

DESIGNING FOR THE AGEING EXPERIENCE: FRAMEWORK OF INFLUENCES ON ADOPTION AND USE OF TECHNOLOGY PRODUCTS BY USERS IN DIFFERENT LIFE STAGES

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1. Introduction

Understanding users' needs, capabilities and attitudes is essential for providing good overall user experience and maximising the chances of producing an economically successful product. With population ageing and the extension of work life, an increasing number of older users are interacting with products and services regardless of whether those users, and their diverse characteristics, were explicitly considered during the design process. For design to successfully meet users' needs, capabilities and attitudes, it is important to consider not only product interaction in the general sense but also the different factors that influence people's adoption and daily use of products and services. Research in the fields of accessibility and usability has made significant advances in the last couple of decades in considering the relationship between population ageing and product design. Today's designers have the possibility to better understand the challenges faced by older users and ultimately to improve the usability of Information and Communication Technology (ICT) products to compensate for loss of capabilities. However, many issues remain, especially in relation to factors that influence user experience. For example, although many previous studies have focused on different characteristics of the user, they have discussed such topics separately and have often vaguely mentioned or completely omitted the factors that influence user experience. Even when mentioned, the different factors of influence are usually not the central point of discussion. Finally, no research has been found to cover broad range of factors in a single study, which also explores the relationships among them in the context of the overall user experience. To fill this gap, it is necessary to consider a greater number of factors of influence on user experience and the underlying relationships among them in a single study and to classify them in the form of a more comprehensive and integrative framework of influences that researchers and designers could easily use. The work presented in this paper is composed of two main parts: (1) a review of existing literature regarding the seven main factors of influence on adoption and use of ICT products by people in different life stages and (2) the results of a survey on mobile phone usage with 562 people in the UK, which aimed to evaluate the claims found in literature and identify the overarching dynamics among the seven factors. Altogether, this study contributed to the realisation that age, gender and education are the strongest influences, with age being the most prominent, because they affect other dimensions of life, such as health status and personality. This in turn has strong implications for design companies as products and services optimised for people in different life stages and their specific needs, capabilities and attitudes will carry more value and, therefore, be more commercially viable.

2. From product design to user experience

Design has been shifting its focus from the object towards the user, advancing from form to function, from function to communication, and from communication to experience. This interest in user-centred approaches has stimulated a shift from the users' behavioural and cognitive experience to the users' affective experience of product interaction [Desmet and Hekkert 2007]. In this context, experience has been defined as “the awareness of the psychological effects elicited by the interaction with a product, including the degree to which our senses are stimulated, the meanings and values we attach to the product, and the feelings and emotions that are elicited” [Schifferstein and Hekkert 2008].

Because physical, sensory, cognitive and affective responses change with age, we can expect user experience to vary with age also. To tackle this issue, a number of design methodologies propose that mainstream products, and not just assistive products, should provide for the needs of less capable and/or older users in order not to exclude these individuals from full participation in society. By doing so, design may help users with limited capabilities to lead a dignified, fulfilling and productive life.

In the case of older users, the negative account of ageing can actually worsen their performance on cognitive tasks and, consequently, discourage product adoption. Conversely, it is believed that products designed to address emotional needs contribute positively to the user's self-image and might be more rapidly adopted among the elderly. Also important, designers should keep in mind that people age at different paces and that users will not stop ageing at the time of product purchase. It is, therefore, essential to address the dynamic diversity in older adults' changing capabilities that accompanies the ageing process [Gregor et al. 2002]. This should be done in such a way that design promotes physical and social inclusion, helping older adults stay healthy, occupied and integrated.

3. Towards better understanding of user experience

In recent years, many attempts have been made to model user experience and to classify the different elements that constitute that experience [Desmet and Hekkert 2007]. The resulting models often decompose experience into a number of attributes that relate more to the product – such as utility, accessibility, usability and desirability, and also into attributes that relate more to the user – such as physical, sensory, cognitive and affective responses, preferences and expectations. Separating the attributes in these two groups can be useful to conceptually understand the basic elements of the user experience. This paper discusses only the attributes of the user.

