Emotionally Meaningful Home Care

Designing for good relationships between patients and devices

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Abstract

Industrial design is an expanding field. Through new research, discussion and explorations the definitions of what designers can and should do is constantly discussed and redefined. The starting point for my master thesis is the investigation of the concept of emotional durability. In other words, I have looked into how designers could create more meaningful relationships between users and products. It concerns product style norms, terminologies for describing relationship types, as well as a product’s meaning to a user. In order to put learning outcomes into practice, this master thesis also involves a design project where I created a proposal for a new rehabilitation product. There is great potential in investigating how meaningful medical devices for the home should be designed. During my design process I try to dig into what it means to design medical products for a home environment. At the same time, I explore how to create emotionally durable experiences for the patients and increase the motivation in their rehabilitation. My proposal is a balance exercising device that introduces a new level of user interaction, which connects back to my research on emotional durability.
Contents

1. Introduction....................................................................................................................... 4
   1.1 Design agendas........................................................................................................ 5
   1.2 Consuming artefacts............................................................................................. 7

2. Project theory.................................................................................................................... 8
   2.1 Relationships and emotions.................................................................................. 9
   2.2 Six-point experiential framework......................................................................... 10
   2.3 Emotional values in products............................................................................... 13
   2.4 A study of household objects............................................................................... 14

3. Design process.................................................................................................................. 16
   3.1 Designing home care............................................................................................ 17
   3.2 A matter of determination.................................................................................... 18
   3.3 Potential concepts............................................................................................... 21
   3.4 A system of tools.................................................................................................. 23
   3.5 Home visit and evaluation.................................................................................... 24
   3.6 Further definition.................................................................................................. 26
   3.7 Relevant style norms............................................................................................ 27
   3.8 Final revisions........................................................................................................ 29

4. Final proposal.................................................................................................................. 30
   4.1 Concept presentation............................................................................................. 31

5. Conclusion....................................................................................................................... 36
   5.1 Norman and Chapman......................................................................................... 37
   5.2 Reflections on the work done............................................................................... 39

6. References....................................................................................................................... 40
   6.1 Acknowledgements............................................................................................... 41
   6.2 References............................................................................................................... 41

Hampus Edström
1. Introduction
1.1 Design agendas

Over the past decades, the industrial design field has gone through many stages of refinement. Particularly when it comes to defining design ethics in practice. The design community deals continuously with the ever growing demands that society and the clients have on the designer, ranging from everything from environmental questions to product profit. Designers are often willing to embrace new tasks and requirements, motivated to please both the client, the consumer, and the society. We have seen the rise of studies in ergonomics since the 1960s, creating a broad awareness of how our environment and products we use should be designed to keep the human body healthy. Further more, design research has moved from focusing only on the healthy human to including the environment as an important stakeholder.

Environmental agenda
Environmental impact has become one of the most important matters for designers to deal with today. Over last three decades, producers and designers have continuously worked towards reducing the different negative environmental consequences from the production, the use and the disposal of products. The progress is slow and often requires new legislation that forces the producers to take action, a state that well describes the situation we are in today.

Sustainability
Many designers feel that it is their responsibility to design nature-friendly products, but it is more complex than that. Sustainability is also connected to technological factors, such as material attributes and composition, energy consumption in production, construction, disposal and recycling, and so on. The main goal is to lower the overall negative environmental impact of all these factors. We still have a long way to go until our products are entirely free from toxins, are durable and fully recyclable. We are heading the right way, many companies are willing to take responsibility for their products, and some companies lead their on research on “green” processes and materials. But this kind of work is beyond the designer’s main competence, which leads us to discussing what responsibilities the designer have regarding sustainability.
**Product life span**

An issue that has been discussed little in sustainability is the duration of a product’s life span. Few companies study the life of their products after they’re picked from the shelf at the retail store and brought into the user’s home. How do they fit into the home, and what happens over time? Today we see the massive pile of wasted products as the effect of our ignorance of how much the product life-span and the user’s feelings matter. We can see clearly that perfectly functional products are disposed of – so why should design put so much emphasis on production methods when the product ends up on the dump within six months anyway? Clearly we need to understand more of what changes in the relationship between the user and the artefact when an artefact loses attraction or even becomes undesirable. This is the journey of the user’s experience with the product and requires us to understand the psychology behind today’s consumption patterns.
1.2 Consuming artefacts

At the same time as we are told through media that we consume more than earth can sustain, we consume more for every year. It has become an everyday habit to shop and consume goods. The products and services we acquire have become markers of our individual identity and lifestyle. Fashion may in the past have been associated with clothes, shoes and jewellery. Now we see that complex, electronic objects such as smart phones, and mp3 players are treated as trendy accessories. They are objects of desire that complete your style or outfit, and we love them it. Inevitably, there are consequences to this shift in mind-set about products.

