Building Persuasiveness into Information Systems

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Abstract: Often the purpose of personal health and well-being systems is to change users' behaviour. Many theoretical frameworks have been developed to support the design and evaluation of these persuasive systems for behaviour change, but their design remains challenging. No systematic way yet exists by which to put the information into practice and build in persuasiveness effectively. The aim of this study is to investigate how the Persuasive Systems Design (PSD) model can be utilised so as to support the development of personal health and well-being systems. To do this, the study discusses and analyses related research and also integrates the PSD model into the development of two health-related behaviour change support systems. In Case 1, the purpose of using the PSD model was to identify new persuasive functionality within a fall risk assessment and fall prevention system. In Case 2, the purpose of using the PSD model was to identify new persuasive functionality and new service concepts within an existing smartphone application for mental wellbeing. The study shows that the PSD model has been used in the development of BCSSs to describe the overall process, analyse the persuasion context and design system qualities. It has also been applied in the evaluation of the existing systems by providing heuristics for expert evaluations and systematic ways to analyse user experience data. The study also reveals that the PSD model can be successfully applied during the user requirements analysis and concept design phases to identify new potential persuasive functionalities. In both Case 1 and 2, this resulted in having more variety in persuasive functionalities compared to those in the initial user requirements or existing application. The PSD model provides support for designing and evaluating BCSSs, but some future directions of development of the model can be recognised.

Keywords: behaviour change support systems, persuasive systems design, design process, evaluation, framework, health, well-being

1. Introduction

Huge challenges exist in treating a large population using traditional reactive healthcare. Therefore a need exists to develop more proactive patient-centred models. Personal health technology can be delivered at low-cost to large groups of people and it can be a competitive alternative to traditional care (Murray, 2012). Often the purpose of personal health and wellbeing systems is to change users' behaviour. Behaviour change support system (BCSS) provides content and functionalities that engage users with new behaviours, make them easy to perform and support users in their everyday lives. A BCSS can be defined as "a sociotechnical information system with psychological and behavioral outcomes designed to form, alter or reinforce attitudes, behaviors or an act of complying without using coercion or deception" (Oinas-Kukkonen, 2012). There already exist a number of theoretical and practical approaches to the design and evaluation of persuasive systems for behaviour change. Regardless of the abundance of various approaches, however, designers and researchers struggle with limited understanding of how BCSSs should be designed. There is therefore room for a study that addresses how to integrate persuasive design approaches into the development of personal health and wellbeing systems.

The concept of BCSS suggests that information systems (IS) can be treated as the core of research into persuasion, influence, nudge and coercion, whether they are web-based, mobile, ubiquitous applications, or more traditional information systems (Oinas-Kukkonen, 2012). One of the key constructs of the BCSS concept is the Persuasive Systems Design (PSD) model (Oinas-Kukkonen and Harjumaa, 2009) which can be used to analyse the persuasive potential of the system. It is a framework which discusses the process of designing and evaluating persuasive systems, i.e. systems designed for changing users' attitudes, behaviour or both.

This study discusses and analyses related research considering the use of the PSD model and describes experiences from two health-related system design cases. The objective of both of these systems is to deliver an intervention which seeks to make positive change in the health behaviour of the users. Case 1 involves a fall risk assessment and fall prevention system to deliver an intervention designed to reduce fall risk. Case 2 involves an existing smartphone application designed to increase mental well-being by teaching skills that boost psychological flexibility and mental wellness. Web-based and mobile technologies provide opportunities for persuasive interaction and open a whole new world for delivering an intervention. Barak et al (2009) define such web-based intervention as: "...a primarily self-guided intervention program that is executed by means of

a prescriptive online program operated through a website and used by consumers seeking health- and mental health–related assistance. The intervention program itself attempts to create positive change and or improve/enhance knowledge, awareness, and understanding via the provision of sound health-related material and use of interactive web-based components." It is important to plan interventions carefully in order to ensure the information system becomes a successful intervention.

The aim of this study is to investigate how the Persuasive Systems Design (PSD) model can be utilised to support the development of personal health and well-being systems and, more specifically, the identification of persuasive aspects in the early stages of iterative, user-centred IS development.

The PSD model and a Persuasive Technology Design Canvas, which was created especially for this study based on the PSD model, were used as theoretical frameworks in both cases. The PSD model provides 28 design principles for persuasiveness under four categories: primary task, dialogue, system credibility and social support. The model was selected since it is a holistic model, but it also provides concrete instructions on how to develop a system that is more persuasive.

