in a human-centred design process

Abstract

This paper presents an argument for why considering relationships other than use can be useful for design. It discusses the role of the user in design currently, and analyses some of the limitations of the concept, before presenting examples from a case study, where people who represent neither users or future users of a technology are activated within a design process and how this can be interesting for design.

Introduction

In design, the concept of the user of products and systems has a distinguished legacy. It is also a concept that has undergone significant evolution over the decades since it was first introduced. The notion of "user-centred design", a phrase originating from computer systems development, was a valuable rallying cry for software designers to consider aspects such as workflow and the ergonomics of use in the conception and deployment of software systems (Schneider et al. 1980). It was also a critique of the then-current fashion to model the human beings who used computer systems as rational problem solvers who were, at base, information processing systems themselves (Kling 1973). In these early formulations, an emphasis on the "user" of designed systems was a means of bringing neglected aspects of the contexts of system use into the picture as having central relevance for the successful design of systems. The success of these systems was conceived in terms of utilitarian ideals such as "maximal efficiency, productivity and job satisfaction" (Schneider et al. p.116), or in terms of how well systems addressed what would later become known as 'the requirements problem', namely how to construct a system that actually met the needs of the people who would end up working with it (Kling 1977). The users in view here were synonymous with workers, and contexts of use were understood in terms of workplaces and divisions of labour. The emergence of "user centred design" as a term of reference in the US in the 1970s was roughly coincident with democratic design developments in the UK (e.g. the Design Research Society's 1971 conference on design participation (Cross 1972) and Mumford's (1983) "sociotechnical approach" to designing with users) and in Scandinavia, where a "work-oriented" approach to design had emerged out of pioneering collaborations between computer scientists and workers' unions (see e.g. Ehn 1988; Floyd et al. 1989).

It was with respect to the design of computer systems in work settings that "users" emerged as a term of reference. Although other design disciplines had other terms for related concepts (e.g. industrial design's focus on the "consumer", or architecture's idea of the "occupant" of a structure), "user" is the term that has gradually infiltrated disciplines outside of systems design. This has become the case as consumer products from coffee machines to automobiles are increasingly embedded with microprocessors and user interfaces, and hybrid disciplines (such as interaction design and service design) have emerged at the intersections of new technologies, practices of consumption and innovative business models. Concurrent with these developments, "user centred design" has become understood as a valuable approach to design with (close to) universal applicability across design domains. Yet such developments have also necessitated an evolution in the concept of the user. The shift from work settings and software interfaces to domestic environments and consumer electronics, for instance,

significantly changed the very idea of "use" in a number of important respects. For one, the corrective changed. For early advocates such as Rob Kling, a concept of the user of systems was initially introduced as a conceptual device to challenge software developers' (rationalistic or mechanistic) assumptions about the people and work processes being supported by systems. In industrial design, however, the introduction of the idea of the user was a challenge to a different set of (mis)conceptions of the people who lived with products. While it might be argued that industrial design's idealisation of the consumer as an amateur aesthete deserved as much critical scrutiny as computer science's rationalistic idealisations of system users, the corrective offered to industrial design by the concept of the 'user' is a very different one. As such, the ideas of 'who the user is' and what is relevant to a 'context of use' also evolve as these concepts travel through different design disciplines. Furthermore, the settings where designed products and systems were deployed transitioned from (mainly) workplaces to other arenas such as domiciles, public spaces and mobile devices, the focus on utilitarian aims closely allied with work (such as functionality, productivity, task orientation, efficiency and usability) made way for new design ambitions that are more closely associated with "homo ludens" (Gaver 2002): playfulness, enjoyment, engagement and delight. The use of a spreadsheet application is a very different kind of thing to the use of an interactive media centre or social network portal. And yet a concept of "use" still proves valuable irrespective of these important differences in aims, contexts, purposes and people. Users may have become ubiquitous in design, but they are not all of a piece.

It is vital therefore to specifically articulate the important contributions that have come to design via an emphasis on use. As we have mentioned, a focus on users was one way of complicating the kinds of misleading stereotypes designers held of the people who lived with their artefacts. It did this by replacing theoretical or conceptual models of people with actual living, breathing human beings who encountered designed artefacts in the ordinary courses of their daily lives. Secondly the pairing of the study of users with their actual contexts of use led to a much more holistic appreciation of the design 'problems' that were being addressed through the introduction of new products and systems. The ethnographic reclamation of the indigenous logic(s) of users in their own contexts remains a vibrant enterprise through which design continues to learn a great deal about the environmental, spatial, temporal, sequential and instructional aspects of successful and unsuccessful technologies (Suchman 2007 remains a touchstone of this species of work). The imperative to take users seriously and on their own terms has led to a widespread recognition of the need for field studies within the design process to inform design. Real people were studied (through ethnographies of practice, for instance) or actually invited to participate (through codesign engagements) in design. Furthermore, as user centred design has been applied in domains far beyond the computerisation of

workplaces, a notion of the user of technologies has informed the broadening focus of design beyond aesthetics and utility (or form and function). In these respects the concept of the user has been, and remains, invaluable to design.

