CHALLENGES AND LIMITATIONS OF APPLYING AN EMOTION-DRIVEN DESIGN APPROACH ON ELDERLY USERS

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ABSTRACT
Population ageing is without parallel in human history and the twenty-first century will witness even more rapid ageing than did the century just past. Understanding the user needs of the elderly and how to design better products for this segment of the population is crucial, as it can offer a competitive advantage for companies. In this paper, challenges of applying an emotion-driven design approach applied on elderly people, in order to identify their user needs towards walking frames, are discussed. The discussion will be based on the experiences and results obtained from the case study. To measure the emotional responses of the elderly, a questionnaire was designed and adapted from P.M.A. Desmet's product-emotion measurement instrument: PrEmo. During the case study it was observed that there were several challenges when carrying out the user survey, and that those challenges particularly related to the participants' age and cognitive abilities.
The challenges encountered are discussed and guidelines on what should be taken into account to facilitate an emotion-driven design approach for elderly people are proposed.

Keywords: Design for Emotions, Mobility aid, PrEmo, Challenges, Elderly, Walking frame

1 INTRODUCTION
An increasing number of companies realized that the emotional impact of a product is a factor influencing the product experience to an extent that should not be neglected. Emotions have a strong influence on how we perceive and experience the world around us which is also the case when we interact with products [4]. The usability of products determines if the product can be used, while the emotional component of it determines if the product will be used [8]. Therefore, product success is closely related to the subjective response of the customers.
Don Norman states different ways to define how one responds emotionally to a product: visceral, behavioural and reflective, and these interweave both cognitive and emotional responses [11]. Visceral responses refer to the most immediate level of processing, and appeal to the senses before interaction with the product occurs; behavioural responses are related to the experience of using the product and are usually concerned with the product's interaction; reflective responses are about one's thoughts after using and owning a product, hence are often connected to self-image and status.
The ones using emotional design methods are not users but generally designers [18], however a study found that the designers of a product and the user of the product do not necessarily agree about the perception that is described by it [1]. Hence, the designer is not always successful in conveying the desired message through their designs. This becomes even more critical when the target user group is the elderly (65+), as they present different challenges from the regular population. Although elderly are quite diverse in abilities and experience, older age is generally associated with a number of well documented changes in sensory-perceptual processes, motor abilities, response speed and cognitive processes, all of which impose requirements on products that are to be pleasurably used by the growing elderly population [16]. In this paper, we will discuss the use of an emotional design approach applied to walking frame users' needs elicitations. Walking frames are products targeting the elderly.
Walking frames assist elderly with reduced mobility capabilities in their daily life and enables transport to places otherwise impossible. In other words they can facilitate a more independent life. This paper is based on the challenges encountered while using an emotion-driven approach for the elicitation of elderly people user needs for a walking frame. The emotion driven case was initiated on

the basis of the hypothesis that the elderly find the walking frames an exposure of their age and physiological decline. Thus they are reluctant to acquire one, even if needed.
At first a questionnaire based upon the product emotion instrument (PrEmo) [4] was developed and applied to elicit the users' needs for walking frames design.
From applying the emotion-driven approach on the elderly several challenges and limitations appeared, as the segment of elderly was quite challenging to work with. Hence, special considerations have to be taken into account, in order to facilitate an adequate collection of data. The PrEmo based questionnaire had to be modified several times in a heuristic manner to counter the encountered age-related challenges. In this paper the challenges and limitations from the case study are discussed and linked to the eventual underlying reasons. Furthermore, guidelines and pointers to relevant considerations that have to be taken when applying an emotion-driven design approach on elderly people are proposed.

Defining the Group of Interest: The Elderly

Most developed countries have a consensus that people above the age of 65 are defined as 'elderly' [17], however this definition does not reflect the demographics in other parts of the world. At the moment, there is no official standard criterion to determine a person as "old". However, the United Nations generally uses 60+ when referring to the older population [17].
In the context of this study the elderly are defined as people aged above 60 with no mental disorders. People with mental disorders are also represented among the Walking Frame users; however, the questionnaire used, in order to extract the emotional reaction to products, requires the elderly to perform tasks that need a certain amount of reasoning. These tasks would be challenging to carry out for participants with reduced mental abilities.

