Context-of-use and the design of user-product interactions: exploring causal relationships

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Abstract

Nine causal relationships that explain the cause and effect relationships between aspects of human experience, context-of-use and particular aspects of product usability have been previously identified in a study that focussed on investigating the aspects of human experience that influence people's understanding of a product's use. This paper reports on a work-in-progress – a pilot study experiment with practising designers - that aims to further explore these causal relationships and to investigate how they can be employed in the conceptualisation stage of a design task that emphasises product usability. Data collection includes sketches and annotations produced during the design task, retrospective verbal reports of the designers' interpretation of their initial design concepts, and opinions about the use of causal relationships during the design process. Indicative outcomes of the pilot study illustrate that awareness of causal relationships can assist designers in generating novel ways to enhance product usability.

Keywords

Context-Of-Use, Human Experience, User-Product Interaction, Product Usability, Product Design

In design research, issues of context-of-use have always been a component of the study of human experience. Research on experience and its relevance for the design of products has been widely explored from various perspectives (Sanders, 1999; Jordan, 2002; Kuniavski, 2003; Sleswijk Visser, Stappers, Van der Lugt and Sanders, 2005, Battarbee and Koskinen, 2005), but has mostly centred on improving user experience through the development of more enjoyable user-product interactions (Sanders, 2002; Forlizzi and Ford, 2000; Overbekee, Djadjadiningrat, Hummels and Stephan, 2002; Sengers, 2003). However, research indicates that experience results from the user's knowledge and interaction with the world (Rosch, 2002), and that the user-product interaction takes place in a context that is shaped by social, cultural and organizational behavior patterns (Forlizzi and Ford, 2000). Therefore, it can be said that different contexts-of-use influence different interactions, resulting in different knowledge and understanding of a product's use. Nevertheless, while experience and context-of-use issues have been addressed in design research, an issue eluding these studies is the specific way in which a

product's contextual information triggers users' understanding of a product's use.

The following section further explores these fundamental notions of context-of-use, human experience and the user-product interaction. The Background Study section then outlines the author's earlier empirical study which investigated how people's experience influences their understanding of product usability (Chamorro-Koc, 2007). Findings from that study identify nine causal relationships explaining the cause and effect relationships between human experience and people's understanding of a product's use and context-of-use; these are presented in the section Causal relationships. Applicability of these findings were verified in a design situation in which a design tool - Experience and Context Enquiry Design Tool (ECEDT) - was devised to present causal relationships in a manner accessible to designers. This tool was devised for trial purposes only (Chamorro-Koc, Popovic and Emmison, 2007) and it was acknowledged that causal relationships required further study in order to determine two key factors: the different ways in which these relationships relate to people's knowledge of a product's use and of their context-of-use; and the relevance of their application in the user-research stage of a design task (Chamorro-Koc, 2007).

Thus, the Current Study section of this paper reports on a work-in-progress, an empirical study that focuses on further exploring these nine causal relationships, and which aims to understand (i) how causal relationships inform a design task and (ii) how designers perceive the relevance and applicability of the causal relationships in a design task. Indicative Outcomes section reports indicative outcomes of the study to date and includes an exemplar from the data collected.

It is expected that this study will deliver two types of results: (i) verification and/or identification of sub-relationships of causal relationships, and (ii) further exemplars of how causal relationships inform the design of user-product interaction. Additionally it will further and strengthen the theoretical background of the ECEDT database which demonstrates the relevance of this knowledge and was trialed in the preceding study.

Context-of-use, human experience and the user-product interaction

The study of user experience in relation to context issues has been considered as part of the study of the user-product relationship and usability related issues (Kahmann and Henze, 2002). The study of how well people are able to use a product supported a definition of usability as the `quality of use in context', which reflects the experience of somebody `doing something somewhere to accomplish a goal' (Wilson, 2002). In the design domain, usability has been defined as the interaction between the user and the product, `mainly focussed on how people use the product' (Kahmann and Henze, 2002, p.297). Within this view, usability of product design focuses on the relationship of product-user-task within a particular scenario of use. Usability research evolved and conveyed the study of human activity and user experience in relation to context issues. For instance, Suchman (2007) stresses that understanding how human actions are informed by situations and how these

become productive interactions, are relevant to the design of interactive devices. Suchman's studies introduced the term 'situated action', which establishes that human action is situated within culture, a particular context, experience and activity. Her concept of situated action has been applied in the field of Human Computer Interaction (HCI) and Design, serving as a platform for emerging concepts, and contributing to other human–machine interaction studies in which human experience has been related to context-of-use issues.

