Using Laddering to Understand the Use of Gamified Wearables by Seniors

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Abstract: Gamified wearables have the potential to assist seniors in living independently with a good quality of life. However, the use of (gamified) wearables by seniors is very limited. The uses and gratifications theory states that needs motivate the use of computer mediated communication. Therefore, this qualitative study aimed to find the needs that motivate the use of gamified wearables by seniors. Laddering interviews have been conducted with a group of 12 seniors that live independently in their own homes. Four needs were identified: the needs for 1) good health, 2) accomplishment, 3) independency and 4) peace of mind. The need to be healthy and the need for accomplishment could be fulfilled by the gamified wearable and motivated seniors to use it. However, the needs for independency and peace of mind were undermined by the gamified wearable Participants expected the gamified wearable to make them less independent and diminish their sense of accomplishment of being healthy autonomously. The participants also feared information anxiety caused by information about their physical health, which they expected to undermine their peace of mind. This study concludes that a more user-centric design is needed for the gamified wearable to meet the needs of seniors.

1 INTRODUCTION

Worldwide, countries face aging populations, a development that results in pressure on health care institutions. This view is supported by Bharucha et al. (2009, p.1), who state that "the graying of the world population poses formidable socio economic challenges to the provision of acute and long-term healthcare". Arnrich, Mayora, Bardram and Tröster (2010) argue that "a massive increase of chronic disease conditions and age-related illness are predicted as the dominant forces driving the future health care" (p.67). These health issues could thus decrease the quality of life of seniors and increase the costs of healthcare. It can therefore be argued that new solutions need to be found.

One of the proposed solutions to this impending problem is a focus on preventative health care in the form of health technology. A variety of health technologies have been researched and potential to help seniors live independently in their own home with a high quality of life has been found (Arnrich et al., 2010; Fritz, Huang, Murphy and Zimmermann, 2014). However, Frisardi and Imbimbo (2011) found that health technologies are not widely used by seniors. Thielke et al. (2012) argued that the lack of fulfillment of specific needs of seniors resulted in limited use of health technologies. This study will apply the uses and gratifications (U&G) approach of Katz, Blumler and Gurevitch (1973) to provide an understanding of the needs that motivate seniors to use a recent health technology: the gamified wearable.

While literature suggests great potential in the use of gamified wearables as a health technology, Kekade et al. (2017) found that currently the use of (gamified) wearables by seniors is very low, similar to other health technologies. Conci, Pianesi and Zancanaro, (2009, p.63) argue that "there is no evidence that that older people reject technology more than people of other ages; elderly, as anyone else, accept and adopt technology when the latter meets their needs and expectations". This view is supported by the uses and gratifications approach taken in this study (Katz et al., 1973), which argues that needs determine which type of media is used. It is therefore hypothesized that the limited use of gamified wearables is caused by the technology not meeting the needs of seniors. This study therefore aims to find the needs that motivate seniors to use a gamified wearable for health purposes. Based on the needs of seniors, this study aims to provide recommendations for the design of a

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gamified wearable for seniors. The following research question is formed: *What needs motivate seniors to use gamified wearables?*

2 THEORETICAL FRAMEWORK

2.1 Health in Seniors

Because of the graying of the population worldwide, significant health challenges occur, especially for seniors. According to Tak, Benefield and Mahoney (2010) the aging population in the US will cause unprecedented challenges for the long term care industry as the number of older persons who have cognitive or physical limitations soars.

In order to face these challenges, a more preventative health care model is needed (Arnrich et al, 2010). Preventative health care has the aim of helping seniors live independently in their own homes with a high quality of life. While the number of factors that cause health risks and need preventative care are numerous, this study is focused on preventative care in the form of supporting physical activity, a healthy diet and mental health. According to the World Health Organization (2002) both inactivity and an unhealthy diet cause major health risks, such as strokes, heart disease and cancer. Besides these two factors, stress was also found as a cause for heart disease.

2.2 Health Technologies

One of the provided solutions for the pressure on health care is the use of health technologies to help seniors live independently in their own homes for a longer time with a good quality of life. This can be done in various ways, by providing feedback on health, reminding seniors to take their medicine, or assisting them in daily activities.

In recent years the use of technology to motivate healthy behavior has been a growing area of research (Fritz et., 2014). According to Zuckerman and Gal-Oz (2014) this focus on the use of technology to motivate healthy behaviour is because these technologies have the potential to improve quality of life. According to several studies health technologies do not only have the power to improve life quality, but can also reduce costs of healthcare (Spil, Sunyaev, Thiebes and Van Baalen, 2017; Tak et al., 2010).

