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## Participatory Design of a Persuasive Mobile Application for Helping Entrepreneurs to Recover from Work

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**Abstract.** Involving end-users in a participatory design process may help researchers and developers to gain better understanding of the end users' views about the target system. In this study, we utilized participatory design approach with focus group meetings and participatory design workshops to figure out requirements for persuasive features of a mobile application for entrepreneurs to recover from work related strain and stress. In many cases, end-user participation in the design process may lead into building more efficient persuasive technology solutions and at least avoidance of many of the design pitfalls, but setting up meetings and organizing workshops can be time-consuming.

**Keywords:** Persuasive Systems Design, PSD, focus groups, participatory design, inspiration cards, micro-entrepreneurs, recovery from work, mobile app

### 1 Introduction

Web-based health promotion can be very effective for health behavior interventions [1] and at times being much better than printed material for problem domains such as dietary practices [2]. Mobile applications can reach people for large-scale population level interventions similarly to web-based approaches, but with seemingly better adherence rates [3]. For health interventions, smartphone technology also offers sensors such as accelerometers for health problem measurement [4] and internal applications such as sound measurement for occupational noise [5].

We as a persuasive systems development team worked as a part of a research consortium that was trying to make a difference with evidence-based health promotion for micro-entrepreneurs. Our aim was to build a mobile behavior change support system [6] based on Persuasive Systems Design model [7] targeting micro-entrepreneurs' health behavior change as regards recovery from work. Because of the assumption of the heterogeneous nature of micro-entrepreneurs, our end-user representatives, we decided to involve them in the participatory design process. We sought out for valuable insights from the entrepreneurs via focus group meetings and participatory design workshops in order to develop the target system. Our research question for this paper is the following: What persuasive system features for a mobile application do end-users view as valuable within the health problem domain at hand?

## **2 Work-life Balance of Micro-Entrepreneurs**

In the European Union, microenterprise is defined as an enterprise which employs fewer than 10 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 2 million [8]. 93% of all companies in the EU-28 countries are micro-enterprises [9]. Their importance for European economies is notable as microenterprises accounted for 30% of employment and 37% of the growth in total employment in 2015 [10]. However, as entrepreneurs are personally responsible for the success and survival of their firms, work tends to dominate entrepreneurs' lives. A clear division between work and family or social lives is often lacking [11]. Thus, entrepreneurship is often stressful and demanding with lots of financial and other kinds of stress. In spite of this, entrepreneurs in general are still satisfied with their work or, in other words, entrepreneurs seem to be energized and fatigued at the same time [11]. Entrepreneurs can achieve an important competitive advantage over their competitors if they can learn to deal effectively with job demands and work-related strain [12].

Owing to the size of the companies, microenterprises by nature have limited human resources: from self-employed to only a few employees in size, there is little opportunity for delegating work during illness or holiday time. Micro-entrepreneurs tend to take fewer sick days [13] and fewer holidays than people employed by others [14]. Factors both at work and outside of work influence recovery. For example how work is organized, what are the requirements and demands, available resources and a person's ability to commit to work are all factors in work that affect recovery; Outside of work factors such as age, family, amount and quality of free time, and amount and quality of sleep affect recovery from work [15]. Sufficient recovery from work is a key factor in anyone's work ability and quality of life [16]. Different types of recovery experiences, namely psychological detachment, relaxation, high control and mastery during off time from work are beneficial [17].