Design studies involving human experience as part of the design process considered that products of design engage people through their interaction in particular locations. This is stated in Plowman's study (2002), which is founded in an ethnographic approach to material culture. Plowman illustrates that people's behavior, feelings, thoughts and understanding of things derive from their experience of everyday activities with everyday objects in a cultural location. He established the notion of 'situatedness', which explains that people's experience with the multiple ways in which they integrate products (objects) designed through interaction, creates understanding about such products (2003, pp.30-31). In this sense, the context in which a product is used (situatedness) and experienced lies at the core of people's knowledge.

The consideration of the user's experience in the design of user-product interactions prompted an increasing interest in designing 'beyond the object' (Redstrom, 2006). This can be seen in the study of Overbekee et al. (2003), whose work on the design of user-product interaction stressed the importance of engaging the user in a fun and beautiful experience, as opposed to a technological or cognitive approach. Overbekee et al. pointed out that ease-of-use has been the focus for usability improvements in the design of products, but stressed that conveying contexts for experience and aesthetics of interaction in the design of products would contribute to an overall experience.

This literature review shows that context has been considered an ingredient in human experience. It is related to culture as it projects people's understandings of the world, and it is related to the physical and social situations of a product's use (Hall, 1976; Neulip, 2000). Previous studies show that the notion of experience has a connection with context issues because it takes place within particular situations, through which people's experience of their interaction with product designs creates an understanding of the world (Frascara, 2002). Furthermore, these studies show that issues of usability have been connected to human experience as part of the studies of the user–product interaction (Maguire, 2001). The design the of user-product interaction has taken account of several issues such as the study of human activity, the focus on user experience, and the design of contexts for experience; however it has not identified how to use human experience issues to inform the design process and enhance the design of user-product interactions.

Background study

An empirical study was conducted to investigate how people's experiences influence their understanding of a product's use and of its context-of-use (Chamorro-Koc, 2007). Findings from this study elaborated on the areas of

human experience that are related to people's understanding of aspects of product usability. As part of the outcomes, the study identified nine causal relationships describing the cause and effect relationships between human experience and aspects of product usability. In the study, the use of the term 'product usability' refers to users' general understanding of the product (parts, functions, rationale of usage, use) and comprises users' knowledge of a product's context-of-use. These findings were verified through their applicability to a design task (Chamorro-Koc et al., 2007). Three recommendations emerged from these findings and aim to assist designers in enhancing the design of product usability by including the consideration of human experience as a component of design.

First, designing to enhance product usability requires that designers pay attention to the differences between their own concepts and the users' concepts of a product's use; designers must not only design from their own understanding and experience, but also consider the areas of human experience that trigger the users' understanding of product usability. Second, enhancing the design of product usability requires that designers pay attention to the social aspects of a product's use. Findings stress that the social context-of-use provides insightful information for the design of product usability. Whilst designers mostly refer to the physical environment in which a product is used, users relate more to the social environment of use. Consequently, reference to diverse aspects or components of the social context-of-use should be included in the design of product usability to facilitate users' understanding of a product's use. These two recommendations helped identify the aspects in which users' and designers' concepts of product usability are different. Such differences are grouped in four areas: (i) context-of-use, (ii) social context-of-use versus a product's features, (iii) episodic knowledge and (iv) expert domain and lack of experience (Chamorro-Koc, 2007).

Finally, it was recommended that the design of product usability must investigate users' familiarity with the product's usability. This familiarity is related to the user's expert domain and cultural background, the sources from which to uncover information about the users' previous experience. Reference to this information should be included in the design of product use in order to assist the user's understanding of product usage, and to prevent potential usability problems. Four specific aspects of human experience were identified; Table 1 describes them in connection to their influence on users' understanding of aspects of product usability.