3.1 Attributes of the user

In order help designers create better interfaces, researchers have proposed different methods for assessing users' physical, sensory and cognitive capabilities. Assessing the affective dimension has generally been discussed separately and a variety of approaches have emerged focussing on different aspects of affective control (i.e. affective computing in the USA and Kansei engineering in Japan). Gregor et al. [Gregor et al. 2002], concerned with attributes of the user other than capabilities, have considered users' needs and wants in relation to the interface, both of which are directly relevant to product design. In this paper three main attributes of the user are considered to constitute the overall user experience – needs, capabilities and attitudes. It should be noted that the literature presented in this paper is based on a summary of the doctoral research of the first author [Medeiros 2011] in which a large number of previous studies from a range of disciplines are extensively discussed and cited.

3.1.1 User needs

The “Needs” attribute of user experience refers to the users' set of personal requirements in relation to the utility of a product. It is about *what* a given product is used *for*. User needs may vary from one person to another and be very specific, but they can be generally clustered in the requirements of wide groups of users, if not of whole generations. However, depending on the product, using the same set of requirements across generations of users may be challenging and segmentation becomes necessary. A mobile phone with limited functionality, for example, is unlikely to satisfy the needs of young adults who would like to use it for listening to music, checking news online or keeping in touch with friends and family by text messaging. The very same handset can, however, fulfil basic needs of retired and

elderly users for making a phone call in unforeseen, sporadic situations. It can also happen that further segmentation within generations, especially in the older population, is necessary. Another issue is that users' perceived needs may not necessarily correspond to their actual needs. Therefore, identifying needs and wants is not simply a question of asking users what they need or want because they do not necessarily know what is possible. Instead, designers need to understand the characteristics and capabilities of users, the goals they want to achieve and the means by which they can reach goals more effectively if they were given different possibilities [Preece et al. 2002].

3.1.2 User capabilities

The "Capabilities" attribute of user experience refers to the users' set of physical, sensory, cognitive and affective abilities, with which they interact with the product. It is about *how* users use a product. The four groups of capabilities are:

- *Physical interaction* is mainly based on the user's motor capabilities, which include locomotion, reach and stretch and dexterity. In order to interact with most mainstream products, the user must be able to physically access and exploit the product's utility. However, since people's abilities deteriorate with age at different rates, it is necessary to consider the diversity in their physical interactions with products.
- *Sensory perception* is the translation system of the features of the environment. It guides people through lights, sounds, colours, textures, aromas and tastes sending information to the brain, which will then decode it into meanings. Separating perception from interpretation in this way is not entirely accurate, but it can be conceptually useful when considering that sensory responses tend to deteriorate with age, which results in different levels of capability that must be designed for. In addition, in the context of user experience, products perceived as beautiful, are likely to be desirable.
- *Cognitive processing* is the management of all information in the brain and the commander of many responses. It refers to the activities involved in attempts to solve inconsistencies between an individual's internal conceptualisation of the environment and what is perceived to be actually happening externally. In the context of consumption, cognitive response refers to the judgments that the user makes about the product, based on the information perceived by the senses. Since ageing influences cognition, it is expected that cognitive responses during product interaction will change through life. For example, older users may be slower at interpreting certain mobile phone features or be more afraid of the consequences of their actions on a given mobile phone feature.
- *Affective mediation* is the supporting tool in decision-making. Affect governs the quality of interaction with a product and influences and mediates specific aspects of interaction before, during and after the use of a product. It also acts as a cognitive artefact in task achievement and is central to how other artefacts are interpreted and how pleasure is perceived.

