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USING VISUALS TO EXPLORE THE CONTEXTUAL ASPECTS OF USER-PRODUCT INTERACTIONS

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ABSTRACT

Experience underlies all kinds of human knowledge and it is dependent on context. People's experience within a particular context-of-use determines how they interact with products. Methods employed in this research to elicit human experience have included the use of visuals. This paper describes two empirical studies that employed visual representation of concepts as a means to explore the experiential and contextual component of user-product interactions. One study employed visuals that the participants produced during the study. The other employed visuals that the researcher used as prompts during a focus group session. This paper demonstrates that using visuals in design research is valuable for exploring and understanding the contextual aspects of human experience and its influence on people's concepts of product use.

Keywords: Visual representation of concepts, Context of use, user-product interaction.

INTRODUCTION

Experience underlies all kinds of human knowledge and it is dependent on context, so that people's experience within a particular physical context-of-use determines how they interact with products (Chamorro-Koc et al. 2009). In product design, various design methods and approaches have been devised to assist the process of addressing users' needs and designing the user-product interaction (Jordan, 1998; Gaver et al., 1999; Khong, 2000; Sleeswijk Visser et al., 2005). This required designers to engage with the user's experience as an essential component of the design of user-product interactions (Overbeeke et al., 2002; Frascara, 2002; Plowman,

2003). Methods aiming to assist designers to engage with users' experience as part of the design process, have involved user workshops in which participants make two dimensional or tridimensional representations of their concepts (Sanders, 1999). User-study techniques employed have included verbal protocols, observations, drawings, collages and tridimensional models (Sanders, 2002; Frascara, 2002; Sleeswijk Visser et al., 2005). While it can be said that these approaches have assisted designers in gathering information about user needs, they have not helped to further understanding of the specific ways in which human experience preconditions people's concepts of products.

The focus of this paper is placed on the use of visuals as a means to uncover the experiential and contextual component of people's understanding of a product's use. Research presented here describes the use of two types of visuals employed in the research methodology of two different studies (Chamorro-Koc and Popovic; 2008): visuals produced by participants as an expression of human experience, and, visuals provided to participants as prompts to elicit prior experience. Study A involves the use of products in the context of personal use. Study B involves the use of products in the context of public use. In both studies, the use of visuals helped uncover aspects of human experience and of a product's context of use that are relevant to the design of user-product interactions.

The initial sections of the paper introduce relevant literature about human experience, the use of visuals in design research, and the background research.

Next, Study A and B are described elaborating on the methodological approach to data collection and data analysis. Finally, results, discussion and conclusions sections discuss the implications of this methodological approach.

HUMAN EXPERIENCE AND THE DESIGN OF USER-PRODUCT INTERACTIONS

Designing to enhance the design of user-product interactions led to the emergence of research that aims to better understand the prospective user and to assist designers to engage with the user's experience as part of the design process (Gaver et al., 1999; Sanders, 1999; Dandavate et al., 2000). The relevant role of experience was established, showing that the user's prior knowledge of similar artefacts affects his or her understanding of products (Kahmann and Henze, 2002; Plowman, 2003). This was demonstrated in studies that focused on including the user's experience and emotions in the design of products (Overbeeke et al., 2002; Westerlund et al., 2003; Horst et al., 2004).

Research about human experience in product design can be associated with other studies arguing that user-product relationships do not take place in isolation but as part of a context and that such context consists of social, technical, cultural and other factors influencing how people relate to products (Hekkert and Van Dijk, 2001; Sleeswijk Visser et al., 2005). For example, consider the case of travellers who find petrol pumps difficult to operate in different countries due to cultural or social practices that determine different ways to interact with such a device (self-service or customer operated). These different types of experience in different contexts-of-use generate different understandings about the use of the same type of product. This simple observation and the existing literature support the argument that experience and knowledge about a product's context-of-use both influence how people relate to a product's use. This argument concurs with Plowman (2003) who maintains that people's understanding of products results from their experiences and the multiple ways they integrate products into their lives. While all this suggests the importance of human experience and contextual information for the design of products

and user-product interactions, current literature does not address the specific ways in which such information triggers people's understanding of product use.