Table 1: Design principles related to the areas of human experience corresponding to aspects of product usability

Sources of experience		Aspects of product's usability
Familiarity	→	Inaccurate or incomplete concepts of a product's **intended use** (IU). This can be associated with a product's description-based concepts (DBC).
Episodic experience	→	Preferred concepts of a product's **social context of a product's use** (ST-s). This can be associated with knowledge of the product's intended use (IU), features with indication of usage (FE), description-based concepts (DBC) and physical context of a product's use (ST-p).
Cultural background	→	Strong concepts of a product's **social context-of-use** (ST-s) ingrained in a particular culture/tradition. This can be associated with knowledge of the product's intended use (IU), description-based concept of features in context-of-use (DBC) (FE), and principle-based concepts (PBC).
Expert domain	→	Partial concepts of a product's **description-based concepts of features/functions** (DBC) (FE) that are focussed on a specific area of expertise. This can be associated with knowledge of the product's intended use (IU), principle-based concept (PBC) and physical context-of-use (ST-p).

Legend: → (generates), IU (Intended use), DBC (Description-based concept), FE (Feature with indication of usage), ST-p (Situation regarding the product's physical context-of-use), PBC (Principle-based concept), ST (Situation), ST-s (Situation regarding the product's social context-of-use).

Table 1 shows four sources of experience that influence people's understanding of product usability. Each of these sources is connected in importance to a particular aspect of product usability. Highlighting each of these relationships can guide the design of particular usability aspects of a product's design. For example, cultural background generates strong concepts of a product's social context-of-use (ST-s) which is ingrained in a particular culture or tradition. The user's cultural background can influence his or her understanding of a product's usage and its context-of-use. It can also generate knowledge about the product's intended use, a description of its features in the context-of-use, and principle-based concepts that explain the product's functionalities. These findings support one of the premises of this study: that 'human experience broadens or limits the user's concepts of a product's usability'.

Relationships presented in Table 1 can be employed in the early stages of the design process to inform designers about the areas of human experience that must be addressed to support particular aspects of the design of product usability. Consequently, designers can enhance users' understanding of product usability by designing and incorporating 'clues' that appeal to particular areas of the intended users' experience. The application of these relationships in a design task for verification of findings employed nine 'causal relationships' that are the basis of the relationships presented in Table 1. They identify the core relationships between users' experience and their understanding of product usability.

Causal relationships

Nine causal relationships identified in the preceding study (Chamorro-Koc, 2007) explain the cause-and-effect relationships between experience, knowledge, and context-of-use. They explain how different types of experience trigger people's knowledge of a product's use, intended use, and context-of-use, and how this influences their understanding of product usability. Awareness and interpretation of these relationships can be employed in a design process to enhance the design of product usability, as indicated in Table 2 below. For example, the causal relationship No 3 - (**IEC-a → DBC + FE**) - indicates that the experience of doing the intended activity (IEC-a) generates knowledge about the product's characteristics (DBC) and its features (FE) in the context-of-use.

Table 2: Causal relationships

Causal relationships	Description
1. IEC-a → ST + IU	Experience of doing the product's intended activity (IEC) **generates** knowledge about the product's intended use (IU) and its context-of-use (ST).
2. IEC-a → DBC + FE	Experience of doing the product's intended activity **generates** descriptive knowledge of a product's features in their context-of-use.
3. IEC-a → PBC +FE	Experience of doing the product's intended activity **generates** knowledge of the product's rationale of use and of its features in their context-of-use.
From:1, 2, 3, 4 ED + IEC + ST → DBC + IU + FE	Memory of a particular occasion, individual experience and knowledge of context of a product's use **generate** descriptive knowledge of the product, its characteristics, its intended use and its features in context-of-use.
4. IEC (specific) → DBC (specific)	Individual experience from a specific knowledge domain (culture/profession) **generates** specific knowledge of a product's features and its characteristics.
5. IEC (specific) → PBC (specific)	Individual experience from a specific knowledge domain (culture/profession) **generates** specific knowledge of a product's rationale of use.
6. IEC (seeing) → DBC new products	Experience from seeing a product's use **generates** descriptive knowledge of new products that might come from imagination.
7. X Culture + IEC → DBC + IU + ST in X Culture	Individual experience within a particular culture **generates** knowledge of a product's features, its characteristics, its intended use and its context-of-use within that culture.
8. **X** Culture + IEC → **wrong** DBC + IU + ST in **Y** culture	Experience in particular culture **generates incorrect** or inaccurate descriptions of a product's features, its characteristics, its intended use and its situation of use when applying it in a different culture.
9. IEC + ED → IU + ST	Individual experience and memory of a particular occasion **generate** knowledge of a product's intended use and its context-of-use.

