Changing Behavior through the Design of Intelligent Systems, Products and Related Services

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Abstract. Through the development of artifacts designers have had an important influence on peoples lives. In the research and educational theme *Changing Behavior* of our department we explore how the affordances of designed environments can be used to invite people to live healthier and keep them in the base line of our society. The approach on how to design for behavioral change is illustrated by means of project examples developed by means of the *Reflective Transformative Design Process*. Based on these examples we discuss three research questions that require further exploration. We intend to assess the effect of a motivational technology and understand how they can attract someone into a certain course of action. Furthermore, we question how design can sustain behavioral change and how a intelligent systems, products and related services should be implemented to provide long-term benefits to one's wellbeing.

Keywords: changing behavior; design; reflective transformative design process; wellbeing

1 Introduction

The generation of adolescents born after 1986 is referred to as the "boundless generation" [1]. Their parents, from the lost generation (1956-1970) and the pragmatic generation (1971-1985) raise their children with the moral that everything should be possible and there are no boundaries. As a result, the current generation is facing a culture that is individualistic and aiming at self-development and self-help. This results into egoism and selfishness. There is a strong need for youth care, and this group has more debts, is more and more leaving school without a diploma, and suffers from overweight. For the first time in history, we are dealing with a generation who will have lower perspectives than their parents.

This generation is very much influenced by all the triggers their environment offers them. From a phenomenological perspective [2] one may consider that they perceive the world by how they act in it. Furthermore, the world offers them possibilities and opportunities, which are defined by Gibson as affordances [3], to act upon it in a certain way. The general tendency is to choose the easiest handles, which often tend to be the less appropriate for their wellbeing. For example, currently children develop

an unhealthy food preference due to an increasing availability of unhealthy processed foods with high hedonic values due to sugars, fats and salts [4].

Designers can take the responsibility to design the handles in such a way that we can support in making the 'right' choices. However, how to design for these 'right' choices and what are the right choices? Designers cannot enforce users to perform certain behaviors that are beneficial for society, but they could support in making these behaviors preferred over the negative ones as in the end people should be independent and empowered to take the decisions by themselves. In this paper we will consider available knowledge on persuasion and link this knowledge to how people believe they make the appropriate choices. We illustrate this link by means of three sample projects and propose four research questions that will enable us to design behavioral change to sustain wellbeing.

1.1 Changing Behavior

Technology is evolving so rapidly and innovatively that it has the potential of transforming our world in ways we cannot foresee. In the Department of Industrial Design of TU Eindhoven we intend to educate people to transform our world, preferably in beautiful ways with societal relevance. This requires a central place for creating a vision in the design process that we teach our students, and it requires support for exploring opportunities instead of solving problems [5].

Within the department we have setup the research and educational theme *Changing Behavior*. In this theme we explore how the affordances of designed environments can be used to invite people to live healthier and keep them in the base line of our society. The target groups are people at risk, either prior to requiring medical professionals or in a rehabilitation state after medical consultancy. With these target groups we can gain tremendous cost reductions in our costly professional health system and social security system. The research of this theme aims at developing design methodologies and intelligent systems, products and related services concepts. We base our approach on the combination of theories on *Health Protective Behavior* [6] and the *Persuasive Strategies Model* [7].

Health Protective Behavior

The term *Health Protective Behavior* is commonly used and is defined as "Any activity undertaken by a person believing himself to be healthy, for the purpose of preventing disease or detecting it in an asymptomatic stage" [6]. The *Health Belief Model* accounts for the perceived health risks and the willingness for people to act accordingly [8,9]. The core of the model consists of three classes of inputs. First, the individual perceptions, being the perceived susceptibility and perceived physical and social seriousness of the disease, determine the perceived threat of the disease. Secondly, modifying factors, like external cues (medical campaigns, illness of relatives) and demographic and socio-physiological factors influence the perceived threat. Finally, there is the likelihood of action, which is influenced by the perceived barriers and benefits to preventive action [9].