**Losing durability**

Functionality and durability has become secondary in a trend-based world. For different reasons, it is cheaper than ever to buy a new set of headphones or an mp3 player, but very few of the gadgets are built to be durable, which creates an inevitably disappointing user experience. Well-made, long-lasting products are getting harder to find in the mass of alternatives. Producers release products every three months to make sure they follow the latest styles and fashion trends.

**Getting emotional**

Many designers feel the burden on their shoulders, feeling somewhat guilty for being part of the creation of products that fail far earlier than they want them to. Still, electronic accessories have made their way into our hearts, and they are likely to stay there for a long time ahead. It seems we have become more emotional with products, embracing them when they feel meaningful to us. But when they fail to be meaningful we quickly leave them behind, which is painfully obvious by the ever-increasing amounts of e-waste we see today. Maybe if designers were more aware of how our emotions work, and how relationships are created and sustained, we could make users’ experiences with products last longer.
2. Project theory
2.1 Relationships and emotions

We are biologically well-trained in applying personalities onto both our fellow humans, to animals we observe, and even to plants and “dead” objects that trigger this behavior (Evans 2001). We do this instinctively to analyze our surroundings, categorizing our impressions in order to act accordingly. In addition, we create relationships with both people, animals and lifeless objects. By applying characters into manufactured objects like dolls, cars and sculptures, we let our imagination wander and allow ourselves to experience different feelings, often merely as entertainment. We are not only physically and mentally affected by our environment, we are also emotionally affected. Most of all we produce meaning to the relationship we are creating with the other, reasons to why we coexist.

Defining relationship types
Jonathan Chapman has in his book *Emotionally durable design* (Chapman 2009) proposed that designers put more emphasis on emotional durability when dealing with sustainability issues. He is of the opinion that we need to know more about user behavior and the relationship between users and artefacts if we are to reduce the amount of failed products. As a start to understand the different ways we interpret and react to our artefacts, in one of his articles Chapman presents a six-point list of relationships that users have with electronic products (next page). This list is based on a survey he made where the respondents would define the presence of relationship factors of a range of objects they owned. Chapman suggests that the experiential framework provides a path for designers to work towards more inviting and emotionally enabling objects. Despite a possible lack of nuances, I think it is an interesting framework that, at least, provides a terminology for relationship types. I will attempt to implement this thinking in my design project, and examine what effect it may have on the decision making and the design process.
2.2 Six-point experiential framework

Narrative
Users share a unique personal history with the product, often related to how, when and from whom the product was acquired. This is one of the most common reasons for why an object feels special for an owner, as seeing and using it brings back important memories from the past.

Surface
The product is physically aging well and developing a tangible character through time and use. Age and treatment makes the object beautiful, and the character serves as a recording of the user’s behavior and habits. Traditional materials such as leather and wood is known for their ability to change appearance through time.

Attachment
Users feel a strong emotional connection to the product, the information it contains and its meaning to the user. Objects that has the ability to store and present personal information often serve an intangible need for the user. Appearance is subordinate, the content is invaluable for the user, which is typical for computers and smart phones today.

Detachment
Users feel no emotional connection to the product, having no emotional demand or expectation. This is common in products that has strict functional purposes, often minimalist designs like tableware, office equipment, workshop tools etcetera. These items can be replaced easily, however, they are likely to last until they break.

Consciousness
The product is perceived as autonomous and in possession of its own free will. By interacting with the product the user gets a sense of its mood and emotional state. Digital interfaces can often be designed to define a personality of the device, most commonly through its language and script. Users often perceive this as if the device has a life of its own, which is communicated through the interaction.

Fiction
The users are delighted by the products as they don’t fully understand it, especially a new product that has yet to be explored. High-end electronic products can mesmerize a user in its complexity that is often hidden in a simplistic cover. What lies beneath the surface is a mystery, and its potential is only described through the interface and interaction. High-fidelity audio systems, computers, smart phones and similar equipment has amazed users over the years as technology develops further.
Objects of fiction
The Placebo Project by Anthony Dunne and Fiona Raby is an attempt to bring conceptual design into everyday life, and to explore how people react to product fiction in a range of different electronic products. The artefacts they designed and placed in people’s homes are described to have a certain function, a built-in function that in some cases is impossible to know if it’s useful, or even existing. Their experiment shows that how the users were affected by the fiction and stories behind the objects. Some felt that their object was actively performing their duty, but without being able to actually prove it. The project is very interesting and awarding for designers interested in emotions and fiction, since it provides a thorough investigation and reflections on their findings.