It can be concluded from recent literature that researchers foresee great potential in the use of health technologies to shift the health care model towards a more preventative form, as they offer seniors a way to remain independent for longer, with a higher quality of life. This study is focused on a recent health technology: the gamified wearable.

2.3 The Gamified Wearable

According to Kumar et al. (2013) the use of wearable health information has the potential to reduce the cost of health care and improve well-being in numerous ways. The following definition of wearables is used in this study: “electronic technologies or computers that are incorporated into items of clothing and accessories which can comfortably be worn on the body” (Spil, 2017).

The potential of the use of a wearable as a health technology has been studied in recent years. According to Kumar et al. (2013), wearables are able to “support continuous health monitoring at both the individual and population level, encourage healthy behaviors to prevent or reduce health problems, support chronic disease self-management, enhance provider knowledge, reduce the number of healthcare visits, and provide personalized, localized, and on-demand interventions in ways previously unimaginable”(p.228). Spil et al. (2017) argue that wearables “can provide sensory and scanning features not typically seen in mobile and laptop devices, such as biofeedback and tracking of physiological function” (p.3618).

Recent literature suggests the combination of wearables with a form of *gamification*, to form a new health technology: the gamified wearable (Spil et al., 2017; Tong, Gromala, Shaw and Jin, 2015; Zhao, Etemad and Arya. 2016a; Zhao et al., 2016b). Gamification is defined by Deterding, Dixon, Khaled and Nacke (2011, p.9) as “the use of game design elements in non-game contexts”. According to Deterding et al. (2011) gamification can inherently motivate people by improving engagement. McKeown, Krause, Shergill, Siu and Sweet, (2016) agree with this view, identifying gamification as “a powerful technique to promote engagement and motivation”(p.67). Cugelman (2013) states that gamification does work, but only under the right circumstances and when used in the right way. According to Cugelman (2013, p.2), “technology is only persuasive when it employs specific behavior change ingredients. Pannese, Wortley and Ascolese (2016, p.1290) argue that “whilst games are stereotypically associated with the younger generation, there are significant potential benefits and a general acceptance of games in the ageing

population". It can be concluded that gamification has the potential to motivate healthy behaviour in users.

Zhao, et al. (2016a, p.239) researched the combination of wearables, gamification and health and fitness to enhance traditional obesity intervention. Their study found that "based on existing technologies and user needs, the idea of employing wearables activity trackers for gamification of exercise and fitness is feasible, motivating, and engaging". Spil et al. (2017, p.3623) also found that wearables and gamification can "function as complementary technologies, which are strengthening each other".

While the use of gamified wearables has the potential to prevent health issues for seniors, Kekade et al. (2017) found that the current use of wearables by seniors is very low. It can be concluded from the available literature that the gamified wearable could be a promising health technology for seniors because of its positive effect on users' motivation to live healthy. Both wearables and gamification possess motivational elements and are hypothesized to strengthen each other. However, use of (gamified) wearables by seniors is still very limited.

2.4 Uses and Gratifications

To better understand the limited use of gamified wearables by seniors, this study applies the uses and gratifications (U&G) approach by Katz et al. (1973). U&G theory provides an understanding why people become involved with a certain type of media, which has great significance in understanding the use of computer-mediated communication (Ruggiero, 2000). According to Lin (1999, p.200) "uses and gratifications has proven to be an axiomatic theory in that its principles are generally accepted, and it's readily applicable to a wide range of situations involving mediated communication". This paper argues that gamified wearables are a relatively new form of computer mediated communication and therefore the uses and gratifications approach is applicable to better understand its limited use.

The U&G process follows the premise that users are aware of their needs and select media to gratify those needs (Katz et al., 1973). This means that needs lead to motivations to use certain media (Lin, 1999). It can be argued from the uses and gratification theory that the very low use of wearables by seniors found by Kekade et al. (2017) can be explained by needs of seniors not being fulfilled. According to Blumler (1985), needs relevant in the U&G theory are a type of self-actualization needs, which are described in Maslow's' (1970) pyramid of needs. When applying the U&G approach to health technologies such as the gamified wearable, it has to be taken into account that more primary needs from Maslow's (1970) pyramid of needs have been found to motivate seniors to use health technologies (Thielke et al., 2012).

