

# Design for Health Behavior Change Supportive Technology: Healthcare Professionals' Perspective

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## ABSTRACT

Health behavior change is a long and difficult process that persuasive technology supports through persuasion and social influence. Designers, oftentimes, do not distinguish the different social influence factors, one of which is social comparison (the comparison of an individual's data to that of others). Social comparison is tested by psychologists on health, coping, and wellbeing. However, design guidelines for social comparison features are almost inexistent.

This paper explores – through semi-structured interviews - healthcare professionals' perspectives on technology supporting behavior change, and social comparison. The results present five categories the designers can look into and get inspired. Finally, design implications are presented: three design components for a holistic persuasive design, and three questions related to the social comparison features' design in order to help with brainstorming and reflection.

## Author Keywords

Design, social comparison, health, behavior change, healthcare professionals, persuasive technology.

## ACM Classification Keywords

• Human-centered computing~HCI design and evaluation methods • Human-centered computing~HCI theory, concepts and models.

## INTRODUCTION

Behavior change is a long process during which, people pass through different mental and physical stages [16]. Behavior change theories describe how people change behavior and what can influence them. Some of them focus on the individuals and their actions [30,41], others take into account the individuals' social context [4,5,32,33]. Designers who work on technology targeting behavior change (also known as persuasive technology [12]), consider behavior change theories and persuasive design models, e.g., [13,28].

Persuasive technology uses social influence (the influence of others on one's behavior [1]) to motivate users to sustain the behavior they wish to change. Up until recently, social influence in persuasive design has oftentimes been treated as a "black box" [26]. The designs may include any kind of feature that connects people or people's data (e.g., messaging between the users [22], connection with social media [37], data visualization of different users [2], etc.) and rarely discriminate between the different aspects of social influence. Recently, seven aspects of social influence have been discovered in the persuasive technology field [34]. One of the aspects is social comparison (the comparison of oneself to others [11]). Social comparison has been used in the healthcare field since the 1950s [6] and different experiments showed its influence on health behavior change [8,14,44]. However, in persuasive design, social comparison has been discussed under the bigger umbrella term "social influence" (e.g., [7,19,21,40]) with little examples of explicit use of the relevant theory (e.g., [17,24,39]) and inexistent general guidelines that neglect the knowledge that could be gained by the healthcare field.

Finally, persuasive design practices targeting health behavior change consider more factors than the theories and models; one of those factors is the condition of the patient [26]. Knowledge about the condition may help persuasive technology designers understand the user (patient) better. The inclusion of healthcare professionals in the design team of persuasive technology may help create better understanding of the different conditions. Past research [10,15,20,43] underlines the importance of healthcare professionals in the design process of applications targeting patients. Specifically, the lack of healthcare professionals' participation may lead to unreliable design [43].

This research attempts to understand social comparison from the healthcare professionals' perspective and transfer knowledge from the healthcare field to the Human-computer Interaction field. In that way, it shed light on one of the seven social influence aspects in the context of design. Additionally, it explores the current use of technology by the healthcare professionals and its potential to better support the doctor-patient relationship.

*What are the healthcare professionals' insights on the social comparison, and how can designs be shaped to holistically support the users who want to change behavior?*

## **BACKGROUND**

This section presents three research areas. Firstly, some health behavior theories are briefly presented, as they are necessary to understand part of the results. Secondly, the social comparison theory is described so the reader can understand the full potential of the theory that can be applied in the design field. Finally, the persuasive technology and relevant design in healthcare is presented to show the limitations of the current theory and practice.

### **Health Behavior Change and Motivation Theories**

Behavior change is a long and complex process. Theories and models have been created throughout the years to describe and/or understand humans' behavior especially in healthcare [16]. Some of them are stage-based, for example, the Transtheoretical Model (TTM) [30] and Precaution Adoption Model [41](PAM). These two models categorized people based on their readiness to change. They have one main difference: the TTM stages are based on how long a new behavior/intention to change has lasted, whereas the PAM is based on the psychological state the person is in relation to the new behavior [16]. Some other theories describe the person as a whole, taking into account the person's social environment in addition to their ability and willingness to change. Such models are: the Health Belief Model (HBM), which takes into account the patients' beliefs about the influence of a condition on themselves and their social environment [5,32]; the Self-Determination Theory (SDT), which takes into account the patients' competence, social environment, and autonomy[33]; and the Social Cognitive Theory (SCT), which takes into account the patients' environment, behavior, and personal abilities/beliefs/ knowledge [4]. Finally, the goal-setting theory (GST) [38] focuses on goals, personal attributes, and influential factors on the behavior such as peer influence, feedback, etc.

### **Social Comparison in Healthcare**

Social influence is the influence of people on other people's beliefs, feelings, and behaviors [1]. Social comparison is an aspect of social influence [34]. Social comparison theory was first mentioned by Festinger in the 1950s [11] and supports that in cases with no objective measurements, people compare themselves to others similar to them in order to evaluate their skills, abilities, and in general to better understand themselves. After Festinger, the theory has been expanded, especially in the field of healthcare, wellbeing, and coping [6]. By comparing oneself to others who experienced similar situations, people may feel that they are not alone. For example, victimized people (e.g., rape victims) may cope with the feeling of uniqueness and deviance if they meet others who were in situations similar to theirs [8].

