Identifying Familiarity in Older and Younger Adults

Simon Lawry, School of Design, Queensland University of Technology, Brisbane; s.lawry@qut.edu.au

Vesna Popovic, School of Design, Queensland University of Technology, Brisbane; v.popovic@qut.edu.au

Alethea Blackler, School of Design, Queensland University of Technology, Brisbane; a.blackler@qut.edu.au

Abstract

This paper discusses empirical research into the familiarity of older and younger adults with contemporary electronic devices. Prior research into the field of intuitive interaction is examined, and the links between experience, familiarity and intuitive interaction are highlighted. An experiment is presented which investigated the differences in familiarity between older and younger adults. Overall the results suggest a negative relationship between age and familiarity, but exceptions to the rule are also demonstrated. This shows that age is not a determinant of familiarity, but it is often associated with a lower level of familiarity. This research also shows that older adults show verbal cues for familiarity far less frequently than younger adults, yet still display familiarity during task execution. The implications of these findings are discussed.

Key words

intuitive interaction; older adults; familiarity; prior experience; industrial design; interaction design.

Worldwide demographic shifts (with the exception of parts of Africa) are moving towards a model which has more adults over the age of 65, in terms of both absolute numbers, and the percentage of the entire population (Fisk, Rogers, Chareness, Czaja & Sharit, 2004; Lloyd-Sherlock, 2000). There are wide reaching social implications as a result of these changes. For example, it is expected that over 50% of the workforce in Australia will be over the age of 55 by 2018 (McDonald & Kippen, 1999).

People interact with a wide array of products on a day-to-day basis, and increasingly these products are electronic, with advanced technology, and more inbuilt functions and services (Heskett, 2002; Margolin, 1995). There is movement towards a more inclusive society, yet older adults often have difficulties using these complex digital devices which are now so prevalent (Djajadiningrat, Wensveen, Frens & Overbeeke, 2004; Docampo Rama, 2001). Devices such as mobile phones, which are firmly embedded in many younger adults' lives (Eisma et al., 2003), frequently baffle older adults (Lawry, Popovic & Blackler, 2009; Pattison & Stedmon, 2006). This can create frustration, which in turn can flow on to feelings of increased social isolation, reduced motivation, and even depression (Mynatt, Essa & Rogers, 2000).

It is becoming more important, on a societal, economical, and ethical level to address the usability issues that older adults are having with modern electronic devices. There are potential benefits, not only for older adults themselves, but also for society in general. Some of these benefits include improved social integration, higher levels of independence and improved health management (Mynatt et al., 2000). All of these benefits are likely to lead to a more fulfilling life (Fisk et al., 2004), and a more valuable contribution to society.

Incorporating intuitive interaction into user interfaces is one way of enhancing the usability of contemporary electronic devices for older adults. Intuition is a cognitive process that can be utilised in interactions with a product interface. Some typical characteristics of intuitive use include a lack of awareness of intuitive behaviour, and quick purposeful interactions (Blackler, 2008). Research into intuitive use and its application to interface is a new and emerging field.

Blackler, Popovic, and Mahar (2008; 2010) identified that intuition and familiarity are related, and that various elements of an interface design can contribute to intuitive interaction. Empirical investigations revealed that older people are less likely to utilise interfaces intuitively (Blackler, 2008). This research investigates and examines the differences in familiarity between older and younger adults with familiar contemporary devices.

Intuitive Interaction

There is no single concrete definition of intuition. Bastick's (2003) comprehensive examination of intuition and Klein's (1998) discussion of the role of experience in high pressure decision making situations have both assisted in shaping an understanding of intuition. Blackler (2008) has conducted an extensive review of intuition which resulted in the following definition: "Intuition is a cognitive process that utilises knowledge gained through prior experience…" (Blackler, Popovic & Mahar, 2002). Additional properties of intuition identified in Blackler's literature review include an increase in speed, higher levels of efficiency than other cognitive processes, and a lack of consciousness regarding what is taking place. For a full review of intuition, see Blackler (2008).