## **3 Persuasive Design of Mobile Applications**

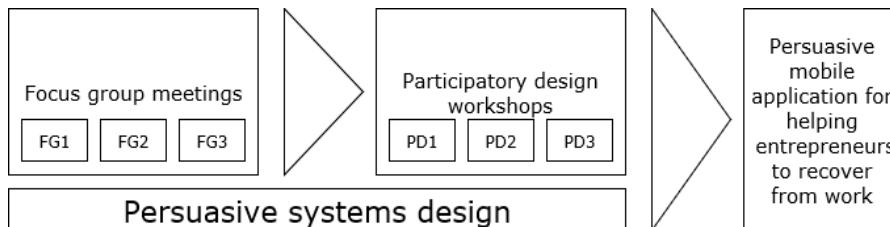
Persuasive Systems Design (PSD) is a framework for designing and evaluating persuasive software solutions, offering a set of postulates to describe the core characteristics

of persuasive systems, ways to analyze the persuasion context, and design principles for persuasive system content and functionality [7]. Persuasive systems enable affecting end-users' behavior even in situations where their attitude is not favorable towards the behavior, as attitudes do not necessarily predict or determine behavior. The end-users may know the proper behaviors or may have the right attitudes, but may not act according to them. Understanding the goal of the end-users is important, including past performance and current progress. When considering persuasion, the message and the route direct and/or indirect should be defined or analyzed. In the PSD model, there are four categories of persuasive system principles: primary task support e.g. self-monitoring tools, dialogue support e.g. reminders, system credibility support e.g. third-party endorsements, and social support e.g. social comparison. [7.]

In our study, we were developing a health behavior change support system [6] for helping micro-entrepreneurs to recover from work. The team had previously worked on a web information system targeting obesity and weight loss with preventing metabolic syndrome at the core [18], whereas the Android-based mobile application here was targeting several health problem domains such as stress and nutrition with recovery from work at the core.

#### 4 Study setting

Involving end-users, or their representatives, in the participatory design process can potentially lead to effective persuasive technologies [19]. In doing so, the user involvement needs to be structured, facilitated and interpreted accordingly for true enhancement of a target system to be possible, as one can easily be overly fascinated to the extent that results become superficial or one is lead astray by the end-user views [20].



**Fig. 1.** Persuasive systems design process in our case.

In order to learn which persuasive system features end-users view as valuable, we organized exploratory focus groups [21] and arranged participatory design workshops [19-20, 22]. See Fig. 1. Additionally, we also wanted the whole research consortium to be involved in the design process of the mobile application. Three focus group (FG) meetings with the end-user representatives were organized before moving into arranging three participatory design (PD) workshops. Obtaining feedback from the end-user representatives in exploratory FGs may help improve the design of the target system incrementally and rapidly [21]. With the help of the exploratory FG meetings based on paper prototypes, we implemented rapid iteration cycles. The iteration cycles also

helped us to refine the semi-structured questions for the second and third exploratory FG meetings, and we were able to present smartphone versions of the target system mockup in the PD workshops.

We arranged the first and second PD workshops in a more conventional participatory design manner, whereas the third PD workshop was arranged as an inspiration card workshop, following the example of Davis [19]. Two categories of inspiration cards were utilized: Technology cards that represent a specific application of technology with a description, and domain cards that represent the information of domains [22].

#### 4.1 Study participants

The end-user representatives were contacted through the micro-entrepreneurship research group, who sent an invitation for groups of micro-entrepreneurs who had previously attended their networking and peer support meetings. The topics and health problem domains of our FG meetings and PD workshops were advertised for the micro-entrepreneurs, who then decided whether they wanted to participate or not. Each of the first four meetings and workshops took place in a local company and the end-user representatives came from nearby areas. The average distance to the local companies was 68 kilometers from the university.

The entire research consortium was involved in the development process through three-week iteration cycles. A total of 19 end-user representatives participated in the focus group meetings (FG1=9, FG2=4, FG3=6). We did not explicitly inquire the participants' line of businesses in the exploratory FGs, but the following enterprises rose up during discussions: web design, car part dealership, cleaning, video editing, studio work, digger operating, and web application design.

A total of 20 people participated in the participatory design workshops (PD1=5, PD2=9, PD3=6). We asked the participants of the first PD workshop to fill in their basic personal data information. The participants' ages differed from 29 to 63 and the level of education from elementary school to university (Ph.D.). The participants reported photography, research, gym and massage, kindergarten and arts, clocks and jewelry as their line of business with an average of 16 years of experience as entrepreneurs (variation from 6 to 31 years).