2. Background

2.1 Approaches to the design of persuasive systems

Development of personal health and wellbeing systems is often characterised by a multidisciplinary design team, customer orientation, and iterative development. In the past when traditional, sequential waterfall-oriented process was used, it led to a long development cycle. Customers and users were very often involved only in the beginning to write the requirements and then at the end to accept the software, which did not work very well (Cohn, 2004). In agile software development methods, such as Extreme Programming and Scrum, the process is iterative and customers and users remain involved throughout the duration of the project. The benefits of this kind of approach are that it helps to prioritize the functionalities and to describe the intended behaviour of the product. (Cohn, 2004) However, when the product is designed for health behaviour change, also its persuasive aspects should be considered.

There are many approaches to the design of persuasive systems. These approaches can be roughly grouped based on their focus on 1) users, 2) technology or 3) the whole design and evaluation process (i.e. holistic approaches). In a design process, it is possible and even favourable to use a combination of guidelines and principles from each approach to form a successful persuasive system.

When the focus is on the users and their behaviour change processes, there are plenty of theories addressing this aspect of human behaviour. These include the Theory of Reasoned Action (Fishbein and Ajzen, 1975), Theory of Planned Behavior (Ajzen, 1991), Self-efficacy Theory (Bandura, 1977) and Elaboration Likelihood Model (Petty and Cacioppo, 1986).

More recent approaches include the Fogg Behaviour Model (FBM) which states that the behaviour is a product of three factors: motivation, ability and triggers (Fogg, 2009). There are also models for understanding general health behaviour. Ryan et al. (2008) have also adapted self-determination theory into the health context and have formulated health behaviour to be determined by the autonomous motivation, perceived competence to make the change and practitioner-patient relationship (relatedness), which is similar to Fogg's model. According to the Health Belief Model (also known as the Health Action Model), a person takes action to alter their health-related behaviour for specific reasons: if they regard themselves as being susceptible to a particular condition; if they believe it to have serious consequences; if they believe that the anticipated barriers to (or costs of) taking the action are outweighted by its benefits (Strecher and Rosenstock, 1997).

There are also approaches that distinguish different stages of behaviour change. They can be used for adapting the system to react in the most beneficial way in relation to the present *behaviour change stage* the person is in. Examples include the Transtheoretical Model which describes six stages of health behaviour change (Prochaska and Velicer, 1997). Recently, Li et al (2010) have presented a five stage process of behaviour change when people turn from passive into active behaviours.

When the focus is on the technology, designing the product and its features are at the core. Most design principles and heuristics fall into this category. Fogg (2003) defines three roles for persuasive computer technology; they serve as tools, media or social actors. The Design With Intent Method provides 101 ideation cards with questions to induce ideas for the design, keeping the intent in mind (Lockton et al., 2010). Many others have also presented design principles, guidelines or strategies to design technology for behaviour change. Nawyn et al. (2006) list three types of strategies for behaviour modification: user experience strategies, activity transition strategies and proactive interface strategies.

When the focus is on the whole process, the objective is to analyse the big picture and guide the entire process from idea creation to the final product. The approach described by Oinas-Kukkonen and Harjumaa (2009) provides an overview of the stages in persuasive systems development (described in the next chapter in more detail). Van Gemert-Pijnen et al. (2011) describe six principles for a participatory eHealth development process. According to these principles eHealth technology development is one that: 1) is a participatory process, 2) involves continuous evaluation cycles, 3) is intertwined with implementation, 4) changes the organization of health care, 5) should involve persuasive design techniques and 6) needs advanced methods to assess impact.

2.2 The PSD model

The PSD model (Oinas-Kukkonen and Harjumaa, 2009) provides an overview of the stages in persuasive systems development. The steps include: 1) analysis of the persuasion context and selection of persuasive design principles, 2) requirement definition for system qualities, and 3) software implementation. The PSD model does not specify how these steps should be implemented; the process can be sequential or iterative. The *analysis of the persuasion context* requires a thorough understanding of what happens in the information processing event, namely understanding the roles of persuader, persuadee, message, channel, and the larger context (Oinas-Kukkonen and Harjumaa, 2008). Thorough analysis will help to recognize inconsistencies in a user's thinking, discern opportune and/or inopportune moments for delivering messages, and effectively persuade. In order to support the *requirement definition for persuasive system qualities and software implementation*, the PSD model lists 28 design principles for persuasive system content and functionality, and describes example software requirements and implementations. The principles are categorised in four categories depending on whether they support the user's primary task, human-computer interaction, the system's credibility or whether they leverage social influence. The model also presents some of the key issues behind persuasive systems, which are formulated as seven postulates.

The PSD model has been used in the development of BCSSs in order to describe the overall process (Alahäivälä et al., 2013), to analyse the persuasion context (Purpura et al., 2011; Young, 2010) and to design system qualities (Derrick et al., 2011; Langrial et al., 2012; Pribik and Felfernig, 2012; Stibe and Oinas-Kukkonen, 2012).