2 BRIEF DESCRIPTION OF THE CASE STUDY

The study of eliciting the elderly needs towards walking frames was initiated by collecting grayscale pictures of 62 existing different walking frame models. These were clustered into 11 clusters and one model from each cluster was selected in order to get a representation of the product segment. Then the emotion-driven method was modified to fit the elderly by developing a questionnaire based on the PrEmo instrument. Three different versions of the questionnaire were developed and tested before getting a satisfying final version. The emotional responses from the questionnaire were examined in order to identify what emotions were evoked by the different models. With these insights, the most representative participants were selected for interviews. The goal of these interviews was to understand why the emotions were evoked. The emotional responses were clustered and translated into specific user needs for walking frame design. However, the elicitation of users needs for walking frame design are not presented here and will be referred to as '*the case study'* in the remainder of the paper.

3 EMOTION-DRIVEN DESIGN APPROACH

The questionnaire and emotional cards (Emocards) used in the case study were developed based upon the Product Measurement Instrument (PrEmo) [4]. PrEmo is an instrument used to measure emotions often elicited by product appearance based on 14 emotions. Seven are *pleasant*: Inspiration, Desire, Pleasant surprise, Amusement, Admiration, Satisfaction and Fascination. The remaining seven are *unpleasant*: Disgust, Indignation, Contempt, Unpleasant surprise, Dissatisfaction, Disappointment and Boredom. Pieter Desmet argues that they represent *"a manageable cross-section of all emotions that can be elicited by product appearance"*[4]. In order to rate the emotional responses from the users, PrEmo uses a 3-point Likert scale and operates with animation labels to represent the emotions, which makes the rating of product emotions independent of a verbal representation of each emotion. It is also argued that PrEmo, being non-verbal, is applicable across cultures and capable of measuring mixed emotions [4]. The above cited 14 emotions were reduced from 347 different general emotions through comprehensive studies. However, the development and validation studies of PrEmo did not include participants aged above 60 years.

It is suggested that in order to get the full benefit from PrEmo, one must investigate if the 14 emotions are adequate for measuring the emotional impact of the specific product [7]. However, the same 14 emotions were used in a case study on wheelchair design for children [6]. Additionally, according to

Misato Nihei, *et al* both wheelchairs and walking frames are categorized as mobility aids for elderly people [12]. This supports our hypothesis that these 14 emotions are also relevant and adequate for the case study of the research presented here, hence no changes to the set of emotions were made.

These arguments were the main reasons for choosing PrEmo as the theoretical framework for constructing the questionnaire for the case study. However, PrEmo is a computer program and was thus not usable, as it is, for a study targeting elderly people as they often have low or no experience in using computers [9][10]. However, because PrEmo is a validated approach, the initial adopted questionnaire was designed to represent the instrument as closely as possible. More details will be given in the following sections.

3.1 Construction of the Questionnaire and Validity Issues

When constructing the questionnaire adapted from PrEmo, one must question the validity of the challenges observed during the use of the adapted approach, as it is an important aspect for any measurement instrument. As cited in the introduction, when applying the emotion driven approach in the case study, several challenges were encountered; however, are the observed challenges related to changing the PrEmo or to the particular age of the respondents? And to what extent do the modifications influence the management of the survey and the results?

As part of the development of PrEmo, the degree of agreement of different measurement instruments was investigated. In that study PrEmo software (version 6) was compared to a questionnaire version which included verbal scales of the same 14 emotions [4]. The comparative study concluded that there is a significant correlation between the emotion scores for all but one emotion, which is an indication that the participants did not respond differently, as a result of the different measurement instruments applied. The questionnaire used in this paper is not exactly the same as the one in [4]. It is however very similar, as both have the same composition in terms of how the emotional responses are reported. Desmet's conclusions from his comparative study, allow us to arguably conclude that it is a plausible assumption that the questionnaire based survey used in this paper does not have a significant effect on the results, and it is rather the target group (elderly) that elicited the occurred challenges.

4 THE DATA COLLECTION APPROACH

The data collection process in the user survey consisted of two main steps. In the first step, the participants were asked to rate to what extent they felt a given emotion while evaluating a certain product. In the second step, it was investigated why the participants felt the way they did towards a certain model of walking frame.