Persuasive Strategy Model

The behavioral model for persuasive strategies describes psychological factors that control whether a behavior is performed [7]. Three factors are distinguished which must be available at the same time. For a target behavior to happen, there must be an appropriate motivation, sufficient ability to conduct the behavior and an effective trigger. In contrast to the *Health Belief Model*, the *Persuasive Strategy Model* is not solely created for health related persuasion as it is also applicable e.g. to invite people to do tasks like filling in forms. The subtle difference can be explained as follows. When we target the behavior of doing more physical exercises, the persuasive model may result in a strategy to invite people to actually move, for example by promoting cycling or walking.

The *Health Belief Model* suggests targeting the perceived negative impact of not moving enough, like gaining weight or reducing ones stamina. Because the *Health Belief Model* targets the perceived influences more explicitly, this explains why special attention is being paid to the demographic and socio-psychological influences. On the other hand the *Persuasive Strategy Model* distinguishes three motivators, six abilities and three types of triggers. The motivators are pleasure/pain, hope/fear and social acceptance/rejection. The elements for abilities are referred to as *Elements of Simplicity*. These are availability of time, availability of money, required physical effort, required brain cycles, social deviance, and non-routine. Finally, the types of triggers are sparks, facilitators and signals.

Table 1. Mapping of the Health Belief Model [9] to the Persuasive Strategy Model [7]

Health Belief Model [9]		Persuasive Strategy Model [7]
Individual perceptions		
Threat posed by illness	<>	Elements of motivation (out of fear)
- Perceived susceptibility to disease	<{	- Fear - Social rejection
- Perceived severity of disease	<>	- Pain
Likelihood of action		
Belief in efficacy	<>	Elements of motivation (out of reward)
Perceived benefits of preventive action	<{	- Hope - Social acceptance - Pleasure
Perceived barriers to preventive action	<>	Six elements of simplicity
Modifying factors		
Cues to action	<>	Triggers

In table 1, the three classes of inputs for the *Health Belief Model* are mapped onto the three motivators and all sub-elements of the *Persuasive Strategy Model*. The overlap is remarkable: only the motivation sub-elements of the persuasive strategy

model have to be split into an “out of fear” and “out of reward” category to make the mapping complete. With this mapping, we have access to clear design criteria to persuade people at risk into beneficial behavior.

Cognition and Behavior

Parts of our behavior (e.g. movement planning) are unconscious, automatised. Unconscious processing in cognition may occur as well, but may be difficult to manipulate. Cognition, perception and action influence each other: cognitive training can be a link to action. In the persuasive strategy model [7], the importance of habits is mentioned, which can be seen as the intuitive behavior. Nobel prizewinner Kahneman distinguishes perception, intuition, and reasoning [10]. Going backwards through these concepts, more and more automating is involved and there is a shift from conscious to unconscious processing. Perception and intuition are assumed to be ‘effortless’. Kahneman refers to the concave shape of the gain-loss curve. This may explain the fact that it is easier to seduce people for bad behavior, while it is hard to sustain healthy actions.

In the theme “Changing Behavior” we are not only aiming at persuasive techniques to invite people at risk to live healthier, we are also envisioning a long lasting permanent change of habits. Therefore, it is essential to explore how affordances can be designed in such a way that they make decisions to live healthier easier that the bad behaviors. Making these healthy options “effortless” and relying more on intuition could offer solutions to design for this behavioral change.

Application areas

In an exploratory study on activities that people perform to protect their health, food, sleep and relaxation, exercise, health care, personal care and emotional care were considered as the main activities to protect one’s health [11]. The ambition of the theme is to explore for permanent changes in daily life. Therefore, an application mapping onto six areas (hygiene, sleep, food, relaxation, exercise and social life) was defined. Health care was discarded as a focus as this already relies on the involvement of a professional caretaker.

2 Project examples

We illustrate our field of research by means of three projects relating to three of the six areas previously defined. The examples illustrate projects that provide feedback on a cognitive (conscious) level, and on a perceptual motor (subconscious) level as well as on a combination of both. We will discuss the three examples in relation to the aforementioned behavior model for persuasive design and the *Health Belief Model*.