VISUAL REPRESENTATIONS IN DESIGN RESEARCH

Pettersson (1989) believes that visuals have always been a natural and iconic way for people to communicate. Collier (2001) explained that visual records are a source for the 'analysis of human experience' in which 'pattern' and 'meaning' are explored. He considered that all elements of an image may be important sources of knowledge through analysis, where the challenge is to properly identify the many aspects of the image, acknowledging that meaning and significance extracted from this analysis produce few viewpoints on human circumstances (Collier, 2001:35-36). According to Collier (2001), two different types of interpretation can be made from the analysis of visual records of human experience: (i) examination of the content of images as data and (ii) interpretation of images as vehicles to elicit information not present in the image.

According to Emmison and Smith (2000), the sources of data that are utilised in visual research can be categorised into three groups: (i) advertisements, which can be viewed as 'texts' and can be subject to semiotic or cultural interpretation, (ii) sketches (diagrams, maps and signs) that are studied by the ethno-methodological tradition and (iii) documentary photographs, which are regarded as 'raw materials' or visual accompaniments for traditional anthropological ethnography. In design research, drawings have been employed as a source to analyse visual thinking and the design activity (Dahl et al., 2001; Rosch, 2002; Tang, 2002). They are considered to be expressions of cognitive activities in a design process, and have been employed in the study of design knowledge and visual thinking (Tovey, 1989; Goldschmidt, 1991; Ferguson, 1992; Goel, 1995; McGown et al., 1998; Suwa et al., 1998).

Understanding the meaning of images has been approached through content analysis, visual anthropology, cultural studies, semiotics and

iconography, psychoanalytical image analysis, and social semiotic visual analysis. Van Leeuwen and Jewitt (2001) explained that some studies take existing images as a resource, while others base the study on images produced for research purposes. There are two approaches in the study of images produced during research: (i) the image as representative of who, where, and what of reality and (ii) the image as evidence of how its maker or makers have (re-) constructed reality. The second is common in cultural studies, semiotic analysis, and ethno-methodological research, which document the process of re-constructing the reality from images. According to Van Leeuwen and Jewitt (2001), visual anthropology and cultural studies seem to be the approaches that are helpful to the understanding of descriptions of past and present, and of socio-cultural relationships with regard to a phenomenon. This supports the use of visuals in the study of context related to a product's use.

These studies not only show that visuals have been employed as a means of exploring design activity, but also support the notion that there is a relationship between drawing and experience, and that drawing is an iterative act that involves seeing and thinking. For instance, Kosslyn (2003) determined that visual mental imagery is seeing in the absence of an immediate sensory input, and is related to human experience where memory not only comprises an image or an event, but also information about its sensorial context. Therefore, it can be said that knowledge in visual thinking is associated with contextualised human experience. This suggests that visuals can be employed as part of an empirical study to access and depict aspects of human experience.

USING VISUAL REPRESENTATION OF CONCEPTS: TWO STUDIES

The background of the research presented in this paper is the researcher's (Chamorro-Koc, 2008) previous study of experience, context of use and the design of product usability. Such study revealed that combining visuals with retrospective reports and interviews is a valuable source for gaining a holistic understanding about the influence of human experience on people's knowledge about a product's use and its context-of-use. The two studies described

in this paper emerged from the context of this initial work and employed visual representation of concepts as part of their research methodology. These studies aimed to explore different aspects of human experience in different domains. With this purpose, Study A and B were set out to investigate the contextual aspects of human experience influencing user-product interactions in domestic and public environments by employing two types of visual representations: (i) visual representation of concepts made by the participants during an experiment session, and (ii) visual representations provided by the researcher as prompts during the experiment session. Previous studies have supported the use of these two types of visuals in design research. The first type—visuals produced by participants during a research task—are viewed as representations of reality and expressions of human experience (Pettersson, 1989). The second type—visuals preselected by the researcher—serve as prompts to elicit prior experience (Kosslyn, 2003) and allow re-interpretation (Tang, 2002).