It was in the first step, that challenges were identified which eventually led to changes of the approach. These changes were carried out at three different stages as follows:

1. Test interview: One-on-One interview.
2. Group-questionnaire session: Questionnaire version one
3. One-by-One questionnaire: Questionnaire version two

The following sections will go through the three steps and present the encountered challenges, the possible reasons behind them occurring and finally explain what was carried out to overcome them.

5 FIRST VERSION OF THE QUESTIONNAIRE: EMOCARDS

Initially the user survey was constructed as a *One-on-One* interview session assisted by Emocards.

The Emocards were based on the animations representing the 14 emotions used in PrEmo. The emotions were represented by the last still position from each animation, and as a support the emotion was also written in both English and Danish. Two versions of the Likert scale were constructed and a test interview should determine which of those were most suitable for rating the emotional responses (See Figure 1).

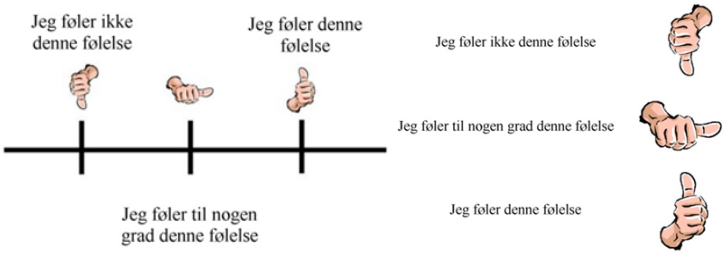

Figure 1 The two versions of the Likert scale

The main difference between the two scales presented in Figure 1, is that the one on the left would allow the subject to gradually rate his/her reaction to a product between not feeling the emotion, feeling it to some extent and entirely feeling the emotion. The second one is the same as the PrEmo scale where the subject would chose one of the three states. The thumbs were used as a visual support for agreeing or not.

According to [4], the non-verbal understanding of the emotion is closely related to the animations, which consisted of 11-14 frames. These frames expressed a resemblance with a human emotional reaction represented by a cartoon character. By only using the last still picture to represent the emotion it was assessed that it would be difficult for a participant to recognize the emotion, thus it was aided by a written description.

However, the written representation could cause translation problems. As the targeted participants were elderly Danes, one cannot assume that they have a good enough understanding of English for causing no ambiguity. Furthermore, in some cases when an emotion is translated to Danish, the inversed translation to English can lead to two different emotions. This is a common problem as in emotion research, translating emotion words is known to be difficult because for many emotion words a one-to-one 'straight' translation is not available [7]. Therefore, while presenting the emotion in English only was not an option as it requires a good enough English understanding in order not to translate it into one's own native language; writing it in Danish only might lead to misinterpretations. Hence, it was decided to present the emotions both in English and Danish. An example is illustrated in Figure 1.

Figure 2 Still picture representing 'desire' with a written caption

6 TEST INTERVIEW

Before the user survey was carried out on a larger scale, the initial questionnaire was tested with a 73 year old female, and a walking frame user. The session took place in her home in Gentofte, Copenhagen, Denmark.

One of the authors observed and recorded the responses while the other managed the interview.

Before the actual interview was carried out, the participant was given an oral presentation of the aim of the case study as well as an oral introduction to the interview procedure regarding pictures of walking frames, scales and Emocards.

The participant was presented with an A4 sized picture of each walking frame and the 14 Emocards were presented one after another in a random order. After each Emocard the participant rated the emotional response according to the Likert scale used in PrEmo.

The participant had to rate 14 emotional responses for all of the 11 models, which adds up to 154 successive ratings. However, the test person managed to rate the emotional responses of only 4 of the 11 models, before the session was stopped. At that time it had already taken 40 minutes, which was far longer than expected and the subject started tiring.

6.1 Observed Challenges

The following challenges were identified during the test interview:

- The test person tended to always rate the emotions in the middle (I feel this to a certain extent) for more than 3/4 of the ratings. She explained later on that the two poles of the Likert scale seemed to be too extreme and hence she felt obliged to answer in the middle. This was the case for both types of scales presented. As she stated: "*I cannot entirely feel these emotions towards any product.*"
- The test person lost focus on the task, as she felt the need to explain the reasons for her rating on every product and every emotion, even when she was encouraged not to.
- The emotions written in English confused more than they helped. The participant often stopped because she did not recognize the English word, which could lead to the impressions of the models becoming less immediate, which goes against the aim of the interview.
- The participant introduced irrelevant topics. This could possibly be related to the interview approach, which might have given the impression that the session was a somewhat informal conversation about walking frames.