3.1.3 User attitudes

The "Attitudes" attribute refers to the users' set of sociocultural and affective aspects in relation to the product. It is about *why* users use a product. Attitudes precede behavioural intention, which in turn precedes actual behaviour in situations where behaviour is under the user's will power [Melone 1990]. For example, social and organisational impositions that users are under may lead to involuntary behaviour, such as when adults are prompted to use a mobile phone for work. Although involuntary behaviour may lead to eventual adoption of technology in large numbers, it cannot ensure actual usage of the technology (positive behaviour) because users' attitudes have been taken for granted. Positive attitudes towards a product or a system are associated with high levels of product use and identified as one of the determinants of voluntary technology adoption [Lucas 1975]. Users' attitudes are described as beliefs, expectations and values expressed towards perceptions of the product's utility and hence the need for the product [Zmud 1979]. Three components of attitudes are:

- *Previous knowledge* refers to the combination of users' prior exposure to information on products and previous experiences with them. Through previous knowledge users gradually develop skills and might become competent in product use. When older users perceive their

task ability is not sufficient to render an emotionally fulfilling experience, they opt not to perform the task and ultimately develop negative attitudes and behaviour.

- *Expectations* refer to cognitive explanations of affective selections. Expectations are based on contrasting present experiences against past ones. For example, if a user has had a product which has been useful, usable and desirable, it is very likely that the user's expectations for a newer version of such product will be high. However, if the product fails to fulfil the user's expectations, the experience will be perceived negatively.
- *Preferences* refer to the wants of the users in relation to the aesthetics of the product. As people age they lose capabilities and tend to focus on emotional satisfaction, which leads them to become steadily more selective. As a consequence, older people may have different needs and wants due to the given life stage they are in [Gregor et al. 2002].

3.2 Influences on the attributes of the user

In order to better understand the influences on adoption and use of technology products by people in different life stages and ultimately to develop a framework of influences on user experience, it is important to investigate other personal characteristics of the users. Especially important is to understand what factors influence users' needs, capabilities and attitudes, and the resulting behaviour towards products. In studies carried out during the 1970's [Zmud 1979], demographic variables and personality have been identified as relevant to successful technology adoption. There are five determinants of use and non-use of technology – age, gender, marital status, health status and education [Medeiros 2011]. Gender and professional background are also factors that influence motivation and acceptance of technology. In this work, seven main groups of factors of influence are identified – age, gender, ethnic background, personality, socioeconomic settings, health status and cultural background. Groups of factors, excluding age, gender and ethnic background, can be decomposed into subsets of factors of influence. Figure 1 shows the three attributes of the user and their seven influences (and subinfluences). Each of the seven influences is subsequently explained.

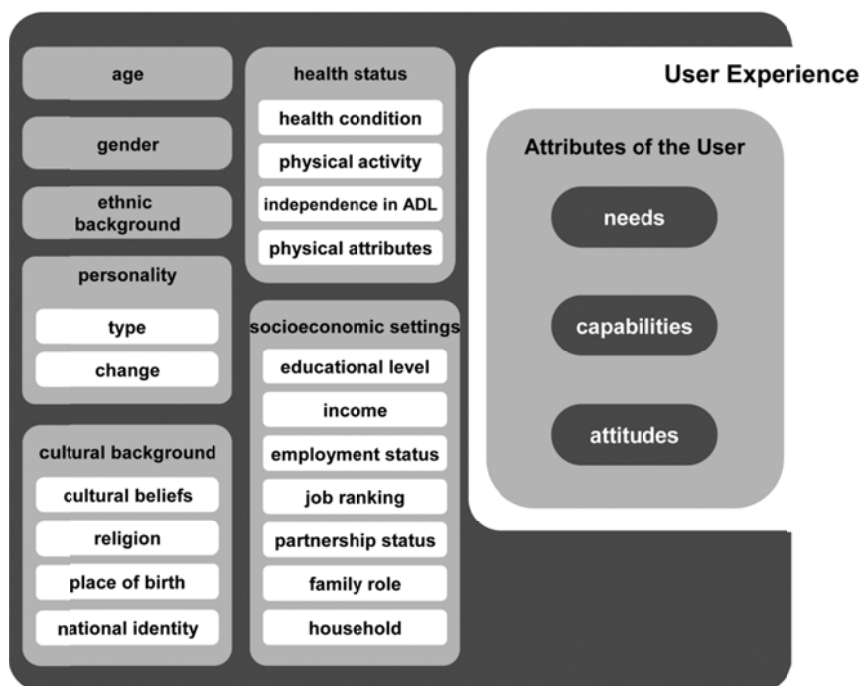


Figure 1. Seven influences (and their related subinfluences) on the attributes of the user

