

EMOTION-DRIVEN ELICITATION OF ELDERLY PEOPLE USER NEEDS ILLUSTRATED BY A WALKING FRAME CASE STUDY

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ABSTRACT

In this paper an emotion-driven design approach is used to elicit the needs of elderly users illustrated by a walking frame case study. First, images of existing walking frames were collected from websites and clustered into categories, followed by a collection and an assessment of the emotional responses of elderly people presented with the representative walking frames from each category, using a questionnaire adapted from the Product measurement instrument (PrEmo). The results of this assessment were categorized using three levels of product emotions (visceral, behavioural and reflective) and then transformed into user needs that can be later used by designers to create new designs.

From these user needs it was found that the elderly had concerns with emotional content as well as more traditional needs based upon ergonomics and functions.

Keywords: Elderly, Design for Emotions, Mobility aid, Kansei Engineering, PrEmo, User Needs, Walking frame

1 INTRODUCTION

Population ageing is unprecedented, without parallel in human history—and the twenty-first century will witness that the elderly will constitute a larger portion of our population. Population ageing is pervasive, a global phenomenon affecting every man, woman and child. Population ageing is enduring: we will not return to the young populations that our ancestors knew and it has profound implications for many facets of human life [14]. Furthermore, the actual generation has become accustomed to receiving great attention to their needs and requirements. Therefore, a new type of elderly will make many more demands on the public sector and expect to get them [8]. This leads to more attention given to their needs and hence a better understanding of what they are and how to elicit them.

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 [2]. A product's usability determines if the product can be used while the emotional component of it determines if the product will be used [7]. Therefore, product success is closely related to the subjective response of the customers.

Andrew Orthony et al. suggest that human emotions are generated from three levels [12][11]. *The visceral level* (subconscious and prewired), *the behavioural level* (subconscious and controls everyday behaviour) and *the reflective level* (contemplative part of the brain and reflective thought). These dimensions will be present in the way we perceive any designed object. The visceral level influences our initial impression of a product using our senses and is generated by the appearance of the product. The behavioural level deals with the interaction and use of the product, thus there are many aspects influencing this level—for instance functionality, performance and usability. At the reflective level the interaction of the product with the user is based on a more cognitive and intellectual thinking, for example one could feel shame or pride of owning a product [11].

Defining the Group of Interest: The Elderly

Most developed countries have a consensus that people above the age of 65 are defined as 'elderly' [15], 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 [14].

In the context of this study 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 a task that needs a certain amount of reasoning. These tasks would be challenging to carry out by participants with reduced mental abilities.

Defining the Product Case: The Walking Frame

Mobility aids are divided in three main categories [10] [6]:

1. Walking Sticks
2. Walking Frames, also commonly called Zimmer Frames
3. Wheelchairs

The field of mobility aids was found to be interesting from the hypothesis that the elderly have negative associations and emotions regarding these products. The need for a walking aid can represent an exposure of age and physiological decline. This might result in lesser usage of the aid even if needed. An increased usage would reduce fall-related accidents among the elderly and increase/improve their mobility [6].

In this paper, we chose to consider the walking frame because the walking stick seemed too simple, while the Wheelchairs had too many parts and tend to target both elderly who are heavily handicapped and elderly who have a lighter challenged mobility. The walking frame appears to have the right balance between complexity and number of parts and targets a rather homogenous elderly group.

When reviewing models of walking frames online, it appeared to the authors that the manufacturers, to a higher extent, position their products on cost and function. At the same time, the walking frames were very similar in terms of the functionality and what they offered to the user. According to P.M. Desmet [2], in most markets, product differentiation is quite difficult because products are similar in respect to their technical characteristics, quality and price. With the correlation between the appearance of the products and the choice of buying it, the manufacturers would have an economic incentive of improving their products' emotional impact and use it as a positional advantage.

In this context an improved emotional impact of the walking frame is relevant, because the emotional impact of a product strongly influences the purchasing decision since the emotional responses can incite the customer to pick a particular model out of the row and the first impression of a product strongly influences the purchase decision [2]. With the benefits of using a walking frame it becomes relevant to consider the underlying factors of the negative and positive emotional impacts of the walking frame on the elderly users. Factors that are, to some extent, intangible and hard to assess. The emotion-driven design approach is arguably relevant to grasp this challenge.