There is a difference between intuition, which is a cognitive process, and intuitive interaction, which is the use of intuition in an interaction. Blackler states the following definition, highlighting the distinction:

> Intuitive use of products involves utilising knowledge gained through other experience(s) (e.g. use of another product or something else). Intuitive interaction is fast and generally non-conscious, so that people would often be unable to explain how they made their decisions during intuitive interaction. (Blackler, 2008, p. 107)

The first empirical investigations into intuitive interaction by Blackler, Popovic and Mahar (2003) reached a number of conclusions. The most relevant conclusions from this research show that interface features which are less familiar are used less intuitively, older adults use products significantly less intuitively than younger adults, and interaction speed is affected by experience and familiarity with similar products (Blackler, 2008). Blackler (2008) suggests that further investigation is required in the area of age and intuitive interaction. Indeed, Blackler, Mahar, and Popovic (2009) have conducted further investigations focusing on exploring the effects of ageing on intuitive interaction. Their investigation included an examination of the role of cognitive decline, as a result of the ageing process, on intuitive interaction. Results show that both cognitive decline and the level of technological familiarity affect time on task, number of intuitive uses, and number of correct uses. Technological familiarity was measured using a questionnaire about relevant electronic devices and how familiar the participant was with certain aspects of the devices. Familiarity had a slightly stronger effect than cognition (Blackler et al., 2009).

Hurtienne and Blessing (2007) report on the definition of intuitive use developed by the Intuitive Use of User Interfaces (IUUI) research group from the Technische Universität Berlin: "A technical system is intuitively usable if the user's subconscious application of prior knowledge leads to effective interaction" (Hurtienne & Blessing, 2007, p. 2). Hurtienne is focusing his research on intuitive interaction with image schemata. Image schemata are knowledge structures that are based upon an understanding of the world developed through interacting with our environment (Hurtienne & Blessing, 2007).

The Engineering Design Centre at Cambridge University is investigating the role of prior experience within inclusive design. From their initial experiments they have concluded that "prior experience with similar products and product features is a strong predictor of the usability of products" (Langdon, Lewis & Clarkson, 2007, p. 190).

Experience and Familiarity

Examining the definitions of intuition and intuitive interactions, the central themes of knowledge and prior experience emerge. There is a close relationship between experience and familiarity. Blackler (2008) states that intuitive interaction is based on internal and external consistency, and that external consistency relies upon familiarity. Familiarity has been defined as "…an understanding, often based on previous interactions, experiences and learning…" (Gefen, 2000, p. 727). Gefen (2000) describes familiarity with a product as an awareness based on experience, where one has an understanding of the behaviour, function or action. Experienced is defined as "having become skilful or knowledgeable from extensive participation or observation" (Hanks, 1990). These definitions show the importance of knowledge developed through prior interactions and experiences to familiarity, and thus also to intuitive interaction.

New products are built upon old products. New products always make reference, in some way, to the previous generation of products (Lewis, Langdon & Clarkson, 2008). Users utilise the knowledge base they have built with previous products when interacting with new products and new interfaces (Docampo Rama, 2001). If the differences between the knowledge required to use the older product and the knowledge required to use the new product are too great, then the new product may be harder to learn, use, and understand (Singley & Anderson, 1985; Sweller, 1999).

Experiment

The purpose of this experiment was to examine familiarity with contemporary devices in older and younger adults. The aim of this research was to identify potential methods to extract familiarity from users in order to design intuitive interfaces.

Experiment Procedure and Analysis of Data

The experiment was conducted in the participant's home, as it was easier and more comfortable for the participant, and it also provides a context which is much closer to a realistic scenario than a laboratory. The experiment also required the use of familiar products that are kept in the home. Four age groups were used for the experiment. The groups were 18 – 44, 45 – 59, 60 – 74, 75+. There were four participants in each age group, four male and four female. A total of 32 participants took part in the study.

The experiment was split into two parts, with each part addressing a different experiment question (Table 1). Part A utilised a semi-structured interview, to extract information about consumer and home-based devices that the participants used. Questions were asked regarding products such as televisions, microwaves, cameras, and blood pressure monitors. The questions varied in depth from frequency of use, to what the product allows the participant to do. Part B utilised a semi structured interview, an observation, and a retrospective protocol. The interview was used to identify a familiar product, and to identify a familiar task with that product. The participant also described the step-by-step process required to execute the task, from memory, with no prompts from the product itself. The observation then required the participant to perform the activity with the device. The participants were required to deliver concurrent verbal protocol while performing the activity. The audio/visual data from the observation was captured with a digital video camera. The video of the participant performing the activity was then transferred to a laptop computer. The audio was muted, and the video played back to the participant, while the participant delivered a retrospective protocol on the interaction.