It has not been beyond critique, however. In several influential papers, Grudin (1990, 1993) critically examined the idea of the users of technologies, suggesting that "user" was a techno-centric term. In other words, it is only technologies that 'have' users, and it is only from the perspective of the technology that a "user interface" is needed. From the users' point of view, they interact with a computer's interface. As Grudin (1993) astutely notes, "'user' suggests a view from inside the system, peering out through the display" (p.117); "the computer is assumed; the user must be specified" (p.112). Grudin's critique arrived on the scene as a part of an agenda that bears a strong affinity with that of pioneers of user centredness like Rob Kling. So although critiquing the concept, Grudin was similarly concerned to dislodge the techno-centrism of computer systems design.

One aspect of Grudin's (1993) critique of the concept of the user was that it wasn't specific enough. He argued instead for terms like "secretaries", "nurses", "writers", or, when no professional title was suitable, "system users" or "application users"; each of these was preferable to a generic "user". These are certainly improvements of a kind, but notice that for Grudin, it is the workplace that is now assumed—the professional role of the user, and his or her context of use. Ironically, then, Grudin's recommendations merely replace one brand of conceptual rigidity with another that may (or may not) be more relevant; we simply cannot say a priori. His recommended substitution of "nurse" for "user" preselects the actor's likely interests in the designed artefact in view. Such preselection introduces a natural bias towards the occupational relevance of actions with the artefact. In many cases, however, occupation is not the only category of relevance, and certainly cannot be assumed to be omnirelevant to design. Any set of accurate descriptors of the person may, in any one case, turn out to be of greater design relevance: that he is a nurse may be of less interest than the fact he is (also) a father, a debtor, a patient himself or a past victim of identity theft. As much as the concept of "the user" might suffer as a design tool for its techno-centrism and lack of specificity, the overspecification of design-relevant relationships is a tack that invites new blind spots of its own. Curiously, Grudin's critique of the concept of the user ultimately has the effect of more deeply entrenching the concept of use by foregrounding the professional tasks and duties that the use of the technology is intended to support.

Other critiques of the concept of use relate more closely to the constructive nature of design as an undertaking. The recognition that design is always engaged in an effort to transcend the status quo is one that has consequences for the concept of the user and its usefulness in design processes. To the extent that the introduction of new artefacts meaningfully transforms

any existing state of affairs, then there (logically) can be no users of the artefact during its design process. "Users" only come into being once there is something to be used Redström 2006, 2008; Ehn 2008). As much as "the user" was a corrective to more distant rationalistic or consumeristic abstractions of human beings, it too is an abstraction. In many cases, it is the idea of a fictional or future user that is present in designer's conversations during design (c.f. Matthews 2007, Sharrock & Anderson 1994), or it is a concept representing a specific figure through which designers' expectations can be enacted and mediated (Wilkie & Michael 2009). Thus it is the user-figure that becomes a tool through which particular design decisions are made. Furthermore, use is not, and cannot be, determined in the design process; and so the meaning of the artefact will be something that emerges instead in practice (Matthews et al. 2008; Wilkie 2011). Just as real users will not actually embody the user-figure that was deployed in the design process, the enactment of use always diverges in practice from the one envisioned in during the artefact's development (Akrich 1992, Redström 2008). Many products create value for people and are enacted in practice, in ways that do not at all resemble the use practices that their designers intended. Far from indicating a failure in their design, the success of many artefacts have has been defined by how people have unexpectedly reinterpreted them in practice (see Redström 2006). Conversely, some of the great failures in recent design history (several modernist post-war inner city housing schemes would certainly qualify here) can be attributed to attempts to rigidly define the practices that constitute "use".

Insights such as these have led design theorists to argue against designing new technologies that overly prescribe how artefacts should (and should not) be used (Redström 2006, c.f. also Akrich 1992). Relatedly, some commentators have begun to recommend alternative values for design to embrace: openness to reinterpretation in use, ambiguity, flexibility, and configurability after deployment. The imperative of this, according to Sengers and Gaver (2006), is not to create artefacts that are so open to interpretation their meaning becomes indeterminate, but for designers to consider "multiple co-existing interpretations", depending on the appropriateness for the application under consideration. Redström (2006) suggests designers use their understanding of the current use context to make the artefact "ask questions about use that remain open for users to answer".   It is along such lines that Tuomi (2005) argues that "the phenomenon of use, therefore, needs to be conceptualized as a relation between the user and the artefact, where the user and the functionality of the artefact mutually construct each other"[1]. This serves a sharp contrast to ideas of use in design that

1. Contemporaneously, the introduction of these ideas has coincided with the emergence of global smartphone platforms that have demonstrated the potential of leaving the use of an artefact open (to a degree at least) to end users, who have the possibility of configuring their own range of functions for the artefact (within the constraints of its hardware/OS/app store pairing). Simultaneously, this has opened the possibility for almost anyone to become a developer—the openness of Google's Android Open Source Project and the availability of Apple's Xcode development kit for iOS are movements in this general design direction. The principal point, of course, is the radical degree

identify design success with the successful prescription of correct use (as in, e.g. Norman's 1990 classical model).