External objects of pleasure
In many scenarios users subconsciously identify themselves with a product’s appearance, interaction, construction or even the brand identity behind it. It is the natural process of surrounding ourselves with people and an environment that we enjoy and are comfortable with. We seek enjoyment and pleasurable experiences, both through social interaction and through activities using our material surroundings. Relationships between people and objects are real and important to get to know if we intend to create emotionally durable relationships.

Photos: www.dunneandraby.co.uk
Context and adoption
Products all fight for our attention, some fail while others succeed to seduce us, and many clients want their products to be seen clearly among other products at all times. Boosting the chances that they will be sold in great numbers merely by being seen first. But for designing successful relationships, it is important to understand how a product is adopted by a user, and to understand the context and environment in which it will be used. A designer should also consider what relation a product should have to surrounding objects in its proximity. A product can be the central gestalt that steals all the attention, or could act like a sensible “butler”, blending in until it is needed. It may seem risky for designers to decide that their products should blend in like a butler, since the client usually expects the opposite.
2.4 Emotional values in products

In Emotional Design (2004) Donald Norman claims that emotions play an important role in design and that objects affect us in very different ways. He presents three types of qualities that help to define the affection and meaning of an object to the user:

**Visceral design** intends to affect us visually with its appearance, beauty and character. We judge these features quickly upon sight, deciding if it appeals to us or not. This concerns are dominated by the senses of look, feel and sound, hence a matter of presentation.

A good visceral design activates our primitive judgement of beauty, grace and taste, but is just as much connected to our cultural norms. A design strategy that focus on visceral values may be very efficient at attracting new customers, media attention and people’s desire. It’s easy to like something that has a strong visual identity or style.

**Behavioral design** is about the actual use of the product, how much you enjoy using it and its functions. Performance is key here, what matters is what a product does and how well it does it. Nonetheless, behavioral design also concerns the user’s understanding of the product, as well as how it feels to use it. Does it inflict feelings of frustration and confusion, or does give a sense of satisfaction and efficiency?

Designers that aim to satisfy users’ expectations does best to test their designs on people that will use it. Through user tests critical failures in functionality can be avoided, and users might even inspire to new ideas and functions to implement.

**Reflective design** will evoke questions and reflections on the different aspects of design, it could uncover norms and conventions that we are very used to. Questioning these conventions would be the main reason for the design, rather than being useful or a pleasure to behold. Even a concept that never reaches the market has a potential to get a space in media by causing discussion and evokes important feelings.

If anything, reflective design is important for the design community as it may uncover norms that we take for granted and give us reasons to explore different ways of designing.

The visceral effect of the Maclaren F1 is strong, it clearly communicates speed and power through form features.

Two very different objects in terms of expression, but with the same focus on functional values.

The Leica M9, a professional digital camera, takes amazing pictures but with the expression of an old and simple camera.

The Ipad redefined the way we enjoy the internet and play games using a way of interacting that had never been experienced before.
2.5 A study of household objects

A friend and I made a home visit to another friend of mine to discuss Norman’s three categories, all three of us being designers. Using as examples a range of objects that I picked in my friend’s home, the purpose was to attempt to rate the objects using these categories, and then discuss our arguments and judgements. Certainly, the rating was based on our individual impressions and flavor, but this made the reasoning and discussion rewarding. The result was particularly interesting as we surprised ourselves by the final ratings and about the way we felt about certain objects.

Visceral strength
Items we consider to possess a strong visual character and form language. Objects that often draw your attention much because of their appearance and style.

Behavioral quality
In the similar manner of commodities, some items were described as products existing for a single reason: to be great to use. Many commodities never seem to intend to charm us, merely convince us of their outstanding performance, while others manage to combine function with good looks.

Reflective designs
Two Apple products were considered to be truly reflective in their designs: the Magic Mouse and the Ipad. The reasoning behind this rating was that both of them defined a new type of interaction, with good and bad results. The cutting board can become a scoop to better slide food into the pan, a quite unusual concept to us.
Strategic use in the design process

Beside the fact that this exercise gave us a new way to analyze objects around us, I became tempted to try get a high rating in all three categories in my own coming design project. Possibly a high ambition that is hard to succeed with strategically. Nonetheless, an important ambition to express in order to reach a high level in my design work. My interpretation is that to score high in these three categories means to attract the user with an strong and appealing form language, to deliver a meaningful and highly pleasing interaction and usability. And finally, it means to present a product in a way that is new and exciting, which opens a door to different perspectives and possibilities. It may sound pretentious, but also be important to bear in mind if you
3. Design process
3.1 Designing home care

Emerging needs in therapy

In the health care sector we see an emerging need for medical devices that are designed for home use. Home care has two major benefits. It reduces the overall cost for the health care sector by moving often chronically ill patients from hospital beds into their own homes, which reduces the overall cost significantly for the health sector. Also, many parts of rehabilitation and care are more effective and successful when applied in home environments, patients recover more quickly.