6.2 Modifications

In order to overcome these challenges the following changes were made:

- A group approach would be used in order to cut the time spent on collecting the emotional responses.
- A questionnaire based survey would be used instead of the interview approach. The developed questionnaire contained the 11 models of walking frames along with the 14 emotions. The walking frames were each presented on an A4 page while the two following pages contained the emotions and a smaller picture of the same walking frame in the top left corner, as illustrated in Figure 3.

  A questionnaire was assessed to make it clear to the participants that a certain task was given and thereby keep them focused. It would also allow the participants to work more individually and therefore the authors could take on a more observational role.
- The oral instructions were supported by a written example on how to fill out the questionnaire with a product (scissors) not related to the case study. This would clarify the procedure of filling out the questionnaire, which would be difficult to explain in a group session. It was also to provide the participants with an understanding of the purpose of the task, directions on how to relate to the models and how to use the scale.
- The models of walking frames were ordered randomly, from one questionnaire to another, in order to eliminate the possibility of the participants to pair up and complete in groups and to reduce the influence of the models order of appearance on the emotional responses.
- The emotions were to be rated on a free Likert scale which enabled the elderly to answer more freely.

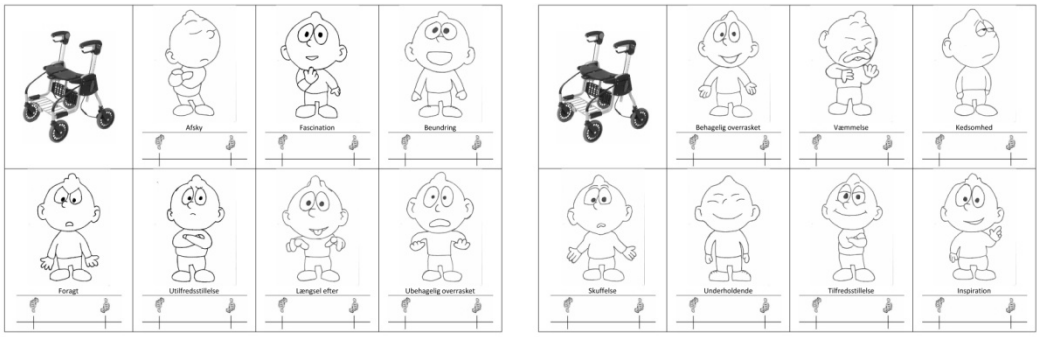

Figure 3. Example of 2 pages containing the 14 emotions for walking frame model C

7 THE FIRST QUESTIONNAIRE SESSION

The first questionnaire session took place in Breelteparken elderly home in Hørsholm, Denmark. Participants attending were 2 males and 5 females (age: 76-88). The participants were selected by the staff, as being, using their words, 'well-preserved' and able to complete the task. The participants were all walking frame users.

The session was organized as a group session with the elderly sitting around a table in the common living room. In addition, two of the staff members from the elderly home were present.

The participants were, before being provided with the actual questionnaire, given a brief oral introduction and the written examples.

After the session that lasted 40 minutes, only one of the participants had almost satisfyingly completed the questionnaire (10.5 out of 11 models). By satisfyingly we mean grading all emotions for the 11 walking frame clusters.

Five out of seven participants completed less than half of the questionnaire. The authors were expecting that the segment of elderly would be challenging to work with, but the extent to which the challenges occurred during that session was surprising.

7.1 Observed challenges

The following is a list of the observed challenges from the first questionnaire session:

- ***Picture recognition***

Some of the Elderly found it difficult to recognize and assess the pictures of the walking frames. At least two of the participants did not notice that the models on the questionnaire pages were different and that the emotions were randomized. Those participants did not rate the emotions for more than 3-4 models in the questionnaire and those pages were only sporadically completed. Some of the elderly asked questions about parts of the models that assumedly most people would recognize: i.e. *"Is that a seat?"*. This lack of picture recognition occurred even though the models were also presented on an A4 page before the two pages with the emotions.

In addition, some of the participants worked in pairs in order to support each other. They discussed and agreed on what to answer while not noticing that the questionnaires had a random order of walking frames and emotions, so they were in fact rating two different emotions to two different walking frames. Challenges regarding picture recognition are found to be age-related, which correlates with the observations from the study presented in [12].