Social comparison can be described as downwards and upwards. Downwards, social comparison is the comparison of one to others less fortunate. This comparison may lead to favorable evaluation of oneself and self-enhancement, usually conducted by people who are in crises or have low

self-esteem [42]. For example, females with breast cancer compare themselves to patients worse off than them to cope with the condition [44]. On the other hand, upward social comparison is the comparison between one and others who are better off. Upwards comparison may occasionally evoke negative feelings, but when these feelings are absent, it may lead to self-improvement apart from self-evaluation [9]. For example, smokers who want to quit smoking and choose to be in a group where others have an easier time quitting than them, have a higher chance of quitting than smokers who choose to be in a group where others have a harder time quitting [14].

It is important to underline that the objective feedback provides information on how people are doing, i.e., bad or good, but it lacks information on how to improve, which can be gained by upwards social comparison [9]. For example, by comparing with someone who has already succeeded at reaching a target, one can learn by seeing how this person managed it. Thus, upwards social comparison may lead to social learning (learning by observing others [3]). Furthermore, social comparison can provide information about the future [36]. For example, a person who has severe problems with reading and writing (due to a learning disability), and wants to continue in academia, can estimate the chances of success, if this person compares themselves to others with the same difficulty who have already succeeded.

Finally, social comparison showed potential in the healthcare field that can be transferred to the design field. Social influence has already been used to motivate people to change behavior [17,24,39]. However, a deeper understanding of the theory - especially in the context of healthcare - may lead to its being better implemented in the design field related to health behavior change.

### **Persuasive Technology and Design**

Persuasive technology, as defined by Fogg [12], is any interactive computing system designed to change peoples' behaviors. According to Fogg's design model [13], behavior change is influenced by three factors: the level of motivation of the persons willing to change, their ability to achieve the change, and triggers to remind them of the new behavior or reinforce the motivation. The components, triggers and self-efficacy (perceived ability to succeed in a task) are mentioned in various health behavior change theories as well, e.g., self-determination theory, the health belief model, social cognitive theory, etc. More models have been developed for designing persuasive technology, e.g., [13,28] but, they are on such a high level that they lack guidance on specific aspects of social influence [25] such as social comparison.

The practitioners underline the importance of having knowledge on the condition or health behavior when designing for healthcare-related technologies [26]. As the health conditions are clearly defined in the medical field, knowledge from this field is useful during the design of

persuasive technologies. Medical professionals have this knowledge. However, their involvement in the design may sometimes be neglected [10,15,20,43]. That may lead to unreliable [43] and unsafe designs due to the dissemination of inaccurate information [20], e.g., an application for weight management could lead users to become anorexic [31].

In the design field, Nelson and Stolterman introduced the term accidental evil, which refers to an accident that happened (through technology) because of ignorance, carelessness, or inattention in the design [27]. In persuasive technology, a similar phenomenon is described as a backfiring effect when the design may lead the user to an opposite or even harmful behavior [35]. It may be impossible to eliminate the backfiring effect or accidental evil, but it can be limited if the design is handled with care, and in the case of health-related technology, by involving healthcare experts.

This paper takes into account the opinions and practices of the healthcare professionals related to social comparison in order to create a deeper understanding of the design of social comparison features in health-related persuasive technologies. It also aims to give insights for a holistic persuasive technology design by taking into account the healthcare professionals needs when designing for patients.

## METHODOLOGY

The healthcare professionals were expected to be unfamiliar with, or have limited knowledge of the term *social comparison*. As such, an open and flexible method was chosen in order to help explore the professionals' practices, find cases of social comparison usage, and prompt them to elaborate. Thus, qualitative research was conducted with the use of semi-structured interviews [29] as a data collection method to answer the questions: *What are the healthcare professionals' insights on the social comparison, and how can designs be shaped to holistically support the users who want to change their behavior?*

The participants had to have education and/or experience in the health-behavior-change field. The interviewees were found using non-probability convenience sampling technique, i.e., people from my work environment suggested me to some healthcare professionals and those suggested me to others or others more relevant to the health behavior change field. One participant was found via door-to-door recruiting.