In each of these critiques of users[2] and the concept of use, however, the central relationship for design remains a relationship of use between the person and the artefact. Grudin's critique instructively supplants a techno-centric view of "users" with a more human centred view of people as responsible professionals, yet reinstates use as the ultimate object of design. Redström's critique reveals the unsettledness of the idea of use as a viable tool for design by demonstrating that the ultimate meaning of technologies are often determined by their unexpected possibilities for reinterpretation. But so long as "meaning is use" (to misappropriate a Wittgensteinian trope here), it is still use that takes centre stage; insofar as the corrective for design is to embrace the possibilities of opening artefacts for pluralistic reappropriation in use, it is use that remains central.

We have not drawn these observations in service of criticising Grudin or Redström; indeed, we see ourselves engaged in a wholly allied enterprise here. Rather, these comments are made only to bring into sharper relief relationships other than use that can constitute constructive material in design research. Other relationships are rarely promoted as having essential importance for design because of their tangential relevance to use. In this paper we report on a series of these relationships that have emerged in the course of a multi-year project that investigates design opportunities for patients with chronic medical conditions.

---

to which the multifarious ends that smartphones are now employed are not constrained by the imaginations of the designers of the platforms that have allowed these subsequent redeployments, nor are they necessarily constrained by users' current practices with these devices.

2.We are aware of other discussions of use and users; Lloyd's (2002) discursive critique of user centred design, Agre's (1994) discussion of the institutional forces underlying managerial and technical conceptsions of the user, and Cooper and Bowers' (1994) analysis of the disciplinary rhetoric of the user. The targets of their discussions are rather distant from our own foci here, however.

1. A dual case study: hearing aids and insulin pens

The Innovating with Pre-Users of Medical Devices project is sponsored by two companies who produce medical devices, Novo Nordisk who produce insulin injection systems, and Oticon who produce hearing aids. Both these companies have experience in involving the users of their current devices in the development of new products, but have come to recognise that some of the most relevant people (from a market perspective) are the people not yet using their technologies. The goal of the research conducted in this project was to adapt user driven and participatory design methods to involve these two groups of "not yet users" in order to investigate possibilities of overcoming any barriers to the uptake and use of these products.

The companies jointly initiated this project because they shared a common concern, in that they both have a large and currently inaccessible market consisting of people who could medically benefit from using their technologies, but who delay or decline to begin treatment for significantly long time periods. From a medical point of view, this delay or refusal can create additional complications to the patients' conditions and their overall wellbeing; the relationships that these people (whom the project initially termed "pre-users") have to the companies' devices are important because significant delays in initiating treatment could have detrimental effects on people's lives. Notice the centrality of a concept of "use" to this characterisation of a state of affairs.

The circumstances are considerably more complicated than this, however. Firstly, function (and by implication, use) is not central. Whereas in a commercial context of consumer goods, a product's lack of acceptance in the market might easily be attributed to its inability to fulfil valuable functions, or the undesirability of the functions it does fulfil, here the issues are not so clear-cut. In this context, improving use issues (in terms of, e.g. form, function, interactivity, usability) will have little or no effect on getting the devices in people's hands any faster. The issue is more closely tied to the fact that the very use of the product is predicated on the user's acceptance of having a medical condition that nobody wants to have. Influential concerns tied to one's identity and self-image are implicated in taking up the device and crossing the threshold from pre-user to user—both hearing impairment and type 2 diabetes are often accompanied by influential social stigmas. Furthermore, the use of medical devices such as these is not market-driven in any simple way. Access to these devices is controlled by health care professionals who have the responsibility to prescribe them in line with their diagnosis of the patient's condition. Through the fieldwork we have conducted, we have observed that different health care professionals (HCPs) can harbour a wide range of views

on the usefulness of the devices and the urgency of patients' needs to have access to them. Additional complications arise in this regard, since a country's health care system subsidies for prescription devices (or lack thereof) has enormous consequence on the ultimate cost of treatment that is passed on to the patient/user/consumer. This especially so for hearing aids, which are sometimes classified as an optional prosthesis rather than a medical necessity, and are not always subsidised under many Western nations' health care systems.

So even though the person with the condition will ultimately be the one interacting with the physical device (i.e. using it), they are only enabled to do so by virtue of their healthcare professional's practices of treatment, and this only in the context of wider societal frames in which the treatment of these conditions has unmistakable moral, economic and/or political overtones. And we are yet to raise the role of national medical regulatory bodies that have an influential say in defining the scope and functions of the technologies, and establishing standards. Attempts to generate a "user centred" process from the ground up in this ocean of institutional interests meet with stubborn obstacles.

'Pre-user' (the term which was originally chosen to describe the individuals we were involving in our design process who were not users of these devices) aptly describes the companies' interests in these people. We acknowledge from the outset that this is not an emic term; to be sure, most of the people who were involved in our studies did not seriously consider themselves future users of these products, so they certainly could not identify with being pre-users. The term relates only to an industry perspective. However the concept was constructed as the project itself was being framed as a means of delimiting the field under examination. Within the project, "pre-user" has come to stand for people who have a diagnosable medical condition in which there is a fair likelihood that in time they will become users of these medical devices. Specifically we have defined the pre users of hearing aids as those people who have an early stage hearing loss but do not yet own a pair of hearing aids, and the pre-users of injection devices/ insulin as people with type 2 diabetes who have not yet started to use injection treatment/ insulin. The practices we have included under the constructed label of pre-use, are not meaningful to those that enact them under that name, unlike use practices which are usually at least recognisable as such to the people doing them, even if they do not strongly identify with them. The term can instead be seen as a way of making this collection of practices relevant to an industry perspective.