2.5 Expectations

There is a need for health technologies to prevent health issues and provide independence for seniors. Researchers foresee great potential in the use of health technologies to shift the health care model towards a more preventative form. The gamified wearable can be a feasible and persuasive health technology. It has the potential to motivate seniors to perform physical activity, motivate seniors to eat healthy and decrease stress levels in seniors. The uses and gratification theory (Katz et al.,1973) is used in this study to understand the use of the gamified wearable, as it proposes that the needs of users motivates them to use the gamified wearable. Self-actualization needs of the U&G theory are extended in this study with safety needs, love/belonging needs and esteem needs. While gamified wearables have the potential to fulfil the safety need for good health and accomplishment, particularly challenging needs to fulfil are esteem needs such as independence and love/belonging needs such as sociability and friendship.

3 RESEARCH DESIGN

3.1 Participants

For this research a group of 12 seniors (60+) that are still living at home were interviewed about their needs that motivate the use of gamified wearables. All participants live in the Dutch regions of Overijssel and Gelderland. Participants were recruited using a convenience-sampling approach. The choice for autonomous seniors still living at home is made as the gamified wearable is a health technology that helps seniors to remain independent. The participants are divided into two age groups, 60-70 and 70+ and two gender groups, as female and male participants are interviewed. Participants of both different age and gender groups were interviewed until a data saturation had been acquired, as described by Marshall, Cardon, Poddar and Fontenot (2013). This means that after a certain number of participants, a consensus has been reached and all available data has been gathered. In the study of Guest, Bunce and Johnson (2006), it was found that after three

interviews in each heterogeneous group data saturation was reached. As four heterogeneous groups could be formed between age group and gender, 12 participants were interviewed. After 12 interviews it was concluded that for this study, indeed data saturation was reached, as no new results surfaced.

3.2 Methods

As this is an explorative study a qualitative method is used. By using interviews this study explores what the needs of the target group are that motivate them to use gamified wearables. A means-end approach: the *laddering* technique, as described by Reynolds and Gutman (1988), is used to identify seniors' needs. This method is used because, as described by Reynolds (1985), rather general classifications fail to provide an understanding, specifically, of how the concrete aspects of the product fit into the consumer's life. With the laddering method it is possible to determine the consequences for consumers that originate from product attributes that eventually results in disclosing the needs of consumers. The results are shaped as 'ladders', built up from an attribute level, to a consequences level, ending at the needs level. This means-end approach "views consumers as goal-oriented decision-makers, who choose to perform behaviours that seem most likely to lead to desired outcomes" (Costa, Dekker and Jongen, 2007, p. 404.) This form as good fit with the U&G approach used in this study, which states that users are aware of their needs and select media to gratify those needs (Katz et al., 1973). Traditionally, means-end-chains (MEC's) are built up to the value level, but Costa et al. (2007 p.412) concluded in their overview of means-end theory that it offers "an improved understanding of which are the relevant consumer needs and which product attributes deliver those needs". This study therefore uses laddering to find needs, instead of personal values.

Before the interview sessions, participants were asked to fill in a form of consent to conduct the interview. The form also emphasized that there were no wrong or right answers. To provide context on the lifestyle of participants, the interview started with general questions about the participants' lifestyles regarding health and computer mediated communication. During the laddering stage of the interview, a free elicitation method was used. This means that participants were first asked to freely identify attributes of the different functions and the design of the wearable. Then they were asked what the consequences of these attributes were for them and why they identified these consequences. As an integral part of the laddering method, during the interviews, the interviewer kept asking follow up questions until the need level had been reached or resistance from the participant to further questions was encountered. As soft laddering method as described by Costa et al. (2007) was used, which means associations between attributes, consequences and needs were reconstructed subsequently during the analysis. Interview sessions took between 20 minutes and 45 minutes to complete. The interviews were recorded on a mobile phone and took place in the homes of seniors, or in other locations they preferred to meet.

3.3 Analysis

The results were analysed by using Atlas.ti. In the program, the interviews were codified, by clustering remarks made by the participants under overlapping codes. For the laddering analysis, remarks made were codified in groups of attributes, consequences and needs. After identifying all attributes, consequences and needs, hierarchical need maps (HNM's) were constructed for the functions of the wearable and design factors. These HNM's combined the various 'ladders' of attributes, consequences and needs. Following Reynolds and Gutman (1988) a cut-off point is chosen for the HNM's to only display the most informative results. For this study, a cut-off point of 2 is chosen for the laddering analysis because of the limited number of participants. This means only relations are shown if mentioned by at least two participants. The intention of this study was also the provide insight in the difference between the two age groups and genders, but no clear differences could be identified.

