Visual Representation of Concepts:

Exploring Users' and Designers' Concepts of Everyday Products

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Abstract:

To address the question on how to enhance the design of user-artefact interaction at the initial stages of the design process, this study focuses on exploring the differences between designers and users in regard to their concepts of an artefact usage. It also considers that human experience determines people's knowledge and concepts of the artefacts they interact with, and broadens or limits their concept of context of use. In this exploratory study visual representation of concepts is used to elicit information from designers and users, and to explore how these concepts are influenced by their individual experience. Observation, concurrent verbal and retrospective protocols and thematic interviews are employed to access more in depth information about users' and designers' concepts.

The experiment was conducted with designers and users who were asked about their concepts of an everyday product. Three types of data were produced in each session: sketches, transcriptions from retrospectives verbal reports and observations. Through an iterative process, references about context, use and experience were identified in the data collected; this led to the definition of a coding system of categories that was applied for the interpretation of visuals and texts. The methodology was tested through preliminary studies. Their initial outcomes indicate that the main differences between designers' and users' concepts come from their knowledge domain, while main similarities are related to human experience as source that drives concept formulation. Cultural background has been found to influence concepts about product usability and its context of use. The use of visual representation of concepts with retrospective reports and interviews allowed access to insightful information on how human experience influence people's knowledge about product usability and its context of use. It is expected that this knowledge contributes to the enhancement of the design of product usability.

Key words: *visual representation of concepts, user-artefact-interaction, user experience, context of use, knowledge domain.*

1. Introduction

The premise of this study is that products delivered for a diverse range of users in global markets convey usability problems that arise from the differences between designers and users concepts of everyday products. Essentially, as explained by Norman [1], the design of any product is influenced by the designer's knowledge and conceptions of the world, which might differ completely from the users'. These differences are considered at the core of the product's usability problems. This study investigates two issues in particular: the users' and designers' experience, and the product's context of use. Their relationship can be seen in the following example: using an information kiosk at an international airport. In this example informed and multilingual users can get confused about its use due to their previous experience with artefacts from different contexts of use that look similar but work different.

Experience and context of use have been studied from diverse perspectives in relation to usability issues. Most of this knowledge comes from the Human-Computer Interaction (HCI) field, where studies about usability issues had focused mostly on the evaluation of finished artifacts. The relationship of usability with human-product interaction and experience issues emerged from HCI studies that connected these issues to usability design [2, 3, 4]. In the design field as in HCI it is now considered that human experience impacts on the ways an artefact is usable or not by a diverse range of users. Experience is therefore a component of the system of interaction that affects the usability of any product. Literature in design research states that precedents are one source of design knowledge; it is typified and relies on prior experience [5, 6]. In this study visual representation of concepts is used as means to understand users' and designers' concepts and their relation to human experience, and to understand how this influences their understanding of product usability and its context of use.

2. Methodology approach and methods

To investigate the aspects of experience that influence the understanding of product usability and its context of use, this study compares designers' and users' concepts of everyday artefacts and explores their differences. From the literature two areas of investigations are relevant for this study. The first area refers to the studies that explain that human experience determines people's knowledge and concepts of things that surround them [5, 7]. In design research some studies suggest that concepts used in design processes are based on designers' past experience (episodic experience), they are typified in the form of design concepts, descriptions and principles that leads to 'solution types' [6, 8]. The second area refers to those studies in which sketches are used as a means for concept visualisation as they seem to convey significant aspects of experience [9, 10]. Sketches are one of the sources of data utilised in visual research [11]. Collier [12] explained that visual data is a source for the analysis of human experience and that all elements of an image may be important sources of knowledge. Methods to analyse visuals distinguishes two types of data: (a) content of the image or (b) cognitive aspects revealed by the process of making it. Regarding the analysis of the content of the image, this can be interpreted as: (a) the image as data and (b) the image as vehicle to elicit information not present in it. Visuals are used in this study as a source to reveal human experience behind the concepts, to extract meaning and contextual information related to them.