The project has involved trying to gain an insight into the practices that are relevant to pre-users from a company perspective and co-designing with people who represent this group of non-users. In our fieldwork we chose to focus for a large part on the clinical interaction between doctor and patient, where the practices involved in the decision to adopt the devices

seemed most evident, and we spent time in clinics and recording interactions between hearing or health care professionals, general practicing doctors in the case of diabetes and Ear Nose and Throat Specialists or Audiologists in the case of hearing loss, and pre-users. We also wanted contextualise this in relation to how the conditions were experienced outside the medical, so we complemented the clinical studies with interviews with people in their homes, and followed the healthcare professionals through their daily professional practices.

The empirical work has been conducted both in Denmark and in the USA. In addition to ethnographic fieldwork, we conducted multiple co-design workshops and also deployed a form of auto-ethnography and probes we labelled "enquiry kits". In Denmark we initially conducted a pilot study that we later extended into a larger investigation, which included interviews with over 16 pre-users, video recordings of consultations in seven clinics, and four exploratory co-design workshops. In the USA we interviewed seven pre-users in their homes (each of whom also completed enquiry kits), and participated in or video recorded consultations in five clinics, as well as conducting three co-design workshops.

Our analysis of this material suggests that while it may be important how people in this situation relate to the medical device, there is no defining relationship analogous to use. Rather there are many different ways in which people are connected, directly and indirectly, to these medical devices. The people and artefacts are linked through networks of different relations of varying strengths. In some of these, the artefact plays a direct role; in others it is only indirectly present. We encountered several ways in which people with the condition and these devices connected. In the next section we will present some examples from this project of relationships other than use that are of interest to design in this case.

1.1 The relationship between the healthcare professional and the device

In the case of medical devices like these, the companies' customer is generally the healthcare professional who will be prescribing the device, rather the end user and in some cases the healthcare professional may have never even seen the devices, let alone experienced using them. Although the healthcare professional may be influenced by their other patients' experiences of use, considering use alone will not necessarily account for all practices that are relevant to the relationships the healthcare professionals have, or could have, to the devices. By focusing on the clinical interaction in our fieldwork, several other practices that could offer interesting potential for design became evident and one in particular that stood out involved the activating of the device in order to persuade the patient to accept the treatment option. In several clinical interactions, we observed healthcare professionals introducing the idea of using the devices to their patients. In some of these instances, the physical devices were actually shown; in others they were not. This seemed to potentially make a difference to the patients' willingness to accept them as an option.

With regard to insulin or injection treatment, the issue of having to inject often arose in the discussions between doctors and patients, with the patients citing needle fear and the fear of pain as reasons why they did not wish to start taking insulin. In response to this, we observed some doctors use words alone and talk about how small the needle was, small or that it did not hurt as much as blood sugar measuring. One doctor for example tried to explain how little the insulin needle was while she gave her patient a flu vaccine injection with a large needle. "You are afraid of the needle because I am giving you the needle, but when it comes to the fact that you will be doing it yourself, and when the needle is not like the one I am using but it is a needle that is like a hair and it really does not hurt". By contrasting them, she may have also associated the non-present insulin needle with the vaccine one, which was actually physically there and being used. Other doctors on the other hand used different tactics which deployed the injection device themselves. For example, we witnessed one nurse in the USA get a sample device out and ask the patient to inject himself within five minutes of her having decided that he might benefit from injection treatment. In another interview, a Danish doctor explained that he used the device on himself to demonstrate to his patients how painless it was to inject; he then proceeded to stick himself with the device during our interview (see Figure 1). In these different practices needles and devices were brought into interactions with patients in order to alleviate their needle fear; having the physical device there was a way of helping to make

Figure 1: Doctor in interview showing how he demonstrates to patients that the injecting does not hurt.

patients' abstract fears concrete and to deal with them directly.

With regard to the hearing devices, patients often have concerns about how visible the technology is and how comfortable it will be to wear. It is only rarely the case that ear nose and throat specialists have hearing devices in their offices, as they do not fit them themselves .[3] In such cases they have to try and alleviate people's concerns through describing the devices. In one consultation we witnessed, the doctor explained "you will get the new ones, those where you have a tiny device behind the ear and then a very thin tube that sits in your ear, you get no closed stopper inside the ear. So you can't even notice you are wearing hearing aids". This doctor in Denmark tried to reassure his patient by arguing that the technology is not intrusive, but without the devices present both he and the patients might have very different images of what they were talking about.   On the other hand two of the hearing professionals we spoke to, one ear nose and throat doctor and one audiologist, actually had hearing aids themselves and brought these in to the discussion in order to convince the patient of their benefit, for example by identifying with their condition. "This is your audiogram... it is similar to mine, and I told you I wear hearing aids." Here the doctor tries to persuade his patient by arguing that they

3. Ear, nose and throat (ENT) specialists can diagnose hearing loss, and can refer patients to an audiologist to be fitted for a hearing aid. It is the audiologist however who calibrates and fits the device to the patient.

are similar and drawing attention to the fact he is wearing hearing aids himself during the conversation.