Related research shows that the PSD model has been applied in the evaluation of existing systems by providing heuristics for expert evaluations (Chang et al., 2013; Myneni et al., 2013; Lehto and Oinas-Kukkonen, 2011) and systematic ways to analyse user experience data (Basic et al., 2013; Segerståhl et al., 2010).

2.3 Impact of PSD principles

Overview of the studies exploring the relation between certain principles or the entire PSD categories (groups of related principles inspected as a whole) in the PSD model and actual health behaviour shows that applying the principles actually has an effect on users' behaviour. Some examples are mentioned below.

Primary task support category includes principles related to reduction, tunnelling, tailoring, personalization, self-monitoring, simulation and rehearsal. The effects of primary task support have been extensively studied from the *personalization and tailoring* perspectives. Oinas-Kukkonen and Harjumaa (2009) define personalization as the adjustment of content to individual users, and tailoring as the adjustment to different user groups (e.g. certain nationalities). However, there are other definitions. As an example, Kreuter's definition of tailoring being an individual adjustment of the context and targeting the higher level adjustment (Kreuter, 2003). The literature implies that *personalization* is indeed significant for behaviour change. In a meta-analysis by Noar et al. (2007), smoking cessation, diet and mammography screening were the most studied domains where personalised print messages were used. In addition to providing evidence for the

effectiveness of the personalisation, the meta-analysis also revealed that the contents should be modified based on the behaviour, demographics and 4-5 different theoretical behaviour concepts, for example. *Self-monitoring* has been proven to be an effective method for controlling blood pressure (Glynn et al., 2012) and blood glucose (St John et al., 2010)). This is no surprise, since the treatment of those conditions is greatly dependent on these measurements. Self-monitoring has also been shown to be effective in increasing physical activity (Conn et al., 2011; Ferrier et al., 2012).

Dialogue support includes principles of praise, rewards, reminders, suggestion, similarity, liking and social role. A more extensive use of dialogue support seemed to predict better adherence which is frequently one major reason why some interventions are not effective (Kelders et al., 2012). The behaviours present in this study were behaviours related to chronic conditions (diabetes, arthritis, etc.), lifestyle (weight management, nutrition, smoking cessation, physical activity) and mental health (anxiety, alcohol, depression, panic disorder, social phobia, etc.).

Credibility support includes principles for trustworthiness, expertise, surface credibility, real-world feel, authority, third-party endorsements and verifiability. The effects of credibility support are studied in a dissertation by Nind (2012). The dissertation includes two studies, one of web-pages related to increasing physical activity and the other of registration as an organ donor through a website. In the studies presented no difference was detected in the self-reported physical activity or the registration rates. But, as Lehto and Oinas-Kukkonen (2013) conclude in their study, credibility is perhaps more related to use continuance than to the behaviour itself. Therefore, it is indirectly crucial for effectiveness.

Social support category includes principles for social learning, social comparison, normative influence, social facilitation, cooperation, competition and recognition. There is evidence that the changing *social norms* affect behaviour change, e.g. in smoking-related behaviours (Dohnke et al., 2011; Zhang et al., 2012). Dohnke et al. (2011) found that intention was dependent on significant others' quitting, significant others' attitudes towards quitting and partners' smoking. In addition, they discovered that the behaviour was slightly different in men and women. Social media has had a strong impact on current applications. This offers also health and wellness applications new possibilities for social support, even though it should be noted that social support is not created simply by adding the Facebook possibility into the system. At least, this kind of solution did not seem to have any effect on increasing physical activity (Cavallo et al., 2012). Reviews of the studies of the health behaviour effects in this field do not exist yet.

There is recent research testing a model for predicting the perceived effectiveness and use continuance including all the PSD categories (Lehto and Oinas-Kukkonen, 2013). According to their study in the weight loss domain, primary task support, computer-human dialogue and social support affect perceived effectiveness. Computer-human dialogue has significant impact on the other three PSD categories. As mentioned earlier, perceived credibility rather affects continuance intention, which in turn is important for possible behaviour change.

3. Research setting

3.1 Research method

In order to integrate the PSD model into the systems development it was necessary to select real life practice-based problems where this kind of design approach was needed and to use the PSD model in them. Thus, the case research strategy was selected as the research method. The selected cases represent typical, information-rich cases from which it is possible to learn from the persuasive system's development.

