

## Value Sensitive Analysis of the Persuasion Context: Case Micro-entrepreneurs' Health Promotion

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### Abstract

Even though the definition of persuasive systems rules out using coercion or deception, in practice it is a challenge to design ethically sound information systems, especially when the use context deals with personal matters such as one's health or lifestyle. The objective of our study was to investigate how to conduct such design through a value sensitive analysis of the persuasion context, in this case for micro-entrepreneurs. The analysis revealed special characters of the persuasion context that are critically important to address early in the development of the application. This study applies a useful method for designers to use in their analysis of the ethical considerations in their persuasive system design efforts.

**Keywords:** ethical analysis, value sensitive analysis, persuasive systems, behavior change, micro-entrepreneurship.

### 1. Introduction

Persuasive systems are information systems that are designed to support a change in people's behavior or attitude [25]. The definition of these systems incorporates the ethical aspect by stating that coercion or deception should not be used and the use of those systems should be voluntary [24], [25]. However, persuasive systems may still raise many ethical concerns [5], [29]. The idea of using information systems to influence people's behavior and attitudes can be terrifying for many and may invoke a fear of being influenced involuntarily and imperceptibly—even though the intention of persuasive systems is quite the opposite.

According to Fogg ([13], p. 227), persuasive systems have intended or unintended and ethical or unethical outcomes. Some unintended outcomes are easier to predict than others. However, the division between unethical and ethical outcomes is not always as clear. For example, a persuader (e.g., an organization or a person behind the persuasive system) may have unethical objectives, even if the system appears to be ethical and the users are using the system voluntarily.

This study focuses on the unintended unethical problems and aims to avoid some by paying attention to the possible negative consequences during the design process. The unethicality in this case means that the main goal of the persuasive system is considered ethical, but the system has ethical concerns regarding some of its stakeholders. In the application domain is microentrepreneurs' health promotion. Microentrepreneurs were

chosen as target group, since they often have health related challenges due to their busy lifestyle and related matters.

Ethical aspects of persuasive systems have been studied from multiple viewpoints; however, a gap of knowledge exists regarding how to include ethical issues in the design process in practice. Karppinen and Oinas-Kukkonen [18] described the following three ethical approaches to describe how persuasive system designers can take ethical aspects into account: guidelines, stakeholder analysis, and user involvement. Guidelines offer general ethical precepts but may leave out stakeholders' explicit values and moral norms [18]. Guidelines also tend to be abstract and fail to offer practical guidance on how to include the ethical aspects into the design. For example, Berdichevsky and Neuenschwander [1] developed a list of eight principles for guiding the design of persuasive systems. The most important principle in their list was that "the creators of a persuasive technology should never seek to persuade a person or persons of something they themselves would not consent to be persuaded to do" ([1], p. 52). Spahn [28] summarized this ethical instruction as three guidelines: (1) there should be consent prior to the persuasion, (2) the goal of the persuasion should ideally be to end the need for the persuasion, and (3) there should be as much autonomy as possible.

The second category—stakeholder analysis—involves the stakeholders' values. The aim of this type of analysis is to identify the relevant stakeholders and their morally important values, which will steer the design process in an ethical manner. As some of the versatile, relevant values may conflict with each other, the designers have the final responsibility to decide which values are most important in a specific situation. There are several methods for conducting stakeholder analysis. Fogg [13] suggested using a seven step stakeholder analysis to determine the ethics of persuasive systems by investigating the stakeholders' gains and losses in terms of values. Additionally, Friedman, Kahn and Borning [15] introduced value sensitive analysis (VSA), which many consider the most comprehensive method for taking human values into account in technology design [31].

In the third ethical approach in Karppinen and Oinas-Kukkonen's [18] framework—user involvement—focuses on the users. For example, participatory design [5], [19] has been used to tackle ethical issues in persuasive systems, and user involvement during the design process is beneficial for not only making the system more ethical, but also helping the designer to better understand the users' needs.

We examine the challenge of mitigating the unintended negative consequences of persuasive systems by exploring the contextual factors arising from a problem domain in form of values. We thus combine VSA [15] with the persuasive systems design (PSD) model [25], as was suggested in [29]. Using VSA, we can explore the relevant values of all the significant stakeholders, and as stated in the PSD model [25], it is important to understand the use context to develop an influential persuasive system. We thus believe that by identifying the values of the relevant stakeholders, the system will not only be potentially more ethical but also more effective than without using the VSA.