How the healthcare professional relates to the medical device affects the way his/her patients are introduced to and encounter them. We saw both the hearing aids and the injection devices being introduced by healthcare professionals as agents for persuasion and to alleviate patients' concerns (two agendas that are often difficult to separate). Healthcare professionals are not necessarily users of the devices, but they use them nevertheless, e.g. to demonstrate, persuade and teach. In this context, patients' relationships to these devices are heavily mediated by those in institutional positions. Physical access to the devices is mediated by the medical practitioner; so too is information about them; and this so in the course of other actions that are conducted in consultations such as advice giving and fear-assuaging.

1.2 The relationship between the healthcare professional and the pre-user

It is not just the practices that involve the device that can affect its uptake. Other aspects of the relationship between the healthcare professional and their patients also had significant bearing. The issue of trust was something that came up frequently in our interview both with the healthcare professionals and the people with the conditions. It was generally recognised that the patient needed to trust the healthcare professional in order to accept the treatment, but the treatment was also an obstacle to this trust. For example one diabetic we spoke to explained how she had for a period stopped going to see her doctor, because she did not trust him partly because of the way he prescribed treatment, "I felt like he just wanted me to take the pills – he never gave me the information that convinced me that he was right," as her doctor did not explain how the pills would help she was able to trust neither him nor them. This was equally problematic in the situation of hearing loss. Healthcare professionals who diagnose hearing loss are often in a position where they need to persuade the patient that hearing aid technology could benefit them. While there can be national health system subsidies for the purchase of hearing aids, these rarely cover the total cost of purchasing the devices. To complicate matters, once hearing aids have been prescribed to a patient, it is often the audiologist who confirms the patient's hearing loss and sells the hearing aids. It can be a delicate operation to balance between healthcare professional and salesperson; audiologists can find themselves in precarious situations when persuading people to use hearing aids.

But it was not just the healthcare professional's ability to obtain trust that was an issue as very often, the people coming in with the conditions often also had their own agendas and were not necessarily willing to defer to the healthcare professional's judgment. We observed in some consultations, how people would work very hard to demonstrate to the healthcare professional that they did not need the device as a treatment. For example with hearing loss people would very often create their own arguments as to why they did not need a hearing aid, despite the results of the audiometric tests. In one case we saw the patient re-state the doctor's assessment that she was unable to understand correctly 15% of the words she heard in a test as a positive in order to argue that she did not need hearing aids "oh well, I can be satisfied with that...my sister has lost 85% of her hearing", activating both the test and her sister's hearing in the discussion, and making it difficult for the doctor to argue for the benefits of getting the treatment without contradicting her.

Figure 2: Doctor and patient discussing blood sugar measurements as part of a control visit.

With the type 2 diabetes consultations, people would often list the different kinds of exercise that they were doing, or the foods that they were eating apparently in order to show the doctor they were in control of the current management of their condition. The blood sugar measuring they did at home themselves was also something they could introduce in order to demonstrate their skill (see Figure 2). For example, consider one patient's explanation of his measurements when asked by his doctor a closed question about the readings:

> Doctor: "What is your blood sugar number when you measure it yourself? Is it always under ten?"
> Patient: "I take, I will take it for example, one time a week, and I shift. Between different days, I take it two hours after breakfast, two hours after lunch and two hours after dinner, and so it lies between 5.6 and 7.2."

Notice the patient's display of competence in his answer. He repeats "two hours after [a meal]" three times, underlining his awareness of the importance of the timing of these measurements to their (medical) validity. In stating the actual measurement numbers, he upgrades the doctor's scale of measurement ("under ten") by an order of magnitude, stating accuracy to one decimal place. In these kinds of situations it becomes increasingly difficult

for the healthcare professionals to make a recommendation for a change in treatment (e.g. to prescribe the patient begin using a medical device) without undermining the competence the patient is demonstrating with respect to his/her own awareness and mastery of the condition.

It isn't wholly surprising that the interaction between the healthcare professionals and people with the conditions involves practices that bear on whether or not people become users of the devices. But it is worth emphasising that these interactions are not always directly related to the devices themselves; i.e. attributes under the control of designers. Trust is a central example here. If the patient does not trust the healthcare professional, if they do not understand their arguments or are not convinced of their motivations for recommending the devices, they are less inclined to initiate treatment. Equally, if the healthcare professionals are not equipped to align the need for treatment with the patients' arguments about their own abilities to handle the condition, then it will be a struggle to convince patients of the benefits of the devices.