The participants of the second workshop consisted of the research consortium (9 researchers), which included research assistants, doctoral students, post-doctoral researchers, principal investigators and professors. All participants had an academic degree, ranging from bachelor's degree to Ph.D.

For the third workshop, the participants were again end-user representatives. The participants' ages differed from 30 to 51 and the level of education from vocational training/school to university (Master's degree). The participants reported financial administration and accounting, arts and wellness, real estate agency, wellness, video services as their line of business with an average of 6 years of experience as entrepreneurs (variation from less than a year to 17 years).

All end-users participated in only one meeting or workshop, with the exception of PD3, which had two participants from FG3. Therefore, we had a total of 37 individuals to participate in the process, including 28 individual end-user representatives in the FG

meetings and PD workshops. No monetary fee was paid for the participants, but they gained a small tax-free kilometer-based allowance for travel costs.

#### 4.2 Focus group meetings

The working agenda of the explorative FGs consisted of semi-structured questions prepared together with the research consortium. Discussion and end-user representatives' opinions or ideas about the usage of persuasive system features followed the questions. We presented mockup versions of the target system in all the meetings. We extracted the data from observer notes and audio files.

In FG1, the end-user representatives expressed their opinions of paper mockups presented. The issues tackled included the use of a slide bar versus typing for inputting numerical feedback, user's personal selection of a goal versus having the system set a goal, and receiving feedback with or without *social comparison*. Also the questions whether to give *praise* with or without *rewards* and if with rewards what type of rewards (trophy icon with or without rich graphic details) were addressed.

In FG2, we brought up the issue of using praise, reward or a combination of both. The participants were also shown icons ('trophy', 'checkmark', 'medal', 'smiley', 'thumbs up') of which they could choose their preferred ones. We asked the participants about their preferences for the frequency of reminders (push notifications) and willingness to input feedback through self-monitoring tools.

As for FG3, we asked the participants whether we should consider some kind of *normative influence* function or not and what would be suitable factors as points for social comparison. We also inquired the user preferences for reminders and sought additional ideas for tools for self-monitoring and preferred usage frequency for these tools and reminders.

#### 4.3 Participatory design workshops

In PD1, we gave the participants an assignment to sketch an additional feature into the mobile application: to design a way for the users to *cooperate* for recovering from work by exercising e.g. jogging. For inspiration, we showed them our prototype version available at that moment. We then divided them into two teams and handed out sticky notes, color pencils and A1 size papers. Both teams sketched a rough model of their perception of the given assignment. The second task was to draw a mind-map of issues they would associate with recovery from work, physically straining work and cooperation.

PD2 did not involve end-user representatives, but the research consortium. Researchers were split into four teams and they were given blank papers, sticky notes and color pencils while tasked to generate ideas about tools for self-monitoring.

PD3 was implemented as inspiration card workshop [19, 22]. We divided the participants into two teams and handed out the card decks. One side of a card gave the name of a PSD principle or health problem domain (sleep, stress, nutrition, sedentary work, recovery from work, physically straining work, working hours efficiency), and the other side had a brief explanation. We instructed them to proceed by choosing one health

problem domain and to discuss which PSD principles would be suitable for the domain. Occasionally we had to remind the end-user representatives to read the brief explanations from the backside of the cards. We also encouraged them to discuss the relevance of all the cards placed around a health problem domain. Occasionally the end-user representatives removed cards after a discussion. When necessary, we gave either examples or details about the PSD principles. For collecting data, we photographed all card sets from both teams.