Legend: → (generates), → wrong (generates incorrect or inaccurate). IEC (Individual experience within context), IEC-a (Individual experience within context regarding the product's intended activity), DBC (Description-based concept), ED (Episodic data), IU (Intended use), FE (Feature with indication of usage), PBC (Principle-based concept), ST (situation), ST-p (situation regarding the product's physical context-of-use).

This study's causal relationships have two components: aspects of human experience and aspects of product usability. Figure 1 identifies these two components in the causal relationship presented earlier (Table 2, causal relationship 9). In this example, the user's individual experience within context-of-use (IEC) and his or her experience of a particular occasion (ED), leads to his or her understanding of a product's intended use and of its context-of-use.

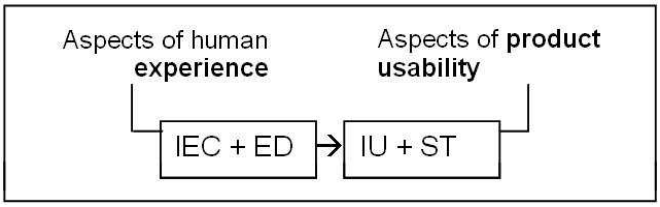


Figure 1: Components of a causal relationship

In this study, a design tool - Experience Context Enquiry Design Tool – ECEDT (Chamorro-Koc, 2007) - was devised as a research model to include and interpret the nine causal relationships in a way that informs designers about the aspects of human experience that must be addressed and to reconfirm the study findings. However, the study acknowledged that the nine causal relationships required further study in order to: find out the different ways in which these relationships relate to people's knowledge of products' use and of their context-of-use, and to explore the relevance of their application in the user-research stage of a design task (Chamorro-Koc, 2007).

The current study

The current empirical study seeks to address these issues. To this end, it employs a predefined design task that is presented to product designers for the application of the causal relationships and is being conducted in two stages: the first, the design stage; and the second, the retrospective verbal protocol and interview stage. Nine product designers are participating in the study, and each of them is assigned one of the nine causal relationships to explore in the design task.

Methodology

The following table summarises the research design of this study.

Table 3: Summary of research

Objective	To investigate: - How do designers understand causal relationships? - How do they apply causal relationships to a design task? - How does the application of a causal relationship enhance the design of product usability?
Participants	09 product designers who are currently practicing designers
Instruments	- Flashcards presenting causal relationships - Design brief and design scenario
Data Collection methods	- Design sketches – Concept books - Retrospective verbal protocol - Interview
Setting	Human Centered Research and Usability Laboratory at QUT

The pool of participants is comprised of currently practising designers and represents both genders and a diverse range of ages, cultural backgrounds and levels of expertise. To assist in the selection of participants, a screening questionnaire was employed. This questionnaire was sent via email with the invitation letter.

Data collection is in ***two stages***: design and interpretation. The design stage focuses on a design task in which each designer is asked to apply causal relationships in the resolution of a design task presented through a scenario and design brief. The interpretation stage focuses on retrospective verbal reports from participants to assist the interpretation and analysis of the design outcomes. Retrospective verbal reports take place in a laboratory environment, so that responses can be video recorded to assist interpretation of visual data (sketches). There is no time limit for retrospective verbal reports.