3.2.1 Age

The effects of age or ageing on users' capabilities have already been discussed above. Other research has focused on the relationship between ageing and users' needs, or explored how ageing influences

(some or all) the components of users' attitudes [Gregor et al. 2002]. It is believed that exposure to technology in early adulthood generally leads to a more favourable and open behaviour towards technology throughout life and, in similar fashion, the lack of perceived benefits in older ages can influence less favourable and fearful attitudes towards ICT products. Moreover, previous knowledge, expectations and preferences can vary in different life stages. As discussed before, ageing directly influences needs, capabilities and attitudes. However, it can also indirectly affect attributes of the user by acting on such factors as socioeconomic settings, health status and personality.

3.2.2 Gender

Because of evolutionary development, men tend to be physically larger, take more risks and participate in more dominance competitions. These characteristics are consistent across cultures and reflect personality differences. Differences in personality could partially explain why in many cases more men than women occupy leadership roles and better-ranked jobs, which may lead to higher income. In addition, gender differences related to personality and sociocultural issues also explain why more men than women choose professions which require them to allocate more time to work and less to extra-professional concerns such as family responsibilities. Gender is also linked to variations in the ways that women and men seek social integration and in the nature of the resulting relationships. For instance, divorced/separated/widowed women are more likely than men in the same situation to experience longer periods in mid/late life without a partner. Also relevant is the fact that women live longer, which means longer periods alone in older ages. Furthermore, gender-related conditions are likely to result in limitations in locomotion and dexterity and account for the variation in the pattern and onset of capability loss. In terms of technology use and adoption, differences in personality between genders, compounded by social norms, may lead to variations in aesthetics preferences. However, more relevant to a positive user experience seems to be gendered differences in the frequency of previous experience. Gender gap in ICT use shows that men develop less anxiety towards new media as they acquire more experience with it.

3.2.3 Ethnic background

An issue when using ethnicity as a variable is that people now mix more than in the past and the boundaries that define ethnic groups in biological terms in the Western countries have generally become less evident. However, even when ethnic groups are still relatively homogeneous, factors other than race have been identified as more relevant in predicting health and well-being in older ages. Regarding relationship between disability and race, results suggest that socioeconomic discrepancies, such as low level of education and poverty, generally account for a significant portion of ethnic differences in health status at older ages. Complementary to this, regional life styles associated with cultural differences appear to be a stronger determinant of health than ethnicity per se.

Older users' capabilities may show variation across "ethnic" groups, because of the higher or lower prevalence of disabling conditions caused by differences in habits during life. However, in most cases, the real differences are in cultural background and in socioeconomic settings. It would be interesting to understand whether/how actual ethnic differences may influence or not the ways in which people interact with products and the consequences of this on user experience, while controlling for socioeconomic and cultural differences.

3.2.4 Personality

Personality has been described in terms of covariation among five basic traits – emotional stability, extraversion, openness to experience, agreeableness and conscientiousness. Based on these factors, it is believed that an individual's personality and intelligence can influence professional development and predict career success. This, in turn, may lead to higher rates of technology adoption.

Personality is partly genetically inherited and partly influenced by the individual's sociocultural environment. As people age, culture becomes more influential than genes and gradual changes in personality allow people to adapt more successfully to their environment. Furthermore, changes in personality along life may be one of the reasons for differences in attitudes and behaviour according to the user's life stage and will influence user experience.