According to Yin (2009) case study is an empirical enquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. In case study there can be many variables of interest, it relies on multiple sources of evidence, and it benefits from the prior development of technological propositions to guide data collection and analysis. If the same study contains more than a single case, it is defined as a multiple-case study. It can be considered that single- and multiple-case designs are variants within the same methodological framework and no broad distinction is made between them. The advantage of multiple-case designs is that they are often

considered more compelling than single-case designs. It should be noted however, that single-case designs have their place in solving research problems related to unusual or rare cases, as an example. (Yin, 2009)

The goal of the multiple-case study was to find out how the PSD model can be utilised to support the identification of persuasive functionalities that would increase the persuasiveness of the system. Because one of the objectives of the PSD model is to show examples of how the suggested persuasive design principles can be transformed into software requirements and further implemented as actual system features (Oinas-Kukkonen and Harjumaa, 2009), the PSD model was applied during the user requirements analysis and concept design phases. In practise this meant that a co-creation session was organised for the people working in the two selected cases. In a co-creation session people work in collaboration and aim to explore potential directions and gather a wide range of perspectives in the process to be used as inspiration of the core design team (Stickdorn and Schneider 2011).

The first co-creation session was organised in November 2012 (Case 2) and the second in February 2013 (Case 1). In total nine people participated in the co-creation sessions and they all were working as researchers in their respective projects. Their expertise ranged from psychology to engineering. The material from the co-creation sessions was subsequently analysed. It included the notes of the two researchers who facilitated the designs of each project, and adhesive notes which contained new functionalities envisioned by the participants during the co-creation sessions. Individual case reports were written after the analysis and cross-case conclusions were drawn and reported.

3.2 Case 1: Fall risk assessment and fall prevention system

Case 1 is a fall risk assessment and fall prevention system for elderly care. It is called Aging in Balance system and it is aimed at preventing falls amongst older people by assessing the fall risk probability and providing *a personalised care plan* to reduce the likelihood of a fall. The target user group of the system includes older people, their possible carers and health care professionals (Immonen et al., 2012).

The system has several components, partly grounded on existing components used by the various stakeholders developing the system together. The requirements analysis and concept design of the whole system included the creation of five scenarios for the use of the prospective system and their evaluation via focus group interviews with older people in Finland and Spain. In this study, the design work analysed is limited to a home exercise programme which will form part of the overall system (see Figure 1). Before the co-creation session one of the designers defined a preliminary list of the user requirements which was intended to describe the most important functionalities of the system.

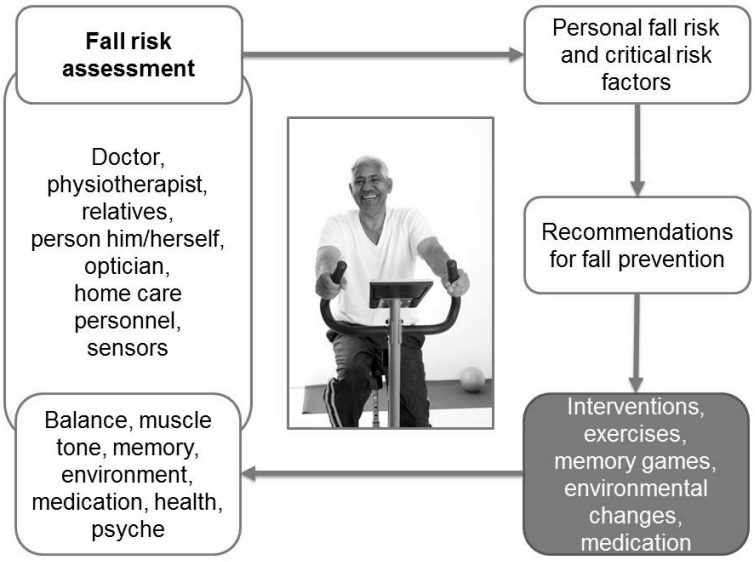

Figure 1: The aging in balance system

3.3 Case 2: Smartphone application for mental wellbeing

Case 2 is a smartphone application for learning skills related to psychological flexibility and wellbeing (Ahtinen et al., 2012). It is called Oiva and is targeted at working age people who suffer from stress and declined mental and physical well-being. The application has been created with the cooperation of experts in psychology, user-centred design and technology, and it delivers an intervention program in bite-sized daily sessions. The intervention program is based on Acceptance and Commitment Therapy (ACT), which aims to increase psychological flexibility: "the ability to contact the present moment more fully as a conscious human being, and to change or persist in behaviour when doing so serves valued ends" (Hayes et al., 2006). The application contains four intervention modules called "paths". Three of the paths are aimed at teaching the user the six core processes of ACT (see Figure 2).