In regard to the interpretation of visual data, previous studies stated visual data required further corroboration with testimonies to uncover ambiguous interpretations [13], while some had used verbal reports to reveal information about the processes undertaken in a problem-solving task [14]. In this study retrospective reports are used to aid the recollection of concepts represented in the drawings; the retrospectives are cued by the drawing itself and by a simple question that prompts the user to report about the elements conveyed in the drawing. Thematic interviews are used to access to more information about the participants' concepts and to the human experience related to it. Observation is used as a complementary technique to verbal reports in order to access data that will support the interpretation of visuals and verbal reports.

3. The experiment design

The experiment gathers responses from two types of subjects, artefact users and artefact designers, in regard to their knowledge (concept) about the use of different artefacts from different context of use (domestic, sports or office). The questions addressed to both designers and users participants are the same. The experiment consists of three-step sessions in which methods employed to collect data and elicit knowledge from the participants are: (i) observation, (ii) visual representation of concepts, (iii) retrospective verbal report and (iv) thematic interview.

The first step of the session employs visual representation of concepts. Participants are asked about their concept of a particular artefact. This technique is used to produce sketches that describe the participant's concept of the artefact. Based on prior research [5, 7, 8, 9], it is expected that visuals will reveal aspects of human experience in regard to the artefact usability. The second step of the session employs retrospective reports to ask participants about the concepts in their drawings. Using retrospective reports immediately after the drawing task allows the participants to interpret their own sketches and to highlight aspects that were difficult to represent. This diminishes the risk of the researcher to misinterpret visuals, eliminates the effects of concurrent verbal protocols that may distract participants during the drawing task [15, 16, 17], and makes verbalisation of thoughts easier for participants from non-English speaking background. Thematic interviews are then employed within the third step of the session to access more insightful information about the participants' knowledge of the usability and context of use of a particular artefact, and the human experience that influences that knowledge.

As this study intends to understand the nature of differences between designers and users, it will also look at how outcomes might be influenced by differences in regard to cultural background, age and gender group, and level of expertise of the adult population. This study takes place in Australia, where participants recruited are locals and from diverse cultural backgrounds. The setting for the experiment is the Human-Centred Design Research and Usability Laboratory of the Faculty of Built Environment and Engineering at QUT. Artefacts used in the experiment are everyday type of artefacts (i.e. tools for gardening and cooking, electronic and digital devices) representing diverse context of use (i.e.: domestic, office, sports, transportation, public use).

To assess the experiment's general criteria, methods were tested through a pilot experiment. Its initial outcomes were useful to correct methods proposed for the experiment.

4. Data analysis process

The data analysed are: sketches produced during the experiment, transcriptions from retrospectives verbal reports and interviews, video recorded observations and field notes. The analysis is organised in a three-step process: (a) transcribing data and identifying the categories that emerged from it; (b) finding relationships between themes, and their relations to the research questions of this study; (c) producing an interpretation of these relationships and building a theoretical framework of what is happening in regard to the research questions.

To aid the interpretation of data, a system of categories was defined based on the concepts that emerged from it. The researcher perspective for interpretation of data into categories focused in looking for details that could provide hints or insights about the participant's idea of context of use and knowledge that derives from experience in regard to a specific everyday object, regardless of who the participant was: a designer or a user. From the data, three groups of categories were identified: experience, knowledge, and context. Their descriptions are conveyed in a coding scheme summarized in Table 1.

Table 1: Coding Scheme

Categories	Description of Categories	Codes
Experience	Features with indication of context of use	**FE**
	Individual experience within context	**IEC**
	- About the intended activity (procedures)	**IEC - a**
	- About features or functions	**IEC - f**
	Episodic data	**ED**
	- Specific occasions/ situations	**ED - o**
	- Particular aspect of use	**ED - u**
Knowledge	Principled-based concept	**PBC**
	Descriptive-based concept	**DBC**
Context of use	Intended Use	**IU**
	Situations	**ST**
	- Physical context (place and settings)	**ST – p**
	- Social context	**ST – s**

After interpreting data, outcomes are analysed by comparing users' and designers' concepts in order to infer the nature of their differences.