The Experiment

The following figure synthesizes the experimental steps:

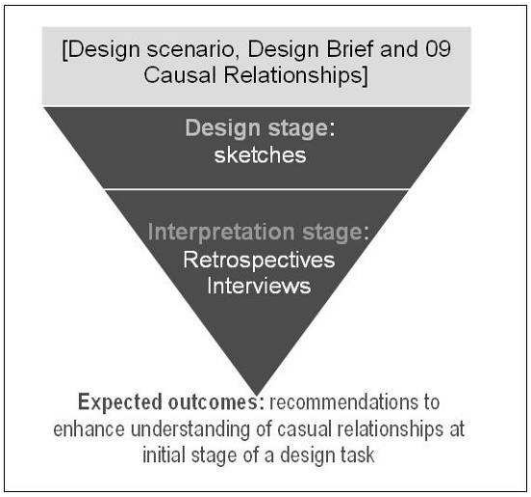


Figure 2: Experimental steps

A design scenario appropriate to the use of all nine causal relationships is presented to each of the participants. The design scenario aims to contextualize and focus on the design problem in relation to usability aspects that need to be considered. A design brief outlining the design task is provided. In this study the design task only comprises the initial conceptualization stage of the design process. Causal relationships are presented to the designers in the form of flashcards. Flashcards are employed in this experiment, to simplify the translation of the causal relationships into a visual form that designers can relate to. Designers are asked to consider the causal relationships and apply them during the design process. However, they are also asked to carry out the design task in the same way they would do in practice.

Design Stage: Sketches

The design stage focuses on collecting design data from the participants. They are asked to solve the design task assigned to them by employing the given design scenario and considering the assigned causal relationships. The experiment instruction is as follows:

Read the design scenario and undertake the design task presented to you. Consider the causal relationship and examples demonstrated during the explanation of this session, and use it to inform your design. Proceed to the initial stages of a design project as you would usually do and aim to deliver initial concept designs. The casual relationship is presented as an additional resource of information for your design process; it is not compulsory to use in your design if you don't find an opportunity to do so.

Figure 3: Experiment instruction

Outcomes of this stage consist of sketches and annotations compiled and dated in a concept book. The design brief specifically asks designers to focus on usability aspects of the design. Therefore, the aim is to explore how designers address product usability during concept generation. This is done through the study of design outcomes represented in visuals and annotations. It is expected that it would reveal how designers interpret the relationships between human experience, context-of-use and knowledge (causal relationship) in the design concept.

Interpretation Stage: Retrospective Verbal protocols

The interpretation stage focuses on understanding the participant's design outcomes through their own interpretation. In order to allow participants to reflect on their designs, meetings for retrospective verbal protocol sessions are scheduled within one week from the time they have finished the design project. This is supported by previous studies that found that the design thinking process is iterative (Schon and Wiggins, 1992) and that designers re-interpret the data every time they revisit it (Goldschmidt, 1991; Goel, 1995).

Retrospective verbal reports are employed to collect a description from the participants' own perspective about the use of causal relationships in the design process represented in the sequence of sketches (Hannu and Pallab, 2000). The open ended interviews are conducted to ask the designers' opinion on the usefulness and relevance of employing these causal relationships to enhance design of product usability. They also focus on asking participants about any other issue arising from the initial observation of sketches, and about any gaps or doubts arising from the retrospective report. The interpretation and analysis of visuals and verbal reports is assisted by ATLAS.ti and aims to identify references made to usability and experience issues in visuals and verbal reports (Chamorro-Koc, Popovic and Emmison, 2008).

The objective of the analysis is to respond to the research questions: *(i) How do designers understand causal relationships? (ii) How do they apply this understanding to a design task? and (iii) How does the application of a causal relationship enhance the design of products*? These questions drive the interpretation and analysis of sketches and verbal protocols. It is expected that ***findings*** will result in a set of recommendations about how to enhance the designers' understanding of causal relationships and their relevance for a design task.

Indicative outcomes

To date, the pilot study of the project has conducted three experimental sessions. At this stage, initial outcomes indicate that causal relationships can

inform the design task about aspects of usability, and that they can be employed as a source of inspiration for more usable product designs. The following sections present one exemplar of the data collected to further describe these indicative outcomes.

Figure 4 illustrates the design scenario and design brief presented to the designer (participant A), followed by the design outcomes and excerpts of verbal protocols supporting interpretation of initial outcomes.