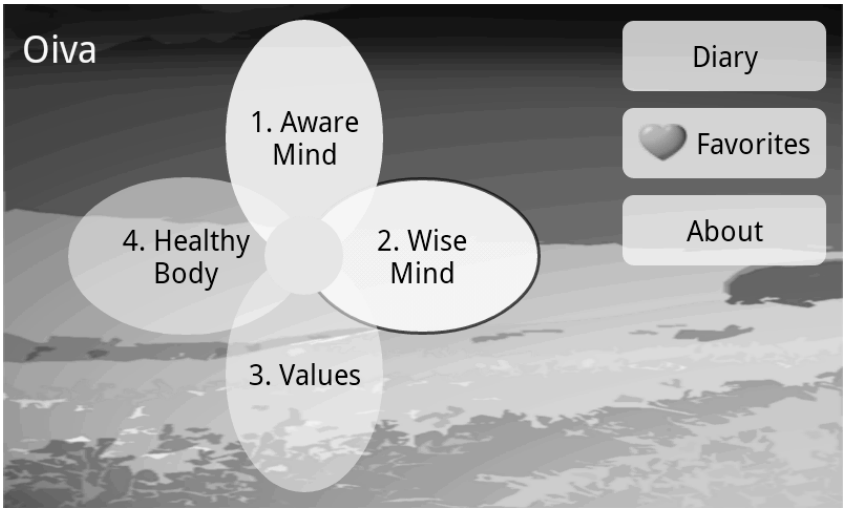

Figure 2: The main menu of Oiva

The design process had already included many iterative cycles. The initial idea of the application had been created based on a needs assessment with a multidisciplinary team, and a model of the therapy process had been created and used to define the structure of the application. ACT-based content and exercises were adapted for the mobile phone by creating audio and video versions of exercises and abbreviating textual content in order to support short daily usage sessions. Users were involved in several phases of the design to ensure that the application would be easy to operate and engage them in its use across several weeks (Ahtinen et al., 2012)

4. Results

4.1 Integrating the PSD model into the development process

In both Cases, the human-centred design process was implemented according to a prototyping paradigm where 'quick design' occurs after a requirements analysis. It aims to represent those functionalities that will be visible to the user and leads to the construction of a prototype. The prototype is evaluated by the user and is used to refine requirements. This iterative cycle is repeated until the prototype satisfies the requirements. During the iterative process the designers are able to develop a better understanding what needs to be done (Pressman, 2000).

The PSD model was integrated into the process by using it in the requirements analysis and concept design phases. In Case 1, there were no existing prototypes of the software. In Case 2, the design process was already much further advanced. There was an existing prototype, a smartphone application, which already had the basic functionality implemented and it was under validation in randomized controlled trials to prove the effectiveness of the intervention when delivered via the mobile channel. Figure 3 describes the development processes of the two Cases (darker colours represent the completed phases).

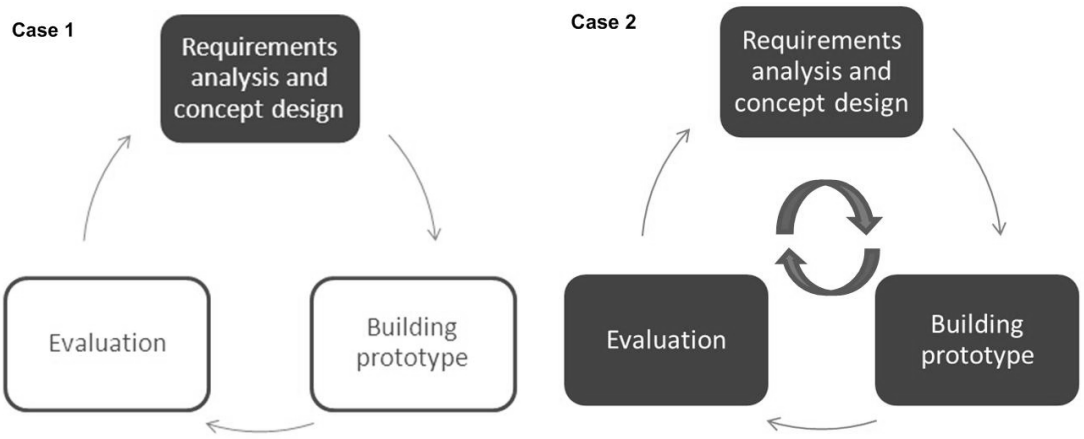

Figure 3: Development processes of cases 1 and 2

In this study the PSD model was integrated into the development work by organising a co-creation session for the people working in both of the projects. The PSD model was brought closer to practice by outlining a design canvas which aimed at facilitating the ideation work. The basic building blocks of the resulting Persuasive Technology Design Canvas are: 1) Analysis of the intention, 2) Design of the content and 3) Design of the functionalities (see Figure 4). To analyse the intention, it is useful to ask: "who, what, when, where and why". To design the content it is useful to ask "what", i.e. what theories, methods or assumptions the technology relies on, what kind of content is provided and what kind of content could be provided. To design the functionalities it is useful to ask: "how", i.e. how the technology has been implemented and how the technology could be implemented. The four categories under the functionalities contain the design principles of the PSD model. The Persuasive Technology Design Canvas is not limited to any particular theoretical model of behaviour change; it can be used across many kinds of design work.