5. The experiment

The experiment is being carried out through individual sessions where the researcher asks the participant about a particular artefact that is selected from a questionnaire previously sent to the participant. Figure 1 illustrates a user's and a designer's visual representation of a digital camera [18]. Here it can be seen that the user's sketch shows several features of a digital camera, which she described by name; from this it was possible to infer that the user drew a camera she knew recalling knowledge from memory. The designer's sketch shows few features of a camera, the most basic for the use of it (lens-flash-shutter). His drawing does not show that it is a digital camera, but it suggests feature attributes like a soft grip for handling and a zoom that can be scrolled for ease of use. It seems that he drew from memory but also from imagination. This shows that the definition of the coding

scheme was based on interpretation of the elements conveyed in the drawing that revealed information about: experience, context of use and type of knowledge.

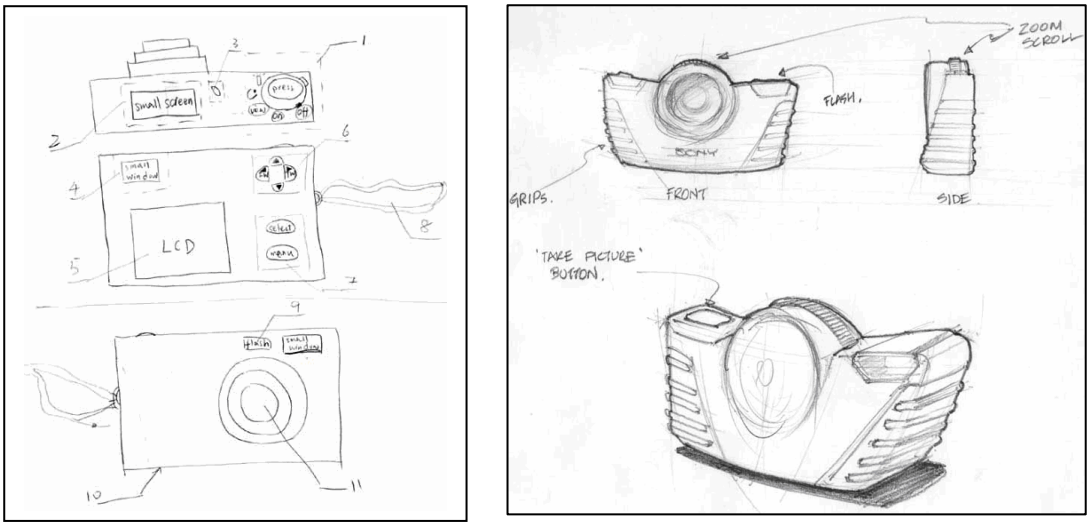

Figure 1: User (left) and Designer (right) concept drawings

Figures 2 and 3 illustrate the application of the coding scheme to a designer's visual representation of a juice maker and to a transcript of his interview. In these examples, the use of the coding system helped to identify references regarding individual experience within context (IEC), feature with indication of context (FE), intended use (IU), descriptive based concept (DBC), and situation of use (ST). For this process of interpretation the software Atlas.ti was used to help organize and manage the interpretation of data.

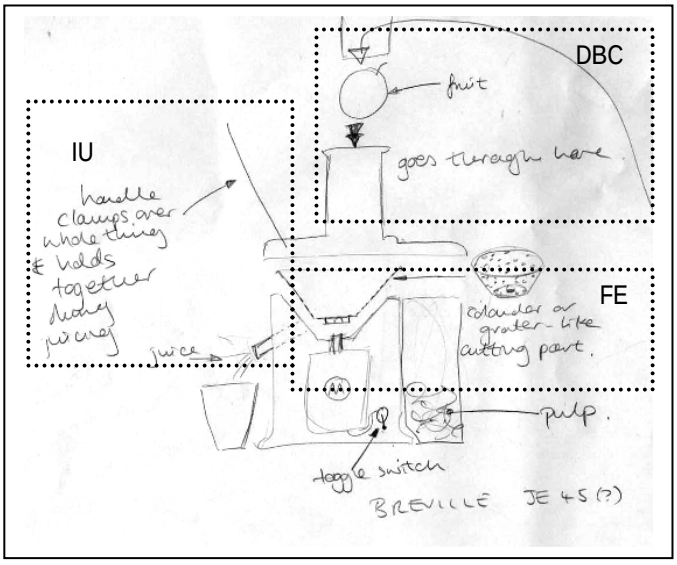

Figure 2: Application of coding scheme to a visual

For example in Figure 2, a section of the drawing and annotation referring to the 'handle' has been coded IU or Intended Use as it is about the use of the handle and the purpose of using it. Similarly in Figure 3, a portion of

the text has been coded IEC or Individual Experience within context as it refers to the participant's experience about the use of the artefact within a family context.