2.1 Food

First we present the 'Eetmeet plate' developed by Kooijman [12]. The 'Eetmeet plate' encourages mindful eating at a healthy eating rhythm. The project was developed for her master's thesis in response to over-eating and fast eating. The plate guides people to eat slower while eating a meal by responding through lights to the speed of eating. It thereby stimulates the eater to wait and chew sufficiently between each bite. The plate normalizes the eating rate encouraging the diner to become aware of how fast they eat transforming the eating experience into a more conscious aesthetical experience.

Fig. 1. Lissa Kooijman with her 'Eetmeet plate' (photography by Bart van Overbeeke).

The 'Eetmeet plate' project was developed because there is a perceived susceptibility to obesity. The designer has developed a motivator by providing a more aesthetical cue to action. The user needs less brain cycles to think of the time required between each bite within the actual routine of eating.

2.2 Relaxation

The second project is a pen that supports stress reduction [13]. The pen detects hand movements that are an expression of people's restlessness and of which the user is not continuously aware. The pen responds by counteracting these movements to reduce stress. The behavior modification is embedded in the interaction. Results from experiments with the pen indicate that people using the pen were more relaxed on a physiological level. This suggests that the pen supported in reducing stress by means of inherent feedback, i.e. feedback that occurs as a natural consequence of ones action [14], to implicit behaviors. It may therefore be possible to affect the stress experience of people without the need of any cognitive reflection.

The affective pen was developed because there exists a perceived susceptibility to chronic illnesses that may occur as a result of stress such as heart disease, ulcers or

mental illnesses. The current solution does not require any physical effort, brain cycles or time as the feedback is embedded in the action and the user does not need to be cognitively engaged in the process.

Fig. 2. Affective pen

2.3 Socialize

Fig. 3. Squease vest developed by Squeasewear

Finally we discuss the Squease vest [15], which has been developed especially for and with children with Autistic Spectrum Disorder (ASD). Children with ASD are highly sensitive to anxiety and the Squease vest is a garment that allows the wearer to apply deep pressure to their body in order to create a calming effect. As such the Squease vest allows the wearer to feel protected and at ease on the move.

The Squease vest was developed based on the premise that children with ASD have a risk of requiring special care if led by anxiety. The Squease vest motivates

them to gain control over their own relaxation without requiring any physical effort or social deviance.

3 Methodology

The *Research through Design* [16] approach was crucial in the development of these projects as it offered the opportunity to experientially explore the design space of systems. Furthermore, it allowed for making various prototypes as a mechanism to generate knowledge. We define *Research through Design* as an iterative process of ideating, building and validating concepts in context (see e.g. figure 4). In research through design the hypothesis to the research question is generally materialized in a prototype to test implications of theory in context and understand how people respond to the designed artifact.

Early prototypes of the intervention were tested and evaluated in context, following a *Reflective Transformative Design Process* [5]. In this process the designer moved through phases of building prototypes, validate these prototypes in context or in relation to existing body of knowledge and reflect on the knowledge that is gained throughout the process. By integrating these steps in the process the designer researcher gained insight into the design opportunities. The decisions of all three designers were guided by their vision on achieving wellbeing through prevention.

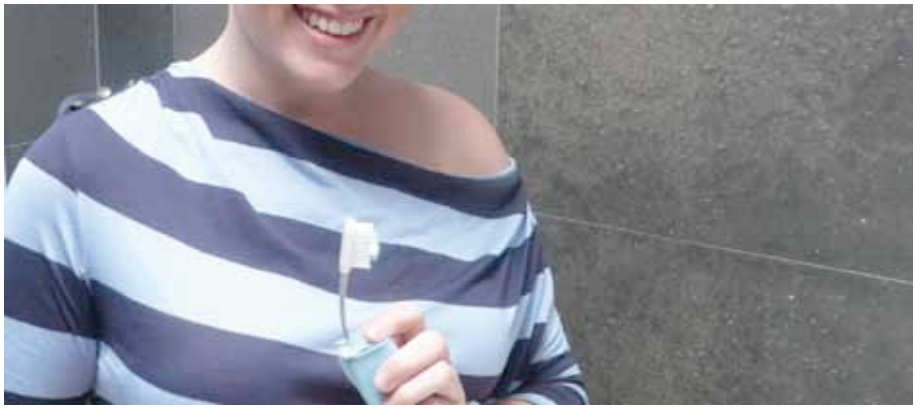

Fig. 4. A user evaluating an early prototype by developed by master student R.R.J. Dijkstra of a toothbrush with inherent feedback.