Study A (Chamorro-Koc et al. 2009) employed visual representation of concepts made by the participants to investigate designers' experiential knowledge and the ways they conceptualise a product's use and the design of product usability. It involved a design task simulation under a participatory design approach. Participants were to produce drawings of initial concept designs in response to the design brief provided. This was followed by a retrospective verbal report in which designers described their drawings.

Study B employed visual representations provided by the researcher to investigate people's interactions with technological devices in the context of public transport. It involved a focus group and a field observation of participants during a daily public transport task. During the focus group, participants were presented with visuals (flashcards with photographs of current technological devices used in public transport) as prompts for discussion. An additional source of visuals was obtained from video recordings of the field observations. Finally, retrospective interviews were conducted in order to obtain the participants own descriptions of the

activities performed during field observations. The following sections describe the methodological approach of each study.

VISUALS PRODUCED BY PARTICIPANTS: STUDY A

This study set out to investigate the following: How do designers design for usability? What types of designers’ knowledge informs that process? and What kind of linkages between designers’ individual experience, their knowledge of context of use and product usability take place during the design process? It focused on observing and investigating the early stages of the design process where usability issues are to be considered. It aimed to identify the aspects of designers’ experience and knowledge that are transferred into the design process, and the relevance of those aspects to the design of product usability. The collaborative design session involved two design tasks (Chamorro-Koc, Popovic and Davis, 2008). The data collected comprised: video-recorded observations, design sketches, and verbal protocols from design tasks and retrospective interviews. This is summarised in Table 1.



Figure 1: Design stage

Figure 1 illustrates a segment when both designers are producing and drawing their own ideas. This process was prompted by initial discussion of the design brief and utilisation of their knowledge about the product based on individual experience. Initial ideas were triggered after consideration of the various aspects outlined in the design brief. Design concepts were then developed upon an iterative reflective process of design issues that were known to the designers or that were previously experienced. Outcomes from this stage consisted of: drawings, annotations, and observations of the collaborative design process in which the designer’s individual experience was verbalised. This visual data was later employed to gain insights into the ways designers incorporate their individual experience and knowledge of the product and context of use into their design concept.

Objective	Investigate how designers design product usability, the role individual experience and episodic knowledge in the design process
Expected outcome	Identification of designers’ experiential knowledge influencing the design of product usability
Participants	Product designers
Design brief	Two design tasks: <ul style="list-style-type: none"> Design task 1: blood pressure monitor Design task 2: coffee grinder
Data collection methods	<ul style="list-style-type: none"> Observation Design task simulation Retrospective verbal protocol Interview
Experiment session	<ul style="list-style-type: none"> Part 1: Design task 1, retrospective report Part 2: Design task 2, retrospective report, interview
Setting	People and Systems Laboratory at Queensland University of Technology (Australia)

Table 1: Research design summary - Study A

The study was conducted in two stages: (i) design stage, and (ii) interpretation. The design stage focused on a design task which was presented through a design brief and a scenario. In this stage, designers were asked to work collaboratively and produce drawings of their initial concept designs.