Seven healthcare professionals (experts) - with a long career in different levels of healthcare - have been interviewed. The healthcare professionals focus on any kind of health behavior change, however in most interviews, the dominant subjects were nutrition and smoking cessation. All the participants had adequate experience in private and group consultation. The following is a profile of the participants:

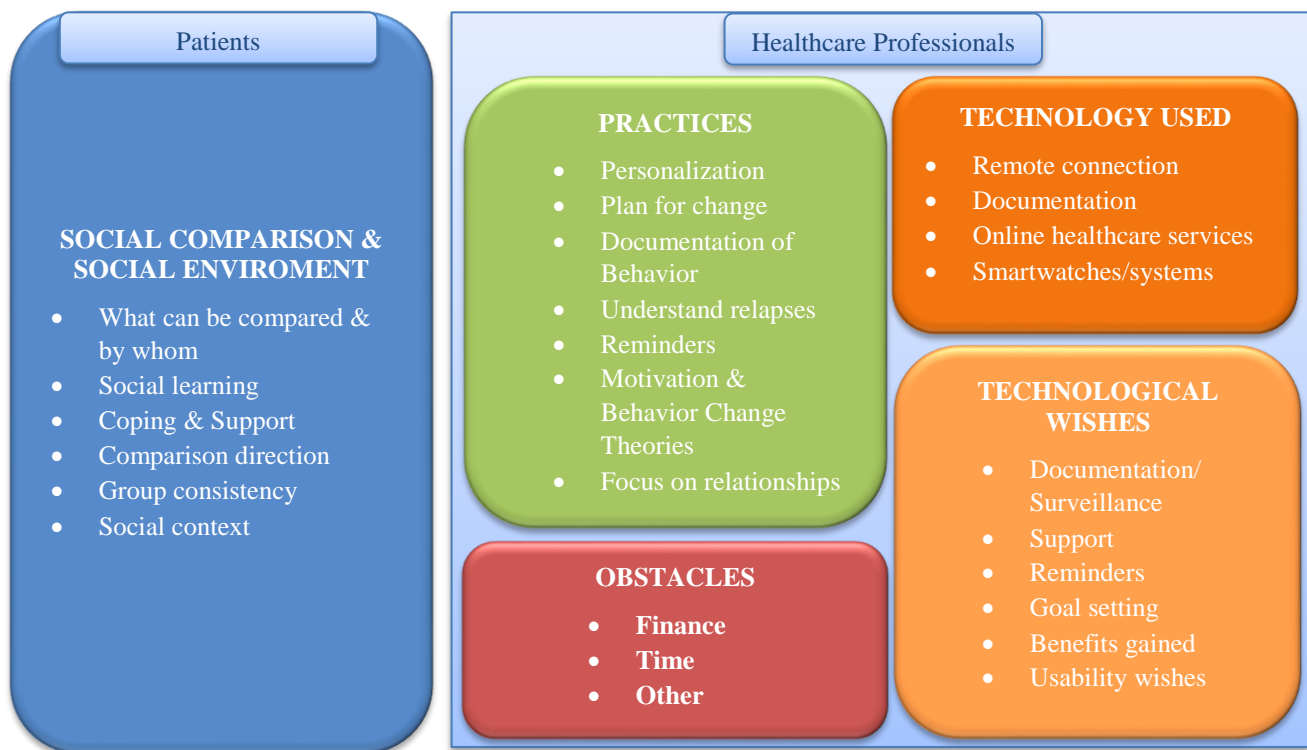
- One nurse specialized in heart diseases and surgery with additional education in psychology and public

health, as well as extensive practical experience with patients.

- Two doctors (MDs):
  - One is the head of a high-level primary care unit with an education focused on cardiovascular diseases and has extensive experience in primary healthcare (also as the head of the medical doctors).
  - The second is working as a pulmonary physician and has considerable practical experience with patients.
- One psychologist/psychotherapist who works as a professor in a public university.
- Three nutritionists:
  - One nutritionist with education in nutrition and health promotion currently working as a coordinator of health promotion in the higher levels of healthcare who has significant practical experience with patients.
  - A second nutritionist with education in nutrition and health science.
  - A third nutritionist/registered dietitian with education in nutrition and diet with long experience with patients.

The semi-structured interviews lasted on average one hour and consisted of the following categories: background, current practices, social influence (social comparison), technology, and closure. Each category had some questions used as a guide.

The category *background* was used to make the interviewees feel comfortable, to get to know them, to warm them up for the rest of the interview, and for demographic reasons. It consisted of questions related to the professional's education and work experience. The category *current practices* was used to understand the current practices and find in which cases the healthcare professionals used social comparison. It consisted of questions that helped understand the healthcare professionals' everyday work, e.g., what methods they use, how a typical consultancy unfolds when people visit them with the aim of changing a health behavior, etc. The social influence (social comparison) category designed to get more insights into the cases of the everyday practice of implementing social comparison. It consisted of questions regarding group consultancies, how patients influence each other, how and if they compare with each other, and the professionals' opinion on the matter. The category *Technology* was used to understand the technology the professionals used or wish to have for helping them in supporting their patients on health behavior change, i.e., what services and support they would like to provide for their patients, but are currently unable to due to various obstacles. This section also revealed wishes for social influence



**Figure 1: Need-to-know areas for a holistic health behavior change-supportive technology design**

features. The category *Closure* consisted of typical closure for interviews, e.g., asking the interviewees if they had to add something, etc. Almost all the interviews were individual; two of the participants could only be interviewed as a group, as they were working on the same subject and had limited time.