With a growing number of chronically ill patients found in the developed countries around the world, home care is becoming a cornerstone in rehabilitation and therapy. As health care is moved to the home we need to adapt a range of medical products for home use. Devices that monitor, treat and assists patients in rehabilitation needs to be redesigned and re-imagined. I wish to explore the ways of designing home care medical devices with focus on emotional durability, to get a grasp of the effects of the different ways we can shape a positive user experience in this type of context. I aim to investigate what type of relationship is valuable between a home care device and the user.

Stroke rehabilitation

There is a range of products that are used as aiding tools in the rehabilitation process of patients that has suffered from a stroke. One of the most important parts of a patients recovery after a stroke is to exercise regularly. The possibilities to exercise is individual as every stroke is different from the other, so stroke patients have very different needs in order to start exercising during rehabilitation. The goal is to help the patient return to normal life as much as possible. Along with physical exercise, occupational therapy and speech therapy are the two most important parts in rehabilitation after a stroke.

Because rehabilitation from a stroke is so individual home care devices should cover different needs. Exercise equipment should be based on the patient's abilities of movement and strength, with the patient's own goals in mind.
3.2 A matter of determination

All in all, life after a stroke is a great challenge for an individual - physically, mentally and emotionally. Depression and demotivation is part of the daily struggle to regain a reasonable quality of life. Activities that were once habit has to be learned again, with great effort. And since the rehabilitation progress depends on the patient’s own engagement it is important that every tool available makes it easier to exercise and practise. Motivation is key to getting back to the way of living before the stroke. Hence, a product for stroke rehabilitation may need to appeal to the user in a variety of ways, considering interaction, scripts, aesthetics, form, usability, color and materials.

There are many parts of the body that needs rehabilitation after a stroke, and the exercises requires a serious effort for a stroke patient (www.stroke-rehab.com). However, some exercises have potential to become more efficient and motivating when tools are involved. By offering tools with both simple and more complex features like resistance, counter weight, a significant level of interaction, collection of data, and more, the exercise activities can be enhanced.

Common areas of rehabilitation

Assistive motion
Basic strength, extending and retracting the arm. For patients with very little ability in the arm an assistant gives a gentle push to retract the arm.

Strength training
Ordinary exercises for muscle training of the whole body. Lifting, squeezing, extending, contracting, etcetera.

Sensory training
Activating numb areas associated to sensing our environment.

Coordination exercises
Concerns our perception and cognitive abilities, as well as fine motor skills in arm, hand and fingers.

Balance exercises
Includes balance basics of sitting, rising to standing, single steps, and walking.
Strength, coordination, cognition and balance
The hand and the arm are important tools in everyday life, so rehabilitation that concerns fine and gross motor skills, strength and coordination is a major part of stroke rehab. Over 70% of stroke survivors suffer from upper limp deficits which severely affects the daily life activities. In particular, the sense for balance is affected since the stroke patient suffers from numbness and the loss of strength in one leg. These areas of the rehabilitation are some of the most important ones in order to become independent and enjoy daily life activities.

A range of exercise tools
Products that are available on the market most often focus on a certain type of movement, muscle or body part. Many of these are simple tools with a couple of intended ways of using them, while others are more complicated and require a careful preparation to be used properly. What matters is that the exercises are carried out regularly and properly, and in my research I have noticed that this is not always the case.

A selection of existing rehabilitation tools
Don’t want to feel like a patient
In the project I established a contact with Sirpa Hellström, a occupational therapist working with home rehabilitation for stroke patients. In my meetings with Sirpa Hellström and her colleagues in the stroke rehab team, it quickly became clear that patients have a hard time getting their rehabilitation started when arriving back home after the hospital. With depression, limited knowledge and ability to exercise the patient often lacks motivation. Introducing training and aid tools that the patient don’t identify herself with adds to the discomfort. The looks of the tools has a big impact on whether the person feels like she is still a patient or just a user that does exercises. This makes the sensible designer so important in the development of medical devices, as the user in this case needs to invest a lot of emotions and effort into her healing process.