- ***Misunderstanding of the scale***

The thumbs on the Likert scale were misleading, as it was not intuitive for the participants that an elicited negative emotion should be marked at the thumbs up sign, which in most cases is interpreted as a reaction to a positive event.

When the ratings from the 7 questionnaires were analyzed, one of the participants seemed to have understood the scale as a two point scale, as there were only markings on the two poles. Furthermore, three others had marked the scale as if it was a three point scale (two poles and center). These ratings appeared systematically on all the pages which show a misinterpretation of the free scale, generally used in emotion driven design approaches.

Only three participants had expressed emotional responses on the entire free scale. Furthermore, some of the participants marked the scale in unconventional ways (off range, parallel to the line, etc.) which are hard to translate into a value. Some of these occurrences are illustrated in Figure 4.

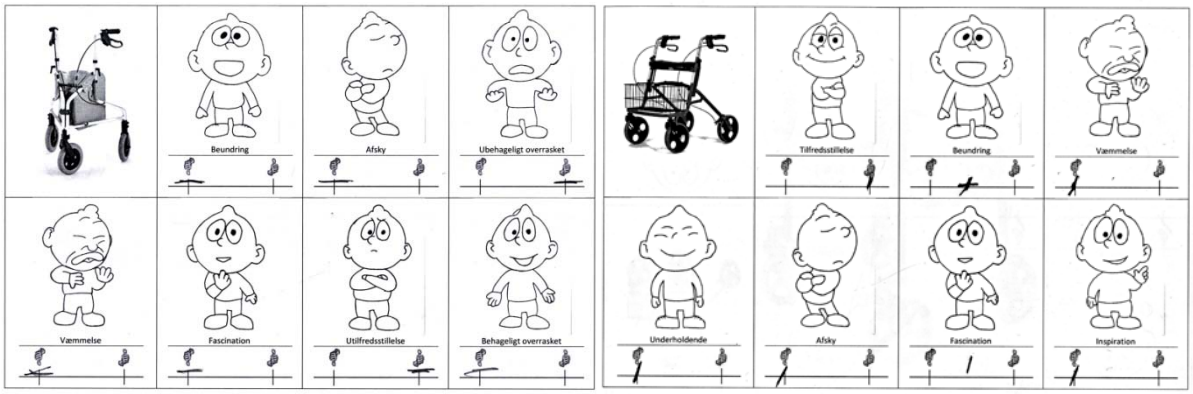

Figure 4 Examples on misunderstood scales: Left a two point rating and right a three point rating

- ***Misunderstanding of the task***

The task was misunderstood as the participants were uncertain and insecure about what to do. Despite the introduction and the instructions explaining the goals of the questionnaire and the study, the participants could not refrain from assessing the walking frames by a comparison to their own. Furthermore, they tended to explain the reason why they rated the emotion like they did, thus forming a less immediate impression of the product. By reflecting longer on the product, the impressions transfer to the *behavioral and reflective* levels of product emotions. This could cause the results to become blurred as it does not accord to the purpose of the questionnaire, which was to clarify what emotions were elicited from an immediate impression of the product appearance. Furthermore, the breaks increased the time spent on completing the questionnaire, which was already a pressing challenge due to the elderly substantially losing concentration with time [3].

- ***Misunderstanding of the purpose***

The participants could not understand how their emotional responses should help to improve a walking frame. There was also a lack of understanding of the purpose of the study and thereby also the questionnaire. Some of the participants expressed several times that it was a subject of irritation that the survey didn't focus on the 'important' aspects of the walking frame, i.e. ergonomics and user friendliness. This caused a reluctance to complete the questionnaire. These frustrations could possibly influence the emotional responses because the situation could affect their mood, which PrEmo does not account for [5]. This challenge is not necessarily age related, but the younger participants generally complete this type of questionnaires without questioning this.