3.2.5 Socioeconomic settings

Variables of socioeconomic settings cover a broad spectrum of personal characteristics. For instance, socioeconomic status is directly driven by the level of education (as more educated people get better jobs) and affects health (as less educated people are usually less aware of healthy habits). Because of anticipated discontinuities in professional life for family reasons, women frequently have lower incentives to invest in higher degrees of education, accumulate less work experience and are perceived to be less productive by employers. Consequently, they frequently reach less prestigious positions, earn less money and are less financially self-sufficient. Moreover, inequalities in pay due to differences in speed of promotion can also be observed among different ethnic groups. All in all, this could explain why (well-educated, professionally successful, young/middle-aged, white) men usually spend more money than women on (expensive) ICT products, or are more likely to be given a mobile phone or laptop by the companies they work for. Either way, the consequences of this on user experience are that men have more opportunities to be in contact with ICT products and acquire experience to successfully interact with such products.

3.2.6 Health status

A person's health status is influenced by the presence of health conditions, the level of physical activity and the individual's weight. Living into old age leads to a gradual loss of functional abilities, which results in diminished independence in activities of daily living (ADL), poor quality of life and increased health-related care costs. Ageing causes loss of muscle mass, which inevitably occurs in both sedentary and active ageing adults [Thomas 2007]. As a consequence, there is a decrease in strength and exercise capacity, and decline in function. In most countries, there is a bidirectional causality given that health is one of the human capitals necessary to produce/improve income and income is necessary to sustain/improve health. One of the possible components of health being affected by low income is that the latter is generally associated with lower levels of education, which have in turn been related to unhealthy behaviour that impacts negatively on overall health. Compounded by the cumulative effects of ageing on health, individuals in lower socioeconomic groups may face a higher probability of developing health conditions that translate into capability loss and diminished independence in ADL in later life. As world's populations are ageing, this places a great challenge on design – how can designers develop affordable products/systems/environments that attend to users' diminishing capabilities and independence, while providing opportunities for an active and integrated life?

3.2.7 Cultural background

Culture can be defined as the customary beliefs and values that ethnic, religious and social groups pass almost unchanged from generation to generation [Guiso et al. 2006]. Religion is an important factor because even if people reject it as adults, they still show some common beliefs and preferences absorbed earlier in life. The degree to which people passively accept (or become more critical about) their inherited culture to form their own set of beliefs is directly influenced by their level of education. National identity is another factor of influence within a person's cultural background. For instance, in countries like the UK, people may have different, multiple (national) identities while still being British citizens. Because people cannot alter their ethnicity or family history and only with difficulty they can change their country or religion, it is advocated that these characteristics can be treated as (nearly) invariant over an individual's lifetime [Guiso et al. 2006]. In the context of economic outcomes, culture directly influences expectations and preferences, which impact on people's decision-making process in relation to acquisitions and/or trades of material possessions [Guiso et al. 2006]. In the context of user experience, cultural background influences user's expectations and preferences within user's attitudes. This results in users perceiving a product as more or less desirable according to their cultural background, which has consequences on behaviour towards the product.

In summary, ageing contributes to most of the changes observed during a person's lifetime. As we get older our personalities change, we assume different social and family roles and pursue different educational and work options. We (unwillingly but unavoidably) lose health but become wiser and our

cultural beliefs may become stronger or weaker with time. Such changes have impact on our needs, capabilities and attitudes in relation to products and services and affect user experience.

3.3 Relationships among the influences on the attributes of the user

As discussed above, there are many relationships among the seven groups of factors of influence in the wider context of attributes of the user within user experience, and also within the groups that have subfactors. These relationships can be seen in Figure 2 (it needs noting that each factor's relationship with other factors is marked in different style line for better readability), where: (1) *gender* impacts – socioeconomic settings, health status and personality; (2) *age* – socioeconomic settings, health status, personality and cultural background, which in turn influence all three attributes of the user (needs, capabilities and attitudes); (3) *ethnic background* – socioeconomic settings and cultural background; (4) *personality* – socioeconomic settings and health status and overall attitude of the user; (5) *cultural background* – socioeconomic settings, health status, personality and overall attitude of the user; (6) *health status* – socioeconomic settings and overall capabilities of the user; and (7) *socioeconomic settings* – health status and personality and overall user needs. In addition, black dotted lines within cultural background and socioeconomic settings represent possible relationships and grey dotted lines within socioeconomic settings signify relationships that relate mostly to women. In general, age, gender, educational level, presence of health condition, personality type and attachment to cultural beliefs seem to be of greater influence. Others, although concluded from the literature, needed to be verified by a field study. Section 4 of this paper reports on a survey carried out for this purpose.