For this study, we chose a specific problem domain, namely micro-entrepreneurs and their health promotion, which we will introduce in more detail in Section 2.1.

## **2. Background**

### **2.1. Micro-Entrepreneurs and Their Health**

Persuasive systems are not designed without context. Thus, contextual factors shape the theories of how PSD works. These factors may affect and be affected by the implementation, persuasion mechanisms, and outcomes of the system. Thus, it is important to clarify what counts as context, how different contextual elements interact, and how the relationship between context and PSD can be understood. The same applies to the context of micro-enterprises.

Micro-sized enterprises are defined as "enterprises which employ fewer than 10 persons and whose annual turnover and/or annual balance sheet total does not exceed two million euros" [9]. A dynamic micro-enterprise sector can be considered a key characteristic of a successful economy. In the 28 EU countries, 93% of the combined 22 million companies are micro-sized enterprises [10]. In 2015, micro-sized enterprises

accounted for 30% of employment and 37% of the growth in total employment [10]. However, a large share of micro-enterprises are non-employer enterprises (solo entrepreneurs). The impact of micro-enterprises on employment is globally significant. While the definition of micro-sized enterprise varies outside the European context, micro-enterprises are the numerically dominant group in every economy. According to a report by the Organisation for Economic Co-operation and Development ([23] p. 34), in all countries analyzed globally, between 70% and 95% of all enterprises were micro-sized.

According to Falk [12], micro-enterprises are a dynamic group of firms characterized by a large proportion of young enterprises, higher growth rates, and high exit rates. Additionally, micro-enterprises are an extremely heterogeneous group, which includes solo entrepreneurs, start-ups, family businesses, lifestyle businesses, and growth companies (see [8]). Compared to their larger counterparts, micro-SMEs typically have fewer financial resources, lower technical expertise, and more limited management skills.

As decision-making in micro-enterprises is largely owner-dependent, the owner plays a pivotal role in the organization's focus and success [21], [2], as owner-managers of micro-enterprises often work at both the management and operational levels [16]. Compared to larger businesses, micro-enterprises have different organizational characteristics and approaches to challenges [20], [22]. Micro-enterprises also have limited resources and therefore operate under financial and expertise constraints [21], and their day-to-day survival requires attention [11]. In addition, owing to the time and resource constraints and minimal environmental power, it is vital for micro-enterprises to embed valuable resources into a core business strategy [21]. In these conditions, decision-making relies on the owner's intuition, which leads to informal and personalized management systems [2] wherein the owner-manager plays the challenging role of multi-talented management "Jacks of all trades" [20]. The owner-managers' life is often consumed by his or her business, which may become a problem [2] because the micro-enterprise may be limited by the owner-manager's capabilities.

However, micro-enterprises benefit from an intuitive, informal, and flexible strategic process. Moreover, direct contacts with customers, suppliers, and employees, and the ability to respond quickly to market signals, are distinct advantages of micro-enterprises [21], [16].

## 2.2. The PSD Model

One of the most-used design models for developing persuasive systems is the PSD model [24, 25], which is based on many theories from the fields of psychology and information systems, such as the elaboration likelihood model [26] and the technology acceptance model [4]. The PSD model can be used for designing and analyzing a persuasive system, which makes it valuable for this study.

Designing a persuasive system is different from designing a non-persuasive system in that the designers must understand, at least to some extent, how a behavior change happens, in addition to the basic knowledge regarding information system design. For that reason, the first stage in the PSD model introduces seven postulates explaining the main issues behind persuasive systems [25]. Examples of these postulates are that persuasion is often incremental, one can use direct or indirect routes to persuade, and the persuasive system should not interrupt the user at an improper moment.

The second stage involves analyzing the *persuasion context*, which in the PSD model consists of the intent (persuader and change type), the event (use, user, and technology contexts), and the strategy (message and route) [25]. The main goal (i.e., the change type) that the system is designed to help the user achieve must be made clear first. According to Oinas-Kukkonen [24], there are nine different possible outcomes including forming, altering, or reinforcing attitudes, behaviors, or compliance. With specified outcomes, the designer can identify and profile the intended users and the persuasion event.