Cross-fertilizing product categories
In order to design an exercise tool that in different way helps motivate the user to exercise, I investigated the possibility to cross-fertilize a rehabilitation tool with electronic gadgets like gaming consoles and sports gear. Expanding on the functionality range and purpose of the rehabilitation tool to become more interactive can help create a more enjoyable and meaningful experience. Embedding digital content also supports the idea of product consciousness, adding a level of intelligence to the object. It is well-known how easily we get immersed by video games, thanks to the well-designed challenges and the strongly visual way we interact with the game. It definitely makes sense to get inspired by this interaction when designing rehabilitation, and there are many examples of health clinics and nursing homes that with great success have implemented video game experiences to increase the resident’s physical activity.
3.3 Potential concepts

Gaming controller and hand exercises
Current exercise tools are often very simple, for instance, consisting of a single piece of material shaped to allow squeezing and pinching. Considering the fine motor skills and the cognition required when playing with a video gaming controller, one idea was to expand the interactivity the hand or arm exercise tools. The main proposal was to place buttons and switches onto or into a hand exercise tool or a dumbbell, allowing both strength and precision training at the same time. Light emitting diodes (LEDs) embedded in the tool could visualize different challenges and give feedback to the user.

Motivating and multiple challenges
This type of device could be more motivating to use than a regular exercise tool, as it requires your attention, challenging you in a variety of ways at the same time. By giving feedback on your attempts the exercises are more efficiently carried out, and improvements are easier to follow. This type of thinking was well received by the stroke team, considering the possible effects on motivation and engagement.

Interactive dumbbell
This dumbbell has built-in sensors that can keep the count while you do the exercise. It makes it easier to focus on the exercise goal, and keep a routine without risk of losing concentration. With sound feedback the dumbbell tells you when the movement is performed properly.

Gaming-style hand tool
Rehabilitating the hand includes both improving strength and coordination, and part of this is practising individual finger movements. This concept could combine many exercise areas in one object. A flexible and elastic material covers an interface of physical buttons with integrated LEDs that provide different challenges.
Basic balance training
I introduced the same idea of embedding sensors and interaction into some balance training concepts. However, I found out that there is a gap of exercise tools for stroke patients in their early rehabilitation. According to the therapists at the stroke steam, the training products I had explored are all far too difficult to use for someone who can barely stand up or take proper steps. This opens up for a new possible product range for performing the most basic of balance exercises necessary to get up wand walk.

Balance pad
As with the hand and arm exercise tools the purpose with this concept is to explore the possibilities of embedding technology to make the use of the product more compelling. This type of balance pad is too hard to use for stroke patients, hence this design is not an option for performing basic balance training.

Balance mat
A thick carpet with a weight-sensitive surface detects the position of the feet and visualizes the interaction and challenges with light and colors. The challenge here is to take steps in various directions when the device tells you to. Not much thicker than a carpet, the balance mat is easy to stand on and provides space to take small steps. Like a foot mapping sensor (picture on the far right), the footprint can be analyzed with a number of weight levels to provide more detailed feedback on the footprint.
3.4 A system of tools

Since a range of interactive devices could be involved in the rehabilitation, it makes sense to see these devices as a system of products related to each other. The rehab system is customized for each patient, but the patients share the same goal - getting better. Part of the exercising is watching the progress you make over time. You are getting faster, more precise and coordinated, stronger, more focused and aware of what you are doing. With the technology embedded in the rehab devices, exercise statistics can be recorded, assembled and visualized on a household computer. The possibility to review the progress can make it more motivating to exercise regularly.

Developing the balance mat

Despite the possibility of designing a whole system of rehab tools I decided to focus on the one with the most potential. The balance mat concept could offer a new way of practicing the basics of body balance, something that the stroke team saw as very beneficial for rehabilitation. Some of the key benefits that were identified are that the user could be guided through certain challenges with the help of an interface, that a certain level of interaction could make it more interesting to exercise, and that the user could perform the tasks without assistance from the stroke team.