4 RESULTS

4.1 Lifestyle: Health and Technology

During the start of the interview general questions were asked to provide an overview of the lifestyles of the participants. Participants of this study were found to be relatively physically active, with most of them walking or cycling. Most of the participants

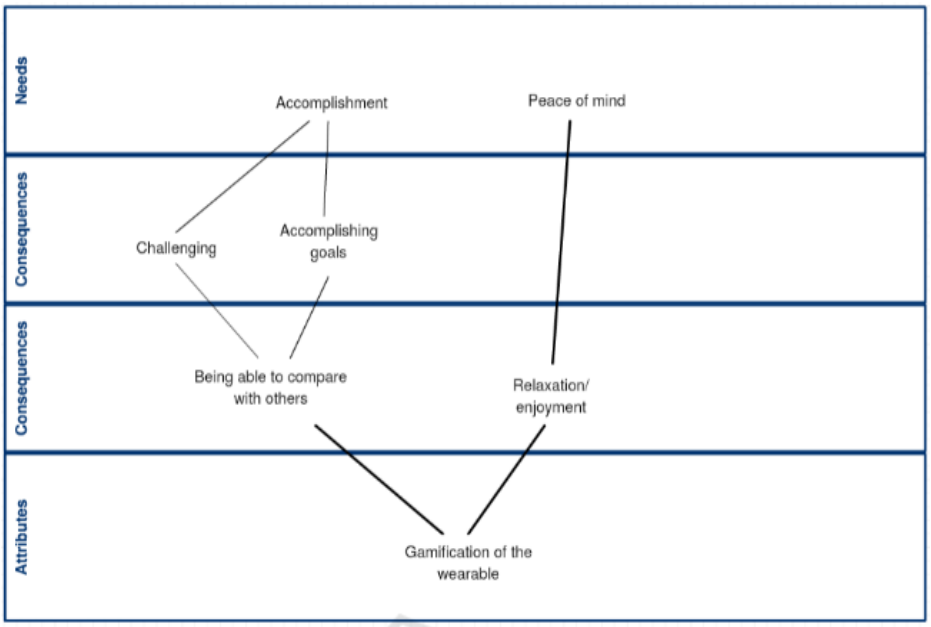

Figure 1: Hierarchical Need Map of Wearable Functions (Cut Off: N=2).

also described themselves as eating relatively healthy. Participants found living healthy to be important. Main factors that were of importance for a healthy lifestyle identified by the participants were physical activity and a healthy diet.

Participants were also found to be relatively familiar with the use of computer mediated communication, with them using it for work, social purposes, to look up general information, to measure their exercise or for gaming. It should be noted that all participants were using computer mediated communication for at least one purpose.

4.2 Wearable Functions

Part of the interviews focused on the specific functions of the wearables. Three different functions of the wearable were discussed during the interviews: the support of mental health, the support of a healthy diet and the support of physical activity. The results of the laddering analysis for the wearable functions are displayed in a HNM in figure 1. The prevalence of these relations is indicated by the width of the lines connecting them.

Attributes of the functions of the wearable that were identified were the providing of information about physical health, physical activity, diet and mental health. Part of the participants expected the information to be unnecessary and did not want to receive it. The need found for this consequence is independence, as participants saw themselves as being perfectly capable of maintaining their health by themselves. This was illustrated by one of the participants saying: “I already walk a lot, so I wouldn’t know why I would need a thing like that”. Another participant stated: “no I can do that by myself, I’ll do that myself”.

Participants did not want to receive information about their physical health (e.g. blood pressure, heart rate) because they expected this to have a consequence of them worrying about the information. They expected this worrying to have the consequence of information anxiety, for which the need of peace of mind was found. The consequence of worrying about the information was demonstrated by a quote from one of the participants: “then you will worry when it's not necessary. For me that would be an objection to measuring everything exactly”. Another participant stopped using health technologies because of this consequence, saying “I was going crazy because I was constantly occupied with that”.

Other participants expected positive consequences for the information about diet, physical activity and mental health. They expected the information to show useful feedback on stress levels, their diet and their physical activity. A participant stated for example: “well, that would give me information about whether I meet the requirements for a healthy life”. Participants expected this useful feedback to help them improve their physical activity and diet and help them deal with stress. For these expected consequences the need for good health was

