About the Persuasion Context for BCSSs: Analyzing the Contextual Factors

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Abstract. Accumulation of contextual data offers new opportunities to improve the preventative health and wellbeing interventions. In this paper, we discuss the importance of understanding the context elements of Behavior Change Support Systems (BCSSs) and present an Event model illustrating the Use, User and Technology Context factors of the Persuasion Context. The model is a conceptual tool for identifying potential meaningful context factors and serves as basis for future research activities.

Keywords: behavior change support systems, persuasive technology, persuasive systems design, context modeling

1 Introduction

Personalized technology interventions have been listed among the top research questions related to big data in computer science and information systems [1]. While personalization possibilities give rise to numerous commercial applications, it is somewhat unclear how actual personalization is implemented and which pieces of information are actually useful. In addition, more emphasis should be given for creating value for individual end-users, the ones actually creating the mass of information. A very potential carrier for preventative health and wellbeing services is persuasive technology [2]: a research field that studies how people are persuaded while interacting with computer technology. While big data provides possibilities for both prediction and explanation, persuasive systems will take that information into action.

Operationalization of the information provided by big data depends on understanding context and improving persuasive (or information) systems' awareness and access to contextual data – which, in turn, increases the richness of communication [3] and can be a predictor to overall adherence. In terms of persuasive systems, Oinas-Kukkonen and Harjumaa's [4] persuasive systems design (PSD) model, which is a framework for developing and evaluating persuasive systems, states that the development process for persuasive systems is multi-phased. The PSD model consists of: 1) seven underlying

postulates defining basic principles of successful persuasive systems, 2) the persuasion context analysis which defines the desired behavior or attitude change type, studies the persuasion event and the effectiveness of different strategies to achieve the desired outcome, and 3) the actual design of systems qualities with four (primary, human-computer dialogue, credibility, social) support categories to be designed, evaluated or implemented at the feature level.

In this paper, the persuasion context analysis of PSD model is deepened by studying contextual factors of the persuasion Event. The following sections of the paper provide a review of literature on contextual information, an outline of the Event context model and discussion of the model and its implications.

2 Background

2.1 Persuasion context in PSD model

In this section we focus on the second phase of the PSD model [4], the Persuasion Context. The Persuasion Context phase is crucial for understanding the user, use case, application domain and technological environment of the system. Context analysis refers to the overall persuasion situation, and involves the study and identification of contextually relevant elements in a user's life situation in order to deliver successful support systems for behavior change. It is divided into three categories, namely Use Context, User Context and Technology Context [4]. *Use Context* covers the factors that arise from the problem domain i.e. the specific features of the application area in question, and also factors of situational relevance. The *User Context* focuses on factors, which create individual differences and may therefore influence the effectiveness of the system. These include, for example, goals, interests, motivations, attitudes, and all kinds of situational and personality elements. *Technology Context* refers to factors which stem from the technological features of the system, such as selected platform type, available devices and application software [4]. All these elements have both their strengths and weaknesses and in accordance with all other context factors they create the overall persuasion context of the system.

Regardless of its crucial nature, Persuasion Context is often not taken properly into account in scientific literature describing persuasive designs [5], mainly because of insufficient system descriptions. The PSD model has also been criticized for being too general and not providing explicit guidance for practical design work [6, 7]. One of the previous works contributing to the Persuasion Context knowledge created a 3D model for analyzing the system users' relation to target change [8] and later the same model was applied to the analysis of Persuasion Context in the PSD model [6]. Another Persuasion Context contribution comes from the field of Green IS [7], where behavior change in organizational settings was studied. The results confirm that the selection of design principles is dependent on the contextual factors of the organizations and the application domain and urge that information systems should be studied in their actual

contexts. Additionally, one of the two core principles identified in the study, tailoring, is inherently rooted to understanding of user groups [7].

2.2 Context modeling

Context itself is such a multidimensional and wide concept that unambiguous definitions are infeasible; instead of trying to grasp the whole entity, it is more practical to find a proper viewpoint and construct the definitions accordingly. While the significance of context has been identified also in information systems research, lately its role in theorizing is also becoming more prominent [9]; most of the work in the field is focused on organizational level and deal with business applications. Therefore the present study draws from the multidisciplinary field of human-computer interaction (HCI) and also from the engineering field of contextual computing. The most common definition of context is by Dey [3] who stated:

> *"Context is any information that can be used to characterise the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves."*

The definition is operational by nature and aims to gather factors which help designing context-aware applications. This definition was further extended in Zimmermann et al. [10] to include both formal (categories of context information) and operational (the use of context) definitions. In the field on mobile HCI, Jumisko-Pyykkö and Vainio [11] presented a descriptive model for context of use. The model is based on a broad literature review and contains five contextual components: physical, temporal, task, social and technical-information components. Also some additional properties and level of magnitude, dynamism, pattern and typical combinations are visible in the model. Despite the dynamic nature of the model, the initial literature review of the study reports that context of use is seen as being rather static. Yet mobile contexts are inherently dynamic and heterogeneous and consist of transitions from one context to another [11]. Thanks to recent development of sensor technologies, true contextual awareness is becoming more sensible target for mobile applications.