1.3 Pre-users' relationships with the conditions

Another relationship that can involve barriers to the adoption of the devices is one that people have with their own body and the condition. In both the hearing and diabetes cases, the consequences symptoms can be subtle (in the case of hearing loss), or difficult to connect to the conditions (in the case of type 2 diabetes). Many sufferers find it hard to feel like they have them. The onset of the condition is usually gradual, taking place over many years. For instance, people may not notice for several years that their hearing has diminished, and they may not be acutely aware of sounds in their environment they are missing. As one man with hearing loss explained during an interview, "I do not notice what I don't hear." The condition is defined by an occasional absence of a symptom (rather than its sudden and discernable appearance), which makes it harder to notice in some situations. When problems of hearing or understanding manifest, it can be difficult to distinguish the extent to which the difficulty is a result of hearing loss (the condition) as opposed to, e.g., environmental factors such as poor acoustics or high levels of ambient noise. Many of the people we spoke to questioned whether a significant proportion of the problems they were having could be the fault of other people not speaking clearly, because in some situations they had no difficulties hearing. One reason for this is that when people experience hearing loss, they tend to do so only for certain frequency bands, which results in a reduced of ability to distinguish between sounds and words, rather than a blanket loss of all sound. The consequences for the person experiencing the loss include becoming tired from concentrating harder and frustrated at miscommunications; this in turn can lead to social withdrawal and isolation without the person necessarily associating these outcomes with their hearing

With the Type 2 diabetes the issue is that it is generally symptomless, but you treat it to try and reduce the risk of getting serious complications in the future. This idea of treating risk is an abstract one, and it is not easy for people to motivate themselves to do this because they do not feel like they are sick. As one diabetic told us, "you have to be careful, because if you're not feeling as if you have the disease then, you know, you get too comfortable…". People do not notice the condition in their daily lives so it is easy to ignore. The result is that the treatment of the disease seems more unpleasant than the disease itself, because that is what is being experienced now. To compound this issue, avoiding insulin is often presented as a goal for patients as opposed to avoiding the complications, reinforcing the idea that the treatment is itself a part of the disease.

Figure 3: Project participant explaining how he does (and does not) experience his hearing loss.

The result of this detached relationship to the conditions and their consequences is that people do not recognise that the condition is responsible for problems they are having now, or may have in the future, and are less able to accept the need to treat it. In this situation using the devices, which requires a certain amount of effort and diligence, can seem like the problem itself (as opposed to a solution). Although this is not directly caused by the device design, this relationship can have a profound effect on the extent to which people believe the devices will be good for them; this is therefore relevant to consider in design, as continued use (known to health care professionals as "compliance") is essential to the functions of the devices.

1.4 Relationships between users and pre-users

Even when the devices are activated in a use relationship, they may have roles to play in other relationships. These medical conditions are often assumed to be stigmatised socially. In our studies, however, we found evidence that the conditions were self-stigmatised as much as they were socially stigmatised. In other words, people with the conditions presumed that others thought the condition was something they ought to be ashamed of, whether or not that turned out to be the case. This attitude could be changed through encounters with people who they admired who also had the condition. In both cases the devices could actually become a way of recognising and making contact with others who also had the conditions. For example we spoke to one woman in her late thirties who had known she had hearing loss for several years, but had felt she was too young to have to wear hearing aids. She explained she was finally convinced to consider them after she met another young woman, around her own age who was wearing them. It was on account of the other woman's very similar story that she was encouraged to actually try them out for herself.

The stigma of type 2 diabetes is rather different, as often it is associated with blame. A diagnosis of type 2 diabetes can be accompanied by value judgments with respect to the patient's lifestyle (diet and exercise particularly) and a latent implication that it is the patient's own fault. Many patients do not talk about it, nor do they easily identify with other people who have the condition; on the other hand, people who personally knew someone else who also was living with the condition often found that very motivating. One informant talked about one of her friends who also had type 2, explaining that even though she was taking insulin, it did not stop her from doing the things she wanted to do. "I know someone who is on insulin and she lives her life as though she is not on insulin she follows the [doctor's orders], eats healthy and everything but she goes anywhere. She goes anywhere, she goes on cruises, goes anywhere she wants to go. She enjoys her life and that showed me that diabetes is not a setback. You can live a long life with diabetes so you know she was an inspiration to me." She also explained this woman would happily inject herself in front of others, and that had inspired her not to be ashamed of having the condition herself.

Currently the design of both these devices is very focused on discretion, which is driven by an understanding that this is what users of the artefacts want, but this approach also plays an indirect role in reinforcing the stigma associated with the conditions, overlooking a powerful agency the devices could potentially have to activate relationships between users and pre-users. This means that although they can help pre-users find people to identify with, who

can both inspire them and demonstrate the advantages of use, people may often not realise others are users, or even have the conditions. Of course, being able to identify users could have negative consequences if people subsequently associate the devices with individuals who they are unable to identify with and/or do not admire personally, but it is perhaps more interesting that the devices have the potential to serve a role in initiating people to talk about their condition, helping to undermine some of the stigma that surrounds them, particularly for others who are facing similar diagnoses.