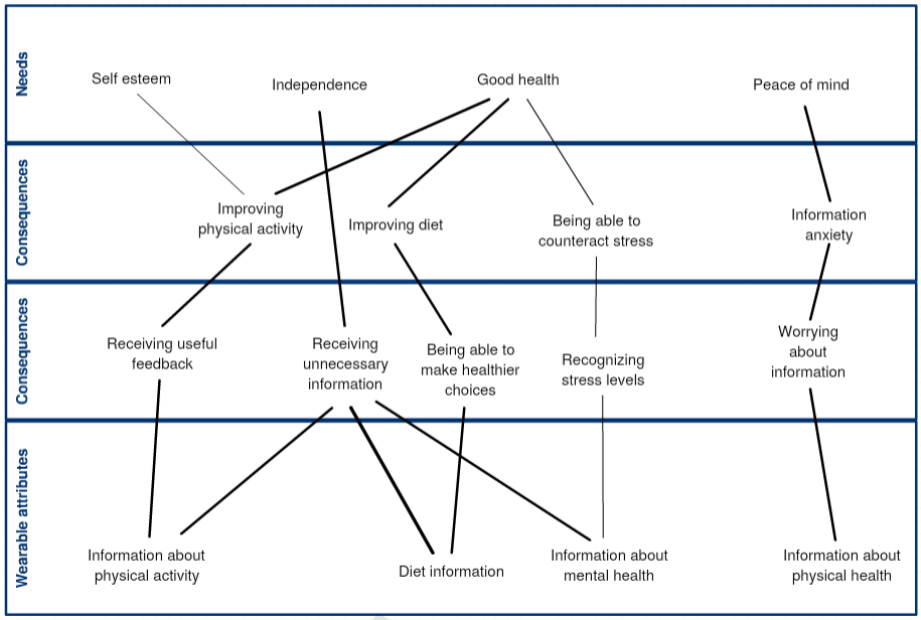

Figure 2: Hierarchical Need Map for Gamification of the Wearable (Cut Off: N=2).

found. A need found specifically for improving physical activity is accomplishment.

4.3 Gamification

In figure 2 the consequences and needs of gamification of the wearable are presented in a HNM. The prevalence of the relations is again indicated by the width of the lines connecting the relations. A positive consequence identified is 'being able to compare with others', which refers to the participants expecting the gamifications to enable them to share and compare their health information with others. They mainly referred to data about their physical activity when describing this consequence, which was expected to be challenging them, causing them to accomplish goals and therefore fulfil their need for accomplishment. One participant stated that "It's a challenge towards each other, you can see how many steps everyone has taken in a week". Others saw the ability to play games on the wearable as an opportunity for relaxation or enjoyment, for which the need for peace of mind was found.

4.4 Design Factors and Support

Besides the functions of the gamified wearable, the interviews also focused on the design and support for the use of the gamified wearable. The attributes, consequences and needs can be found in the HNM displayed in figure 3. Once more the prevalence of the relations is indicated by the width of the lines.

One of the attributes discussed by participants is the perceived simple design of the wearable. This attribute had the consequence of the gamified wearable being easy in use, which led to an expected consequence of feeling secure. For this consequence a need for peace of mind was found. Support in the use of the gamified wearable is found to have a consequence of getting explanations/being able to ask questions, which also had the consequence of feeling secure, originating from a need for peace of mind. Participants identified a complicated manual as an attribute they often encountered when using new technology, stating that "manuals for new devices are sometimes badly designed". This had an expected consequence of the gamified wearable being difficult to use, which in turn had an expected consequence of feeling insecure. It was found that this consequence undermined the need for peace of mind.

5 DISCUSSION

5.1 U&G Approach and Laddering Method

In this study a U&G approach is used to understand the use of gamified wearables by seniors. The premise of the U&G theory that consumers actively choose their media use based on their needs offered great insights in the (limited) use of gamified wearables by seniors. This line of thinking is supported by the find-