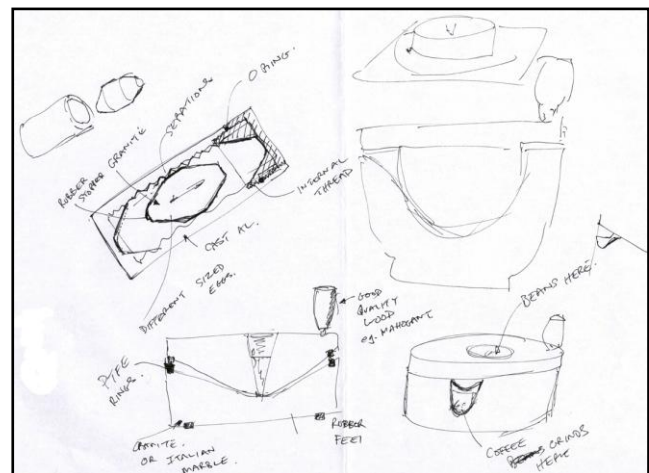


Figure 2: Interpretation Novice designer's concept of a coffee maker

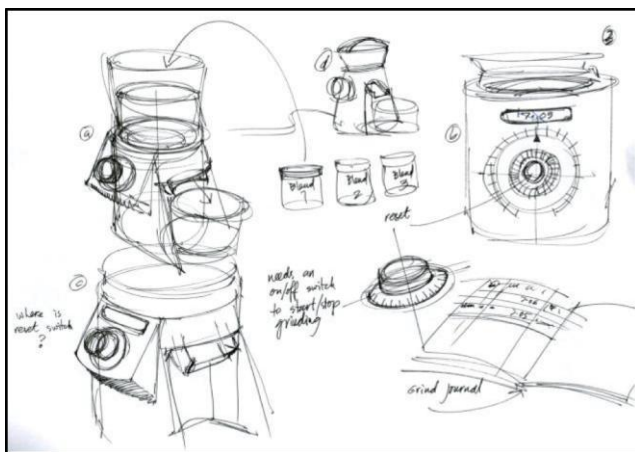


Figure 3: Expert designer's concept of a coffee maker

Figures 2 and 3 show exemplars of a novice's and an expert designer's concept design. The novice's elaborates on the details of the features, functions and mechanism of the product. Differently, the expert designer's concept design demonstrates not only understanding of the principles behind the functions and use of this type of product, but also presents a 'story' behind the product use. This story refers to a particular function of the product, a type of 'selection' or 'setting', which can be recorded for future uses (Chamorro-Koc et al, 2009). The following is an excerpt from the expert designer's verbal protocol during the design stage corresponding to the design shown on figure 3:

"...We are also heading towards perhaps having a digital display which makes it easier to recalibrate or reset, so the knob is really just completely relative. So you set how far these... what did we call those things again [name], the mechanism... we set the distance from the burrs using the giant knob and you do your grinding. And then that gets ground into a glass container to reduce static. Then you make coffee - the small detail you make coffee. Then you have to rate the coffee. So in today's experiment, which you carefully date next to your blend and the burr setting you record your rating and your notes, and that's today's experiment. That means you can duplicate the blend of beans and the setting..."

Figure 4 shows a segment of the interpretation stage session in which designers are describing their concepts, ideas and the design process undertaken. This session focused on understanding the designers' design outcomes through their own interpretation.

After the design stage, retrospective verbal reports were employed to collect a description from the designers' own perspectives about the design task represented in the sequence of sketches (Hannu and Pallab, 2000). Designers were asked to describe their drawings, and to explain how they addressed product usability in their designs. At the end of the session, an open ended interview was conducted to ask designers about any other issue arising from the initial observation of sketches, and to provide the researcher with an opportunity to ask about any gaps or doubts arising from the retrospective report.



Figure 4: Interpretation stage

VISUALS AS PROMPTS: STUDY B

Little research has focused on interactions with technologies (e.g. ticketing machines, online journey planner, 'Smartcard') in public contexts. This study was set out to investigate how user-product interactions with current technological devices occur in a public context of use. It considers that designs from emerging technologies that aim to enhance daily tasks, tend to change the way people interact with products, and can be perceived as complex and difficult to use. This is critical in the context of public use where products and services are implemented to be used and accepted by the population at large: adults, children, the elderly, people with disabilities, and tourists.

This study aims to find out how people with different backgrounds and experience use technological designs in public contexts. It investigates technological devices involved in planning the journey, entering and exiting the system, as well as devices utilised for supporting tasks around this activity (e.g. vending machines, information kiosks,

Smartcards, location maps, ATM machines, automatic teller machines, etc). The experiment involves a screening questionnaire, field observation, and talk aloud protocol. Table 2 summarises this study’s research design.