- ***Concentration problems***

The time in which the elderly could sustain concentration was very limited, after 6 minutes it was observed that the first participant started to skip pages and rush through the questionnaire. During the session it became apparent that the elderly had a hard time understanding the task and they got overwhelmed by the comprehensive, long questionnaire. When observing the elderly while they worked with the questionnaires, it could be concluded that for at least three of the elderly, there was a tendency to rush through the pages as time went by; resulting that the later pages were filled out within a few seconds or simply skipped. This could be an indication that the elderly had problems maintaining concentration. The issue of the participants' concentration is something one should take into account when forming any questionnaire survey. Simon Schütte engages the issue and states that *"[…] as a rule of thumb 15 minutes is the maximum including introduction to the products in question. So the maximum number of ratings lays around 200."*[14]

Studies have shown that attention capabilities decline with age thus elderly have a lower sustained concentration compared to the population in general [2] and our observations did correlate with this. The elderly lost concentration after the first pages of the questionnaire, as five out of seven completed less than half of it and only one was close to completing it, thus the questionnaire either had to be less extensive or the session split into two. On an interesting note, Shütte states that: according to a Japanese researcher the rating of up to 20 products with 100 emotional words each was no problem in Japan, but in Europe it was [14].

- ***Maintaining focus***

The elderly had difficulties maintaining focus on the task given. During the interviews it was observed that the elderly tended to turn their focus towards issues that were not relevant for the survey. For example they explained the reasons for their answers or discussed the walking frames and other topics with each other. Studies suggest that this inability to maintain focus is correlated to the age of the participants as age related decline in cognition occurs due to the inability of older adults to stay focused on primary information, as they frequently diffuse their attention across both relevant and irrelevant information [13].

7.2 Modifications of the approach: Second Step

The following section explains what was done to overcome the challenges from the group session.

- ***Including non-users in the surveyed panel***

With none of the questionnaires adequately completed in the timeframe suggested, the frequency of success had to be increased in the upcoming session. In order to increase the rate of successful completions on the subsequent questionnaires, non-users (60+ of age) and care staff members (no age limitation) were included to the survey. The non-users were included in order to counter the problem with the users' tendency to compare the questionnaire model with their own. The care staff members were included, as they had daily interaction with walking frame users and hence understood their challenges and routines. By including these participants the collected data would be more comprehensive and thus the following data treatment would be carried out on a stronger foundation.

- ***Reduce the number of clusters from 11 to 5***

The number of clusters was reduced in order to make it possible for the elderly to complete the questionnaires, without getting mentally fatigued. However, by reducing the number of clusters one limits the potential inputs to the identification of the needs of the elderly towards walking frames. However, this was assessed to be necessary due to the reduced time the elderly could sustain concentration and that the timeframe did not allow the sessions to be split up, for reasons such as participant, space and care staff availability.

By reducing the number of cluster from 11 to 5, the amount of emotional ratings was reduced to 70, almost three times less than the 200 recommended by Simon Shütte [14]. There were two reasons for this relatively large reduction in the clusters. Firstly, five out of seven participants completed less than half of the questionnaire and secondly the only participant that almost completed it, used 25 minutes, which is 40% more than the recommended 15 minutes [14]. The number of ratings in that version was 154, which indicates that the elderly rate the emotions slower than younger participants.

- ***From workshop session to One-by-One sessions***

In order to be able to optimize the number of correctly answered questionnaires, it was necessary to let the elderly complete the questionnaire one at a time. This approach allowed the interviewers to support the elderly if/when uncertainties about the questionnaire occurred. In the first session, 6 of the 7 participants repeatedly needed support and expressed insecurity about making mistakes. But by only being able to help two at a time (only two interviewers were present), this lead to the remaining ones discussing the questionnaire with each other or starting to complete them together. This happened despite the fact that it was specifically emphasized several times that the questionnaires should be completed individually.

- ***Written introduction***

Instead of providing an oral introduction a written one was prepared. It contained instructions for correct completion, an example with scissors as well as the purpose of the task. This was to ensure consistency in the introduction as well as reducing the participants' eagerness to introduce irrelevant topics.

- ***Modification of the scale***

It was the authors' assessment that a discreet scale with well defined boundaries expressed by seven boxes, would be more intuitive for the participants' to use. The thumb icons were replaced by the statements *Do not feel* and *Do feel* in the poles of the scale.

A box is easy to mark and the translation into a value is not sensitive to the type of symbol used for the rating, as long as it remains in a single box.

The above mentioned changes should contribute to solving the encountered challenges.