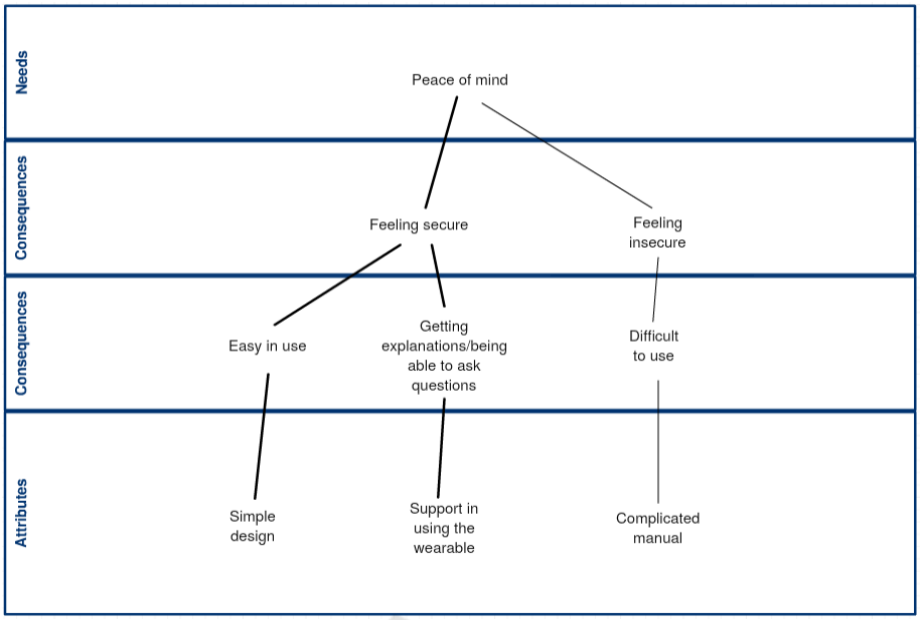

Figure 3: Hierarchical Need Map of the Design Factors and Support of the Gamified Wearable (Cut off: N=2).

ings of other studies that health technologies are rejected by seniors when they do not fit their needs (Copelton, 2010; Neven, 2010). This study however did find the need to extent upon the self-actualization needs included in the U&G approach, as for health technologies more primary needs from Maslow's (1970) pyramid of needs motivate the use of seniors (Thielke et al., 2012). Based on the literature review and results, this study proposes that in order to understand the use of computer mediated communication that aims to improve health, such as health technologies, the including of safety needs and esteem needs in the U&G approach is necessary. Seniors were found to be motivated to use the wearable by 1) the safety need for good health, 2) the esteem needs for independence and accomplishment and 3) the self-actualization need for peace of mind. The need for sociability was expected to be challenging to fulfil by the gamified wearable, this need was however not found to be undermined, nor fulfilled by the gamified wearable. It could be argued that the gamified wearable is a health technology aimed at seniors living independently in their own home, thus not replacing personal health care and limiting social relations of seniors.

This study uses the laddering technique as described by Reynolds and Gutman (1988) as its method. The use of laddering enabled this study to not only understand the use of gamified wearable by seniors on a surface level, but to look beyond mere acceptance and use and offer qualitative insights in the cognitive structures of seniors regarding the use of this health technology.

5.2 Lifestyle of Participants

The participants interviewed all had a fairly active lifestyle, with almost all of them either walking or cycling regularly. It is important to note this, as the relatively healthy lifestyle of the participants of this study could cause them to have other needs than seniors who are less active.

Participants of this study were also familiar with computer mediated communication, as all of them regularly used a type of computer mediated communication. Only a small minority had used health technologies before. This familiarity with computer mediated communication could make participants feel more at ease in using the gamified wearable.

5.3 Safety Needs: Good Health

Participants expected the information about their physical activity, mental health and diet to give them useful feedback on these health aspects and expected these attributes to fulfil their need for good health. The need to be healthy is one of the primary human needs according to Maslow's (1970) hierarchy of needs, as it belongs to the 'safety needs', which are the second needs a human has, only above physiological needs. However, fulfilling the need for good health only leads to the use of a health

technology if individuals share the developers concerns about health (Thielke et al., 2012). That some participants did not identify the need for good health to motivate them to use the wearable might seem contrasting to the hierarchy of needs that states that the primary needs first have to be fulfilled before individuals can focus on other needs. However, these participants might already feel secure in their health, which causes them to try to fulfil needs higher up the pyramid of needs, such as the esteem needs and self-actualization needs described later in this discussion. It can be concluded that the group of participants that identified the need for health as motivating to use the gamified wearable shared concerns about their health and expected the information about their physical activity, diet and mental health to fulfil this need.

5.4 Esteem Needs: Accomplishment and Independence

The need for accomplishment, described as an esteem need by Maslow (1970) in his hierarchy of needs, was found when discussing the attribute 'information about physical activity'. It can be argued that being physically active is something seniors are proud of and through the use of a wearable, can show to others. It can also be hypothesized that being physically active is more important for the esteem of seniors than dealing with stress or eating healthy. Recent studies still support the notion that people strive for accomplishment. For example, Crocker and Park (2004) argue that in domains in which their self-worth is invested, people adopt the goal to validate their abilities and qualities, and hence their self-worth. This study supports this conclusion and shows that, when provided with information about physical activity, seniors see this as a way to validate their abilities and qualities and to help fulfil their need for accomplishment.