Use, user, and technology are the main focus points when analyzing the persuasion event. Use context focuses on the problem domain and its specific features. In practice, an expert of the problem domain should be involved in the design process to make sure

that the problem domain and characteristics arising from it are understood. Persuasive systems are often health related [24] and include common topics such as smoking or alcohol cessation, weight management, and healthy eating habits. With these types of problem domains, expertise on these topics needs to be acquired to design an effective persuasive system. Otherwise, even if the developed system feels effective on a surface level, the users may not find that the system truly helps them to change their behavior.

However, it is not enough to just understand the problem domain; the user is also a key factor for building an effective system. Even though users are pursuing the same goal (e.g., losing weight), they are not a homogenous group. Thus, a persuasive system also needs to take into account differences such as the users' needs, motivations, abilities, pre-existing attitudes, lifestyles, and cultural factors [25]. Two people struggling with the same challenge may have completely different backgrounds. To design an effective and supportive system for different types of users, those differences should be largely understood.

Since the persuasion in persuasive systems is done via computers (i.e., smart phones, tablets, and wearables), the technology aspect is also an important part of the context analysis. New technologies enable new ways to implement persuasive elements into persuasive systems. In the early days of persuasive technologies, the persuasion was often done via desktop computers or laptops, and users could decide when to spend time with a persuasive system. Now we can utilize mobile technologies, which are practically always with the user and send notifications at certain moments (e.g., when a user is climbing stairs or has not moved enough in a certain hour). This new technology has changed persuasive systems remarkably. However, designers need to keep in mind that every feature in a persuasive system has to be meaningful and justified; features should not be added just because the technology allows it.

The third and final stage of the PSD model is the persuasive software features [25]. The model introduces a wide variety of software features in four categories: primary task support, dialogue support, system credibility support, and social influence. The understanding and knowledge regarding the persuasion context obtained during the previous stage of the design process will guide the developer in choosing the proper set of persuasive features.

However, even though the PSD model emphasizes the importance of addressing ethical considerations, it does not take a strong stance on ethical issues. The ethical side is visible in the model in suggestions to ensure the overall goal of the system clear for the users and that the use of the system should always be voluntary. In a similar vein, the definition of persuasive systems does rule out unethical means of changing people's behavior, but in practice it still remains ambiguous on how the ethical side should be taken into account during the PSD process.

### **2.3. Value Sensitive Analysis**

One promising method for including the ethical side in PSD is to utilize Value Sensitive Analysis, VSA, as proposed by Friedman et al. [15]. Values are defined as what people consider important in life, with a focus on ethics and morality [14, 15]. In general, people are more satisfied with life when they can live according to their values, and this extends to using information systems; thus, the information systems should respect users' relevant values by incorporating them into the system. Incorporating values may also help to prevent negative consequences in technology use [32]. VSA is a technique to account for human values throughout the design process [15].

The VSA method is a theoretically grounded method for designing information technology in a value-oriented manner by taking into account both technological and socio-structural perspectives [14, 15], although it can also be used to analyze an existing system. The value is defined as something that a person or a group considers important in life [15]. The method consists of three investigations that are used iteratively: conceptual, empirical, and technical. The conceptual investigation includes identifying the relevant direct and indirect stakeholders and their values and determining how to handle competing values in the design, implementation, and use of information systems.

Since conceptual analysis has its limits, the second iteration involving an empirical investigation is often needed to evaluate the design in the human context. Observations, interviews, and surveys are examples of how this method can be utilized during the empirical investigation. The last investigation addresses the technological aspect. During this phase, the designers should focus on how the technology could support or hinder values. This investigation can be performed as either a retrospective analysis of an existing system or a proactive design to support the values identified in the first investigation.

Although the VSA method is not yet a fully rigorous method and has received criticism, it is considered a potential method for taking the stakeholders and their values into account in the technological development process [6, 7]. One topic of the critique towards VSA regards the idea, that certain values are universal, although the cultural differences may make them play out differently [15]. We believe that values should always be viewed in context. Even people in the same group may interpret and perceive the values differently; thus, the researchers have the responsibility to open the values and make sure they have been understood similarly among the stakeholders.

The VSA method has also been criticized for lack of a specific ethical theory. To overcome this shortcoming, we followed Yetim's [32] suggestion to include discourse ethics in the form of a boundary critique. Yetim [32] stated that the boundary questions developed by Ulrich [30] can help to define the boundaries of stakeholder analysis by helping designers to notice where to cut off the ever-broadening circles of involvement.