2 THE EMOTION-DRIVEN APPROACH

Emotional Design/Kansei engineering is a distinct approach to extract user information. According to Schütte (2005) quoting Nagamachi (2001): "*Kansei is the impression somebody gets from a certain artefact, environment or situation using all the senses of sight, hearing, feeling, smell, taste as well as their recognition.*" Kanseis are experienced in hierarchic stages where short and spontaneous Kansei construct higher degrees and more general elicitations.

For example, sitting on a beach on a warm summer day could elicit *Kansei* like happy, beautiful, pleasant or fantastic. These are *Kansei of first degree* but they are just a small part of the overall experience. *Kansei of second degree* relates to for example, why one could be happy because of the sound of the waves, children playing in the sand or that the sun is shining. The sum of these, constructs the *General Kansei* e.g. happiness. It is related to the individual, which and how many of the lower *Kansei* make up the reason for the happiness. However, by gathering enough data on the

lower *Kansei* from different people and analyzing it, the higher levels can be constructed. This approach is used in this paper.

In order to measure the emotional impact, a modified version of the Product Emotion Measurement instrument (PrEmo) is used. PrEmo is a computer program, developed as an instrument for evaluation of emotions, elicited by products [2]. PrEmo was developed to aid the understanding of the relationships between the product's appearance and its emotional impact on users. This understanding would help designers improving the emotional impact of their designs.

As a non-verbal self-report instrument, PrEmo operates with 14 emotions of which one half are *pleasant* and the other half *unpleasant*. These emotions were identified as most commonly evoked by products. The selection of the 14 emotions was reduced from 347 emotions through several steps and comprehensive field studies. It was concluded that those emotions were the most common product emotions 1.

The PrEmo instrument uses animations each consisting of 10-15 stills; see Figure 1 [2]. By using animations to show the emotions, it is argued that the instrument is usable across cultures and languages, because it is non-verbal [2]. A validation study showed that all the animations were understandable by Dutch and American participants. Thus it is plausible that Danish participants would also understand them.

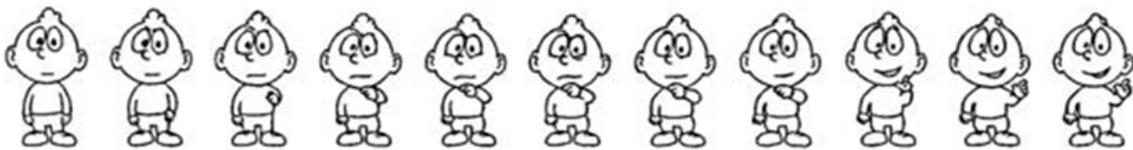


Figure 1. Frames constructing the animation of inspiration

On a three-point scale, the participants rate their emotional response. The scale represents the following statements: *I do feel the emotion*, *I do to some extent feel the emotion* and *I do not feel the emotion*.

There are several examples where PrEmo has been used to facilitate an emotion-driven design process, for example wheelchairs for children, automobiles and chair design [4].

The decision of using PrEmo was guided by the use of a non-verbal approach. This contrasts with a more traditional *Kansei Engineering* approach, where it would have been necessary to collect relevant *Kansei* words from the target population. However, it is reported that reading abilities deteriorate with age [13]. Furthermore, older adults find it difficult to concentrate in busy environments and filter out irrelevant information [1], which would make it challenging with a list of *Kansei* words only.

3 METHODOLOGY

The challenge of measuring emotions in product design is not only to understand what emotions are elicited, but also why they are evoked. The PrEmo instrument is only usable if the participants have access to a computer and know how to use it. With the participants aged above 60, it was apparent that the use of computers would be challenging. It was decided that interviews or questionnaires would be more intuitive for the elderly, and hence avoid the eventual frustrations or insecurities caused by using a computer that would influence the outcome of the emotional impact of the products [2].

The questionnaire used in this study was adapted from the PrEmo instrument. In order to get the full benefit from PrEmo, it must be first investigated whether the 14 emotions are adequate for measuring the emotional impact of the specific product [5]. However, the same 14 emotions were used in a case study on design of wheelchairs for children [4] and according to Misato, N, *et al.* both wheelchairs and walking frames are categorized as mobility aids for elderly people [10]. This leads us to conclude that these 14 emotions are also relevant and adequate for the case study of the research presented here.

In order to facilitate an emotion-driven design approach to the case, the following steps were carried out:

Step 0: Existing Product Models

This step consists of collecting existing images of as many different walking frames as possible. A survey of internet websites was done and 62 different images representing walking frames were collected.