For further development, the *Reflective Transformative Design Process* requires different steps to be undertaken that are described as: incubation, nursery, and adoption [17]. The incubation is an early developmental phase in which quick and dirty prototypes are built in short design cycles, which are evaluated by experts. This is a step prior to the prototypes that are presented in the current article. In the nursery, the most promising concepts of the incubation phase are taken to a level in which users can actually experience how the concept is envisioned and evaluated. The ‘eetmeet plate’ and the affective pen are currently at this stage of development.

Finally in the adoption phase, the prototypes or final intelligent systems, products and related services are actually put in the field and evaluated as to how they change the life and behavior of their users, as can be observed in the example of the Squease vest.

4 Discussion

In the projects described we distinguish various aspects that motivate our research. First of all, the examples presented in this paper argue for the possibility of changing behavior by means of cognitive stimulation or by guiding people through their perceptual motor skills. Thus there appear to be various mechanisms that allow changing behavior, and not all need to be experienceable. In relation to the argument of Kahneman [10] it may be possible to design for healthy behavioral change through perception and intuition. This leads to the first research question i.e. how can intelligent systems, products and related services attract someone into a course of action that is beneficial to his or her health, without requiring any effort?

As can be regarded by the process from incubation to nursery and finally to adoption the eventual goal of designing for changing behavior is to implement developed knowledge in such a way that it allows for changing society. One of the main questions this entails is on what basis one can predict the effect a behavioral change will have. One may question how the designer can evaluate at an early stage what the long-term effect of such intelligent system, product or related service may be. As the *Research through Design* requires considering decisions based on the evaluation of early prototypes, the second question that needs to be addressed is how one can assess the effect of a motivational technology on wellbeing in the early phases of the design process.

In addition to determining the effect that a motivational technology may have it is also important to consider how it will be accepted. Given the previous examples, in some cases there exists an intrinsic motivation to use such product. Given the Squease vest it is clear what the immediate benefits of such product are towards children with ASD as they will immediately experience the calming effect. We envision a long-term effect where the user re-gains his or her self-confidence, and may eventually go out in public without the supporting tool. However, the effect of the affective pen could be more relaxing and experienced over a shorter period of time, although the effects may only be noticeable after a certain period of use. On the other hand, the 'Eetmeet plate' requires a longer process, and it is even unclear whether a person will actually benefit from this behavioral change, as a user may never experience the actual benefits.

It will be important to understand why a user would want to obtain a product such as the plate to prevent mindless eating, if the user has no problems with obesity yet. This requires looking at different stakeholders that might have a long-term benefit if the user does not eat mindlessly. Therefore, the third question that seems to be relevant to ask is how an intelligent systems, products and related services that provides long-term benefits to one's well being needs to be implemented.

Not only will these three research questions form the core of the educational and research theme *Changing Behavior* it will also be important to consider the ethical

issues that designing for behavioral change may entail. If intelligent systems, products and related services will persuade people to engage in certain behaviors that others may consider beneficial to their health, there should probably be a level of self in control. But, if people are in control of their behavior, the most important question that arises is: how and what can be designed for sustaining healthy behavioral change?

5 Future

In the current paper we provided some solutions of how the different research questions can be tackled. Through a combination of analyzing situations, making prototypes and evaluating them in context we will explore how to achieve our vision of a healthier society by changing behavior. Further progress will be made by elaborating on these concepts and explore how we can change the affordances of the world in such a way that people with decide to take healthy decisions themselves.

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