The challenge for this paper, however, is more practical: how to separate the essential context factors from everything else that is present in our everyday life. This same question was addressed in a longitudinal study of mobile internet [12]. The study developed a conceptual framework for contextual elements which likely influence human behavior when using the service. In addition to a very practice-oriented context model, the study revealed that the services were actually used in a very limited set of contexts despite the ubiquitous availability of the mobile internet. Some context factors also had different effects on utilitarian vs. hedonic and active vs. passive services, giving clear implications that identifying the key context factors for each service might be enough for delivering specialized (tailored or personalized) services. Context also plays a crucial role in the value customers perceive in services, especially in mobile services [13]. The conditional value of the service is created, when contextual elements interacting with the service user and the service enhance the service's value in-use. The study found four contextual elements (time, location, lack of alternatives, and uncertain conditions)

which act as filters for the service value offered by the service provider; depending on the context, the user either perceives those values or not [13]. While this study is from the economics field, it highlights an important issue also for the BCSSs field: the system needs to fit to the use and user context in order to deliver the intended service.

2.3 Context in user experience

In the field of user experience (UX), the role of context in constructing the subjective experiences of the users is acknowledged. In their well-known definition of user experience, Hassenzahl and Tractinsky [14, p.95] specify context as one of the three parts of UX:

> *"UX is about technology that fulfils more than just instrumental needs in a way that acknowledges its use as a subjective, situated, complex and dynamic encounter. UX is a consequence of a user's internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g. complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g. organisational/social setting, meaningfulness of the activity, voluntariness of use, etc.)"*

In the context of BCSSs the target is more than just good user experience, but also to change behavior with support of the system. It is acknowledged that design is an influential factor and even though there is increased knowledge on effective mechanisms, this area lacks the detailed understanding of contextual factors. In fact, it is argued that persuasive strategies are means which could be applied to basically any "end", referring to the application domains [15]. Also design patterns contribute [16] to the vision that persuasive strategies are not context-dependent and are therefore posing an interesting challenge to context sensitive literature. Regarding user experience, BCSSs have a very specific goal: the achievement of intended user experience by influencing the users [17] and ensuring the experience is meaningful.

3 Modeling the Persuasion Event

In this paper, the focus is on deepening the understanding of Persuasion Event of the PSD model [3], namely the elements of Use Context, User Context and Technology Context. In broad sense this means understanding the user of the system, both situational factors and more enduring issues of their life situation as well as the technology platform supporting the system. The PSD model itself is generic and applicable to both evaluation and design of the BCSSs, and likewise the proposed Event model aims at both evaluating and studying the existing system and guiding the design of future systems. In the long run, understanding the users in their real Use Contexts will aid the designing of new systems. For now, it is constructed for identifying meaningful contextual factors. It is a conceptual tool that helps identify potential concrete elements in

the everyday lives of end-users and should not be considered as a new context modelling theory.

Regardless of the viewpoint, most of the contextual factors have both situational and more enduring effects. While both types of factors are important and necessary for adaptive and well-tailored systems, it is relatively difficult to determine which type would dominate in any given persuasion situation. Therefore the original categories of the Event are divided into situational and more long-lasting factors: Use Context refers to situational factors and User Context to elements, which relate to individual differences of the user. Technology Context is kept as separate category but it mainly assess sustainable elements of selected technology (Figure 1).