This study found that gamification can also help to fulfil the need for accomplishment. Participants expected games to give them the opportunity to compare their physical activity with others and challenge them, which they expected to provide them with a sense of accomplishment. Participants also expected playing games to be relaxing and to provide enjoyment, satisfying their need for peace of mind. The fulfilment of these needs by games is in line with the motivating strategies composed by Cugelman (2013), who proposed that in order for gamification to work and provide a health intervention, social connectivity and the comparing of progress have to be present. This study finds that the gamification of wearables can be very useful in fulfilling the need for accomplishment of seniors, as it gives opportunities to set goals and compare oneself with others. It is found that, in line with previous studies such as that of Spil et al (2017) and Zhao et al. (2016, a) gamification provides a useful addition to wearables, providing the ability to satisfy the needs for accomplishment and peace of mind.

However, not all participants saw the gamified wearable as a way to satisfy their esteem needs.. Some participants viewed the information from the wearable as unnecessary and seemed to have a strong desire to remain independent of technology to live healthy. This need for independence is classified as one of the esteem needs by Maslow (1970). The need for independence in seniors is prevalent in literature. Thielke et al. (2012) described the fact that that health technologies may undermine esteem needs by limiting independence as a 'particular challenge'. Neven (2010) found that the developers of health-enhancing robots expected their users to want and be in need of help, but the older adults they surveyed strongly rejected this position, defining themselves as capable and independent, and finding the robots "obviously not for me". Similarly, elderly with diminished health expressed that monitoring technologies would be useful for "the person who absolutely needs it", but not for themselves (Mann et al., 2001–2002).

The gamified wearable is a technology to prevent mental and physical issues instead of a tool curing these problems. It can be argued that such preventive health technologies are not seen as an absolute necessity to be healthy by seniors. So, as long as seniors still think they are able to live healthy without assistance, they prefer to get the feeling of being independent that comes with it, instead of feeling reliant on technology. To this group of seniors, the gamified wearable fails to convince them they can remain independent longer by using it and does not adequately address their needs. It can be concluded that for them, information about their physical activity, diet and mental health undermines their need for independence.

5.5 Self Actualization Needs: Peace of Mind

The attribute of providing information about physical health (i.e. blood pressure, heart beat) was expected by participants to make them worry about the information as a consequence. For example, they expected it to lead to them worrying about their slightly high blood pressure. The need that was undermined by this consequence is the self-

actualization need for peace of mind. This phenomenon of information leading to worrying is adequately described as *information anxiety* by Bawden and Robinson (2009). This is a new finding, as information anxiety regarding the use of health technologies is not discussed in relevant literature. Besides the content of the information, the frequency also has the potential to lead to anxiety: instead of going to the doctor once a year, the participants expected to get daily worrying information about their health status. This could lead to information anxiety through *information overload*. Bawden and Robinson (2009) state that "the feeling of overload is usually associated with a loss of control over the situation, and sometimes with feelings of being overwhelmed. In the extreme, it can lead to damage to health" (p.183). It was found by Given, Ruecker, Simpson, Sadler and Ruskin (2007) that anxiety and stress caused by information overload can be particularly strong in seniors. In this study it was found that the anxiety from the gamified wearable is caused by both the potentially worrying nature of the information as well as the frequency which was expected by participants to be very high. It can be concluded that information about physical health, contrary to other forms of information, undermined the need for peace of mind.

Other attributes that are of importance in fulfilling the need for peace of mind were found to be the design attributes of the gamified wearable, the support participants received from the manual and from others in the use of the gamified wearable. The attribute participants identified in the design of the wearable was that it had a simple design, meaning few buttons and other seemingly difficult design functions. Marschollek et al. (2007, p.258) found that "The user interface should be intuitive, easy to use, and adaptable to individual preferences". This study shows that a simple design can help fulfil the need for peace of mind when using the wearable. Besides the design, participants expected support from others to enable them to ask questions and understand the technology better, leading to more security in using the technology and peace of mind. The findings in this study are in line with the hypothesis of Phang et al. (2006, p.6) that "as senior citizens may be relatively unfamiliar with computers, they may value support available from surrounding people to solve the problems that they face in their effort to use computers". Furthermore, participants expected the gamified wearable to have a complicated manual, as according to them this is often the case when they try to use new technology. The need for a simple manual is in line with findings in literature: Kobayashi et al. (2011, p.95) found that when working with mobile touchscreens, the elderly participants "were often confused due to unclear instructions".

It can be concluded that in order to provide security in the use of the wearable and to fulfil the need for peace of mind, seniors need to receive sufficient support from the manual and from others. Besides, the design of the gamified wearable needs to be easy in use, without many more complicated features.