Step 1: Clustering of the Models

The aim of this step is to assemble a broad representation of the walking frames from existing models to be used in the questionnaire. This was carried out by identifying which products are represented within the product domain and classifying the products into categories, and then identifying which walking frame would be the best representative within each category.

Step 2: Modification and preparation of questionnaire

At this step, the method was modified to fit the elderly by developing a questionnaire based on the PrEmo instrument. This was done to enable the questionnaire to be carried out without the use of computers, which many of the elderly do not feel comfortable using [9].

Step 3: Questionnaire

The user survey was carried out with the Elderly and the results were analysed to identify what emotions were evoked by the different products.

Step 4: Procession of the questionnaire data

With the results and insights from the third step, the number of participants was reduced to the most representative individuals. This reduction of surveyed subjects helps going deeper in the discussions on why the emotions were elicited.

Step 5: User interview

The goal of this step is to understand why the emotions from the questionnaire were evoked. This was done by interviewing a selection of the participants.

Step 6: Processing of the user interview data

In the last step, the emotional responses were clustered and translated into specific user needs.

In the next sections the six step methodology is explained in detail.

4 CLUSTERING OF PRODUCT SEGMENT

In order to elicit user needs using the PrEmo, one relies on the visual impressions from the user group towards different products, in this case walking frames. A cross-section of the models available on the market is therefore needed. Only by identifying an adequate cross-section can one be sure that most products will be presented for the user group. The hypothesis being that models with different visual expressions will affect the users differently and these stimuli are the foundation that the emotional analysis will be based upon.

4.1 Existing Product Models

The investigation was performed by using internet search databases to locate larger internet suppliers such as *1800wheelchair.com*, an American web shop and *hmi-basen.dk* which provides an overview of the Danish market for walking frames gathered by the Danish Centre for Assistive Technology. The search was continued until repetitions frequently began to occur. A total number of 62 different images of walking frames were collected, digitally saved and a picture in greyscale with similar perspective, background and size was printed. By presenting the products with the same neutral setting it is assumed that only the appearance of the product will influence the emotional response of the subjects.

The relatively large number of walking frames will enable the formed categories to have a certain degree of diversity that should represent the product domain. It is of importance to ensure a certain degree of diversity, as the identified models will be the foundation that the emotional analysis will be based on.

4.2 Clustering of the Models

The clustering of the models was performed by 4 people (3 males and 1 female), 2 of the authors of this paper (case group) and 2 extra reviewers. The extra reviewers were not related to this study. They were involved to provide a more objective clustering. This was important as the case group got already accustomed to the walking frames during the model search, which might have an influence on the clustering.

A short introduction was given that asked the participants to cluster the walking frames from their initial impression of which models appear to be the more similar.

The clustering resulted in four individual categorizations which needed to be combined into one. In order to do this, the degree of agreement between the reviewer's clustering had to be evaluated. The criterion to define an agreement between the participants and thereby form a cluster was based on the *Kappa Test*. It is agreed that a Kappa value above 60% is considered as *substantial agreement*.

With this definition three out of four participants had to cluster two models in the same category. An agreement between the participants is an indication that the walking frames triggered similar stimuli for all reviewers. However, it was at this point not relevant why those stimuli were matching or if they were related to the same emotional content towards the walking frames.

From this process, half of the 62 walking frames were clustered into five categories and the rest were categorized by the case group. Validation of the last clustering resulted in an agreement with a Kappa value of 0.72 which was defined as a *substantial agreement*. The final amount of categories was 11; Figure 2 illustrates some of the walking frames belonging to these categories.



Figure 2. A section of the chosen walking frames for the categories

By creating categories based upon appearances and not function or size it would be valid to assume having walking frames representing larger numbers of similar models for this research. Additionally, by reducing the number of products the questionnaire becomes more manageable in terms of how comprehensive it would need to be.

5 DATA COLLECTION

The computer based PrEmo was not used for this questionnaire, hence an adapted approach had to be created. The questionnaire was carried out using Emocards. The Emocards were based on the animations from PrEmo, where the emotions were represented by the last still position from each animation. As a support to the character, the emotions were also written in both English and Danish in order to reduce possible translation problems. It was considered necessary to strengthen the understanding of which emotion was pictured on the Emocards by attaching the emotion in a written form. This was intended to compensate for the lack of dynamic movement offered by the animations that can be crucial for the understanding [2].