Objective	To investigate: how people from different experience backgrounds use technological designs in public contexts
Expected outcomes	To explore the contextual aspects that inform and facilitate the use of technological devices in public
Participants	Frequent and infrequent users of technologies in public transport
Activity/task	Observation of people’s interactions with technologies during a public transport journey experience. From departure to destination point.
Data collection methods	<ul style="list-style-type: none"> ▪ Focus group ▪ Field observation ▪ Retrospective interview ▪ Survey
Experiment session	<ul style="list-style-type: none"> ▪ Part 1: Focus group in lab environment ▪ Part 2: Field observation and retrospective interview
Setting	People and Systems Laboratory at Queensland University of Technology (Australia)

Table 2. Research design summary - Study B

Focus group sessions are organised around two groups of users: frequent and infrequent users of public transport. The sessions aim to explore the users perception of technologies embedded in current public transport. To assist participants to evoke the technologies, flash cards with pictures of the current technologies are presented to them (Figure 5). These cards are numbered for ease of identification during data analysis.



Figure 5: Exemplar of a flash card

The facilitator of the focus group sessions prompts participants with two questions: What travel mode do you employ on a regular basis? What do you like and dislike about current technologies? The purpose of the focus group session is to identify problem areas and to flesh out the type of user-product interactions that are in place. Field observation sessions are organised on a one-on-one basis: participant- researcher. This required participants to be followed during a daily life journey activity in a designated public context-of-use. The researcher follows the participant throughout the activity and the participant is asked to talk aloud while interacting with technological devices. The researcher audio records his or her observations as well. The aim of field observations is to further understand the problem areas identified from focus group sessions, where the complexity of technology complexity affects travel performance.

Retrospective interviews take place immediately after field observations aiming to gain further insights from field observations. It asks participants about the usability problems encountered in the use of technological devices. The purpose of this is to confirm the researcher’s observations and to identify difficulties and appreciations encountered by participants when making use of current technologies. To assist in debriefing participants, videos and audios from the observation are shown so that he or she describes the sequence of events, difficulties found, and appreciation of the technologies employed in his or her experience of technological devices.



Figure 6: Focus group session.

Figure 6 shows a focus group session at the moment where participants are using the flash cards provided as prompts to discuss their views on the technologies currently implemented in Brisbane's public transport service. The session facilitator asked the group to organise images in three groups: likes, dislikes and unsure. Next, the facilitator asked each of the participants to talk about their flash card groupings. Using visuals as prompts for discussion in a flash cards format helped participants to relate to: the service provided by the technology, the context aspects, aspects of use, and previous experience. This approach contributed to a fluid conversation and exchange of views about the particular technology during the session as flash cards eliminated the need to 'recall' what the technology is; and prompted participants with ideas about the image being viewed. Two focus group sessions were conducted with six participants. Each focus group session lasted for one hour time.



Figure 7. Field observation

Figure 7 depicts a moment during a field observation where a participant interacts with a visual display (bus timetable). The researcher followed the participant during a daily life type of journey and recorded his or her interactions with technology embedded in the public transport service of choice. Observations helped identify the participant's perception of the ease of use of the technology, the contextual aspects informing his or her travel activities, and his or her previous knowledge or familiarity with the technology.

Identifying usability problems encountered in the use of technological devices is critical in the context of a journey experience in public transport as it affects daily life activities of a broad range of users:

commuters, the ageing population, school children, and tourists. For these diverse categories of users, different requirements must be met in order to provide easy access to the transport system. Previous studies about users' perceptions of public transport (Stradling, 2002; Carmien et al., 2005) found that the use of public transport requires one to comprehend, manipulate and process essential navigation artifacts (e.g. maps, schedules, landmarks, labels or signs), creating cognitive burdens for travellers. This is, in particular, critical for public transport users with disabilities, the elderly, and the unfamiliar or out-of-town visitor. Reported responses from users suggest that the usability of the public transport system is a critical factor influencing people's choice of transportation (PTUA, 2008). Accordingly, the design of technological devices for public use requires designing better user-product interactions that support the efficiency of public transport systems and enhances user's satisfaction.