Ulrich [30] defined 12 questions for finding the boundaries or groups that should be involved by determining the source of the motivation, power, knowledge, and legitimation. These questions bring up issues relating to the purpose of the system and whose expertise to consult. The process of defining the boundaries should be iterative and show unresolved boundary issues whenever a conflict arises (e.g., between the measure of improvement and resources controlled by the decision maker). The questions are also intended to give a voice to those stakeholders who do not have power in the decision-making process but are affected by the system.

Another challenge to including the relevant values in the design is conflicting values. Human values do not exist in isolation [14, 15]. Values can conflict on different levels within an individual, among individuals or groups, or even among institutions, nations, and societies [15]. There is no clear way to handle the dilemma of conflicting values; however, according to Friedman et al. [14], the iterative approach of a values sensitive design method helps in dealing with the conflicts and in finding a suitable solution.

### **3. Methods**

Following the guidelines of Friedman et al. [15], we conducted VSA to holistically analyze the persuasive system use context in our case. The context analysis is one of the vital parts of persuasive system design process [25]. The artifact for which the analysis was conducted was a persuasive application to help micro-entrepreneurs recover from their work exertions. For now we are on the explorative stage on our research, thus we decided to limit the scope of this paper to the conceptual investigation to identify relevant direct and indirect stakeholders and their related values. The identification was done by the first and second authors. The first author is an expert in persuasive systems and the second possesses wide professional expertise regarding the domain of micro-entrepreneurship. We also examined existing scientific literature to ensure we recognized and addressed all relevant stakeholders.

The identification of the stakeholders and their values was done in two iterations. The first author (an expert in persuasive systems) and the second author (an expert in micro-entrepreneurship) identified relevant direct and indirect stakeholders and their values during brainstorming sessions, as was done by Rector et al. [27]. In the first session, we focused on identifying the relevant stakeholders. To guide the stakeholder identification, we followed the boundary questions by Ulrich [30] and the questions introduced in the VSA method. This produced a list of potential stakeholders and the justification why and how they were relevant.

After the first meeting, the first author further analyzed and categorized the identified stakeholders to categories. At the beginning of the second session, the two experts reviewed the analysis together to make sure they agreed with the results and understood them in the same manner. It was necessary to make sure that there was no misunderstanding due to differences in terminology since the experts' knowledge came from different fields.

The focus in the second meeting and the second iteration was to identify the values of the identified stakeholders. Most effort was put into identifying the micro-entrepreneurs' values because they were the central stakeholders. In addition, many benefits and harms to other stakeholders occur through the micro-entrepreneurs. The values were drawn from mostly from second author's broad expertise with microentrepreneurs. We went through examples identifying values common for many microentrepreneurs. The second meeting therefore provided a list of values, which the first author later analyzed and incorporated in the final list of relevant values. All authors were involved in the final evaluation of the identified stakeholders and values. At this stage, there were no microentrepreneurs involved with the investigation, except the third author having own experience as a microentrepreneur.

## 4. Analysis

### 4.1. Stakeholders Identified Using Value Sensitive Analysis

The stakeholder analysis produced numerous different direct and indirect stakeholders. Since the number of different stakeholders was quite high, we decided to group them according to their relationship to the direct stakeholders (i.e., the micro-entrepreneurs), as can be seen in Table 1.

Table 1. Identified stakeholders

Stakeholder Type	Stakeholders	Subgroups
<i>Direct stakeholders</i>	<i>The micro-entrepreneurs</i>	Personal, non-work-related groups
		Family members
		Friends
	The micro-enterprise's stakeholders	Employee(s)
		Customers
		Suppliers
		Cooperation partners
		Competitors
	<i>Indirect stakeholders</i>	Other stakeholders
Health care professionals, health care in general		
Lawmakers		
Research institutes		
Education providers		
Society		

As is common in persuasive systems, the main stakeholders were the main user group who benefit the most from the system by developing an improved ability to recover from work. Since the micro-entrepreneurs are a heterogenic group of people, we divided them into smaller groups based on various aspects such as the main reason for the stress (e.g., financial problems, time management issues), the number of people working in the company (e.g., only the entrepreneur, one to three employees, and more than three employees), and the different dimensions of affective well-being at work [17]. The differences in the causes of negativity in the micro-entrepreneurs' personal lives also affected the requirements for the persuasive system. As one solution does not resolve all of the micro-entrepreneurs' challenges in recovering from work, we needed to consider these differences as much as possible.