<table>
<tr><td></td><td>Part A</td><td colspan="3">Part B</td></tr>
<tr><td>Data collection method</td><td>Interview</td><td>Interview</td><td>Observation</td><td>Retrospective Protocol</td></tr>
<tr><td>Experiment Question</td><td>What products are the participants familiar with, and what role do the products play in everyday life?</td><td colspan="3">What are the differences in description, execution and reflection of a task with a familiar product?</td></tr>
</table>

Table 1 Experiment structure

By comparing the steps the participant described to perform the activity, with the steps that the participant actually undertook to execute the task, it is possible to identify the level of familiarity the participant has with the product, and with different parts of the interaction. A coding scheme was developed in order to define the activity and provide information regarding the steps taken (Table 2).

Coding Scheme

The coding scheme was applied to the participant’s description and the participant’s execution of the task using the video recording of the task. Each step performed by a participant during the task execution was coded. Steps are any action the participant makes which involves the product they are interacting with, such as picking up a remote, or entering a time on a microwave. Data input, such as entering a phone number, or time in a microwave was coded as a single step, rather than multiple steps.

Each step was first coded in terms of the matching description given by the participant before hand, and also the correctness and familiarity of the step. The codes used in relation to the description were: Accurate Description, Inaccurate Description, No Description, Incorrect Description, Grouping, and Failure to Execute (Table 2). The ‘Accurate Description’ code is used when the description of that step matches the execution of the process exactly. The ‘Inaccurate Description’ code is used when the step is not quite correct, or the step is performed out of order from the process given during the description. The ‘No Description’ code is used when the participant performs a step and there is no mention of that step in the description given by the participant before hand. The ‘Incorrect Description’ code is used when the step performed is contradictory to the description given, but still leads the participant closer to the required outcome. The ‘Grouping’ code is used when the step performed is described in a manner which includes multiple steps in a single description.

The codes which describe each step of the interaction are the Correctness and Familiarity codes. The correctness codes are: Correct, Incorrect, and Inappropriate. A step is coded ‘Correct’ when it takes the participant closer to the required outcome. A step is coded ‘Incorrect’ when the step takes the participant further away from the required outcome. The ‘Inappropriate’ code is used when the step is not required in the interaction. The Familiarity codes are: Very Familiar, Moderately Familiar, and Not Familiar. These codes have been adapted from Blackler’s (2008) coding heuristics, where similar codes were used to help identify intuitive interaction. The ‘Very Familiar’ code is used when the participant performs a step quickly and fluidly, and with no obvious thought or reasoning. The ‘Moderately Familiar’ code is used when some uncertainty is shown in the performance of the step, and the interaction is slower, and is executed with some hesitation. If a step is executed very slowly, with indecisiveness and hesitation, then it is coded as ‘Not familiar’. The concurrent protocol also contributes to the identification of familiarity, through lack of verbalisation, and in depth descriptions of possible alternative actions for example.

Category/Code	Statement	Interpretation parameters
Step Description		
Accurate description	The specific step is described correctly before hand.	A specific step is described accurately and precisely.
Inaccurate description	The specific step is described incorrectly before hand.	The specific step is described before hand, but is not described correctly.
No description	The specific step is not described before hand.	No mention of the step before interaction.
Grouping	The step is described in a manner which groups multiple steps together.	Generalisations, including multiple actions in one sentence.
Failure to execute	Step is described beforehand but not performed.	Step is described before hand, but the participant does not perform during the interaction.
Correctness		
Correct	The step is correct for the activity.	The step takes the participant closer to the required outcome.
Incorrect	The step is incorrect for the activity.	The step takes the participant further away from the required outcome.
Inappropriate	The step is inappropriate for the activity.	The step is not performed at the right time.
Familiarity		
Very Familiar	The step is very familiar to the participant.	Quick use, no obvious reasoning.
Not Familiar	The step is not familiar to the participant.	Uncertain, slow interaction.
Intermediate familiarity	The step is moderately familiar to the participant.	Some certainty shown.
Procedure identification		
Procedure	Identifying groupings of steps.	Consecutive ‘very familiar’ steps with no interaction break.

Table 2 Coding Scheme

The final code used is the ‘Procedure’ code. The procedure code is similar to the grouping code in that it identifies where several steps have been grouped together. The procedure code is used to identify groups of steps during the interaction. This differs from the grouping code as the grouping code applies to the description by the participant, where the procedure code applies to the steps the participant makes during the execution. A procedure is coded when a participant performs consecutive 'Very Familiar' steps with no gaps or breaks in the interaction. A procedure is a very fluid interaction.