8 FINAL EDITION OF THE QUESTIONNAIRE

For the final edition 14 people participated. They were represented by 9 females and 5 males of which 4 were elderly users (74 , 80, 85 and 92 years), 3 were nurses (24, 55 and 58 years) and 7 were non-users (61-67 years). The questionnaire sessions were carried out in an environment that was familiar for the participants. The sessions resulted in 12 out of 14 completing the questionnaires.

8.1 Observed Challenges

The following is a list of the observed challenges in the final edition of the questionnaire:

- The two participants that did not complete the question were both male walking frame users with ages of 85 and 92. The oldest participant rated 1 emotion and the other 7 before giving up.
- Both the younger and elderly participants expressed difficulties in relating certain emotions to the walking frame models. This is an indication that this problem is not age-related.
- The length of the written introduction was 5 pages; however it only consisted of about 500 words. The length of the document was due to the use of a larger font size (16) along with 6 figures showing how to rate the emotions. The introduction seemed to overwhelm some of the participants, as they seemed to skim through it which caused them to be confused about how to begin the task.

8.2 Possible Improvements to the Final Edition of the Questionnaire

Optimization could still be possible, since the participants still expressed some difficulties in terms of relating certain emotions to the walking frames. As mentioned before, the 14 emotions are the general emotions most frequently elicited towards user products appearance [4][7]. According to P.M.A Desmet, it is not said that the emotions used in this paper, also represent emotions that are experienced towards dynamic human product interaction. Some emotions may be over represented, whereas others may be missing [7].

An identification of the emotional words relating specifically to walking frames could reduce the extent to which the participants felt that the emotions did not fit the product. A tailored set of words describing a product domain can, according to Simon Schütte, vary between 50 to 600 words [14]. The process of reducing those to a practical number for the elderly can be challenging. Furthermore, a tailored set of emotional words would most likely not just relate to the product appearance but also usage and interaction. An example for a descriptive word for walking frames could be *stigmatizing*. The rating of this word requires the participant to reflect upon a usage scenario before being able to rate the emotional response, thus the emotional ratings would no longer be based on an immediate impression. This differs from the set of 14 emotions used in the PrEmo instrument [4].

9 DISCUSSION

Many of the observed challenges were related to the age of the participants. Generally the oldest participants found the questionnaire more difficult to complete compared to the younger ones. The relationship between the decline of cognitive abilities and age has been confirmed in several studies [15]. However, in this study it was observed that in some cases the cognitive abilities of the elderly differed independently of their age. This could indicate that there is not a one-to-one relationship between age and cognitive decline. According to Timothy Salthouse, other factors influence this relationship; motivation, persistence, and various personality characteristics are also important, and they either may be unrelated to age or may follow different age trajectories than measures of cognitive functioning [15].

This could explain why two of the participants, that were among the oldest (80 and 81), did perform the task well compared to the younger ones. The 81 year old that attended the session in Breelteparken elderly home, in which the questionnaire with 11 clusters was used, was capable of supporting the other participants while completing her questionnaire.

When including non-users and care staff members it is assumed that their answers are reliable and correlate across groups, this has not been validated in this paper.

10 CONCLUSIONS AND GUIDELINES

The strength and value of the data collection strictly depends on the participants' ability to adequately complete the questionnaire. From the work of adapting a questionnaire from the PrEmo instrument to fit the elderly user group, challenges that related to the participants age were observed. From the identified challenges and the changes carried out to tackle them, general guidelines for future development of emotion-driven user surveys for the elderly are proposed in the following points:

- The time used on completing the questionnaire should be limited. For the elderly, in this study, it was observed that their sustained concentration was lower than the 15 minutes generally proposed as the ideal time used to complete a questionnaire session. It must be taken into account that an extra amount of time will be used due to the fact that the elderly are generally slower at processing tasks than the average population [2], and also confusion about how to complete the questionnaire will most likely occur. One way to encounter this is to split the questionnaire sessions. However, this might have the effect of adding the time perspective on the emotional responses as a different timeframe can induce a different mood and hence different reactions. Another possibility is to reduce the number of ratings, which is adapted in this paper. Our study showed that the elderly did not manage to rate 154 emotional impressions, below the 200 which was recommended as the maximum number. From our observations about 100 ratings should be a rough maximum for one session.
- The cognitive capabilities vary among the elderly. Some of the participants were not able to complete the questionnaire while others completed it without any major difficulties. One-by-One sessions would be the most suitable approach, even if in our case the elderly with the best cognitive capabilities helped the others in a group setting. In both One-by-One or group sessions, it is important to make sure that the elderly perfectly understand the task before doing it, as some of the elderly hesitated to express their need for support during the session. Examples on how to fill out the questionnaire can ease the understanding.
- In relation to the reduced picture recognition, it is recommended to use as big a picture as possible to represent the models. This would help to have a positive effect on the impaired vision that many elderly have.
- The free Likert scale did not work as intended. A discreet scale seemed more intuitive for the elderly to use, as they were more guided on where to put their rating.
- Including participants close to the target group but not necessarily old would lead the collected data to be more comprehensive and provide the following step of data treatment with a stronger foundation. They could also ease the search for participants and thus provide more data sets to be analyzed.