2. What displacing use can mean for design

The relationships presented above emerged in the course of a project in which the central position (for design) of the concept of use was intentionally displaced. What was observed, however, is bound in essential ways to the idea of pre-users, a fabricated concept that provided just enough scope and definition to find and follow specific people who had a tangential (but potentially valuable) relationship to the medical devices in question. It is conceivable that some of these relationships might have been uncovered in a traditional user centred design process that investigated sites of use. For instance, the medical consultation is where new users are taught how to use the devices and might be a focus of a user centred design process for new hearing aids or insulin pens. However, it is also unlikely that the specific observations we have collected would have been given the kind of weight we have given them. It isn't that these relationships would not be noticed at all; rather it is that they appear at first blush to be largely tangential to the design of these devices. It is only when we displace use (i.e. by holding functionality, usability, etc. on the margins of the process) in favour of relations such as these that we are compelled to take them seriously as design material. This in itself is a generative strategy for design. In the following we suggest two additional strategies designers might use in order to seriously treat relationships other than use. The first relates to alternative interpretations of an artefact apart from that of use. The second relates to the consideration of practices which do not involve, but could affect, use practices.

2.1 The artefact multiple

The devices we have been considering move in different contexts from being a drug delivery system, to a threat, to a demonstration tool; at one time it is part of a solution to the medical condition, at another it is a conspicuous symptom of the illness it is designed to combat (c.f. Mol and Law's 2004 discussion of the "body multiple", to which we are indebted). The multiplicity of the roles of the artefacts we design is clearly not delimited only by how that device is used, but by the many different contexts in which it might make a cameo appearance as a momentary agent of influence or reference. This is not so much a matter of creating artefacts with 'open scripts' (in Akrich's 1992 sense of script) but in shaping artefacts in valenced ways (c.f. Woodhouse and Patton 2004) so that they facilitate (or resist) their enlistment in the local institutions and agendas they already appear within.

For example, from the cases presented above, and considering the multiple roles the devices can play, this could involve developing the devices in ways that afford communicating the conditions to others. Hearing aids could be designed to be visible, or to have a more dynamic interactive role in conversations, so both the person wearing them and the people they were communicating with could activate them. Similarly how the injection devices might play a role in public practices, such as eating out, becomes an open question for design. Different roles the devices can be play in the clinical interaction, such as identifiers, teaching aids or bargaining tools are brought into relief. Taking these other roles into consideration in both the physical design of the devices and the way they are packaged and marketed has the potential to support the healthcare professional's ability to use them in these different ways. It is not just that we can or should think of artefacts as 'multiple' in this sense, as this is something design research has understood for some time. Early ideas about reconceptualising the space of design solutions, i.e. redefining form/context boundaries (Alexander 1964) or frame shifting design problems (and thereby their solutions) (Schön 1983) are among design theory's core insights into the successful practice of design. What, if anything, is unique in this proposal is that this approach of "displacing use" imposes a discipline on the direction in which the design situation is to be reframed. By displacing use and yet remaining wedded to the ideals and context-sensitive methods of user centred design, we discover (rather than invent) participants' alternative framings of the artefact and the networks of relations it centrally or peripherally participates in.

2.2 Networks of practices

In addition to focusing on the multiple roles the artefact plays, we can also centre the different practices that affect, directly or indirectly, the design issues we are addressing. This is a question of respecifying what we are designing and for whom. If we consider the context for design as a network of interlinked relationships, we can begin to identify different junctions in this network where a design intervention might be fruitfully introduced. We can also explore how activating indirect relations will affect the design issue we are addressing, and through engaging these sites in a design process we discover how interventions will alter relationships across this network.

This involves recognising the importance of indirect relationships, and introducing interventions that can alter these. In the cases presented, the kinds of design spaces this opens up include ways to help establish trust in the healthcare professional-patient relationship, or to help equip both participants to communicate their different interests, and by doing so facilitating the adoption of the devices. Here we suspend any interest in the role of the medical device in these practices, but are rather interested in supporting or enhancing the practices themselves. This requires an appreciation of how the conditions are understood and related to by the people who have them, and recommends design focus on developing solutions that respond to an emic interpretation of the need to treat, rather than the form of treatment itself. As above, however, the point is not just that this introduces a broader or alternate space for design to explore, but that it does so in a way that is neither imaginative nor speculative but remains grounded in fieldwork and tied to people's existing practices; these just happen to be practices that are not of use.

2.3 Summary

Taking these observations together, we can more clearly articulate the value (and limitations) for design in pursuing a pre-user centred process. The issues and relationships identified above are, as we have noted, not directly about use. However they do bear an important relation to the ultimate use of the medical devices: they clearly identify a number of the contextual conditions that preclude, occlude the uptake and use of insulin pens and hearing aids. For example, the manner in which the device is introduced within the clinical encounter brings into relief the extent to which pre-users' relationship to the devices are mediated by institutions (such as healthcare systems), professional practices (e.g. diagnosis) professionals themselves (doctors' familiarity with, and attitudes towards the devices) other people (users or patients) and identity concerns that can greatly affect pre-users' expectations of use. These contextual conditions are important not only to people transitioning to use these devices, but for the use of these devices themselves, since the use of these medical devices is embedded within these same institutions, professional practices and user communities. In contrast to Grudin's (1993) overspecification of users' professional interests in interface technologies, our conditions were identified through a process that deliberately underspecified the relationship between the people studied (pre-users) and the devices in question. On account of the fact that no prior use relationship existed through which to define people, functions, tasks or contexts of use, our ethnographic approach to design displaced use and users with other design-relevant relations—contextual conditions—that are of interest to design. Displacing use and users in a design process has the effect of underscoring the importance of contextual conditions that prefigure use.