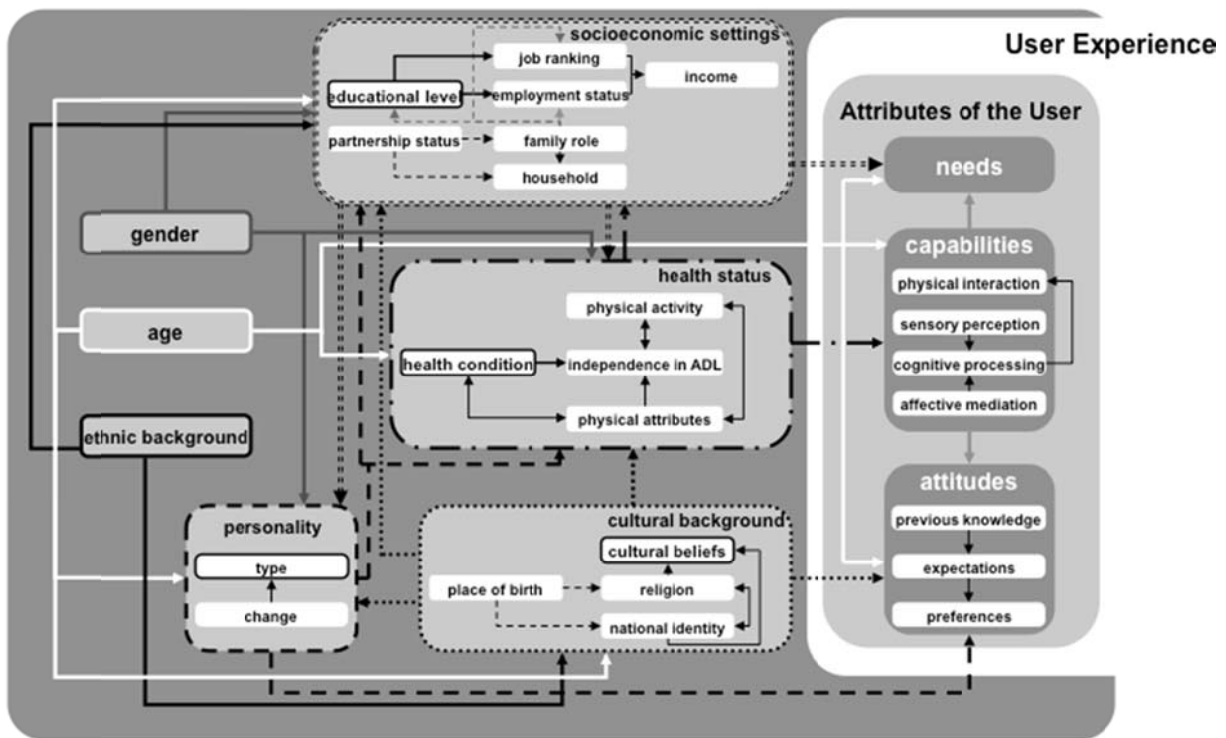


Figure 2. Relationships among influences on the attributes of the user

3.4 Context of use

Apart from the aforesaid influences on the attributes of the user and those acting on the attributes of the product, other factors may play a role in the experience. With the widespread use of portable handheld devices, researchers have become steadily more concerned with the context in which a given product, system or service is used. In the authors' understanding, context of use is made up of: (1) situation of use (*how?*), (2) environment of use (*where?*) and (3) time of use (*when?*). Situation of use refers to how the psychological characteristics of the user are, in the moment or period of time when the user interacts with the product. Environment of use refers to the technical and physical conditions

of the surrounding area, where the user interacts with the product. Time of use refers to the moment or period of time when the user interacts with the product. These three attributes are all dynamic and, therefore, temporary. They are also interconnected – every experience takes place in a given time and place, with the user in a particular socioemotional state. It could happen that the situation, and/or the environment, and/or the time of use are favourable or hindering for the interaction. However, the product should be able to cater for the needs and capabilities of the user in any context of use.