This paper, reported several challenges encountered when using an emotional driven approach on a target group that was not included when the method was developed. For the majority, the challenges were overcome by both adapting the questionnaire and the way the data collection sessions were carried out. Several guidelines for future use are proposed above which should help future studies achieve better results for the data collection.

REFERENCES

[1] Ahmed, S., and Boelskifte, P., *Investigation of Designers Intentions and Users' Perception of Product Character*. Proceedings of Nordesign, Reykjavik, Iceland, pp. 372-381, 2006.

[2] Barret J. and Kirk S., *Running focus groups with elderly and disabled elderly participants*, Applied Ergonomics, 31–6, pp. 621-629, 2000

[3] Baychest, *Older adults more vulnerable to distraction from irrelevant information*, http://www.baycrest.org/Research/News/default_10702.asp, consulted the 26th December 2010

[4] Desmet P.M.A, Designing Emotions, 2002, Doctoral Thesis., 2002.

[5] Desmet P.M.A, A multilayered model of product emotions. Design Journal, 6(2), 4-13., 2003.

[6] Desmet P. M. A., Dijkhuis E., A Wheelchair can be Fun: A Case of Emotion-driven Design, Proceedings of DPPP03, Pittsburgh, USA, 2003.

[7] Desmet, P.M.A, Measuring emotion: development and application of an instrument to measure emotional responses to products, Funology: from usability to enjoyment, Kluwer Academic Publishers, Norwell, MA, 2005.

[8] Forlizzi J., Goetz J., Hirsch T., Hyder E., Kurtz C *and Stroback J., The Elder project: Social, Emotional, and Environmental, Factors in the Design of Eldercare Technologies, Proceedings of the 2000 conference on Universal Usability*, CUU '00, 2000
[9] Goldstein M. K., Miller D. E., Davies S. and Garber A. M., *Quality of Life Assessment Software for Computer-Inexperienced Older Adults: Multimedia Utility Elicitation for Activities of Daily Living*, Proceeding of the AMIA Symposium., p. 295-299, 2002
[10] Hawthron D., *Possible implications of aging for interface designs*, Interacting with Computers, 12, pp. 507–528 , 2000.
[11] Norman D.A., *Emotional Design: Why we love (or hate) everyday things*, Basic Books, 2004
[12] Nihei M., Inoue T., Mochizuki M., Yamaki C., Kusunaga T., Fujie M., *Proposition of Development Concept of Mobility Aids Based on Phychological Model of Older Persons*, Transactions of the Japan Society of Mechanical Engineers, 73-725; pp. 266-273, 2007.
[13] Park D.C., *The Basic Mechanisms Accounting for Age-related Decline in Cognitive Functioning*, Cognitive Aging: A Primer, Taylor & Francis, USA, 2000
[14] Schütte S., *Enigneering Emotional Values in Product Design – Kansei Engineering in Development*, Doctoral Thesis, 2005
[15] Salthouse A. T., *What and When of Cognitive Aging*, American Psychological Society, Volume 13 – Number 4, pp. 140-144, 2004
[16] Wijnand Ijsselsteijn , Herman H., Kort Y., Poels K., *Digital game design for elderly users*, Proceedings of the 2007 conference on Future Play, November 14-17, 2007, Toronto, Canada
[17] WHO, http://www.who.int/healthinfo/survey/ageingdefnolder/en/index.html, consulted on 14th of November 2010
[18] Yamaoka T., *An Emotional Design Method Based on Human Design Technology*, Proceedings of the IASDR 2009 conference, pp.4435- 4443, 2009.

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