ANALYSIS OF VISUAL DATA

In both Study A and B, the process of analysis comprised: (a) an iterative process of identifying the categories that reveal aspects of human experience and context of use, and (b) an interpretation process. This process aims to convey both the participants' perspectives and the researcher's observations. Emerging issues responding to each study were identified and established as a system of coding categories (Table 3 and Table 4). The coding process of visuals was complemented with the coding of retrospective verbal reports. Previous studies (Loizos, 2000) emphasised that images must be corroborated, and that perceptual variations of this medium make the visual data an ambiguous record, thus suggesting that visual data also needs further corroboration with testimonies or other means to 'uncover' ambiguous interpretations. Research presented here is aligned with this view, and thus it employed the coding of retrospective verbal reports to complement the analysis of visuals. The coding process of visuals and verbal protocols was assisted with ATLAS ti: a specialised software to assist qualitative analysis of data. Outcomes of the coding process were then interpreted, and relationships between experience, knowledge and context-of-use

that are relevant to the design of user-product interactions were identified.

DATA ANALYSIS OF STUDY A

Drawings, annotations, and verbal reports resulting from the experiment, were analysed and interpreted aiming at identifying references made to designers’ knowledge, design process, experience, and usability issues in visuals and verbal reports (Chamorro-Koc, Popovic and Emmison, 2008). Table 3 shows the coding system.

Category	Code	Description
Experience	IE	Individual experience (of doing-using)
	EE	Episodic experience (situated - memory)
Use	Tu	Typical use (function - intended use)
	Au	Anticipation - idea of future use
Solution	Ps	Prototypical solution (prescribed)
	Cs	Creative solution
	PBC	Principle base concept (procedural)
	DBC	Descriptive base concept (explicit)
Context	Ac	Activity
	St	Situation (physical social, etc)
Usability	Eu	Ease of use
	Iu	Intended use
Process	Ds	Discovery (solo ideation)
	Rf	Reflective (outcome from collaborative design context)

Table 3. Coding Scheme - Study A

The coding system reveals different types of experience: individual experience with similar products (tacit knowledge), reference to a particular experience situated in a particular context (individual or episodic experience), procedural knowledge, and anticipation of future experiences. Codes also aim to identify the usability aspects considered by designers. Thus, aspects of the process are identified as reflective, discovery, and creative, and usability issues have been referred to aspects of ‘use’, for example: intended use and, ease of use.

The coding system was applied to the appropriate segments of drawing produced by the designers or transcription from verbal protocols. For example, Figure 8 shows an image of a coffee grinder designed by a pair of novice female designers who have some work experience at coffee shops. In this section of the drawing, the code ‘Principle Base Concept’ (PBC)

has been applied as it refers to the product design described by the rationale behind its functions. In this instance the drawing suggests that the designer knows how this type of product works and therefore, he has tacit knowledge of the assembly and function of the product, and thus, it indicates that tacit knowledge informs their usability design.

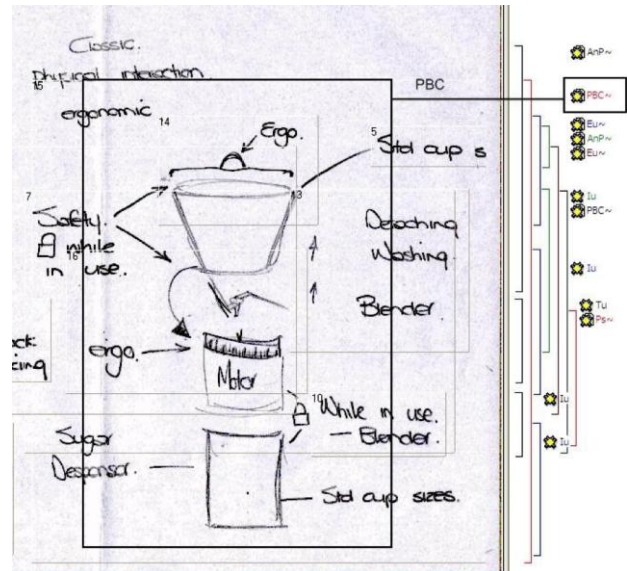


Figure 8: Exemplar of an application of the coding system

Analysis of visuals from Study A shows that designers’ knowledge comes from their experience of using products or from episodic experience. It also demonstrates that designers transfer their experiential knowledge into solutions where tacit knowledge is represented through the procedure of a product’s use, or into basic descriptions of features. Results also show that designers prefer to develop design concepts based on anticipatory knowledge (assumptions or predictions) rather than generalizing (or adapting) known solutions.