3. Conclusion

The concept of the user is, and remains, extraordinarily fertile for design. Even in attempting to articulate an alternative to it, we have difficulty describing our efforts and results in terms other than those of function and use. It is a struggle to conceive of design apart from use. In this paper, however, we have sought to displace (rather than remove or replace) use from its central perch in user centred design. We have done this by constructing a concept of the pre-user of medical devices. This concept enabled us to identify a collective of people with tangential and fragile relationships to the medical devices in view. Through adapting user centred design methods to engage these people in an ethnographically-informed design process, we identified a set of relationships other than use that are of relevance and interest to design. This has been advanced as a general approach that is both grounded (in fieldwork and participation) and generative for design. In particular it is an approach that offers the possibility of ethnographically identifying the contextual conditions that are prior to and determinative of use—regions of the design space worth generating approaches to explore.

References

Agre, P. E. (1995). Conceptions of the user in computer systems design. In The social and interactional dimensions of human-computer interfaces (pp. 67–106). New York: Cambridge University Press.

Akrich, M. (1992). The de-scription of technological objects. In Shaping Technology / Building Society (pp. 205–224). Cambridge, MA: MIT Press.

Alexander, C. (1964). Notes on the synthesis of form. Cambridge, MA: Harvard University Press.

Cooper, G., & Bowers, J. (1995). Representing the user: Notes on the disciplinary rhetoric of human-computer interaction. In The social and interactional dimensions of human-computer interfaces (pp. 48–66). New York: Cambridge University Press.

Cross, N. (Ed.). (1972). Design participation: proceedings of the Design Research Society's conference, Manchester, September 1971. Academy Editions.

Ehn, P. (1988). Work oriented design of computer artifacts. Stockholm: Arbetslivscentrum.

Floyd, C., Mehl, W.-M., Resin, F.-M., Schmidt, G., & Wolf, G. (1989). Out of Scandinavia: Alternative approaches to software design and system development. Human–computer interaction, 4(4), 253–350.

Gaver, W. (2002). Designing for homo ludens. I3 Magazine, 12, 2–6.

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: Empowering people (pp. 261–268).

Grudin, J. (1993). Interface: an evolving concept. Communications of the ACM, 36(4), 110–119. doi:10.1145/255950.153585

Kling, R. (1973). Towards a person-centered computer technology. In Proceedings of the ACM annual conference (pp. 387–391).

Kling, R. (1977). The organizational context of user-centered software designs. MIS Quarterly, 1(4), 41–52.

Lloyd, P. A. (2004). The paradox of the average: why users need designers but designers don't need users. Design Philosophy Papers, 2004(1).

Matthews, B. (2007). Locating design phenomena: a methodological excursion. Design Studies, 28(4), 369–385.

Matthews, B., Stienstra, M., & Djajadiningrat, T. (2008). Emergent interaction: creating spaces for play. Design Issues, 24(3), 58–71.

Mol, A., & Law, J. (2004). Embodied action, enacted bodies: the example of hypoglycaemia. Body & Society, 10(2-3), 43–62.

Mumford, E. (1983). Designing human systems for new technology: the ETHICS method. Manchester Business School Manchester.

Norman, D. A. (1990). The design of everyday things. New York: Doubleday.

Redström, J. (2006). Towards user design? On the shift from object to user as the subject of design. Design Studies, 27(2), 123–139.

Redström, J. (2008). RE: Definitions of use. Design Studies, 29(4), 410–423.

Schneider, M. L., Arble, F. B., Olson, N., & Wolff, D. (1980). An overview of ergonomic considerations in computer systems. In Proceedings of the seventeenth annual computer personnel research conference (pp. 116–124). New York, NY, USA: ACM.

Schön, D. A. (1983). The reflective practitioner: how professionals think in action. New York: Basic Books.

Sengers, P., & Gaver, B. (2006). Staying open to interpretation: engaging multiple meanings in design and evaluation. In Proceedings of the 6th conference on Designing Interactive systems (pp. 99–108).

Sharrock, W. W., & Anderson, R. J. (1994). The user as a scenic feature of the design space. Design Studies, 15(1), 5–18.

Suchman, L. (2006). Human-machine reconfigurations: Plans and situated actions. 2nd Ed. Cambridge University Press.

Tuomi, I. (2005). Beyond user-centric models of product creation. In Everyday Innovators (pp. 21–38). Springer.

Wilkie, A. (2011). Regimes of Design, Logics of Users. Athenea Digital, 11(1), 317–334.

Wilkie, A., & Michael, M. (2009). Expectation and Mobilisation Enacting Future Users. Science, Technology & Human Values, 34(4), 502–522.

Woodhouse, E., & Patton, J. W. (2004). Design by society: science and technology studies and the social shaping of design. Design Issues, 20(3), 1–12.