The semi-structured interviews were recorded and transcribed. The transcriptions have been analyzed based on thematic analysis [18] using the cutting and shorting technique [23] – in which the categories/themes emerge after the relevant quotes have been printed, cut, and shorted out based on their relevance in the content. The modification of the technique was that it was done electronically by cutting and pasting all the relevant quotes of a document and sorting them out in it. After the first grouping, a second filtering was conducted to find any emerging sub-categories.

As none of the interviewees were native English speakers, the quotes have been modified grammatically so they can present the participants' thoughts as clearly as possible. The use of she and he - in the result section - is random and it does not reflect the gender or sex of the interviewee for respecting the interviewees' privacy. Moreover, sex and gender of the healthcare professionals are not considered as an analytical category because the focus is on their practices. Thus, the role of gender or sex is irrelevant to this research.

## RESULTS

The thematic analysis resulted in five categories, which are part of two groups: that which is relevant to the patients, describing healthcare professionals' insights in social

comparison and social environment of the patient/user; and that which is relevant to the healthcare practitioners, describing some of their practices, obstacles, and thoughts on technology. The five categories consist of sub-categories (see Figure 1). The first category is *social comparison and social environment*, which gives insights on healthcare professionals' perspectives on social comparison and the social context of the patient. The second category is *obstacles*, which shows the current obstacles that healthcare professionals face when they work with behavior change. The third category is *technology used*, which reveals what technology is used by the healthcare professionals and which needs it currently covers. The final category is *technological wishes*, which reveals the wishes for future technology and specifically, persuasive technology.

### Social Comparisons and Social Environment for Patients

The category "social comparison and social environment" has six sub-categories in which the professionals describe how people react in group meetings (e.g., 10 people who want to lose weight to follow a group session), and how the social context influences the patient and the healthcare professionals' work.

The healthcare professionals underline the danger of comparing incongruent values (that which can be compared). For example, the patients who want to lose weight could compare different techniques they use to avoid cravings but not their kilos, as this could lead to a dangerous outcome: "If you just look at the numbers, you can lose weight if you don't eat anything or, if you just eat something

and drink water. But, the point is that you need to eat everything and you need to learn to eat the right amounts.” However, group progress on kilos could be revealed “sometimes in the last appointment I [may] say “altogether you have lost for example, 20 kilos [that’s good], but never that there is one person who has lost 10 and the others [have not].”

Comparing different techniques to overcome problems is a common practice (social learning) in the groups which is also recognized and encouraged by the professionals. This comparison could lead to social learning “I think that the best thing in the group [is] that they discuss with [others] and compare techniques”, and “When there are other people [with] the same problem, you can discuss: How did you manage with that?”. Some of the professionals compare the patients’ data to standards, e.g., an image of a food portion in the education material to a picture of a patient’s portion. Moreover, the comparisons between the group members should never be started by the healthcare professional (**by whom**) “the group counsellor should not compare [the group members] during the meeting, [but the group members] can compare [to] each other. But [the group counsellor] can’t do that, during the meeting. I think it’s terrible if the group counsellor [does that]”.

Being in a similar group of people for coping and support is also mentioned in the interviews. The people in the group may feel that others have similar problems: “I think the most important thing when you are in the group is that you can feel that you are not alone, that everybody else has the same problem and [you are] not the only one”. The professionals described the different ways the patients support each other, such as positive feedback, encouragement to keep on trying, and exchange of experience. Furthermore, one healthcare professional mentioned that he is unable to completely empathize with the patient who wants to quit smoking, as he was never a smoker and he has never have experienced the quitting process “They [in the group meetings] can rely on [each other]. [This is what] they lack when they come [to individual meetings because] I have not been smoking, I cannot [understand the experience of quitting]; I haven’t tried.”

Comparing with others can have various results (comparison direction). For example, someone can compare themselves to people who are doing worse than them to feel better: “They want to know they are doing well, they [think], he or she smoked three cigarettes last weekend [,] I only smoked one.” Professionals also mentioned the other side of the comparison: when people have negative feelings because they think they are doing worse than the group, e.g., “the next time [person x] isn’t there. They [do not] want to share it anymore, because they feel that everybody else is successful, but [they are not].” They also mention that even if the patients have the same targets, e.g., eating healthily, they may have different conditions, and therefore be influenced differently by being in a group and

comparing. “We also have underweight [anorectics] but not [as] many [as] obese ones. [For anorectics], we don’t have group counselling [, it is always] private meetings. [Maybe] because they could compare themselves, I am 40 kilos and I’m only 30 kilos and [then] try to just [lower the kilos]. That’s the problem with anorectics. They compare too much in the wrong way.”

The professionals mentioned that there should be variety in the group and that they try to minimize minorities (group consistency), e.g., have more than one person of the same sex, age, etc. Only two professionals referenced the fact that, in rare cases, they have groups based on body mass or behavior change level (based on the transtheoretical model) “it’s more fruitful or it’s more giving if that group is on the same level, on the same step.” The dynamics of the groups mentioned during the interviews were similar. In the groups, there are always some people who participate, some who are silent, and some who are unmotivated.