Each drawing and transcription was analysed by applying the relevant codes. This study was assisted by three independent coders in order to achieve consistency and eliminate potential bias. In addition, memos and notes were used to note discrepancies, uncertainties, ambiguities or other characteristics that were to be discussed after the coding was completed. This approach helped to validate the coding process.

DATA ANALYSIS OF STUDY B

This study employed visual representation of concepts as prompts provided by the researcher

during the focus group sessions. Images of the various public transport services and of the technologies currently implemented in Brisbane were provided to the participants during the focus groups session. This was followed by field observations, which involved the researcher following and video-recording a participant during a daily life public transport journey. Verbal protocols from the focus group session and the think aloud process captured in the video recordings of field observations were transcribed for the analysis process. Initial thematic analysis of those transcriptions was conducted to identify themes related to the users' engagement within the public transport system, technologies and infrastructure. Table 4 shows a summary of the coding system.

Category	Code	Description
Context (of use)	Cs	Context social
	Cb	Context built environment
User (type)	Uf	User frequent
	Ui	User infrequent
Experience	Ee	Episodic Experience (situated memory)
	Ei	Individual Experience (using-doing)
Actions	As	Action successful
	Au	Action unsuccessful
Perception of use	Pu	Unreliable
	Pr	Reliable
	Pd	Difficult
	Pe	Easy

Table 4: Coding Scheme - Study B



Figure 9: Results from grouping of flashcards during focus group session

During the focus group sessions, participants were asked to discuss their 'likes' and 'dislikes' from the

images provided and to group their flash cards accordingly.

Figure 9 depicts a summary of main outcomes from the flash card grouping that participants did during the focus group session. Some images prompted more responses than others.

From these responses and from transcripts of the focus group discussion, experiential and contextual aspects of the user-product interaction with technologies in public contexts of use were identified. In this study, the coding scheme was applied to transcripts of verbal protocol of participants during their discussion prompted by the flash cards. The following provides examples of the coding process:

The last one is no. 7. I like that – the Walk sign. I do like the sound of it and I do often put my finger on it to feel the pulses! || Cb
Pe
Ei

I don't like this machine, no. 9, the Translink thing. No. 14, the journey planner, I guess maybe that's more of an indifferent one. I haven't really used it much and it can be kind of annoying if you mess up and have to start all over again. || Ui
Pu
Ei

Figure 10: Examples of the coding of transcripts from Study B's focus group sessions

In the particular example presented in Figure 10 (bottom quote), the coding shows that a participant disliked three aspects relevant to a user-product interaction with a technology. These are: infrequent use (Ui), experience of doing (Ei), a perception of something that is unreliable (Pu). Relationships found between codes applied across all transcripts revealed that underlying issues contributing to a user liking or disliking a technology in a public context of use are: the time required for interaction, mental effort demanded by the technology, and type of feedback received.

The findings above are consistent with the ones emerging from the coding of verbal protocols collected during field observations. These emerged from participants talking aloud while interacting

with the different aspects of the public transport system. Figure 11 shows an example:

P2: Usually there will be a long line of people waiting for 461, that's my bus, but today that bus is here at the platform, not many people.

I: So this is not very typical of how long the line usually is?

P2: The line – it depends on what time I leave...because there are people waiting for two buses, they don't form two lines. Those who take this bus, they get into the bus, they stand and wait from the other people. Fifteen minutes is a long wait.

I: So what information do you use?

P2: Just that one (overhead). It says if there is a delay, or any change, so I just depend on that one.

I: So it updates information all the time?

P2: Yes. I know the bus schedule. I don't go and read it there. If I needed to at this stage, there would be something wrong, I think.