The three point Likert scale consisted of the expressions *I do not feel the emotion*, *to some extent I feel the emotion* and *I do feel the emotion* translated into Danish. Two versions of the scale were made both using thumb icons to assist the response and one using a horizontal scale. (Figure 3)

They were constructed to investigate which of them would be more intuitive to use, as the time needed to collect the emotional impact has an influence on the result [1].

The data collection should take place in a familiar and secure environment for the elderly, such as their home, in order to reduce the influence of being in a particularly bad or good mood when answering. A happy person might assess the models more positively than a person in a bad mood [3]. This would conflict with their objectivity. It should be mentioned that this process cannot remove the uncertainty caused by the mood but only reduces its impact.



Figure 3. Two versions of the Likert scale (Left non-assisted and right assisted by horizontal scale)

To test the setup and identify which scale worked the best, a test interview with a 76 year old woman was performed. From the test interview a number of challenges were identified:

- The structure of one-to-one interview was too time consuming
- The oral introduction would make it challenging to assure a homogeneous and equal introduction to the task for every subject
- The face-to-face interview pressured the subject into trying to answer faster
- The emotion written in English was confusing because the subject was mainly Danish speaking
- The two poles of the Likert scale seemed to be too extreme and hence the subject felt the need to answer in the middle

To overcome these challenges, a questionnaire for a group session approach was developed. This would enable the participants to answer at their own pace. It would also give the interviewers an observing role instead of directly communicating with the elderly. The English text in the Emocards was removed and a free Likert scale with a thumb down for *do not feel* and a thumb up for *do feel* at the ends was provided. Figure 4, shows an example of one of the surveyed models with a section of the related emotions.

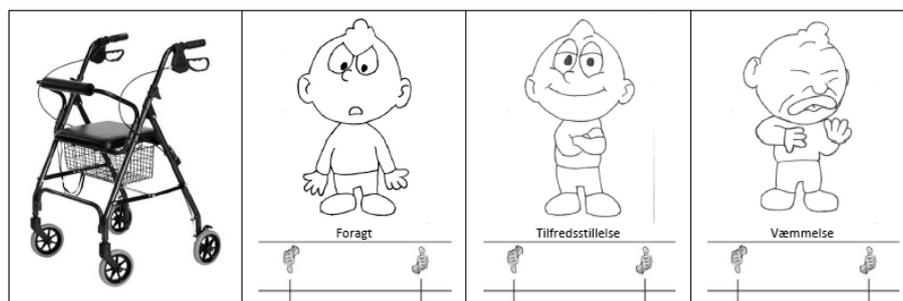


Figure 4. Section of the questionnaire showing the upper half of one of the pages

5.1 Emotional Based Questionnaire

The 11 walking frames and the 14 emotions were arranged in random order for each questionnaire so the influence of the order, in which the models are presented, on the results is reduced. To ensure the same introduction and provide an understanding of the task given, an example with emotional responses towards scissors was made and shown to the participants. Scissors have an appearance that is not related to walking frames, thus it would not influence the participants of this study.

5.2 Questionnaire modifications

After the first questionnaire session in Breelteparken Elderly home in Hørsholm, Denmark with 8 participants (3 males and 5 females) with age ranging between 76-88 years, changes had to be made to the questionnaire because no one was able to fully complete it. Some of the reasons for this were as follows:

- The questionnaire was too long and the subjects either lost interest, focus and/or concentration
- The thumbs in the free scale were misinterpreted
- The free scale was often checked out of range or by random symbols, etc.

In order to overcome these challenges, the number of main categories of walking frames was reduced from eleven to the five most representative walking frames illustrated in Figure 5. This task was carried out by the authors with a good agreement (Kappa value of 0.63).