The conceptual stakeholder analysis also revealed numerous indirect stakeholders, which we divided into subgroups based on their relation to the micro-entrepreneurs. The first indirect stakeholder group included those with a personal, non-work-related relationship with the micro-entrepreneurs, such as family members and friends. These people are indirectly affected by the persuasive system, since they will witness the results of the micro-entrepreneur using the system. If the persuasive system is successful in improving the micro-entrepreneurs' abilities to recover from the exertions of their work, the micro-entrepreneurs will have more free time and their general well-being will improve. This improvement might also benefit the micro-entrepreneurs' relationships with their families and friends.

Another indirect stakeholder group comprises those who are quite close to the micro-entrepreneurs through their work such as their employee(s), customers, suppliers, competitors, and other cooperation partners such as bookkeepers or bank officials. Since there are numerous kinds of micro-enterprises, there are also numerous kinds of cooperation partners and customer relationships, and some of them are closer than others. For example, a hairdresser may have quite a close relationship with his/her regular customers, while an entrepreneur selling products only over the internet most likely has a much more distant relationship with their customers. Nevertheless, the well-being of the micro-entrepreneur greatly affects the company, and thus also the relationships with partners and other stakeholders of the company.

The last group of indirect stakeholders is miscellaneous, potentially affected parties such as business development agencies, which help start-ups and small companies to develop their businesses based on the needs of the company. The persuasive system under development may affect these agencies by, for example, giving them a tool to help micro-entrepreneurs. In the same way, the persuasive system can also affect health care professionals and health care in general. If the system turns out to be highly beneficial in helping micro-entrepreneurs recover from their work, it could benefit society as a whole and could influence lawmakers by showing real evidence of the successful means of helping micro-entrepreneurs and micro-enterprises.

#### **4.2. Values Identified Using Value Sensitive Analysis**

After the stakeholder identification, we identified stakeholders' relevant values (Table 2). Values are not isolated, but rather they relate to each other on different levels. For many entrepreneurs, the *freedom to make all the important decisions* regarding the company by *themselves* is highly valuable. The same freedom and control to decide when and how to use the application is an important factor that the designers need to consider when designing a persuasive system for micro-entrepreneurs. Furthermore, the use should be voluntary. If some party demands that micro-entrepreneurs use such a system, it may become merely another burden among other official obligations, no matter its effectiveness.

Micro-entrepreneurs typically have limited time resources due to their demanding work. For many, entrepreneurship is a lifestyle rather than just work, which leads to them having little, if any, free time. Thus, a persuasive application should not require too much time and effort from the user, either for learning to use the system or for using it, but the allow the user to use his time *effectively*. This is connected to the freedom: the user can choose when and how much to use the system. The time issue is also relevant when the system is effective, since the time spent with the persuasive system is time away not only from work but also from family and friends. Ideally, the user will learn to recover from work, and when the new skills become a habit, there will no longer be a need to use the persuasive system.

**Table 2.** Micro-entrepreneurs' values regarding a persuasive application that supports users recovering from work

Value	Description in the Context	Influence on PSD Process	Influence on Practical Use
Freedom to make own decisions	Freedom and liberty to make self-driven decisions	The persuasion should be designed to allow users to freely choose how and when to use the system	The system does not require being used regularly or at certain times of the day to have an effect
Effectiveness	Only having time for the very important things outside of work	Designing multiple goal options, from which a user can choose the most suitable one. It is also a possibility to skip the content the user does not feel important at the time	The system offers only important and relevant content. Practical results make a difference to the user's everyday life
Challenging oneself	A need for developing and challenging oneself	Clear behavior/attitude change goals	The application supports users to develop themselves
Achieve goals and see the results	The application should show the progress	Developing a suitable means for visualizing the progress regarding each goal	The system has a clear visualization of the development and results
Well-being	For being able to work and take care of the company among other important things in life	The goals of the system are related to (physical and mental) well-being	The system supports and aims to improve the users' well-being
Transparency	The persuasion should be open and never manipulative	The goal and developer(s) of the system needs to be revealed	The user knows who is behind the system and why it was developed

Since the entrepreneurs come from different fields and have different skills and needs, the system needs to be versatile. This versatility can be achieved by offering various goals from which the users can choose. Although all the goals relate to physical and mental well-being, the user has an option to choose a specific goal or goals. From a developer's viewpoint, the number of options has to be limited, beginning with the most needed goals. With future updates, more goals can be added.