Cs
Ui

Ei

Cs

Pr

Pr

Figure 11: Excerpts of a talk aloud transcript from field observation

Coding of verbal protocols from field observations were supported with images from video recordings of the observations. This allowed the researcher to code the transcriptions by relating what the participants said with what actions they were performing. In Figure 10, the participant relates to her experience as frequent user (Uf) and to her experience of taking this bus on daily basis (Ei). Her comments reveal that she uses references to the social context (Cs) to inform her knowledge of the timetable of this particular bus route. She understands the technology (visual display in Figure 6) which she finds reliable (Pr), but does not use as she knows the bus schedule very well. In general, the analysis revealed that the information participants used to inform their 'actions' (or interactions with technology during a public transport journey) came from three main sources: 'previous experience', relating to a users past experience of an action; 'context', relating to the immediate environment and how this informs the users actions; and 'technology, relating to the users engagement with

technology to inform their action. The analysis identified a strong connection between context and action. Participants primarily informed their actions based on immediate contextual factors on more occasions than on their previous experience. Coding clusters illustrate that when describing their interactions with public transport infrastructure and emerging technologies participants would reference the context situation or environment to base their action on. Overall findings indicate that familiarity, previous experience and knowledge of the situation and environmental context are catalysts to participants' actions.

RESULTS AND DISCUSSION

In Study A, the analysis from visuals revealed that designers' knowledge comes mainly from their episodic experience (using a product in a particular situation). A comparison of outcomes from novice and expert designers revealed that novice designers focus mostly on the design of features and functions, while expert designers focus on describing the principles of use or activity (and context), rather than on the object's features. In Study B, the analysis from visuals revealed that the immediate contextual factors (episodic experience, social context) are the main sources that inform users' actions, and that context references guided their understanding of a product's use. In both studies, using visual representation of concepts assisted the analysis of the data. Participants referred to visuals to describe what they knew, or to talk about their experience, likes and dislikes. It was found that users primarily inform their actions based on contextual references that dominated their understanding of a product's use.

Methods employed in previous design research have involved drawings, collages, and 3D mock-ups to elicit knowledge from participants, and to uncover information of the observed reality (Sanders, 2002). Previous design studies involving drawings, collages, and the making of tridimensional mock-ups to elicit knowledge from participants, focused on exploring aspects of human experience and uncovering information of the observed reality (Sleeswijk Visser et al., 2005; Sanders, 2002). However, such methods and techniques have not been employed to

investigate the aspects of experience influencing user-product interactions. This paper demonstrates that using visuals in design research is a valuable source to explore and gain further understanding of contextual aspects of human experience and its influence on people's concept of product use. Thus, the use of this methodological approach can effectively contribute to enhance the design of user-product interactions. Further investigations must be conducted in order to: (i) uncover and explore other aspects of experience in different domains, and (ii) to gain in-depth detail within the aspects of experiences already uncovered in this study, and how these can possibly change with regard to user's demographics.

CONCLUSIONS

This paper has described the use of visuals in design research to explore human-product interactions in personal context of use and public context of use. It explains that combining visuals with retrospective reports is a valuable source for gaining a holistic understanding about the influence of human experience on people's knowledge about a product's use and its context-of-use. Two design research studies employing two types of visual representations are described: visuals produced by participants, and, visuals provided as prompts for discussion. In the two studies, the use of visual data allowed the researcher to visualise the participants' concepts of products as they see them in their minds. The approach to the analysis of both types of visual data, allowed the researcher to: gain insights into people's experience and contextual aspects informing people's interactions with products or technologies. Retrospective reports were instrumental to: access the participants' own interpretations of the visual representations they had made, eliminate the risk of the researcher misinterpreting concepts, and gain a greater understanding of the issues embedded in drawings, and that were related to the participants' experience. Research presented here demonstrates that employing visuals to explore user-product interactions with products and technologies in personal or public contexts of use is a valid methodological approach to inform design research. The next step is to explore whether this methodological approach can be employed in the

study of contextual aspects of human-product interactions in highly specialised areas of knowledge, such as in the exploration of contextual aspects that inform expert performance in the health professional domain. For example; in the exploration of expert performance of nurses, paramedics, and surgeons.

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