Overview of the design process is illustrated in Figure 5. At the start of both co-creation sessions, the PSD model was introduced to the participants and the original article including detailed descriptions of the design principles was distributed to them. The Persuasive Technology Design Canvas was drawn on a large board. The researchers discussed and created a shared understanding of the intention and content of the behaviour change support system and wrote it down on the board. As an example, in Case 2 *the intention* was to increase the psychological flexibility of people who suffer from stress and depression, to be used in everyday life and *the content* was a coaching program based on ACT. Then they worked independently to envision new functionalities based on the design principles and wrote their ideas on adhesive notes. In Case 2, the participants identified first the existing persuasive functionalities using the Persuasive Technology Design Canvas, and then potential future functionalities. After the participants had gone through all categories, the adhesive notes were grouped and analysed. The result was an affinity diagram comprised of all of the new potential functionalities that could be included in the design of the system.

<table>
<tr><td rowspan="1">Analysis</td><td colspan="3">1. Intention</td></tr>
<tr><td rowspan="3">Design</td><td rowspan="3">2. Content</td><td colspan="2">3. Functionalities</td></tr>
<tr><td>Primary task</td><td>Dialogue</td></tr>
<tr><td>Credibility</td><td>Social support</td></tr>
</table>

Figure 4: The persuasive technology design canvas

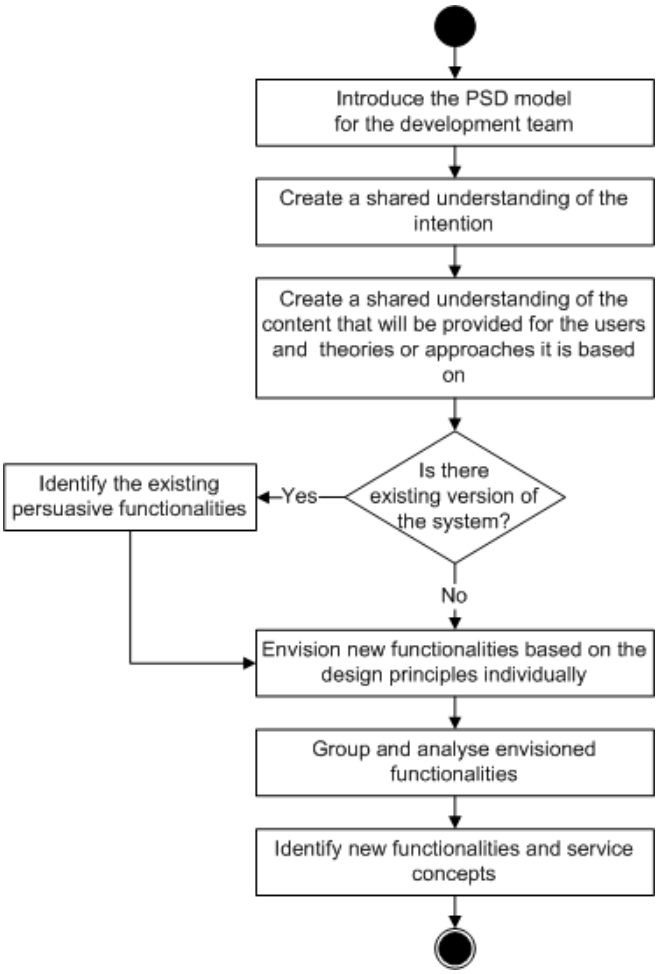

Figure 5: Overview of the design process

Because there was empirical material collected from a previous small-scale field study in Case 2, this was also used to identify new functionalities and create new concept ideas for further discussion and development. This material was already analysed and reported but not published. After participants had identified existing and future persuasive functionalities with the Persuasive Technology Design Canvas, they used this empirical material to identify new functionalities and create new service concepts.

4.2 The outcome of the integrated process

Material from the co-creation sessions was analysed afterwards. The adhesive notes from Case 1 were written up and the quantity of new persuasive functionalities envisioned by the participants was compared with the quantity of persuasive functionalities in the initial user requirements document. Initially there were 15 different persuasive functionalities applying principles from three categories: 1) primary support, 2) dialogue support and 3) social support. After the co-creation workshop there were 39 different functionalities from applying principles from the four PSD model categories (see Table 1).

Adhesive notes from Case 2 were also written up and the quantity of new persuasive functionalities envisioned by the participants was compared with the quantity of the existing persuasive functionalities. Participants in the co-creation session identified that in the current application there were 17 different persuasive functionalities applying principles from three categories: 1) primary support, 2) dialogue support and 3) credibility support. After the co-creation workshop there were 27 different functionalities applying principles from the four PSD model categories (see Table 1). In addition, dozens of new ideas were identified based on the empirical data. These included not only new requirements but also improvement ideas and service concepts. Overlapping items were removed in both Cases.