Procedures are coded as periods of time, as they are coding a series of actions executed during the task. Individual tasks are coded as being grouped, rather than being coded as periods of time. This allows the grouped steps to be coded for familiarity and correctness, rather than how long the grouping lasted for.

The coding scheme was applied to the observational data using The Observer XT 8.0 (Noldus, 2009).

Analysis

By examining the coded observational data, it was possible to identify the differences in familiarity across the selected age groups. The time-event logs (or data maps) display the data from individual participants (Figures 3 and 5), while the graphs (Figures 1, 2 and 4) display the mean of the data across age groups.

It is important to note that time is not a relevant variable for this experiment. Each participant chose a product that was specifically relevant to him or her, and performed a task which was also specifically relevant to him or her. Thus a comparison of time between individuals, or age groups is inappropriate. This experiment is investigating the differences in how people remember, execute, and reflect upon a familiar task, in order to identify experiential knowledge.

Figure 1 illustrates the mean of the percentage of total steps that were coded as grouped, by age group. The youngest age group (18 – 44) demonstrate the highest percentage of steps that had been grouped with 34% of executed steps coded as grouped. The 45 – 59 age group demonstrated the next highest percentage of executed steps coded as grouped with 25%. The next age group (60 – 74) had a much lower percentage of executed steps coded as grouped, with only 8%. The 75+ age group had only 4% of executed steps coded as grouped. This shows a negative relationship between age and the percentage of executed steps coded as grouped.

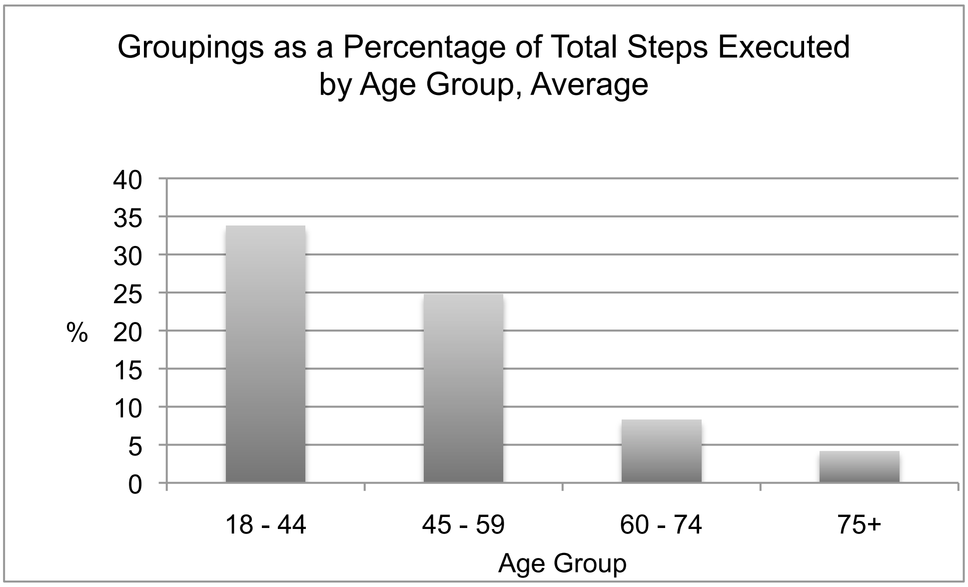

Figure 1. Mean by age group, of groupings as a percentage of total steps executed

Figure 2 shows the mean total time for which a procedure code was present during the task. It shows the mean percentage of the total task time which is spent in procedure. This illustrates that the 18 - 44 age group spends 66% of time using the product in procedure. The 45 – 59 age group spent, 44% of the total time on task in procedures. Time spent in procedure for the 60 – 74 age group was 24%. The 75+ age group spent 18% of the time in procedure. This demonstrates a negative relationship between age and percentage of time in procedure while executing a familiar task. Also, the 18 – 44 age group spends considerably more time (50% more) in procedure than the 45- 59 age group.