Blood pressure monitor

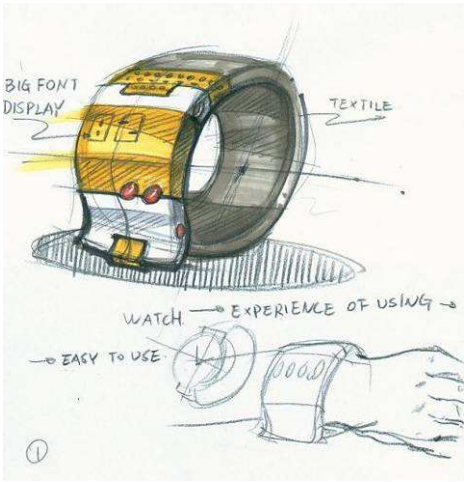
Samantha is a 65 year old lady who lives alone. She has been an active person all her life and has enjoyed good health. Nevertheless she has started suffering from high blood pressure and sometimes she feels very ill. The doctor has asked her to check her blood pressure every 4 hours but she has been using one that she finds confusing and the measurements are most of the time incorrect. This is because Samantha confuses the reading on the screen or because she has put the arm cuff incorrectly. She needs to use a blood pressure monitor but she cannot find one that she understands well.

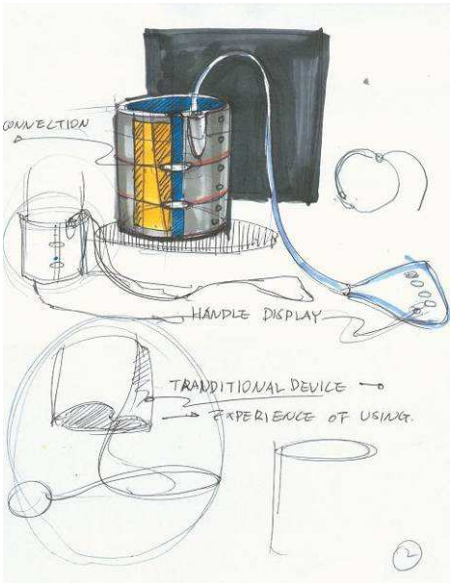
Design Brief

The design task is to design a digital blood pressure monitor that is easy to use by elderly people or by people who gets confused with technology. The design must make sure that the position of the arm band is placed correctly, and that the digital screen can be read and understood easily.

Figure 4: Design scenario and design brief from pilot study

This design scenario and task was presented to participant A, a Chinese product design practitioner, who is temporarily living in Australia while undertaking his PhD studies. From the start, the designer highlighted that elderly people in China would not use blood pressure monitors by themselves, but would be assisted by family members with whom they live, or they would go to the nearby hospital for help. This situation contrasts with the social context in countries such as Australia, in which elderly people are encouraged to live independently. In the case of the design of the blood pressure monitor, it seems that social context plays an important role in the experience that elderly users might have of this type of device. The following visuals show two





of the concept designs produced by the designer.

Figure 5: Design concept 1 (left), design concept 2 (right)

Figure 5 (left) shows the designer's concept 1 of a blood pressure monitor. The visual shows that the blood pressure monitor has been transformed into a wrist band, which is composed of a soft section (annotation indicates this as 'textile'), and a display section that uses large fonts. It illustrates a 'clip' to secure the wrist band and red operational buttons. Figure 5 (right) illustrates a blood pressure device that looks similar to the traditional one that is used around the arm: it has some connection points along one side and the air pump has been transformed into a handle display, as indicated by the annotations.

In the retrospective interview, the designer described his concept designs and the design process undertaken. The designer stated:

> *"First I read the causal relationships and tried to understand them. I think about the user group capabilities and investigated current products (blood pressure monitors in the market). In China, the elderly person would go to the hospital have their blood pressure measured. These products are designed for professional use – the doctors - and not for users self-use. .. I then related to the Chinese users' experience in hospital, they know how the professional device look like, but users would not know how to put the different parts together... From my understanding of casual relationships, I have related to the elderly user experience of using watches; this has inspired my design ideas"*

Figure 6: Excerpt from retrospective verbal report

For concept 1 he stated that he employed the causal relationship of familiarity and experience with similar products on a particular occasion. This is the relationship: ED + IEC-a + ST -> DBC + IU + FE, which states that the memory of a particular occasion and experience in the context of a product's use generates knowledge of the product, features, intended use and context-of-use (Table 2). He explained that elderly Chinese users are not familiar with technology but they are familiar with wrist watches as an object they can put on and wear. He also explained that, if they have to use a blood pressure monitor by themselves, then they would refer to their memory of having their blood pressure taken by the doctor. He used these ideas as inspiration to design something that resembles a wrist watch, so that users would know how to put this on. A large display is provided for ease of reading, and the use of soft material (or textile) follows the users' familiarity with the textile material employed in the traditional blood pressure monitor used by doctors.