A typical value among micro-entrepreneurs is *challenging oneself*. Being a successful entrepreneur demands gaining a plethora of knowledge on diverse topics and understanding customers and markets. Thus, entrepreneurs do not typically shun challenges. However, this does not mean that the persuasive system should be difficult or challenging to use; the system should enable the users to challenge themselves when learning different strategies to recover from their work exertions. Related to challenging oneself, micro-entrepreneurs also enjoy achieve goals and see the results of their work, whether it is about finishing a job or making visible progress. Because seeing the results may further motivate them to make a behavior change, the system should show the development as the user becomes better at recovering from work.

The competitiveness of the micro-entrepreneur's company relates highly to the *well-being* of the entrepreneur. This relationship is especially noticeable when there are no or only a few employees because if the entrepreneurs' wellbeing deteriorates, they may be unable to work or at least unable to give as much to the company as before. The well-being of micro-entrepreneurs also affects their close ones and societies in the long run. Thus, it is vital for micro-entrepreneurs to recover from their work and to take care of their overall health and well-being. As a value, well-being embodies other issues; for example, the system should not be too addictive because the benefits from the system could quickly become negative and decrease their well-being.

Trustworthiness is always important in persuasive systems, but especially in domains, where the goal of the system is related to users' health. A trustworthy system is potentially more persuasive than untrustworthy system [25] In this case, trustworthiness means that the information provided in the system needs to be kept up-to-date and should be based on evidence. The system should also help the users to recognize reasons why

they have a poor ability to recover. As mentioned earlier (see Section 4.1), micro-entrepreneurs are a heterogeneous group, and thus the reasons for their poor ability to recover will differ. If the system recommends incorrect behavior changes to help them to recover better from the effects of their work, the end result may be worse than the starting point. In addition, the persuasion should happen in a transparent manner, with no manipulative means. Users should be able to trust the system to support them in reaching their behavior goals.

In addition to the context-related values, the values that arise from the PSD model are also valid. Basic requirements for information systems in general, such as ease of use, usefulness, privacy, trustworthiness, and unobtrusiveness, are important regardless of the context [25], even though they did not explicitly come up during our investigation.

## **5. Discussion**

According to Oinas-Kukkonen and Harjumaa [25], a central facet in analyzing the actual persuasion event is to investigate the use context. The identified relevant stakeholders and their values help in understanding the contextual issues arising from the problem domain. The aim of our study was to investigate if and how VSA could benefit the use context analysis.

### **5.1. Implication for Research**

The PSD model offers a method for designing influential systems for behavior and attitude change. An important issue in persuasive system design is analyzing the problem domain and use context. However, as the model does not take a strong stance on how the analysis should be performed, there was a need to determine which method would be most beneficial for the analysis. We propose that combining VSA with Ulrich's boundary critique is useful for conducting a use context analysis. The VSA complements the PSD model and makes it stronger.

Combining VSA with Ulrich's boundary critique also answers the question related to the ethicalness of persuasive systems and provides a method for including the ethical aspects in the design process in a relatively robust manner. Although, the ethicality is easily taken for granted when designing such systems by trusting one's own moral standards, the proposed method forces at least some discussion related to the values during the design process. By including a broader set of relevant stakeholders with their values, the ethicality will likely increase. The broad set of values will create a need for the designers to ponder the possible conflicts and decide with the stakeholders which values are more important. Ideally, the designed system will be ethical at least from the stakeholders' viewpoint.

### **5.2. Implication for Practice**

When beginning to identify the relevant stakeholders and their values, one must be aware of one's own values and prejudices about the domain. For example, in our case, all authors unsurprisingly had some idea about micro-entrepreneurs and micro-entrepreneurship beforehand, but only the second author, being a professional expert in the field, held strong scientific knowledge. Because of the prejudice, the researchers and designers needed to be open to the experts' new knowledge and to that of the users during the empirical investigation and testing. The developers' values and prejudices could prevent them from noticing significant issues if they are unaware of their biases. For this reason, it is crucial to have at least one domain expert involved in the PSD, even though it will take a minimum of two iterations with the expert to create a comprehensive list of stakeholders and values.