Two of the professionals referred to how legislation can help people and professionals with behavior change (social context) “I: as a doctor, it’s very difficult to start talking about weight loss. [It is] easier to speak about smoking, because in [our country] a lot has been written about smoking and people are [ashamed] if they [smoke]. I2: Yes. We have a very strict tobacco law”. They also mentioned how the family can influence the behavior (social context): “sometimes there [are] both spouses in the group. [That is - I think-] very good because the wife and the husband [can] encourage [each other at home]. And it’s very difficult if you don’t eat pizza and your husband [wants] to eat pizza,” and “if the husband [tries] to eat more vegetables and the wife [is doing] the shopping and [doesn’t] buy them.”

### **Practices of the Healthcare Professionals**

The category “practices” has seven sub-categories in which the professionals describe how they work and what kind of information they want to know about the patients.

Almost all of the healthcare professionals underlined that they adjust their practices to fit the individual patients or group of patients (personalization) - in case the patients participate in group meetings - “as many as there are [patients], there are [as] many strategies that are good.” Even in the group meetings, the professionals distinguish between different types of people. To create a personalized counselling, the professionals may need to know more details about the individuals: their lifestyle, “we should discuss your [way] of living, and your situation [in] life. Is it [the] right time for you to take care of your weight problem?”; their habits, “What kind of habits do you have, [e.g.], eating habits, exercise habits?”, and motivation: “We of course begin with your motivation. [Who] wants you to quit smoking? Is it yourself or your family?”.

For the professionals who had experience with overweight people, it is important to make a plan (a plan for change) for after the consultancy, “We make a plan for what kind of

*diet you should [adopt]...*”. In the group meetings, everyone has already set their own goals and they use the group meetings mainly to help them reach their goal.

Some of the professionals ask the patients to record their behavior (documentation of behavior), or wish they could know more about the patients’ behavior. Relevant quotes are “*if you are a weight-losing patient, you can take a picture of your meal*”, and “*[keep a] food diary, then I can see what you eat*”, also “*I need to know the habits. How many cigarettes [do they smoke] in the morning, how many do they smoke during office hours...?*”.

Both in the group and the individual meetings, the patients discuss and reflect on their progress and relapses (understand relapses). In both cases, the basic idea is to reflect on their behavior and find solutions to keep the new behavior longer. Criticism and blame are unacceptable “*So you shouldn’t [have] smoked three cigarettes last weekend, okay that’s okay, it’s going to be fine, you don’t need to be ashamed.*”

One healthcare professional explicitly mentioned that she makes use of reminders, i.e., she calls her patients to see what they have decided, e.g., whether they will start the new behavior. At least one more health professional mentioned the need for reminders and support when patients are close to relapse.

All the healthcare professionals had knowledge on the behavior change models and motivation theories. The most commonly used – especially in weight loss – is the transtheoretical model. Moreover, as the professionals talked about their practices, some of their comments could indirectly connect to different theories. For example, goal-setting theory: “*I ask them to set goals themselves. I ask them for the next time[to take on] one or two eating habits*”; or the Precaution Adoption Model, and their readiness to change “*if you are, for example, in the middle of graduating and you are very busy and very stressed, then it not might be [the best] time, to lose weight*”; or the Health Belief Model, and their individual beliefs: “*When I’m talking about the medication or the nicotine patches, they think, ‘they are too expensive,’ and still they go and buy (cigarettes).*”

One healthcare professional described a different way than focusing on behavior. This healthcare professional focuses on the relationships the patients were building throughout their lives that could be the cause of the unwanted behavior. Thus, the unwanted behavior is a symptom of one or more defective relationships.

### **Obstacles the Healthcare Professionals Face**

The category “obstacles” has three sub-categories in which the professionals describe problems in their work and obstacles for the patients in their behavior change process.

The healthcare professionals described that the main problems they face are time and money (finance, time). The healthcare system in which they belong prioritizes people

who already had some problems with their weight, for example. These people get to make more appointments and faster than the people who were willing to lose weight for preventive reasons. “*It’s very difficult to get time for an appointment, even [with a] nurse, and especially [with a] doctor. And if you don’t have [any] diseases, it’s impossible.*” If the healthcare professionals work in a private healthcare center, then they also highlight the capacity of the patient to pay for the visits.

**Other** obstacles to the behavior change of people and to the healthcare professionals’ work in the area are: uneducated patients, unmotivated patients, unmotivated healthcare professionals to support the patients, inability to support their patients after hours, and the social/family context of the patient which may not support the behavior change. For example, “*if the husband [tries] to eat more vegetables and the wife [is doing] the shopping and [doesn’t] buy them.*”

### **Technology Used by the Healthcare Professionals**

The category “technology used” has four sub-categories in which the professionals describe the technology they use.