Possible emotional qualities

Considering the topic of this thesis, it would be rewarding to design a product that could have a significant emotional effect on the user. As it resembles a carpet, the balance mat could be placed on the floor in the living room or the bedroom, and as a result, be a part of the home interior. That could affect the user in a similar way as with other interior objects and furniture, which raises questions about its appearance and style. The balance mat is likely to rest on the floor most of the time, ready to be used, and sometimes stored away when necessary. How will the new device be adopted by users depending on its style? How should the product be designed in terms of style, color and materials? The balance mat concept is a new type of training device to be used in the home. Expression will have a certain impact on the user’s interpretation of the device.
3.5 Home visit and evaluation

Mockup testing and exercise programme
An early mockup was prepared before a home visit to a stroke patient with difficulties of standing and walking, living in a small flat with his wife. I went there along with a therapist from the stroke team, bringing a mockup I had made, with the intentions to discuss the product concept, the overall dimensions and the possible interaction. The patient and the therapist demonstrated which exercises they usually made, exercises that are common for a majority of the stroke patients. Afterwards we discussed how the balance mat could be used for the kind of exercises they worked with. In addition to stepping forwards, backwards and sideways, the therapist explained that it is crucial that the patient learns to stand straight, putting equal weight on both feet. Normally, the patient’s weight symmetry is analyzed visually, by the therapist during exercise, by the patient using a mirror or someone else that is present. This hard to practice, so I decided to try implement a training programme in the balance mat concept.

Considering ugly products
In addition to talking about exercises, dimensions and interaction, both the patient and his wife and the therapist talked about the appearance of aid and rehab products that are available on the market. They felt that they were not designed to blend into the home and most of them were quite ugly. The couple had bought some items that they felt were ugly and had sometimes avoided buying tools because of their appearance. The therapist agreed on their opinions and added that among patients is a general desire to have tools that fit into the home better than today.

Visceral quality
Connecting back to my research on emotional design, it seems that a majority of rehab products lack visceral qualities, something that is clearly affecting users’ motivation to use the products. My intentions are to work consciously with the visceral part of the product, to develop a product expression that is attractive. Appearance is important to us, and to design a product that you avoid because of its expression is a waste of good functional values.
New mockup and main design feature
As a result of the discussions on dimensions and interaction with the patient and therapist, a new mockup was made to enable further evaluation. At this time, I took the final decision to use an LED matrix for communication, and the pressure sensitive surface I had been considering. A new feature was also tested, adding handles and the possibility to fold the mat, which makes it easily to carry when needed.

Animations of exercises
To visualize the interactive exercise concepts for the balance mat, I created animations of the challenges that were discussed. I explained the concept of practicing weight symmetry - lighting up the LEDs under your feet and then using a line of LEDs as a scale pointer, moving from left to right with the mid point as the correct weight symmetry. For the stepping practices I demonstrated taking sidesteps, using animated LEDs showing where to move, one foot at a time. These videos were shown to the stroke team who were pleased with the way I designed the challenges and feedback concept.

Excerpts from video demonstrating the exercises

When working with weight symmetry, a line of LEDs demonstrate the center point of the body in real time. The user can then see how much the body is leaning to one side, and can practice compensating for this.

When the stepping exercises are active, the user starts in the middle, then the LEDs light up and animate where to place the feet, one at a time.
3.6 Further definition

Seated symmetry exercise
In addition to evaluating the animated exercises, the stroke team and I discussed how to further improve the product. One of the significant suggestions were to make it possible to practice the weight symmetry while seated, as an initial step before standing up. Spontaneously, my concern was that the user puts the chair legs onto the product surface, which might damage the sensors. Hence, I worked with a way of adapting the shape of the product to accommodate using a chair on the short end side, trying a range of different cut-outs of the corners.

Tactility and ergonomics
I considered the balance mat able to be made maximum 20 mm thick, which had an impact on the ergonomics of the handles. It was necessary to have a suitable design that allowed the handles to meet in a smart way when folded. As the LED matrix was defined, I decided to make the interaction more tactile by adding a small bump in the surface above every LED. This way the user is not only guided by light but also gets feedback from the surface.

Designing the interface
A number buttons were necessary to be placed on the product. Firstly, a power button, then buttons to activate the different exercises. Initially I chose to name the different challenges P1, P2 and so on, to make it flexible. Secondly, there was also a need for a button to toggle communication with a computer, to upload exercise data via Bluetooth. Finally, it made sense to add a sound feedback function if users finds it hard to see the LEDs. The sound effects can be played when an action is encouraged during an exercise, and to give feedback on successful actions.
3.7 Relevant style norms

As functions, dimension and parts were decided, the balance mat was developed far enough to considering the color, material and finish. By exploring color and materials you automatically associate with certain style norms that affect the different product categories. Working with an obvious design norm can make it easy to place a device in a certain category of products. It is also a common strategy for companies to brand their products into specific product categories and market segments, making it crystal clear for the consumer what kind of product it is. The balance mat is an interactive object that you are intended to use frequently for exercising your balance skills in your home. My interpretation is that this product concept relates to three types of product categories in particular: Medical devices, sports gear and electronic gadgets. The three categories has served as my main inspiration during the defining of the appearance.