Table 1: Quantity of the persuasive functionalities before and after the co-creation session

	Before	After	Increase
Case one	15	39	160 %
Case two	17	27	60 %

4.2.1 Case 1: Fall risk assessment and fall prevention system: persuasive functionalities

In Case 1 the basic functionality of the personalised training program had many similarities with the initial user requirements, which had been defined earlier. It was expected that a personalised training programme with goal-setting, self-monitoring and feedback features would motivate older users to exercise and thus, the likelihood of fall would be reduced. A concrete plan and schedule of performing the intended balance exercises should be provided for the users and they should be reminded at opportune moments to perform the exercises. The system should offer instructions for how to perform the intended behaviour in practice, provide motivational information related to the exercises and give positive feedback when users reached their goals.

As a consequence of using the PSD model new functionalities were identified. It was discovered that simulations of the consequences of exercising (or not exercising) should be used to increase exercise motivation. The system should provide links to external websites providing useful and trustworthy information. It was also found that the exercise instructions should adapt over time as users would require more challenging exercises.

Regarding the four categories within the PSD model, the credibility and social support categories were the least taken into account in the initial user requirements. It was found that the system should provide information about the validity of the training program, show third party endorsements and logos in order to increase the credibility. The end-users should be provided an opportunity to send feedback to the developers of the solution. The potential for including group functionalities was recognised to be important, although in the first phase the system was targeted for individuals. End-users could have a club, as they might in real life, and they should have shared goals. The system should monitor the group's progress and give feedback accordingly. Club members should have an opportunity to send suggestions about useful exercises to other club members, discuss with the others, share their exercises with the others, have public recognition of their achievements, know when the others are performing their exercises, and to volunteer to help others to achieve their goals.

New, non-functional requirements were also identified in addition to the persuasive functionalities mentioned above. To list a few, the system should be error free, easy to use, and the user interface should be "pleasant and credible looking" from an older person's viewpoint. Although one of the postulates of the PSD model states that the system should aim at being both useful and easy to use (Oinas-Kukkonen and Harjumaa 2009), these aspects are general software qualities and not specific to persuasive systems only.

4.2.2 Case 2: Smartphone application for mental wellbeing: persuasive functionalities

In Case 2, the existing application already followed many persuasion principles. It provided thorough opportunities to rehearsal, which can enable people to change their attitudes or behaviour. Exercises were in both textual and audio format and users had self-monitoring potential through keeping a diary and activity log showing how many exercises were carried out. It suggested a program, "a path", to follow, had reminders of exercises, and reduced barriers to the user performing the exercises when compared for example to a book with written instructions. It provided expertise by showing video presentations by a real therapist and stated the evidence-based theory behind the application. It motivated users by giving a virtual reward for performing an exercise.

As a consequence of using the PSD model, new functionalities were identified. The system should provide feedback on the user's progress with regards to their goals, skills and committed actions. It should also give recognition via praise for performing the target behaviour. The system should adopt the role of a therapist, or virtual coach, who is always available to help. The content should be tailored to the interests and needs of the user, and the users should be provided with testimonials from other users who have been helped by using the application.

Many of the functionalities related to creating a more engaging user experience, such as providing a more attractive look and feel. The system should also provide opportunities to rehearse difficult situations in role play and provide animations, pictures or mini movies to emphasize of the benefits of the exercises. Similarly to Case 1, the credibility and social support categories of the PSD model were the least taken into account in the existing design. To increase credibility, the system should provide information on who provides the application, evidence of the effectiveness of the therapy method, third party endorsements and logos as well as the means to verify the accuracy of the content. Regarding "social functionalities" it was discovered early in the design session that although it is possible to identify them, they might not be applicable in the context of mental wellbeing. As an example, "competing with others in performing exercises" is not useful, but on the other hand, it could be useful to provide opportunities to follow other users' progress at some level, because this might encourage people to perform their own exercises.

In Case 2, new improvement ideas and functionalities were identified also based on the empirical material collected from a previous study. Many of them concerned ways to better integrate the solution into the everyday lives of the users, where a typical barrier amongst the field trial users was being too busy to carry out the exercises. Similarly to the requirements gathered using the PSD model, the need for a virtual coach and a more engaging user experience were suggested. While the principles of the social support category were not earlier considered especially applicable, it was identified that supporting communication or sharing exercises with friends and family could be useful.