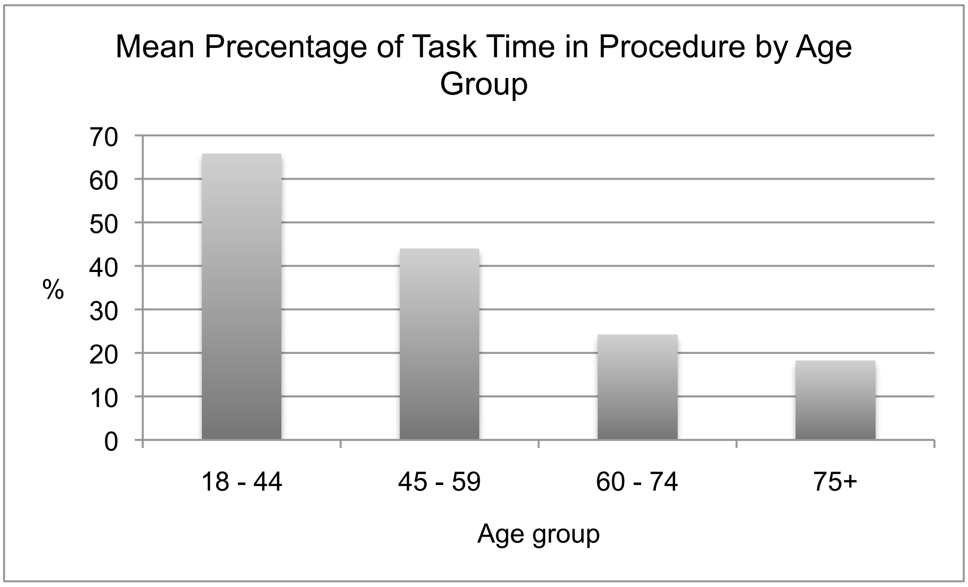

Figure 2. Mean by age group, of percent of task time spent in procedure

The time during the task execution where the participant was in procedure was isolated. The time in procedure was analysed in terms of whether grouping occurred with in the procedure or not, and by age, and step description. An example of the map created highlighting the time the participant spent in procedure can be seen in Figure 3.

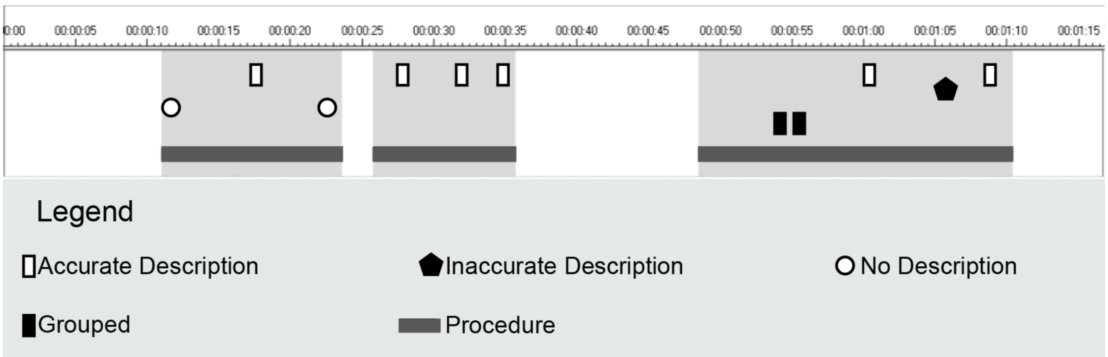

Figure 3. Example of data map showing procedures isolated

The light grey areas show the areas where the data is being displayed (Figure 3). Each vertical mark represents a coded step. In this example you can see that within the first procedure, the participant executed two steps that were coded as 'No Description' and one coded as 'Accurate Description'. The second procedure contained three 'Accurate Description' steps. The third procedure contained two 'Grouped' steps, two 'Accurate Description' steps, and one 'Inaccurate Description' step.

Figure 4 shows the percent of procedures that contained grouped steps. In other words, this displays the percent of performed procedures which were described beforehand as a grouping. The 18 – 45 year old age group had 71% of procedures conducted include grouped steps. The 45 – 59 age group had 50% of the procedures they executed contain grouped steps. The 60 – 74 age group had 22% of the procedures they executed contain grouped steps and 11% of the procedures the 75+ age group executed contained groupings. This displays a negative relationship between age and the occurrence of grouped steps within procedures. The data presented is the mean of each age group.