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<thead>
<tr>
<th><strong>Electronic gadgets</strong></th>
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<tr>
<td>Defined shapes &amp; split lines</td>
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<td>Plastics with metal details</td>
</tr>
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<td>Glossy surfaces</td>
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<td>Colored details</td>
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</tr>
<tr>
<td>Material mix</td>
</tr>
<tr>
<td>Saturated CMYK vs All black</td>
</tr>
<tr>
<td>Ornamental details</td>
</tr>
<tr>
<td>Light weight</td>
</tr>
<tr>
<td>Trend based styles</td>
</tr>
</tbody>
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<tbody>
<tr>
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<td>Bulky and practical form</td>
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<td>Textured thick plastic parts</td>
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A range of variations
I used 3d software to create a defined model of the balance mat and then a large variety of colors and materials were documented. A designer friend of mine and myself then evaluated the range of styles that were generated. Some of the keywords we discussed were seriousness, product association, ergonomics, playfulness, medical expression, home interiors, and so on. The goal was to chose a direction that made sense and felt like a combination of the three styles I had as inspiration.

Images and comments from evaluation

- Good to limit colors to one
- The frame is easy to see
- The color is too saturated
- Outdoor sporty style

- Unnecessary with a blue edge detail
- Works well with a bright wooden frame, could use less contrast in texture
- Getting closer to furniture using wood

- The alarming colors are not suitable
- Looks like a toy

- Good material and color combinations
- Nice with color working as accent
- Dark wooden frame works well

- Bright and clear contrast to the floor, especially with the dark corners
- Yellow is too alarming

- Interesting color relation between handles and the center line
- Fresh and sporty, but also gamer style

- Dark color on frame makes good contrasts

- Sporty, hygienic style with white surface

- A dark frame and bright surface puts focus on the surface

- Serious impression, professional gear

- Sober, white shirt and black tuxedo

- Dull, too little contrast
### 3.8 Final revisions

**Color scheme**
The colors I finally selected after the experimentation and evaluation consists of a few grey scale swatches and one in a soft green tone. It is a color scheme that I consider makes the product seem serious but friendly. The green tone is slightly toned down to avoid attracting too much attention. Using the dark grey on the surface gives good contrast to most floors, with the almost white frame to increase this contrast further. A 50% grey center line reveals the joint where the product is folded and provides a subtle grid to relate to during the exercises.

**Final adjustments**
While the final CAD model was being made, with the recently chosen style, an important aspect rose during some late evaluations of the product’s construction. I considered it possible to reduce the thickness of the board and still fit the components I planned for. This enabled the frame to become thinner than what was first intended. As the frame was getting more slim, it was more likely that a chair could get close to the active surface. After making some quick mockups of the new frame I realized that the cut-outs of the corners were unnecessary. The user will be able to sit properly with the feet on the active surface without the cut-out corners, so these were removed.
4. Final proposal
4.1 Concept presentation

Rehabilitating your balance after a stroke is a tiresome and challenging process. Having a numb leg makes it hard to stand straight and walk properly. The first step in rehabilitation is to become aware of your weight asymmetry between the legs, and learn to correct your posture. After that, simple stepping exercises in different direction is the next step to get back to walking independently.

The balance mat
This product is designed for home use and to be operated by the stroke patient herself. The product helps the user to become aware of the weight symmetry in an efficient and pedagogical way. The symmetry exercise can be performed both while seated and standing. And as the weight symmetry improves, it is time to do some basic stepping exercises that the balance mat provides.

A new approach to stroke rehab
Becoming aware of an incorrect weight symmetry needs you to either have a large mirror or an assistant that informs you and helps you to correct it. With the balance mat this becomes much easier to practice without assistance, which is beneficial for the daily rehabilitation. The stepping exercises are communicated clearly on the balance mat with the animated yellow LEDs. This interactive approach makes rehabilitation more appealing, motivating and rewarding for the user. A sense of flow is easier to achieve when the user is guided through the different exercises.
How the balance mat works

Located below the protective top surface is a pressure sensitive matrix, able to scan the feet to determine their position and the average weight of each foot. This technology is used today in similar products to analyze footprints, using a higher density of sensors compared to what is needed for this kind of concept.