For concept 2, the designer stated that he used the same causal relationship as in concept 1. The designer explained that the design follows the aesthetics of the traditional monitor, so users would be familiar with where to put it (on their arm). To facilitate ease of use, the designer has produced an 'integrated device', which does not need to be assembled like the traditional one used by doctors. The arm band or cuff is easy to close as it employs a 'clip' mechanism. The design has an extension that connects the cuff to a 'handle display' which looks like the air pump employed in the traditional one. The designer explains that this would help users to understand the need to hold the handle display which contains the controls and the display screen.

The interview section of the session focussed on gaining further insights into the designers' opinion of the use of causal relationships as a source to inform the design of product usability at the initial conceptualization stage of a design. The designer (participant A) believed that the use of causal relationships is

useful and can inspire innovative concept designs. He further explained that, in their current form, causal relationships *`help raise knowledge points'* upon which he could build concept designs. However, the designer also pointed out that he is not sure if initial ideas would prove to be `usable' by elderly users, as this requires investigating elderly users' needs in more detail. The designer stated that perhaps the use of causal relationships could be an iterative tool during the design process, that *`maybe after conducting further user research, the designer can go back to causal relationships to continue improving the design concept*'. These statements are consistent with those of the other two participants. For example, participant B stated that *`causal relationships were useful during his design process as a reminder of usability aspects to consider'* and inspired his design concepts. Also, he considered that *`causal relationships can be used at a later stage of the concept development, after initial design ideas have been explored; in that way they would further support the design process of addressing usability issues*'.

The exemplars describe and provide further insights into the indicative outcomes stated at the beginning of this section. Regarding the research questions, these initial outcomes indicate that designers can relate to causal relationships and that they find it useful to inform their design process and enhance the design of product usability. In the case of the example presented in this paper, excerpts from the retrospective verbal protocol show how the designer was able to connect the user experiences (of wearing wrist watches and having doctors take their blood pressure with the traditional device), with particular users' knowledge of product use (how to put on a wrist watch, the use of textile as reference to the parts of the traditional blood pressure monitoring device). While causal relationships assisted designers to focus on usability aspects at a very early stage of the design process, the format in which causal relationships were presented to designers emerged as an issue to resolve for the main study. In this regard, one of the designers (during the interview section of experiment) claimed that: *`still pictures used in flashcards do not help to convey the full context of the user experience in relation to the usability aspects that are being emphasized by the causal relationship'*. Overall, feedback received from designers about the causal relationships presentation format indicates that the instrument employed (flashcards) must be reconsidered as this can have an important effect on the designers' perceptions and understandings of the information conveyed.

Conclusions

This paper has presented a work-in-progress that focuses on further exploring a set of causal relationships that describe cause and effect relationships between aspects of human experience and users' knowledge of product use and context-of-use. Initial outcomes indicate that causal relationships are applicable and can help address the design of product usability at the conceptual stage. Presenting the same design scenario and design task to all participants in the study, allows comparison of the different uses designers would make of causal relationships knowledge. Furthermore, interpretation and application of this knowledge has the potential to help to identify new emerging causal relationships. However, outcomes from the interview section indicate that designers' understanding of causal relationships can be affected by the form and format in which causal relationships are presented

to them. This aspect of the study was not considered in depth in the research design, and is currently being further explored before continuing with the experimental sessions of the study.

Overall, it is expected that this study will provide better understanding of the nine causal relationships and how they can be applied in a design task. This will support the further validation and development of the Experience and Context Enquiry Design Tool (ECEDT) conceptually developed in the preceding study (outlined in the section Causal Relationships). More specifically, it will enhance the tool's capabilities to assist designers in addressing context-of-use issues and support user research at the initial design conceptualization stage.

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