4. Survey

Further work was necessary to bring together all the factors that influence user experience (as previously they were either reported on individually or some of them were completely ignored [Medeiros 2011]) to confirm and generalise findings from the population at large. Unlike any other method of observation, surveys are very useful at gathering and describing characteristics of a large population, allow the collection of statistically significant results and are relatively inexpensive (if self-administered). Therefore, a survey was conducted on the topic of people's experience with mobile phones to gather responses from a larger sample that could be representative of the broader population. A mobile phone has been chosen as an example in the survey because, as the world populations are ageing, there is a need for older adults to remain fit, independent and safe and mobile phones allow people to be socially integrated, instantly reachable by family members and caregivers and healthier since frequent interpersonal communication improves people's overall well-being [Medeiros 2011]. Also, despite all the advantages that technology can provide, most mobile phone have not been developed with the older user in mind and, therefore, in the context of the survey study it made sense to investigate them.

Although electronic surveys are usually easier and cheaper to run, the survey was paper-based and not electronically distributed in order to capture the responses of mobile phone users who do not use the Internet. This way, it was hoped that the sample would be more representative of the population at large. A total of 3,593 survey copies were distributed within the Cambridgeshire county in the UK between January and March 2009 and 562 completed surveys were returned to the researchers, which represents a total response rate of 16%. The survey questions, spread across 20 A4 pages, focused on different aspects of the mobile phone experience – from purchase to maintenance costs, purpose and frequency of use, used features and their importance. Besides these, there were questions on the attributes of the user, including: (1) questions on physical interaction including dexterity, size and weight of the device; (2) questions on sensory perception including issues with screen, buttons, lights and sounds; (3) questions on cognitive processing including the abilities to learn and remember how to operate the device; and (4) questions on preferences, which included style, colour and brand, for instance. Furthermore, there were questions on complaints, satisfaction and frustration regarding the handset and service, and on what feelings people attach to mobile handsets and mobile technology.

5. Data analysis

Initial analysis of the survey results involved the running of simple frequency distributions in order to understand the demographics of the sample. Next, the Pearson's chi-square test was used in order to verify correlations between pairs of variables in cross-tabulations. The intention was to identify relationships that would be helpful in better understanding users, from a social perspective. Most frequently, variables were contrasted to age, gender, education, employment status, job rank and income, in order to characterise users' life stages and life styles. In some cases other relevant variables were also tested, when necessary to visualise some correlations more clearly. Sometimes it was necessary to control for one variable to investigate the relationship between two other variables.

During the analysis, the seven factors (and their subfactors, when applicable), identified during the literature review, were contrasted using cross-tabulations so that existing correlations could be visualised (see Figure 2). These factors included age, gender, ethnic background, socioeconomic settings, health status, personality and cultural background. Combined with findings from the literature, this process sought to understand the dynamics among (and within) such factors of influence, even though the analyses were based on correlations and not on causality.