4.3 Observations from the process

When participants began the co-creation session looking at the definition of intention, it was found that the intention part of the Persuasive Technology Design Canvas was not self-explanatory. One participant commented that there can be different kinds of intentions, such as theory-driven or more practical ones, and it was not clear what was meant in the Canvas. In persuasive design, 'intention' refers less to the 'design objectives' in general, than to a focus on the intent to change attitudes or behaviours. Fogg (1998) has stated that persuasion requires intentionality, i.e. intent to change attitudes or behaviours.

It was observed that the PSD model was more useful in Case 1 than Case 2, which may be due to the fact that in Case 1 the participants had less understanding and experience of the users and use context and thus, the participants were more open to new ideas. In Case 2, the designers had already had frequent contacts with the potential end-users and were armed with findings from a prior field trial, and thus, their experience was more evident when making comparisons using the PSD model.

In both Cases it was observed that some principles were overlapping, and participants found these somewhat confusing. They also commented that there were many principles in credibility and social support categories that overlapped. In both Cases participants doubted the efficacy of virtual rewards. They stated that improvements in health are the best motivation for continuing the suggested behaviours and the system should make these improvements more obvious, e.g. by providing more personalised feedback rather than virtual rewards or praise.

In Case 2 it was identified that the application could provide more guidance, but it was difficult to include this in any of the four categories of the PSD model. The ability to adapt was also considered to be important for the persuasiveness of the system, but it was difficult to find a corresponding principle from the PSD model.

5. Discussion and conclusions

The aim of this study was to investigate how the Persuasive Systems Design (PSD) model can be utilised to support the development of personal health and well-being systems. The related research showed that the PSD model has been used in the development of BCSSs to describe the overall process, analyse the persuasion context and design system qualities. It has also been applied in the evaluation of existing systems by providing heuristics for expert evaluations and systematic ways to analyse user experience data. The more specific objective of this study was to discover how the PSD model can be utilised to support the identification of persuasive aspects in the early stages of iterative, user-centred IS development. The PSD model was integrated into the development process by using it in the requirements analysis and concept design phases through organising a co-creation session where a Persuasive Technology Design Canvas was used.

It was found that where the PSD model was utilized, participants of the co-creation sessions were able to identify more persuasive functionalities compared to their existing preliminary user requirements or designs. This is a positive result, since the PSD model suggests that a systematically designed persuasive system has software requirements that apply persuasion principles. It should be pointed out, however, that the large number of persuasive functionalities does not necessarily guarantee an effective system nor the users' adherence to the intervention delivered through the system, but the way in which they are implemented also matters. Overall, recent studies show evidence of the effectiveness of the principles.

The most important result of the co-creation sessions was, however, the increased awareness of the features needed to accomplish a personal health and wellbeing system that changes users' behaviour. The earlier the different requirements are identified and communicated to the development team the easier and cheaper it is to integrate them into the final system.

The PSD model provides support for designing and evaluating BCSSs, but some future directions of development of the model can be recognised. The PSD model suggests that it is important to understand the meaning of intentionality in the persuasion process. However, the researchers' observations showed that the intention part of the Persuasive Technology Design Canvas was not self-explanatory for the workshop participants. In the information systems field, the intention or motivation behind the technology is often difficult to identify and thus there is a need to understand intentionality in a more thorough way. This issue has been tackled in further studies of e.g. Oinas-Kukkonen (2012) and Wiafe et al. (2012). In both cases, some principles were considered to overlap by the participants of the co-creation session, and it made them somewhat confused. Thus, clarifications to the principle descriptions and examples would be needed. In general, it can be mentioned that the PSD model comprises many components and it might seem to be a complicated model when compared to some other approaches. The PSD model has also received some criticism for being too high a level model, because it does not provide a sufficient guide to the designer on how to perform the activities mentioned in the model (Wiafe et al. 2012). To summarize, there is a need to simplify the process, but more guidance should be provided for the designer.

Although the PSD model proposes how persuasive systems should be developed in a very holistic manner, its disadvantage is that it does not explicitly give advice on how to include 1) a framework or theory into the development of the content delivered via the system, or 2) customers or users in the development process. In practice, especially when BCSSs are developed in a health context, it is recommended that the content is based on a theory (e.g. in case 2 ACT was used). Regarding user involvement, one of the new design practices analysing the persuasion context states that it is important to understand the user. However, actual user participation is not explicitly suggested although its importance has been acknowledged (e.g. ISO, 2010). In future work, the content creation and users' role in the design should be described at a more detailed level.

This study has some limitations. Although the research approach was a multiple-case study and thus, the study was once replicated, it is not guaranteed that the use of the PSD model would lead to a larger set of persuasive functionalities in every case. The scope of the project and the characteristics of the workshop participants might influence on the results as well as the starting point where the process outcome is compared.

This study contributes to the IS field by demonstrating how persuasiveness can be built into systems. It also specified the purpose of the PSD model; it clearly helps to identify new requirements for persuasive systems.

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