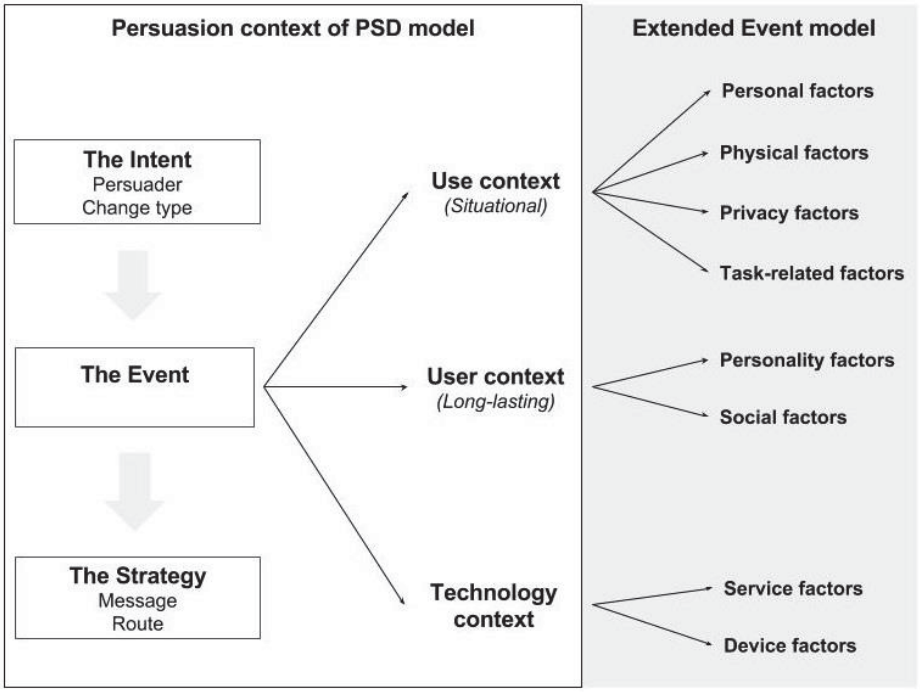

Fig. 1. Persuasion context of the PSD model with extended Use, User and Technology context elements of the Event.

In addition to the PSD model, the Event model is strongly influenced by Lee et al. [11], who studied the use of mobile services in a longitudinal research setting. The study focuses on real-life situations and identifies ten sources of situational variation in the use contexts. They suggest two main categories: personal and environmental. Environmental factors are further divided into physical and social factors. Personal and physical factors are integrated also into the Event model. Examples of personal factors include emotions evoked in the use situations and subjective nature of time; physical factors refer to, for example, a location element. Social context of Lee et al. [11] is re-defined

as privacy factors, concerning the private or public nature of use situations and the level of interaction with other people around. Additionally, the situational Use Context has the task-related factors category, which refers to characteristics of user tasks. Overall, the situational factors are selected based on their measurability in end-user surveys: some additional factors could be introduced to the model should automatic sensing parameters be accessible (for example in a field study where tracking with sensors is utilized).

The User Context in the PSD model focuses on user-dependent issues, such as needs, goals, motivation, abilities, and attitudes, taking a more holistic approach to the life situation of the user. The same applies to Event model, but the nature of factors is long-lasting, e.g. mood is not part of User Context, but it is grouped as situational factors and is therefore part of Use Context. The main difference between the Use and User Contexts is therefore how time-sensitive the factors are. The User Context is divided into personality and social factors, which aim to group this challenging mix of features into smaller entities. Social factors are predominantly social elements such as social influence and subjective norm and personality covers factors like attitude, persuadability, goal-directedness and habits.

The significance of User Context is observable in the interplay between the other Event contexts: the User Context is in a key position when considering tailoring a persuasive system so that it can best serve each individual user. Tailoring, in turn, is a way of leveling Use Context and Technology Context so that these remain more predictable at least to some degree. Various psychological processes are included in the processing of persuasive messages, and tailoring the persuasive messages to an individual user increases the opportunity of gaining a positive outcome [18].

The Technology Context deals with the features of the selected technology and technological aspects of the service. All levels of inquiry are encouraged, such as the platform of choice, the application features, and the specific implementation details, in order to assess both the strengths and weaknesses of the Technology Context. This group aims to cover elements, which have enduring, general level impact on the service, while situational elements are handled in Use Context, in the task-related factors section.

4 Conclusion and discussion

The presented Event model is built on the PSD model and has the intention of serving as an evaluation and design tool. The ultimate goal of the model might be that some links from context factors to end-user groups, application domains or some other factors could be identified and those could be used as design guidelines for future systems. This would further contribute to our understanding of persuasive mechanisms. In the meantime, the model is first validated with empirical methods, to verify the factors and basic items for each factor and later used as research model for analyzing the relevance of different BCSS features.

Compared to conceptual model of Lee et al., [11], this model has both situational and more enduring aspects of the context. Behavior change process takes time so it will not be feasible to focus only on situational factors. On the other hand, situational factors

contribute to the overall user experience of the service or application and therefore cannot be overlooked either. As the model is primarily developed for health BCSSs, this might limit its application and is therefore a limitation of our study. Also the practical nature of the model might decrease its applicability.

When studying these different types of contextual elements, one should keep in mind that there might be elements that override all other elements in some or most situations. This dominant or recessive nature of context elements might be the key for identifying, if not the most opportune moments for persuasion, at least avoiding some of the worst ones. The interplay between "situational and dispositional variables" [19] and effect of situational factors on goal prioritization [20] also pose interesting viewpoints for evaluating and developing new BCSSs. Goal-setting considerations are another interesting aspect for context modelling: behavior change applications typically have both short and long-term goals and both should be supported by the design. If the service fails to support the user in difficult moments which require situationally sensitive functions, the overall long-term goal support might soon become useless.

The context also plays a crucial role in habit formation. Stable context functions as trigger to habitual actions and according to some studies [21], strong habits can also outweigh goals. Understanding the contextual elements triggering the habit might enable us to find tailored or even personalized solutions which attack the key habit trigger by creating new context cues to suppress it.

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