All of the professionals use some kind of technology. The main reason for using technology – such as e-mail and Skype - is to communicate with patients in different places (remote connection). Some nutritionists hold group meetings online “*We also have a special kind of system, which is [on the] internet. The group first meet in real life and afterwards [online] and they have there their meetings [together with the group] counsellor.*”

Two healthcare professionals mentioned that they ask their patients to take pictures of their food and keep a diary (documentation), some patients use applications for the diary. Two healthcare professionals mentioned online systems (online healthcare services) people could visit such as an eating online diary, which can calculate the calories, and a virtual space for primary care. One healthcare professional mentioned that she could use recordings of the counselling sessions so the patients could see their progress throughout the sessions, if that proved to be helpful.

One healthcare professional use a more advanced system including a smartwatch and an online system (smartwatches/systems). Through this system, she is able to follow the patients’ exercise routines and physical condition, “*[the smartwatch sends] all the information that it gathers to [the] program and I can go from my computer to that system and I can [see] how they have been rehearsed. [...] Usually the main points for me to see [are] the heart rate [,] schedule [,] the length [,] and the time they have used to rehearse.*”

### **Technological Wishes of the Healthcare Professionals**

The category “technological wishes” has six sub-categories in which the professionals describe the technology that could be useful for them and their patients.

One of the two most common wishes is to be able to know the objective behavior of the patients (documentation/surveillance) so they could support them accordingly. For example, the amount of cigarettes they smoke, the amount of nicotine gum they chew, how much they eat, etc. “Given the, number of cigarettes [smoked,] I could see okay, this has not been [a] good week, I think, I can [send a] message: Are you okay? Do you want to see me or do you want me to call you? [If] I can see he or she hasn’t been smoking this week, I could, send a message: Very good, well done”, and “Then you can see what kind of amounts they [really eat]. Because when people [express] it in words, they usually minimize it. But when you see it as a picture, you see what is really happening.”

The second biggest wish of the professionals is for their patients to have support even when they are unable to meet them (Support), i.e., lack of time or after hours either by predetermined messages or by their peers. The healthcare professionals want their patients to receive motivation messages when they keep up with following the new behavior; “for example, like recognition messages: that was a great day, you didn’t smoke so much!”. They want the patients to support each other and share knowledge: “I think [some of them] have Facebook groups or WhatsApp groups, so they could discuss [with people who have group sessions together], but [it] could [be good], some kind of application [for example], ‘I have managed very well today and the others [can] encourage [me].” Furthermore, the healthcare professionals wish they knew when patients are close to relapsing so they could act at that moment: “They are alone, they just want to eat some sweets, and they know that [they] should not eat, but they [just want], some kind of technology

for [these situations], it’s difficult because [I can’t] contact [them], in the evening.”

Two professionals mentioned the importance of the reminders “‘have you eaten vegetables today?’ and those kind of reminders.” One professional mentioned goal-settings “[It would have been] nice if you had an application [that would allow] everybody to set their own goal - for example I eat more vegetables - and, they could [every] day record [whether] they have [achieved the goal]. And when we are in group, we could, for example, together, check how many of them have managed their goals.” Moreover, one professional underlined the importance of visualizing the benefits gained from the new behavior, in this case quitting smoking, “Money saved. That’s very good support. [...] how much [less at-risk they are for] cancer or what has happened in their heart and circulation.”

Finally, the last sub-category includes issues related to usability (e.g., voice input/recognition, ease of use for both patient and healthcare professional), and novelty (usability wishes) “It’s easy to use, for the patient and for me. And, it should be [something] more than you just [inputting] that, today I didn’t smoke, or I smoked two cigarettes. It has to be something else.”

## DESIGN IMPLICATIONS

The practices and technology used categories show how the healthcare professionals currently operate. Personalization is a common practice as the professionals shift their practices based on the patients (e.g., behavior change theories’ applications). This personalization reflects the healthcare professional–patient relationship, which should be supported by technology. The target is not to replace the healthcare professionals with an app, but rather to facilitate support and