The collected data is then communicated to the user with the help of a matrix of LEDs located on the surface. The LEDs are animated to present live feedback and to guide the user through the exercises. In case it is difficult for the user to see the LEDs, sound effects can be activated to support the animations.
The two interfaces

The interface consist of five buttons, three of which were described earlier: power, volume and Bluetooth. What was P1, P2 and P3 is now replaced with two buttons symbolizing the two main exercise programmes: symmetry practice and stepping exercises. A remote has been designed to relieve the user from leaning down.

Using the balance mat

The balance mat is ready to be used after being connected to the household power and turned on. The user selects one of the programmes, the LED matrix lights up, showing where the feet should be placed in order to commence the exercise. Throughout the exercise the LEDs guides the user in what to do and where, and gives feedback on the user’s interaction.
Symmetry and steps

The user can decide to sit or stand during symmetry practice. When the feet are placed in the zones, the balance mat compares the feet’s weight and visualizes the current balance using an LED line. As the user corrects the weight, the LEDs move towards the center of the balance mat.

When the stepping programme is active, the user chooses to either practice steps sideways or forwards and backwards. When the feet are placed in the zones, the balance mat starts the exercise by animating a frame of LEDs, illustrating where the user should step. The challenge involves moving one foot at a time.

Progress review and smart storage

Staying motivated is key to a successful rehabilitation. The balance mat can be connected to a computer with Bluetooth in order to save exercise data, enabling a review of the progress over time.

As the balance mat is foldable, it makes it easy to carry and to store when necessary. When folded, the two handles meet, creating a single, ergonomic handle great for carrying.
5. Conclusions
5.1 Norman and Chapman

Over the years I have become more and more confident in my design process, in the way I execute projects using my design methodology. This skill set has been in practice successfully in this project as well, allowing me to end up with a result that I am satisfied with. Even so, working with this thesis has made me realize how hard it can be to apply a new terminology and perspective to my design process.

Reflective
My ambition with the design work has been to work consciously with all three of Norman’s categories to open up for a range of emotional impacts on the user. As the project progressed, the novelty of the final proposal convinced me that the concept has a certain reflective quality. It presents a new perspective on rehabilitation, offering a more interactive and actively motivating approach than products in general today.

Visceral
During the design process I have had the intention to design an rehab product with a friendly but serious expression, something that I think is meaningful for this kind of product. I decided to use a green color as an accent and grey scale tones on the majority of the parts, a color palette that I finally picked from a great number of color tests.

Behavioral
The whole experience of using the balance mat has merely been tested using a mockup model and later visualized with animations. This makes it difficult to evaluate the method of interaction and use, until you actually have a working model to test. However, despite the limitations of evaluating, the continuous feedback I have had from the stroke team, and the comments from people that I have presented the project to is overall very positive. The good feedback concerns both the appearance, the proposed interaction and use, as well as the very concept of interactive rehabilitation. For these reasons, and in the light of Norman’s terminology and theory, I am satisfied with the work I have presented.
Consciousness, fiction and attachment
To connect back to Chapman’s experiential framework, the most obvious connection to his list is that the balance mat can be considered to have a certain consciousness. The pressure sensors and the LEDs create the notion of a smart device that has an amount of awareness. This also connects to fiction, as the user may be intrigued by the product’s technological content. Apart from the LEDs, the technology is below the surface, hidden inside a rather sober form language. Furthermore, I think that the possibility to record and save exercise data makes it easier to create a positive relation to the product. Even though the data is presented on a computer screen, the content could be interpreted to be located in the balance mat.
5.2 Reflections on the work done

Emotional values in home care
The initial goal of the whole design project, and my own motivation, was to put a new perspective on rehabilitation products. Medical devices has traditionally been designed for clinical use by professionals. Bearing in mind the development from clinical care to home care - a completely different context - we now need more carefully designed devices. In this light I feel content with my new theoretical insight, despite the fact that I think it has been complicated to put into practice. One certain thing that I have realized is that I really want to put more time into evaluating final proposals with users in the right context, to see some reactions and get relevant feedback.

Emotional durability in practice
My aim has been to put Norman’s emotional values and Chapman’s experiential framework into practice. This has not been easy to do, as I did not know exactly what it meant to put it into practice. My strategy has been to get a good understanding of what their definitions actually mean by gathering product examples that the definitions may apply to. These references have followed me in my design process, reminding me of what is possible and what could be useful for my proposal. When reflecting on my process and result afterwards, I think it is hard to see very obvious signs of this theoretical foundation. I conclude that it takes a lot of practice to revise your design process, adding new perspectives and agendas that you intend to work with consciously. Regardless, my design process and methodology will evolve by itself, based on my motivations and ambitions. The insights gained in this project will definitely affect my designs from time to time.
6. References
6.1 Acknowledgments

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6.2 References