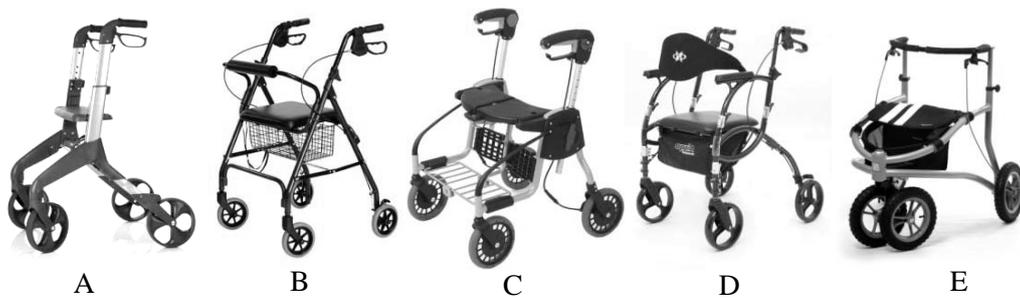


Figure 5. The five representative walking frames

The thumbs in the scale were replaced with *I do not feel* and *I do feel* sentences and a seven-point discreet Likert scale was used. The introduction was written down with information not only on the task given but also on why they were asked to participate. Furthermore, the participants for the questionnaire were extended to include both elderly users as well as non-users from 60+ and people with jobs related to elderly care; this would allow one to get needs from both point of views. Additionally, Elderly care staff e.g. nurses (58, 55 and 24 years of age) were included, as they had daily interaction with walking frame users and understood their challenges and routines. They were specifically asked to look at the task from the point of view of the elderly using the product

6 DATA ANALYSIS AND TREATMENT

The survey resulted in a total of 12 completed questionnaires by three males and nine females, of which three were staff members, two were users and seven were non-users.

The collected data on emotional responses had to be analyzed in order to identify which participants were most relevant for an interview, in order to extract the most information of the relevant individuals that would explain why the emotional responses were evoked. A data treatment was carried out using the extreme studentised deviate (ESD) method, also commonly referred to as Grubbs' test, in order to identify and remove answers that had a statistical mismatch and hence considered as outliers.

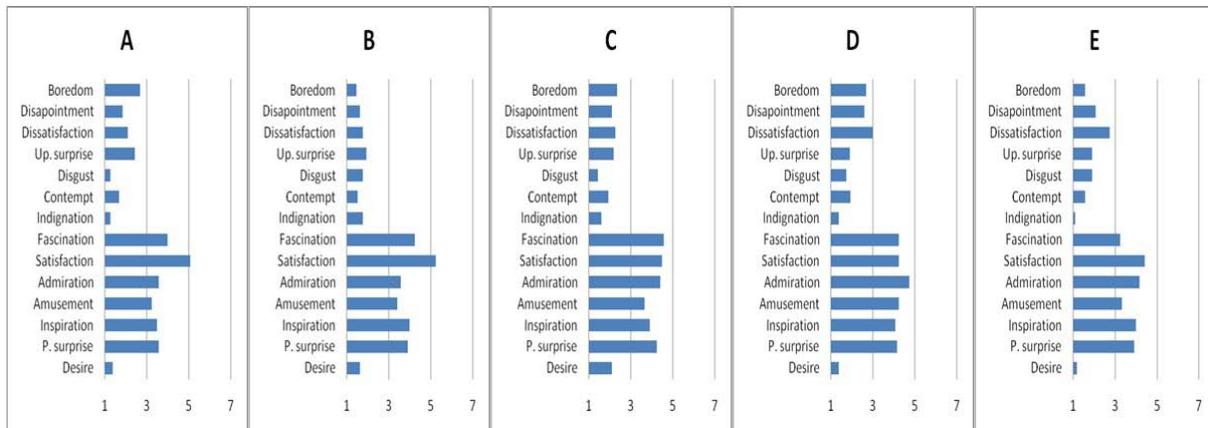


Figure 6. Average emotional response for each category

The diagrams in Figure 6 show the mean values for all the evoked emotions from the 12 completed questionnaires. The diagrams show that the pleasant emotions are elicited to a higher extent than the unpleasant, except *desire* which for all the walking frames have a score below two.

The scores are very similar for all the models, thus making it difficult to identify the model with the most positive emotional impact or the one with the most negative. Interestingly, the model B appears to be in the lower end of the negative emotions but that does not improve its positive impact.

Data Treatment

Six subjects were chosen for step 5 of the methodology. The selection of the participants was carried out according to the following:

1. The average standard deviation (SD) for all 70 emotions was calculated (Average=1.66).

2. If an emotion had a lower SD than the average it was defined as an *alike* emotion (uniform emotional response) and if higher as a *not alike* emotion (non-uniform emotional response).
3. Only one participant was selected for each of the 37 *alike* emotions because the low SD was assumed to be an indication that the participants would provide a similar type of explanation.
4. For the 33 *not alike* emotions the emotional response had a high dissemination. The two participants furthest from the average response were chosen to explain their reactions. It was assumed that these participants would have a stronger impression of why the emotion was or was not evoked, thus easier to explain during the interview.