In our case, the VSA revealed the stakeholders and, in particular, the values that would have easily gone unnoticed otherwise. The needs to challenge oneself and see the results are examples of influential values that should have an effect on the design. Voluntary use is a key value in persuasive systems in general, but it should be highlighted in the domain of micro-entrepreneurs. Overall, VSA is a beneficial method for gathering stakeholders and their relevant values with reasonable explanations for

both.

The stakeholder and value analysis also showed the importance of including a domain expert in the conceptual investigation. Although it might be enough to base the conceptual investigation on solely the literature review, as was done e.g. by Dahl and Holbø [3], the involvement of expert(s) is useful in multiple ways. First, experts have a deep knowledge regarding the problem domain. Their expertise has been built over the years or even decades, and they also usually have practical tacit knowledge, which is difficult and time-consuming to obtain from the literature. An expert consultation may also shorten the time needed to conduct the stakeholder and value analysis, depending on the contextual issues. In some cases, there might be a need to include experts from different domains, since the problem the persuasive system is intended to help with may be multiform. In our problem domain, there was a need for health expertise, specifically expertise in recovering from work-related stress. However, even with the expert, the results (identified stakeholders and values) needed to be confirmed by the literature and later by the users.

The conceptual investigation gives a good groundwork for developing prototypes to test with users during the empirical investigation. The identified values guide the designers in choosing persuasive software features, which are potentially the most effective and valuable in that domain. However, some values are easier to turn into software features than others. For instance, in our case, the visualization of results will require measuring the user's performance. From the PSD model, the self-monitoring feature seems to fit well with this value. Still, because self-monitoring—as with any persuasive software feature—can be designed in numerous ways, the implementation needs to be tested with real users to find the effective form of the domain.

The stakeholder analysis often reveals numerous affected groups. Special attention should therefore be given to finding subgroups from the main target user group. Regardless of the problem domain, the main user group is going to be at least somewhat heterogeneous. Thus, when designing persuasive systems, there is a need to understand the differences regarding the behavior change goal and user context. Even though the overall behavior change goal is the same, different users have different needs, which may affect the ways and extent to which the persuasive system should support and guide the users in their behavior change. If the system uses incorrect persuasive methods, the consequences may be negative and even severe. In our case, we concluded that the categorization should be done in multiple different ways to help identify as many diverse values as possible. If the categorization of the micro-entrepreneurs was done in only one way, some of the important values and stakeholders might have gone unnoticed.

Conflicting values are a challenge in value sensitive analysis. Our case was no exception. Some of the values are already challenging as they are. However, the challenge often has to do with limitations, and the solution will most likely be discovered during the empirical investigation. For example, the value of challenging oneself as a persuasive method is problematic since we had to find a balance between making the system challenging and interesting enough for the users, but not to the extent where the system caused more stress than support for the users learning how to recover from the stress of work. Additionally, a problem that concerns all persuasive systems is to try to make the system attractive enough to get users to use it regularly, but not too addictive that it makes them e.g. spend too much time using it. The value of diversity is also problematic in the sense that it is impossible to include all differences between the user groups. Many decisions have to be made to cover only the essential differences.

## 6. Conclusion

As the PSD model does not dictate how the persuasion event's use context should be analyzed, the objective of our study was to investigate how VSA could benefit the context analysis and increase the ethicality by mitigating the unintended negative consequences. VSA provided a list of relevant direct and indirect stakeholders and their values, which can be useful for designing a persuasive system. While challenges still exist in terms of how to turn the values into software features, the found values remain a

strong starting point in that task. Overall, we can state that VSA is a valuable method for analyzing the use context when designing persuasive systems using the PSD model.

Utilizing such value sensitive method can also reveal some of the designers' own values, which will most probably affect to the design. The VSA forces the designers to inspect and justify the values going to be implemented in the system. However, it demands robust and truly honest process to come aware of all the values, both the stakeholders' and the designers'.

Of course, this study has also some limitations. The analysis was carried out by experts from the persuasive systems field and the micro-entrepreneur field. Future studies should involve also an expert or experts from the health field to benefit the design of the persuasive system with additional insight into recovery methods and signs of stress. Naturally, to validate the results they should be applied in actual systems development efforts and be tested with real users.

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