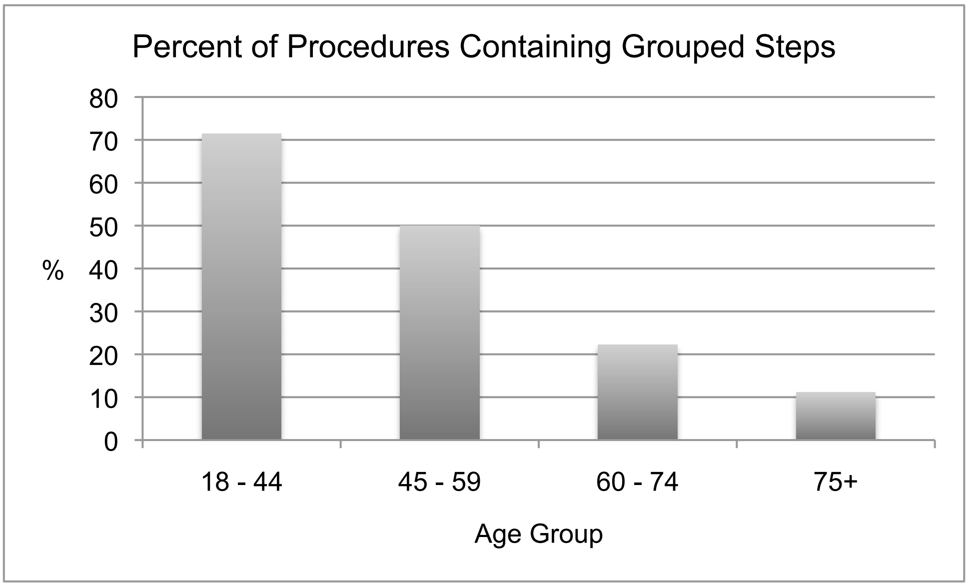

Figure 4. Percent of procedures, by age group, containing grouped steps by age group

The data presented to this point suggests that, generally, age has a negative relationship with familiarity. Figure 5 shows maps of three participants from different age groups. The following maps show that individual familiarity can be high regardless of age. The first is an example from a participant in the 18 – 44 age group. The second, a participant from the 45 – 59 who exhibited a high level of familiarity. The third map is an example from the 60 – 74 age group. The second and third maps demonstrate a high level of familiarity comparable to that of the participant from the youngest age group.

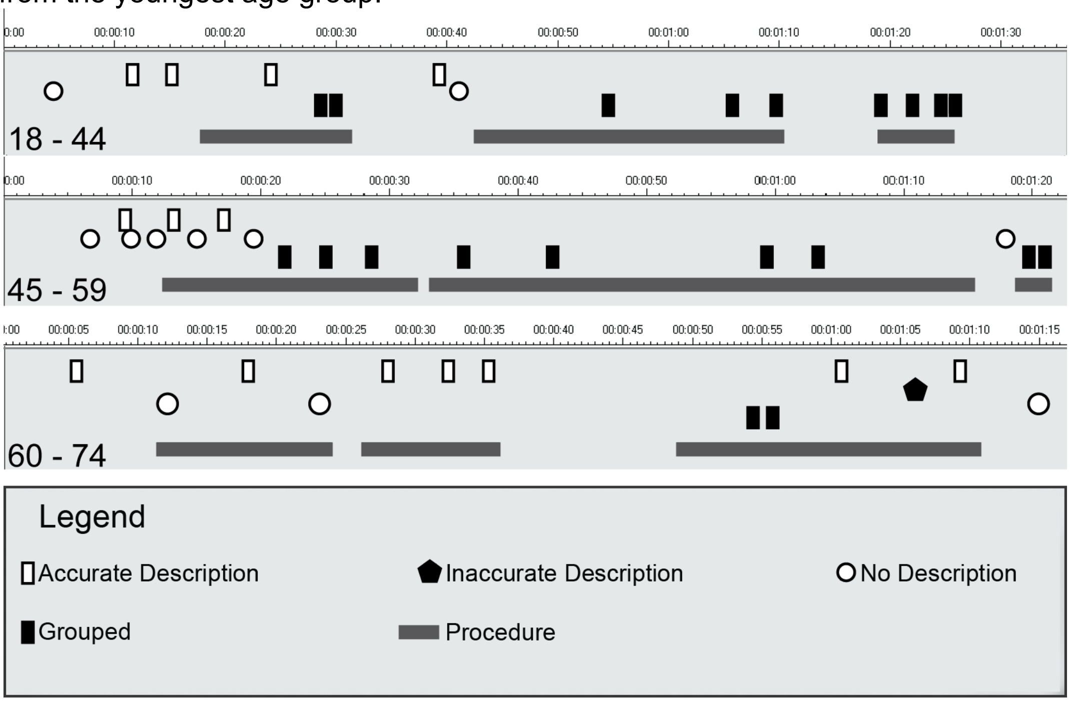

Figure 5. Examples of participants displaying high familiarity over different age groups

The levels of familiarity displayed are fairly similar. All three participants spend over 50% of their time in procedure. The 18 – 44 year old participant spent 50.4% of task time in procedure (mean for age group is 65.8%), the 45 – 59 year old participant spent 77.4% of task time in procedure (mean for age group is 43.9%) and the 60 – 74 age group participant spent 58% of task time in procedure (mean for age group is 24.2%). The number of grouped steps is the same between the 18 - 44 year old and the 45 – 59 year old at 9, while the 60 – 74 year old grouped only 2 steps together.