The six participants with the highest amount of *not alike* emotions were selected for interview and the *alike* emotions were divided equally between them. It is worth noting that we assumed that the participants have the same reason to why they feel the same emotion. Their general *Kansei* may be alike but that does not mean the lower and more personal levels are identical. This counts for both the '*alike*' and '*not alike*' emotions. However, by investigating the emotional responses for five different walking frames, one obtains at least five explanations on why or why not the emotion was evoked.

7 ELICITING ELDERLY USERS NEEDS

The interviews started by clarifying the goal and the structure of the session. It was stressed that it was the products and not the participants that was the focus of the study. This contributed to keeping the interview on track and reducing the processing time. This is important because of the limited time in which the participants could maintain concentration and in which they were available.

Another important element of the interview was to keep asking why the emotion was elicited and what parts of the product model were mainly responsible for it. By moving into the deeper emotional levels the participants began to explain their needs and why they were essential to them.

The interviews provided a dataset consisting of 80 comments related to the reasons of the emotional responses and in order to provide a better overview of the results the comments were clustered regarding how the concerns related to either the *visceral*, *behavioural* or *reflective* level. It is worth noting that some of the concerns could relate to more than one emotional stage, thus it was hard to precisely cluster them. A clustering process was first performed individually by the authors and the categories were afterwards compared. Of the categories only one differed and those comments were placed after an agreement in the project group. 29 of the comments related to *visceral*, 40 to *behavioural* and the last 11 to the *reflective* stage. As one can see, 36% of the comments are in the visceral level, a level more related to the aesthetics and how the product looks while 50% are related to the behavioural level which generally deals with function and ergonomics, in other words how the product fulfils its task, while only 14% relates to the more complex reflective level.

Afterwards, these categories were analyzed in order to identify similarities between the participants' comments which are turned into a comprehensive table of the emotional user needs. Figure 7 provides an overview of the data from that table. The top level shows the goals and standards of the elderly regarding walking frames. The middle level describes the consequences they see as being beneficial to their needs. While the bottom level shows a list of the expressive features which the elderly assessed as helping them to gain the desired consequences.

The arrows in the vertical direction show the relationships between the different levels of user needs. For example if the walking frame looks *Manoeuvrable* then it would have to be *Versatile* which influences both *freedom* and *life quality* of the user.

Goals and standards

The elderly emphasized that they wanted to be independent in terms of everyday activities, such as going to the supermarket or attending various social activities. This relates to the aspect of freedom and life quality. Freedom also relates to the fact that the walking frame should become a part of their daily routines and be as little a burden as possible to them or to their surroundings. As one of the elderly stated: "*I like that it can fit into the boot of the car of my son.*" Another argued: "*I have to walk backwards into the bathroom in order to get the walking frame with me.*"

Before acquiring a walking frame, the elderly have to acknowledge their need for support. The reluctance to acquire one specifically relates to the stigmatizing aspect of using a walking frame.

The need of *security* is about the feeling of being safe when having a walking frame to aid your walk. Security also related to the importance that users are able to trust the device in terms of that it should not break or dysfunction in any way.

Consequences

The elderly are aware of their physical limitations and that is something they do not want to expose to people surrounding them. The walking frame was by many of the elderly regarded as an artefact that enhanced this perceived vulnerability; however the users tended to overrule this due to the benefit their use of the walking frame provided. Additionally, the walking frame has to have an appearance of being capable of operating both inside and outside as well as to fit different user scenarios and environments. Hence, the walking frame could be taken everywhere and always supports the elderly. This is expressed as *Versatility*.