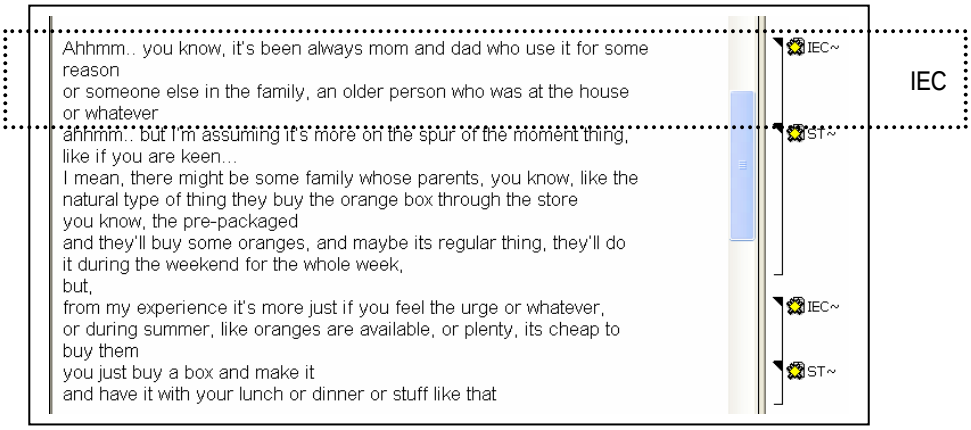

Figure 3: Application of coding scheme to a text

After the coding process, the outcomes are organised and related to one another in a way that relationships between codes were found regarding the research questions of this study. This process focuses on identifying the 'how' and 'why', and the 'cause-effect' relations in the findings, and in understanding the participant's concepts in regard to context of use and experience. It aims to observe the nature of the elicited concepts by finding relationships within the dynamics of the elements they convey in their sketches, retrospectives and interviews. The aim of the research is to identify the relationships among all the elements that refer to context of use and experience issues.

6. Initial findings

The experiment aims to provide an understanding from users and designers about the references they use to explain their concept about an artefact, and to identify what their differences. As this study is still in progress, the following presents a summary of its initial findings:

a) **Visuals indicate that designers and users use similar references to build their concept about an everyday artefact. Differences of knowledge domain allow designers to describe more by drawing, while users described more by using annotations that accompanied the drawings.** Sketches mostly show descriptions of features with some indications to experience through references to the feature's context of use (FE) and references to the participant's experience of a feature's functionality in its context of use (IEC-f). Designers' indications about FE were mostly extracted from the drawings, while users' indications were extracted from annotations; this could be due to their different knowledge domain. Sketches were indicative of some associations between experience and knowledge: when there is no experience connected to their knowledge of an artefact, only 'descriptive based concepts' (feature descriptions: DBC) of it were indicated. When there is an experience or references to familiar artefacts, 'principled based concepts' (descriptions of relationships among parts or functions: PBC) were identified. Users provided more references to the artefact's context of use than designers. Designers almost ignored this information in their drawings. Users were able to indicate

context of use thought annotations in which description of features included some specifications about the physical environment of use (e.g. use in water).

b) **Retrospective reports are consistent with interpretation from visuals. Users provided more information to complement data presented in the sketch.**
Regarding experience, even when the users' participants did not have a first-hand experience in using the artefact, they tried to support their descriptions based on previous knowledge and from experience that they had observed. They placed artefacts within their context of use in order to describe them and provided more references to their experience than designers. Retrospective accounts of sketches helped users to trigger references to their individual experience in order to support their description of the artefact, therefore, users referred more to experiences regarding activities performed with the artefact. Users' knowledge about the artefact was indicated by DBC and PBC, and they provided indications about intended use, the human-artefact interaction and the context of use of an artefact by referring to the physical environment of use. Designers provided fewer references about context of use than users; they were able to provide detailed visual representation of concepts, but did not provide more information about the artefact use.