Discussion

There are some interesting results demonstrating the difference in familiarity across different age groups. In general, the results suggest that familiarity decreases with age, in the execution of a familiar task with a familiar product. The analysis shows negative relationships between age and the occurrence of both groupings and procedure. This suggests that age is a predictor of familiarity. Figure 5 shows that older participants can be just as familiar, if not more so, than their younger counterparts. Despite the analysis suggesting a negative relationship between age and familiarity, the findings in Figure 5 demonstrate that there are exceptions showing older adults who are just as familiar as younger adults, if not more so. Indeed, Fisk et al. (2004) say that age results in an increase in wisdom experience and knowledge. Vercruyseen (1997) states that age does not have to limit motor behaviour, and the use of adaptive behaviours of will put an older adult on par with younger adults (Bosman, 1993; Czaja & Sharit, 1998; Lundberg & Hakamies-Blomqvist, 2003).

Groupings

Groupings are the integration of a series of steps which would be executed during a task, into a single description. For example, a participant described the process of entering all of a new contact's data into his mobile phone as 'Input'. The participant condensed the six consecutive steps he executed when performing the task in to a single word description. It is suggested that this grouping occurs with a high level of familiarity. The participant knows the process so well that, in his mind, the series of steps required to execute that part of the task is only a single action.

The findings show that the 18 - 44 age group has a higher percentage of total steps as groupings compared to the other age groups (Figure 1). This ratio declines with each consecutive age group. This implies that, as age increases, a familiar task with a familiar product is less likey to be described using groupings.

Some possible explanations for these findings include declines in memory and recall functioning, and speech and verbalisation function, as a result of ageing (Gregor, Newell & Zajicek, 2002; Hawthorn, 2000; Klein & Scialfa, 1997). Reductions in memory and recall function could affect the ability of participants to accurately remember the task. Reductions in speech and verbalisation could prevent participants from communicating exactly what they are recalling.

Procedures

Procedures are the integration of a series of disparate steps executed in a task into a single fluid action. Some signs of a procedure displayed by the participant can include: no hesitation when starting a procedure, no or very little verbalisation during the procedure, brief verbalisation once the procedure is complete, fluid or flowing movements, and no pauses in between individual task steps. It is suggested that a procedure is a demonstration of familiarity, as procedures exhibit many of the characteristics of intuitive interaction that Blackler (2008) discusses, and as discussed earlier, familiarity is an important aspect of intuitive interaction.

Figure 2 shows the youngest age group spends the highest amount of time in procedure. It is found that the amount of time spent in procedure declines with each subsequent age group. The 75+ age group spends a mean of 48% less task time in procedure than the 18 – 44 age group. This could also represent a lower level of familiarity amongst older user with familiar tasks and familiar devices.

Some of these findings could be explained by a decrease in motor function (Vercruyssen, 1997) and visual and audio processing, increasing feedback processing time (Hawthorn, 2000), and cognitive load as a result of ageing (Korteling, 1994). It has been reported that delivering concurrent protocol can increase difficulties for older adults when using unfamiliar interfaces (Dickinson, Arnott & Prior, 2007). This could also apply to familiar products.

The Relationship Between Groupings and Procedures

There is a strong relationship between groupings and procedures (Figure 4.). They are very similar, in that they are the integration of steps into a process. The difference is that groupings concern the integration of the description of the steps of a process into a single descriptive word or sentence, while a procedure is the integration of distinct steps of a process into a smooth, flowing action. Groupings are descriptive, and thus they are based on the knowledge that an individual has of a device. This knowledge can be accessed without the device present, and Norman (2002) refers to this as “knowledge in the head”. Procedures, on the other hand, are context based and are always performed with the device. The device provides feedback and prompts, as the users interact with it, enabling easier recall. Norman (2002) refers to this as “knowledge in the world”.

Groupings almost always occur within a procedure. Of the steps that were coded during procedure, 94% were coded as grouped. This may occur as procedures have additional prompts and feedback from the device. This could mean there are more opportunities to recognise the next step. Groupings do not have additional prompts. The only prompt is what participants can recall from memory. Thus it is argued that it may be more difficult to form a grouping than a procedure, as the grouping has less prompts, and relies solely on memory (Norman, 2002). This could explain why groups fall within procedures most of the time.