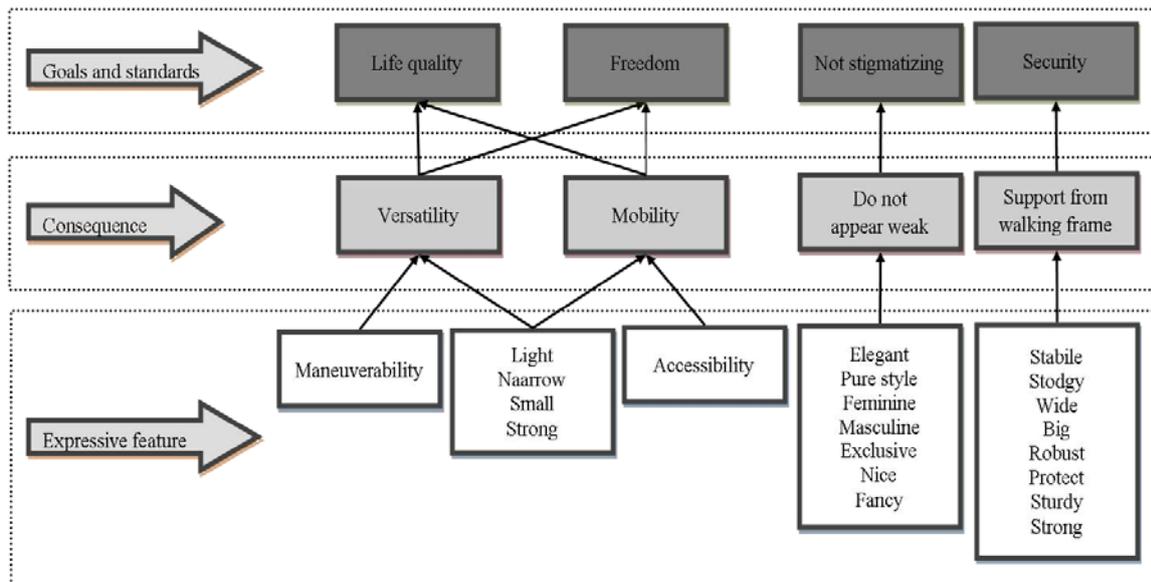


Figure 7. Walking frame user needs tree

Expressive features

When looking at the comments it was noticed that the goals and standards resolve in conflicting expressive features. For instance, a wide walking frame would improve stability but on the other hand it would make it more difficult to navigate in places like a living room with a lot of obstacles. Concerning the *stigmatizing* aspect, the elderly were positive about the models that to a certain extent significantly differed from other models. This might have been influenced by the fact that the elderly, in Denmark, are provided with a walking frame from the municipality, thus certain models dominate the market. There was a wish to be able to personalize one's own model. An example was a woman who attached flowers to her walking frame. The models however, should still be recognizable as a 'walking frame', as the elderly would feel uncomfortable using one where the functions are not intuitive. Furthermore, the walking frame should look like a product for the elderly. One of the walking frames resembled a mountain bike, and was not associated with a product traditionally made for the elderly. This resulted in many of the elderly not seeing it as being a valid mobility aid.

A good design concept would have to obey these guidelines to create a more desirable design and especially find a fine balance between the conflicting features of the walking frame.

8 CONCLUSION

Applying an emotion-driven approach for eliciting elderly users needs towards walking frames resulted in four needs: *Life quality*, *freedom* and *security* which mainly relates to the functions and interaction and *not stigmatizing* relating to the appearance. The walking frame should have functions which make it usable both indoors and outdoors, which translate into the needs of *mobility* and *versatility*. Walking frames as a mobility aid should be relied on by the elderly; this is generally embedded in the quality of functions but an adequate visual expression will help improve the elderly's

perception of it providing the need of *security*.

Some of the expressive features that related to *mobility* and *versatility* conflicted with the expressive features of *security*. It will be the task of the designer to find a workable balance between these points.

The last identified need is *not stigmatizing*; it relates to the fact that the elderly do not want to appear weak. It is important for them to have a walking frame that fits their surroundings and that does not make them stand out for the wrong reasons. The elderly do not wish to be invisible; they just do not want to attract unnecessary attention. Hence, a more discreet appearance is desirable.

The elderly are more and more sensitive to small changes in their environment [7] and thus assistive technologies used in homes, like the walking frame, have to match the elderly in style and appearance. By making a design that fits the general interpretation of this age group, this could be achieved. However, the walking frame should still look like a product the elderly are familiar with and know how to use while at the same time it should be different from other existing models in order not to lower their self-worth. The challenges of working with elderly people were mainly concentrated around their decline of cognitive abilities and time span in which the elderly could maintain focus on the particular given task. This affected the case study and how the questionnaire was constructed and the sessions performed. It is worth noting that these challenges occurred despite the participants having no psychological disabilities and considered capable of successfully completing the tasks. This places strict limitations on the procedure and the instrument used to gather the emotional impressions of this particular target group.

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