6. Results and discussion

Survey results suggest that, although interwoven, not all variables are of the same importance for the user experience. In particular, age, gender and education are strong influences because they affect other dimensions of life, such as health status and personality. However, age was found to be the strongest among all factors because it also influences cultural background (at least the level of attachment to beliefs and religion), and directly impacts on the attributes of the user – needs, capabilities and attitudes (see Figure 2). In the context of ICT products, there was a clear division line – better-educated respondents, who were less frequent mobile phone users, on one side, and less-educated respondents, who used their mobile phones more often, on the other side. A similar division line was observed in relation to gender – women used a variety of other electronic products, and spent less money on mobile handsets and service, whilst men tended to concentrate on the use of computers and mobiles, and paid more money for their handsets and maintenance cost. Lastly, age was perhaps the biggest divisor – the way young adults, middle-aged adults and older adults interacted with technology was simply different. It is not only the frequency of use (and associated expenditure) that is in question, but also important are concepts such as attitudes towards when and where the use of mobile phones is appropriate, the needs towards and reasons for using such products, the way users interact with mobile phones in the four levels of response (physical, sensory, cognitive and affective), and the resulting user experience. Despite being related to the age, gender and education, the other variables seem to occur either as consequences or in a less statistically significant level. For example, generally, gender-related differences lead women and men to pursue complementary but different goals in life. Such differences will, at some point in life, be reflected in women and men's socioeconomic status, health, attachment to culture and changes in personality.

Overall, the results of this work provide insights into the relationship between users' needs, capabilities and attitudes across different life stages and the utility of modern technology products. These insights could potentially be used in the industrial context in order to make more informed decisions about producing better products that encourage adoption and bring more gratifying experiences to their users' lives. For example, as noticed from the survey, while many young students may be thrilled by mobile phones with big touch screens, cameras and media players, economically active adults may prefer handsets which provide easy access to the Internet, and can send and receive emails for professional reasons. In contrast, retirees might want a mobile phone which presents a legible keypad and screen, and exhibits restricted functionality, perhaps only making phone calls and sending text messages. What many people in later life stages are usually unaware of is that they could compensate for cognitive decline by making use of currently existing features such as task reminders, voice memos, notes, alarms, address book and organiser if they just knew how to access and use these frequently ignored functions, or better, if these functions were designed with these users in mind.

In terms of identifying critical concerns in the user experience and the consequent behaviour towards technology, according to life stages, it was observed that for the three main stages of adulthood – early, middle and late – there was potentially a dominant relationship between one of the three attributes of the user and one of the product. Capabilities-usability issues, for example, seem to be more likely to prevent older adults from using a product. Attitudes-desirability issues may be more influential to middle-aged adults' decision to stay aside the mainstream or join in, and needs-utility issues may represent a greater and deeper concern for young adults due to social imposition. Hence, in the process of product development, it is important to consider users of different life stages and their specific characteristics.

7. Conclusions

This paper discussed the framework of seven factors of influence on user experience in different life stages developed based on the findings of a literature review and the results of a survey with 562 individuals. The research presented here-in has found that out of the seven factors of influence – age, gender and education – are the most prominent because they affect other dimensions of life, such as health status and personality. However, age was found to be the strongest among all factors because it

not only impacts on users' capabilities but also influences the level of attachment to cultural background and related beliefs, which directly impacts on users' need and attitudes.

In conclusion, the ageing process causes many changes in people's functional capabilities, which result in: (1) several behavioural adaptations that compromise the product's usability; (2) shifts in social roles and economic resources that affect users' needs in relation to a product's utility; and (3) age-related differences in general knowledge and attachment to cultural beliefs that influence users' attitudes and the degree to which a product is perceived as desirable. Altogether, these changes directly impact on how people respond to products and also how they experience them. The resulting experience ultimately influences people's quality of life as they will not adopt technology they cannot use, or are not motivated to use, even if that technology could potentially be of benefit to them. The framework and implications presented in this paper aim to assist researchers and designers in the development of better design guidelines and products, which, combined, can contribute to an increase in the user's overall well-being, especially in later stages of life. Finally, it is noteworthy that, although technology is rapidly developing, it takes a long time for the entire population to adapt to innovations. Therefore, designers should not just take into account users' past experiences, present physical capabilities and limited contexts of use; it is equally important to look ahead and design for the future, integrating technology products and systems into people's different life stages in a way that is less frustrating and less frightening. After all, positive experiences with products are more likely to be remembered and repeated, and this makes the adoption and use of technology a more natural and pleasurable process.

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