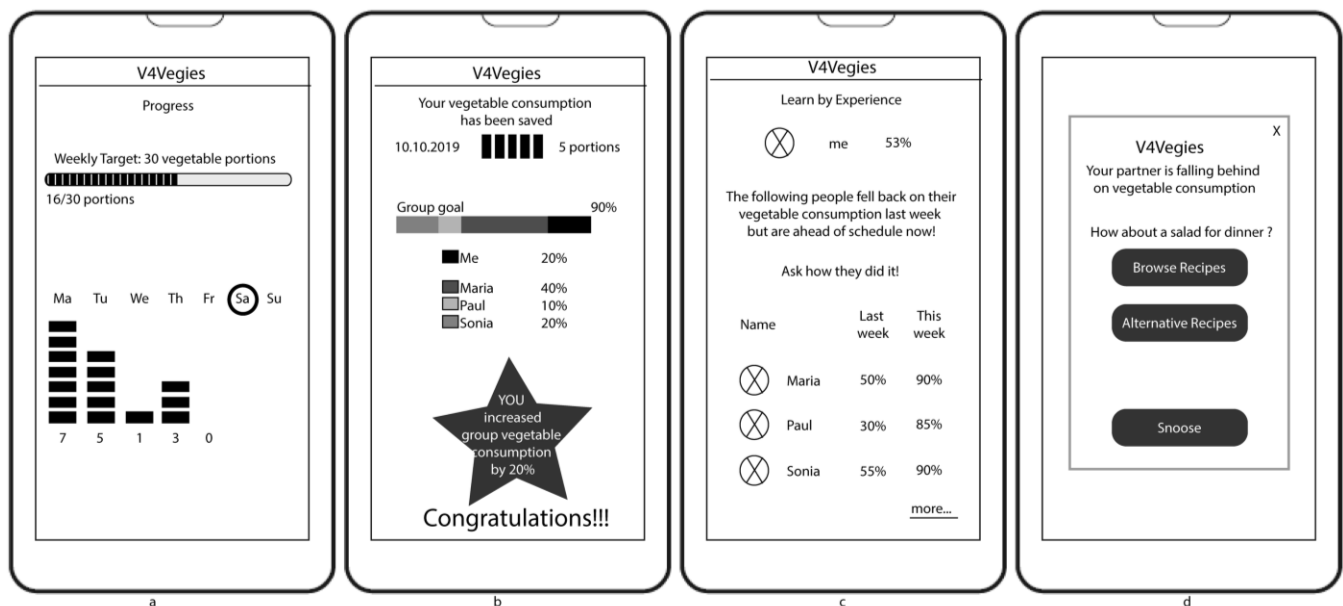


Figure 2: Illustrations of the examples in the text. These images are text more understandable, not to illustrate a full and finished interface design or idea.

augment the services they already provide to better support the patients' behavior change.

The categories, obstacles and technological wishes can inspire the design that **supports** the healthcare professional-patient relationship and the patient during the absence of the healthcare professionals. These categories show what the healthcare professionals would like to be able to offer their patients in order to help them in their health behavior change, e.g., documentation of the new behavior and relapses, inclusion of reminders, benefits of the new behavior, goal-setting, etc. These should also be taken into consideration when designing for the patients, so the relationship between healthcare professional and the patient is supported in avoiding conflict between the suggestions of the professionals and the technology. If this factor is neglected, then the user/patient may have two different paths to follow, i.e., the application may suggest something the doctor is against or unaware of, resulting in the patient either choosing one of the two or getting demotivated - as following two courses to achieve the same goal could be tedious. As such, the patients' ecosystem - including the healthcare professional - is as important as the target the patient wants to reach.

**Motivation** is the basis of behavior change. The relevant behavior change and motivation theories, referred to in the background, are based on either how motivated people are to change or how to motivate people based on their psychology. For example, self-determination theory [33] divides the motivation into two big categories: internal, when the people just enjoy the activity they are doing; and external, when people engage in an activity because of external reasons, for example, because other people told them to. Motivation can be seen in practice of the professionals: *"we begin with the motivation of course. [Who] wants you to quit smoking? Is it yourself or your family?"* In general, healthcare professionals try to find ways to motivate their patients to sustain their new behavior by showing them the benefits of the new behavior, giving them personalized advice, supporting them, etc. One way to motivate them could be social comparison theory, e.g., use social comparison to lead the patients towards social learning, support, competition, etc.

**Involve** the people in the users' social environment. In the patient group, the healthcare professionals acknowledge the importance of the social environment of the patients and their everyday life factors (social context). In some behaviors, for example, losing weight, the family may play a big role, as the person who is shopping the groceries and cooking, may be different from the person who has to lose weight. The ideal would have been a design that could include the role of the family in the patient's life, for example, the patients may have an interface visualizing their progress while the family may have an interface that helps them support the patients, for example, figures 2a and 2d.

Three basic components for designing persuasive technology in an inclusive and holistic way have been presented. Firstly,

**support** the patients in their moments of weakness and in their relationship with their doctor, providing them with progress documentation that is - as much as possible - in line with the healthcare professionals' needs. Secondly, **motivate** the patients to carry on with their progress through social comparison or other ways (the healthcare professionals referred to reminders, reflected on the relapses, documented the behavior, etc.). Thirdly, **involve** the people in the patients' social circle. This can happen by giving them roles, letting the patient give them roles, or even by letting them decide if and how they can help.

### **Social comparison**

The professionals underlined the controversial nature of social comparison features, as they can influence people in a positive but also negative way. This care highlighted by social features should be designed in order not to promote negative feelings such as jealousy, despair, disappointment, etc. However, the healthcare professionals were positive on the good sides of social comparison that can lead to learning by other patients' experiences, support by others in the same situation, and cooperation. In the following section, some ideas are presented on how to implement the positive aspects of social comparison.