#### 4.4 Target system mockups

The first version of the target system mockup presented in FG1 was a crude paper prototype, containing simplified examples about the functions, tasks and feedback. The paper prototype had two options for each presented persuasive feature e.g. goal setting (choosing the goal versus having the goal set by the system). We discussed the collected data with the research consortium and the discussions guided the next iteration of the target system mockup. The process remained similar during the three-week cycles. We made a second version by using PowerPoint, which allowed participants in FG2 to navigate inside the mockup with ‘hyperlinks’ in the slides, which imitated target system functionalities e.g. pressing a radio button changed slide. The mockup in FG3 had an upgraded graphical layout. Fourth version of the target system mockup was made with Android Studio for PD1. From this point onwards, we presented a crude demo version of the target system in PD2 and PD3.

#### 4.5 Study setting and timeline

The three meetings and the first workshop followed a three-week cycle timeline (from March to May 2017). In the first week of each cycle, the development team held design meetings. The planned participatory design materials for participants were presented for the research consortium in the following week. The third week of each cycle consisted of us traveling to meet the end-user representatives. See Fig. 2.



**Fig. 2.** Three week-cycle of the design process between three parties involved.

The second workshop took place at June at the university campus, right after the first one. The results of the previous research steps were discussed and a participatory design workshop with the researchers was held. The third workshop was arranged at September in the premises of a shopping center, during a two-day event for entrepreneurs. We invited the end-user representatives to join our workshop as a warm-up to the main event.

A small number of other interested parties (researchers or colleagues of end-user representatives) were present in the meetings and workshops, with the exception of PD2, which was only for the research consortium. However, we carefully instructed that only end-user representatives could comment verbally on the issues presented. The end-user representatives formed their own teams consisting solely of micro-entrepreneurs, and the additional participants present at meetings and workshops had their own teams. The contribution of the additional participants was explicitly marked, for example by giving pencils of different colors, and excluded from the final data analyzed.

#### 4.6 Data gathering

We sought out to gather data, both qualitative and quantitative, from the focus group meetings and participatory design workshops. On the one hand, we expected that qualitative data in the form of ideas, opinions and preferences would help us to understand our target group. On the other hand, we expected that quantitative data would help us to reach decisions about which PSD principles we should implement into the target system.

We had at least one moderator or facilitator per team and at least one observer making notes present in all the meetings and workshops. We recorded all the workshops and meetings that involved end-user representatives. The audio files were helpful for backfilling observer notes.

## 5 Results

In our study, we received valuable data about persuasive system features and their categories as well as subareas of health and well-being.

### 5.1 Persuasive system features

As *goal setting* is a core element of PSD, we sought to learn about the end-user representatives' views about goal setting in FG1. Seven participants wanted to choose their own goal and two wanted a goal chosen for them by the system. All participants in the FG meetings expressed their opinions quickly and with no hesitation.

**Primary task support.** The participants expressed their willingness to monitor self-perceived recovery from work by regularly answering timed inquiries. They also ended-up discussing ideas about *self-monitoring tools* independently (in FG2 and FG3), and came up with ideas such as linking heart rate monitoring and a health diary with the application. The concept of brainstorming self-monitoring tools was the core of PD2 (table 1). Some of the ideas presented at PD2 were actually *reminders* rather than self-monitoring tools (and therefore did not qualify as ones), e.g. alarms that inform the users to go to sleep or push notifications that remind the users to eat at appropriate times.

In PD3, we also gave end-user representatives a quick chance to brainstorm ideas about self-monitoring tools. They came up with two categories: giving input for self-

perceived situation e.g. stress can be associated with different colors or different animal icons; different sensors or external devices for detecting health problems e.g. blood pressure monitor, decibel measurement, muscle tightness measurement et cetera.