The data shows that the younger a person is, the more likely a procedure is to have steps described as a group (Figure 4). The youngest age group had groupings in 71% of procedures, while the oldest group had groupings in only 11% of procedures. This shows that, as age increases, an individual is more likely to show familiarity through their actions rather than through the description of process. Thus older adults should not be considered unfamiliar with a particular product or task if they do not group the task description. This has implications for designers performing user research on older adults. This shows that verbal cues for familiarity and experience do not adequately demonstrate actual familiarity that older adults have with products. Observations allow the adequate identification familiarity, which can then contribute to the design of more intuitive interfaces.

Groupings almost always occur within procedures. This suggests that if people use a grouping when describing a task, then they have a high level of familiarity, as the grouping would also suggest a procedure would occur on execution of the task. Using a task description and groupings to identify familiarity is likely to demonstrate more familiarity for younger adults than older adults, as younger adults use groupings more than older adults (Figure 4). As groupings only identified a total of 44% of procedures, it is suggested that such a method is inadequate as a sole measure of familiarity, especially with older adults.

Conclusion and Future Research

The aim of this research was to discover methods that elicit familiarity from individuals regarding contemporary electronic devices. The findings of this research show that familiarity can be identified by determining if a user integrates successive steps of a task into a single step or process. This can occur in terms of both action, and the description of that action. It also shows that familiarity, both in terms of grouping and procedure, declines with age.

The data suggests that a process involving task description could be one possible way to quickly and easily identify familiarity. These findings suggest that if a participant was to use a grouping in the description of a task, it is likely that they would be very familiar with that part of the process. However, the data reveals a method such as this is likely to be less effective with older adults, as the older an individual is, the less likely they are to display their familiarity in the form of a grouping (Figure 4). Also such a method would exclude 66% of procedures, another indicator of familiarity. The analysis suggests that a method that incorporates the evaluation of both task description and task execution is required to get definitive insight into participant familiarity.

This research identifies characteristics of familiarity, such as verbal groupings and smooth interactions flow, that are present in different age groups. It also shows different ways in which individuals express familiarity. This research is significant because it demonstrates the differences in how familiarity is shown by younger and older users. The research techniques used also contribute significantly to the field by demonstrating some potential ways to identify that familiarity.

Further research will attempt to replicate the findings of this study. Additional areas of investigation may include comparing very familiar older adults with very familiar young adults, explorations of possible ways to identify proceduralised steps without the device present, and additional testing around the familiarity of older adults.

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Simon Lawry

Simon is a PhD Candidate in the School of Design at the Queensland University of Technology, in Brisbane, Australia. His research focuses on the intersection of experiential knowledge, industrial and interaction design, and intuitive interaction. This aim of this research is to enhance the independence of older adults by helping designers create more usable products. He is in his third year of PhD.

Vesna Popovic

PhD, is a Professor in Industrial design in the School of Design at the Queensland University of Technology (QUT), and she is the founder of the Industrial Design infrastructure in Brisbane, Australia. She has made an international contribution to product design research where she has integrated knowledge from other related areas and applied it to artifact design in order to support and construct design applications. In particular, she has been a forerunner of human-centred design research as applied to artefact, services and systems. The impacts of her work lie in the cross-fertilisation of knowledge across humanities and technology to design and produce humanised artifacts as well as to enhance our culture by facilitating understanding between professionals with diverse expertise and experience. She has published widely and is the recipient of numerous awards and research grants. She is a Fellow of the Design Institute of Australia and Fellow of the Design Research Society (UK). She was an Executive Member of the International Council of Societies of Industrial Design (ICSID) from 1997 to 2001 and co-founder of ICSID Education Conference in 2001. Since 2001 she has been an ICSID adviser.

Alethea Blackler

PhD, is a senior lecturer in the School of Design at Queensland University of Technology. Her principle areas of research interest are the intuitive usability of products and design history and criticism education. She is currently working on intuitive interaction for older people and also design methodologies for intuitive interaction. She has received various grants and awards for her research and teaching, most notably an ARC Discovery grant of $280,000 for Facilitating Intuitive Interaction for Older People. She was the first to address intuitive interaction in any depth and the first to publish any empirical research in this area. She has now been working in the area for ten years and has applied her research to commercial projects. She is a member of the Design Research Society.