5.6 Working towards a User Centric Design

It has been found that several needs of seniors are not met by the gamified wearable, which, following the U&G approach (Katz et al., 1973), explains the limited use of wearables by seniors. This is problematic, as there is much pressure on the current healthcare model and health technologies such as the gamified wearable have the potential to play a role in the transition to a more preventative healthcare model. To fulfil the aim of helping seniors live independently in their own home, this study proposes several adjustments to its design. The argument that adjustments are needed to make the design of gamified wearables more user-centric is strongly supported by Thielke et al. (2012, p.485), who state that "many technologies which intend to improve quality of life, health, and independence may not address the specific needs which are directly relevant for individuals". Besides, "researchers and developers should remember at all times that users are at the centre and that technology should be built for them" (Augusto, 2009, p.12).

While the needs for good health, accomplishment and peace of mind (by gamification) motivated participants to use the gamified wearable, the need for independence and the need for peace of mind (by information about physical health) are undermined. This study argues that the undermining of esteem needs and the need for peace of mind are critical barriers for the use of the gamified wearable, following Thielke et al. (2012, p.483), who argue that "people will not engage consistently in behaviors which do not satisfy the specific needs which apply to them at a particular time".

To overcome the barrier of undermining the need for peace of mind, several recommendations can be done. Firstly, peace of mind is expected to be undermined by seniors because they expect information about their physical health to give them information anxiety. This anxiety can be (partly) removed by designing the gamified wearable in a

highly adjustable way, allowing seniors to specifically select the nature and frequency of information, as well as the way they are notified of this information. This way, the wearable can fulfil health needs in specific health areas where seniors desire assistance, without overloading them with information or causing information anxiety. Besides altering the functions of the gamified wearable, a simple design, support from others and support from a comprehensive manual can provide security in the use of the wearable and help fulfil the need for peace of mind.

Removing the barrier of undermining the need for independence is far more challenging, because the very nature of the gamified wearable is to assist seniors in tasks they are still able to do independently. However, if the message is conveyed properly that health technologies such as the gamified wearable can help seniors live independently in their own homes with a good quality of life, use can increase. If seniors accept that the gamified wearable may diminish their need for independence on a short term, but can help fulfil it in the long term, this barrier can be overcome.

6 CONCLUSIONS

The U&G method in combination with laddering proofed to be very valuable in conducting this study.

This study aimed to find the needs that motivate seniors to use a gamified wearable. Three fulfilled needs were found: 1) Good health from information about diet, physical activity and mental health 2) accomplishment from gamification and 3) peace of mind from gamification, simple design and support. Two undermined needs were found: 1) independence, from information about diet, physical activity and mental health and 2) peace of mind from information about physical health. To realize and overcome the undermined needs, gamified wearables have to be developed in close harmony with the elderly users as laid out in the discussion.

7 LIMITATIONS AND RECOMMENDATIONS

This study calls, following Augusto (2009), for a more user-centric design of gamified wearables. It proposes to design the wearable in a more adjustable way, so users can choose the nature and frequency of the health information they receive to fulfil their individual needs. Besides, the design of the gamified wearable should be simple and support should be given by others and by a comprehensive manual. This can increase the sense of security in use and help fulfil the need for peace of mind.. In order to fulfil the need for independency, while challenging, new ways should be found to convey that gamified wearables can provide independency on the long term, by preventing health issues. It can be concluded that while the gamified wearable has the potential to assist seniors in living independently in their own homes with a good quality of life, changes in the design are required to fit the needs of seniors.

This study its main limitation is one often found with the use of a laddering method: it sometimes resulted in resistance in the participants. Another limitation is the validation of the results. While previous studies found in literature confirm and explain the needs found in this study, these studies were done in different contexts and concerned different health technologies. More studies regarding the use of gamified wearables by seniors are therefore necessary, both in a qualitative and quantitative form.

Besides, specific research is needed on the gamification aspect and the needs of seniors. It is needed to test different gaming elements and interview seniors about their opinions. Furthermore, research is needed on the relation between health information and information anxiety in seniors, as this was found to lead to one of the main barriers for the use of the gamified wearable: the undermining of peace of mind. Further research is also needed on the need for independence in seniors, as this seems one of the most challenging barriers for the use of health technologies. In depth qualitative research is needed on how to convey to seniors that the gamified wearable and other health technologies can assist them in their independence in the long term, instead of just diminishing their independence in the short term.

Lastly, this study proposes more research on the further possibilities of the gamified wearable, as the combination of information and gamifications offers many opportunities. The needs fulfilled or undermined by a gamified wearable that supports medicine intake or is used to quit smoking are examples of areas where research is needed.

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