**Table 1.** Self-monitoring tool ideas from PD2

<i>Tools for self-monitoring</i>	<i>Health problem domain</i>
Input for reflecting sleep (quality and quantity)	Sleep
A sensor for measuring sleep quality (rolling around in bed)	Sleep
Input for describing stressful situations (when and why)	Stress
Photos of meals and a diary (what and when)	Nutrition
Input for answering questions about recovery from work	Recovery from work
A sensor for detecting user stillness	Physically straining work
Input for dividing the hours between actions during the day	Working hours efficiency
Diary and/or calendar (time used and for what)	Working hours efficiency

**Dialogue support.** The participants in FG2 and FG3 came up with the same average number for *reminders*, three per week, and thought that more than four weekly reminders would be irritating. Some of the participants also commented that if they had a busy or stressful week, having to deal with reminders might be irritating, even if there was less than three per week. Both groups preferred an option to set the time and day of the reminders themselves. In overall, the end-user representatives thought that reminders can be helpful, but they would have to be relevant. For example, a timed reminder that informs the user about coffee breaks was considered useful. Another example was a reminder for an external wearable activity tracker connected to a mobile application, which would remind the user to start exercising e.g. go to a walk.

As for the PSD principles of *praise* and *reward*, we wanted to know if the participants in the exploratory FGs would prefer both or just one of them (and which one). The participants preferred praise as a standalone feature, whereas reward or a combination of both were not preferred. The participants commented that trophies, medals and other similar virtual reward icons could be associated with competition, which they would like to avoid in mobile applications meant to relieve stress (health problem domain presented in FG1 and FG2). Because of the comments from FG1, we presented different images of virtual reward icons in FG2. Three out of four participants deemed the ‘thumbs up’ icon as encouraging and positive therefore being best from the presented options. The end-user representatives did not prefer ‘trophy’ and ‘checkmark’ icons, whereas they thought that ‘medal’ and ‘smiley’ icons are moderately good as virtual rewards.

**Social support.** We brought up *social comparison* in all the focus group meetings. Most participants liked the idea of social comparison and came up with such factors as age, gender and geographical area as comparison points. Interestingly enough, they



thought that line of businesses might not be a suitable factor for social comparison because of the heterogeneous nature of micro-entrepreneurs. Additionally one team of participants in PD1 ended up ideating about the possibility of having a geographical social comparison function in a mobile application. As for *normative influence*, the participants in FG3 thought that it was a good idea, but did not discuss it in detail.

Interestingly, the FG participants came up with some system feature ideas occasionally even without prior discussion. *Cooperation* was one of the persuasive features that arose in the free form discussions during the exploratory FG meetings. We did not introduce cooperation in the focus groups, but as the participants brought it up by themselves, we decided to have cooperation as a theme for PD1. We asked the end-user representatives to design ideas about cooperation for recovering from work through exercising e.g. jogging. The ideas were two different matchmaking functionalities that enabled cooperation between different micro-entrepreneurs. The user could choose a geographical area and sport e.g. tennis, after which the application would suggest someone interested in the same sport from the same area; the application would support gathering a group of people and the user could choose to join the group. The participants also came up with ideas of relaxing exercises and small exercising acts of everyday life e.g. walking the dog or going to swimming together with a colleague.

## 5.2 Subareas of health and well-being

We presented seven health problem domains (domain cards) and twenty-eight PSD principles (technology cards) for the participants in PD3. The participants proceeded by picking one domain card and discussing which technology cards to place next to the domain card. After the participants were finished discussing and had placed the cards, we photographed the result and the participants were free to pick the next domain card. The inspiration card workshop was finished when all the domain cards had been discussed by both teams. The number of principle category cards is presented in Table 2.