First, **what** can be compared? The values that can be compared should avoid triggering bad habits and negative feelings, as plenty of quotes demonstrated; comparing kilos can lead to undesirable results. The healthcare specialists can tell what is good or bad to compare based on their education, experience, and patients' conditions (e.g., anorectics tend to compare in order to keep their bad behavior instead of finding ways to keep up with the new behavior). Information on the patients/users condition can be acquired in multiple ways, of which three are presented here. The first is for the design group to have a specialist of the condition or a healthcare professional who has worked with the particular group of people. The second is for the designers to interview healthcare professionals about the particularities of the targeted behavior change. The third one is to educate part of the team on the particular behavior change.

The second design consideration is **where** should the comparison lead? / from **where** should it be sourced? The comparison can lead to social learning, self-evaluation, self-entertainment, support, etc. Learning can be promoted by comparing with people better than oneself in terms of how they handle their targets, cravings, or even their general situation (Figure 2c). Support can be promoted by showing to the users that other people have the same problem, or by motivating them to ask for help from peers (people similar to them) during cravings. For example, have a feature on the home screen of the cellphone that, when the user feels weak, can be selected and automatically connects the user to a peer who can help. Comparison through cooperation can be promoted by setting group targets and showing how each individual contributes to the group, for example, the increase of the groups' general progress in vegetable consumption



(Figure 2b). This can promote self-enhancement if the user is better than others are, but also social learning, if the user is worse than others are. The designer should be careful when it comes to upward comparison, so it will not demotivate the users but rather make them see the positive side, which is social learning.

The final design consideration is **how** to design comparison so it can lead to a specific result. The compared value/unit should be personalized and unidentifiable. As referred to in the comments, the progress towards a personal goal can be compared to that of other group members, but making this individual goal known to the group is irrelevant. Moreover, the comparison of the progress towards the goal could happen in a way that motivates the users to ask each other questions to get tips (Figure 2c). Finally, as there is an intention for persuasive design to support the users in pursuing the new behavior they wish to have, the data presented to the user could be modified based on the users' actions and moods (i.e., how to design so as to lead to a specific outcome). For example, if the system knows that a person needs to feel better, it may adjust the data to promote downwards comparison. On the other hand, some people may be motivated by competition, thus comparisons that foster competition may be suitable for them.

This section presented three considerations that need to be addressed when designing social comparison features: firstly, **what** values can be compared in order to minimize unwanted results in this particular condition, secondly, **where** the comparison should lead, e.g., support, self-enhancement, social learning, etc. and thirdly, **how** to design the comparison to lead to the desired result.

## DISCUSSION

Some designers treat social influence as a “black box” without understanding its different aspects [26] such as social comparison. The persuasive technology design guidelines and frameworks [13,28] are on such a high level that the aspects of the social influence features are lacking in depth description [25]. This paper sheds light on one of the social influence aspects in the design context by exploring social comparison. It poses some questions (what to compare, where the comparison is leading, and how to design the feature for the comparison to have the desirable result) that can guide the designers while they work on social comparison features, cause them have the theory [11] in mind, and act as a tool for brainstorming and exploration of such features.

As the healthcare professionals should be a part of the design team or at least involved in the design of applications targeting patients [10,15,20,43], this research took into account their practices to result in the design concepts (involve, support, motivate) that can be used as an extra tool for designing persuasive technology.

The need-to-know areas for creating a holistic design that suits the patients' environment and supports their

relationship with their healthcare professionals, is in relation to the current practices as presented in the article, but also the behavior change theories that take into account the social context of the patient/user [4,5,16,32,33].

Finally, this research underlined once more the importance of the medical condition on the design for healthcare [26] and the importance of having a healthcare professional on the design team [10,15,20,43]. The healthcare professionals can inform the designer about the condition of the patient. In that way, designers can better support the patients and their design can be perceived as more trustworthy, both by patients and by healthcare professionals [43]. Furthermore, a holistic design should take into consideration the users as well as the users' social environment such as social norms, doctors, the medical system as well as friends and family as it is described in some behavior change theories [4,5,16,32,33].

## CONCLUSIONS

This paper attempts to inform the design field and give inspiration to design practitioners on social comparison features design and persuasive design by using healthcare professionals' insights. Regarding the social comparison features, the healthcare professionals discussed what should or should not be compared, where the comparison should lead, and how it should be designed. Regarding the persuasive design, the professionals highlighted the importance of support, motivation, and the involvement of the patients' social environment (friends, family, social norms, etc.). Six subcategories have grown out of the interview analysis with the aim to shed light on how the healthcare professionals use social comparison with their patients. Additionally, four categories were created - more closely related to healthcare professionals - that can show the doctors' needs to better support their patients.

By exploring social comparison, this paper sheds light on one of the social influence aspects in the context of design. Nonetheless, more research is needed in the social comparison aspect as well as the other six aspects of social influence. As the interviews of the study were limited, and the healthcare professionals interviewed were from different fields, the results of this research cannot be generalized. However, they can be used as inspiration for designers and food for thought when designing for the purposes of health behavior change and social comparison. In the future, extended research could be conducted in order to have some design guidelines for different conditions. Moreover, the insights of the patients' perspective on social comparison could be useful for a holistic persuasive design. In the end, more research on the relationship between the healthcare professional and patient can provide better insights on personalization.

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