c) **In regard to context of use, interviews indicate that both designers and users employed similar concept representation, however, users referred more to the intended use of an artefact based on their own experience.**
Users provided more references about their individual experience in order to explain their concepts of an artefact. Their references were more about the activity performed with the artefact than about its features. In regard to knowledge, designers focussed more on discussing and describing new design concepts of the artefact rather than relating descriptions to what they know about the use of it; they were able to provide more indications about DBC and PBC than the user group. Users provided the most number of references to the intended use of an artefact (IU) and to human-artefact interaction aspects of it; they placed their descriptions of the artefact in the environment of use (physical context of use) and within its related activities (social context of use). In the case of the designers, there were fewer references to intended use and context of use as they mostly focused mostly on explaining the new concept, isolating product from the user and the context of use.

7. Discussion

The experiment indicates that the nature of the experience influences on the participants' knowledge about an artefact, which is represented either as principled-based concepts (PBC) or as descriptive-based concepts (DBC). It also indicates that human experience is influenced by the type of the situation (ST) in which it has been generated, and by the episodic experience (ED) or 'moment' in which that situation happened. In the absence of first-hand experience, users relate to things they have seen or to familiar artefacts, and designers generate new design concepts instead of describing one from memory.

Outcomes were also compared regarding the participants' age, gender, cultural background, and expertise. In the cases where there was a generational gap among participants, their knowledge was influenced by their individual experience and not by age. For example, gardening activity is usually related to older users, but when comparing a young and an older female participant about their knowledge of a gardening tool, it was found that the younger could relate to it from her childhood memories of using and observing the use of it. Likewise, some results show that age difference is influenced by professional background. This was observed in the case of new devices marketed to the generation who have grown up within the digital technology era. The experiment showed that mature users were able to relate to these new devices by familiarity with other artefacts they used for their professional occupation. Regarding gender, outcomes show that it had an influence only in relation to usability issues that refer to human-artefact interaction; for example: regarding the mechanical operation of an artefact female participants made more references about lack of force, safety, and ease-of-use issues.

Individual experience is a more significant influence on people's knowledge than cultural background differences. This was evident when two Asian female participant of the same age bracket were asked about their concept of a juice maker. One could only relate to the manual squeezer while the other immediately referred to a Western concept of electric juice makers. It was also interesting to find out that differences regarding knowledge domain influenced outcomes; this was observed when an expert designer and an expert user were compared. The expert user was knowledgeable about the artefact and provided principled-based references (PBC), while the designer was knowledgeable of the design process and provided only descriptive-based references (DBC). It shows that if expertise has to be compared, then both designers and user should be experts in the use of the artefact itself. In most of the cases, the use of familiar artefacts helped participants to overcome lack of experience and enabled them to express their concepts by referring to familiar features.

The above can be summarised into the following:

- Human experience is a powerful source that drives concept formulation about artefacts and their context of use; in the case of a designer, it influences on the design of the artefact usability.
- The user's and the designer's knowledge domains illustrate the main differences between their concepts about product usability (principle knowledge vs. descriptive knowledge).
- Cultural background is identified as an influential factor for the understanding of product usability, but it is largely influenced by the individual experience of users.

Some aspects of these conclusions are concurrent with previous studies about human experience [5, 7], design domain [6, 8] and the influence of culture on the user's mental models [19, 20].

8. Conclusions

Combining visuals with retrospective reports and interviews has been valuable to gain a holistic understanding of the influence of human experience on people's knowledge about product useability and its context of use. This study has revealed that this knowledge conveys context of use references not only regarding the physical but also the social environment of use (family, friends). These include characteristics related to the intended use, user and to the useability aspects of it (i.e. human-artefact interaction issues). Conjointly, characteristics of both -

experience (episodic, individual experience within context, feature within context) and context of use trigger the type of knowledge (principled or descriptive) that users and designers form about an artefact. It is expected that the use of visual representation of concepts as a source for design research and the inclusion of context of use and user experience issues in the design process can make a significant contribution to enhance the design of product usability for global markets.

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