**Table 2.** PSD principle card placement by categories and health problem domains

	Primary Task Support	Dialogue Support	Credibility Support	Social Support	Total
Sleep	2	3	2	1	8
Stress	8	1	2	0	11
Nutrition	3	5	1	0	9
Sedentary work	3	3	0	1	7
Recovery from work	5	7	1	2	15
Physically straining work	5	6	0	0	11
Working hours efficiency	5	3	2	4	14
Total	31	28	8	8	75

It is noteworthy that the participants held primary task support and dialogue support categories in much greater value than system credibility or social support. Credibility

support was somewhat overlooked and for instance *real-world feel*, *authority and surface credibility* were not deemed as important. Neither team placed cards of the aforementioned principles next to a domain card. The end-user representatives from earlier meetings and workshops had brought up *social comparison* from social support category. Therefore, it was a bit surprising to find out that the participants of PD3 did not consider social comparison very valuable for the presented health domains, since neither team placed social comparison card next to any domain card. The other social support features were not popular for the given problem domains either, with the exception of *social learning*, which both teams emphasized for ‘recovery from work’.

Another surprise was that *praise* was considered a key feature by one team (working hours efficiency), whereas *reward* for four other domains (one card per domain from all teams). This contradicts our findings in the exploratory FGs, since praise was deemed better than rewards. In addition to praise, both *similarity* and *liking* from the dialogue support category were suggested only once for one domain (similarity for physically straining work and liking for nutrition). From the primary support category, both *simulation* and *tunneling* were chosen twice with one principle card per domain from either team (simulation for stress, recovery from work and tunneling for stress, nutrition). All the other PSD principle cards from the primary support and dialogue support categories were considered suitable either for several domains and/or by both teams. Nevertheless, this indicates that for the given context, both primary support and dialogue support categories were seen as especially valuable, which can also be seen from the total amount of PSD cards chosen by both teams: 31 for primary support, 28 for dialogue support.

## 6 Discussion

We succeeded to recruit 28 individual micro-entrepreneurs to join our meetings and workshops. All the focus group meetings and participatory design workshops were successful as we gained valuable data about the end-user representatives’ preferences and views. We suggest that the participatory design process described here helped us to reach a seemingly effective design specification, yet we noticed that setting up meetings and workshops is time consuming. Recruiting participants, planning and communicating with other researchers, traveling, organizing meeting places, coffee, snacks and helping participants in travel arrangement while at the same time developing the actual target system took a tremendous amount of resources and time.

In order to avoid becoming too fascinated with the views of the involved users [20], we decided to arrange an inspiration card workshop [19, 22] in PD3, so the end-user representatives could discuss and justify their persuasive technology preferences. The popularity of primary task support and dialogue support feature categories in this workshop might be because they offer direct hands-on ways to persuade e.g. tools for *self-monitoring* and *rehearsal* as well as *reminders* and *suggestion*. Some other PSD principles are more abstract and perhaps more difficult to be understood by non-experts during single short workshop. It might also be that the participants could have been

unsure about the differences between the concepts of *social comparison*, *social learning* and *social facilitation*, since the concepts are so close to each other and had to be explained more than once to the participants.

One could speculate that as system credibility support features are more or less default in professional websites and applications, they might not stand out in this setting. Nevertheless, absence of system credibility support features, such as surface credibility, e.g. competent look and feel, might lead into situations where users might be less willing to use such systems. Additionally, one of the expressed challenges regarding self-monitoring tools was that if the end-user representatives are shown self-perceived input, they might not have interpreted their own situation properly when they were inputting the feedback, e.g. self-perceived stress level could be either too low or too high.

There are also limitations for this study. We advertised the meetings and workshops for the local micro-entrepreneurs, but only those supposedly interested about health topics and mobile application development joined the meetings and workshops. All the end-user representatives also came from a relatively limited geographical area.

## 7 Conclusions

This paper offers insight into the views of micro-entrepreneurs for persuasive system features in mobile health applications. Helping system developers to understand the needs and preferences of end-users is important in order to make the system practical. Exploratory focus group meetings and participatory design workshops help involving the end-users into design processes and collecting data. Additionally, this paper discusses the methodology of how to carry out such processes. With good planning and when in conjunction with a research project, valuable research data can be acquired. In sum, participatory design is a fruitful approach albeit laborious approach for developing persuasive systems.

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