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# BCSS Study: Case Soothing Sleep

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**Abstract**

We present our on-going research for developing a Behavior Change Support System (BCSS) for sleep deprivation. In this paper, we describe the design of the Soothing Sleep system that is developed by using socio-psychological theories and the Persuasive System Design model. A brief description of the conceptual BCSS is presented followed by summarized report of the trial study. Our work presents implications for e-health, wellbeing and HCI.

**Author Keywords**

Behavior Change Support Systems; PSD Model; Sleep Deprivation

**ACM Classification Keywords**

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

**Introduction**

Persuasive systems are designed to bring a positive and desirable change in users' attitudes and/or behaviors. Social web technologies and native mobile applications have created opportunities for developing novel information systems that could bring a appropriate change in users' attitudes and/or behaviors, in particular fostering healthier lifestyles [1].

## **Behavior Change Support Systems**

**Definition of BCSSs:** "A socio-technical 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."

### **Intended change:**

Identifying what kind of change is intended i.e. there are three potential voluntary outcomes – formation, alteration or reinforcement of attitudes, behaviors or compliance.

**O/C Matrix:** It is a framework that can help designers to identify that change that they aim to bring in the users.

**Persuasive Potential:** The Persuasive Systems Design Model (Oinas-Kukkonen and Harjumaa, 2009) is proposed as a methodical tool to analyze the persuasive potential of BCSSs.

**Reference:** Oinas-Kukkonen (2012).

Adequate sleep supports people to achieve healthy lifestyles. Sleep-related issues such as insomnia are rigorously studied in medical sciences [2]; according to Alhola and Polo-Kantola [3], chronic sleep deprivation has a potential to adversely affect on an individual's cognitive abilities; as stated by Taheri et al. [4], chronic sleep disorders cause fatigue, weight loss and/or weight gain. Likewise, evidence from medicine and psychology indicates that insomnia is a contributory factor to depression and anxiety.

Building upon prevailing research for wellbeing and persuasive systems, Oinas-Kukkonen [1] put forward a novel concept of Behavior Change Support Systems (BCSSs). A BCSS is defined as, "A behavior change support system (BCSS) is a socio-technical 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" [1]. The ultimate aim of a BCSS is achieving three potential voluntary outcomes i.e. formation, alteration or reinforcement of attitudes, behaviors or compliance. In addition, Persuasive Systems Design Model (PSD) is proposed for designers and researchers for developing and evaluating behavior change support systems. The model is a state-of-the-art tool that was conceptualized by Oinas-Kukkonen and Harjumaa [5]. It is a comprehensive framework that promotes synthesis of persuasive software functionalities and features. The model outlines seven postulates and 28 software features divided in four distinct categories i.e. Primary task support, dialogue support, credibility support and social support. Primary task support features help users monitor and achieve their goals, dialogue support features augment human-computer interaction, credibility and social support

features address issues relating to general perceived credibility of the information and highlight the prominence of social interaction among users of a behavior change support system.

According to [1], behavior change support systems are transformative, and deliberately designed to bring rational change in the users. Designing BCSSs is a complicated task. Not only it covers user interface issues, it requires detailed understanding of human-computer interaction, computer-mediated communication and incorporation of socio-psychological theories. Ideally, behavior change support systems should be accessible 24/7, be unobtrusive and assist users in achieving desired goals incrementally. A quick overview of the history of information systems in health and well-being arena shows that digital interventions were traditionally used in preventive medicine. More recently, persuasive systems were developed as stand-alone applications aiming to tackle diverse range of behavior/attitude change issues. BCSSs, on the contrary, are conceptual platforms that would provide users with extensive support through enhanced computer-human interaction, facilitate social interaction, empower users, improve task adherence and be scalable. BCSSs bring new elements into play for researchers, such as in-depth analyses and application of persuasive software features (tailoring, reminders, feedback, virtual rewards, social influence, etc.), persuasive strategies such as direct and/or indirect routes and it emphasizes the significance of use and user context.

## Soothing Sleep Interaction

**Registration Process:** Users record their personal details including sleep habits.

**Completing the Scenarios:** Users read the scenarios and subsequently respond to the questions prompted by the system.

**Self-monitoring:** A progress bar represents completed, skipped/missed and to-be-completed scenarios.

**Dialogue Support features:** Praise and reminders are incorporated to augment user-system dialogue.

**Social Learning:** Users can opt to share their progress with fellow users. This is analogous to recognition and provides means to know how other users/fellows are performing.

**Rehearsal:** A persuasive software feature that provides means to rehearse a behavior.

## The Soothing Sleep System

We designed a web-based persuasive system, Soothing Sleep, which we anticipate would help people improve sleep behaviors. The system in its current form draws functionalities from the PSD Model. At present, the system is incorporated with certain persuasive software features i.e. reduction, tunneling, self-monitoring, indirect reminders, social comparison and rehearsal. In future, the system can be augmented to a well-developed Behavior Change Support System. We acknowledge that our research is a challenging task nevertheless the emergent focus in research community to tackle sleep deprivation inspires us.

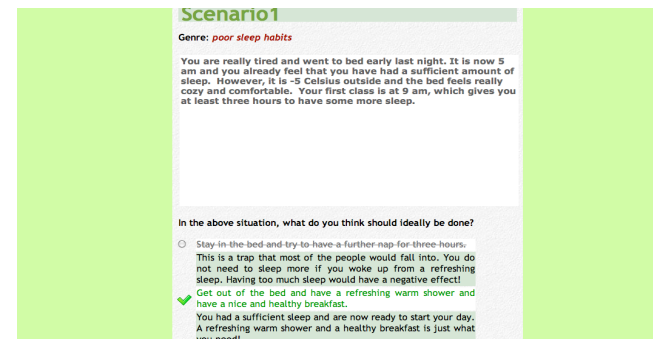
The Soothing Sleep system is designed to support people to improve poor sleep habits primarily through virtual rehearsal. To our knowledge, virtual rehearsal has not been implemented in information systems research to tackle sleep complaints. Users of the Soothing Sleep system will have an opportunity to rehearse and learn healthy sleep behaviors. We expect that virtual rehearsal supplemented with reminders, feedback and self-monitoring will help users gain confidence and self-efficacy. According to the PSD model it is fundamental to understand the problem domain while designing persuasive information systems. Further, the context has to be examined followed by a comprehension of the intent, event and the design strategies as proposed by [5]. The Soothing Sleep system involves with the following stages of interaction for the users:

- ✚ Registration Process
- ✚ Completing the Scenarios
- ✚ Self-monitoring

- ✚ Dialogue Support Features
- ✚ Social Learning
- ✚ Rehearsal



**Figure 1:** Self-monitoring and reminders for scenario completion.



**Figure 2:** Completed scenario with feedback.

### **Trial Study: Research Setting and Evaluation**

The goal of the trial was to examine persuasive functionalities of the system. In all, eight (N=8) users were involved in the trial process where four were computer science researchers and the remaining were graduate students from the University of Oulu, Finland. All the eight participants were recruited through emails and a brief description of the system was given. The evaluation process was carefully subdivided into four main steps as briefly mentioned below.

#### **Scenario Completion**

Participants were required to perform tasks in accordance with predefined scenario completion package, i.e. one scenario per day for seven days of the trial. All the participants were advised to note down their observations relating to the design and functionalities of the system. They were also advised to evaluate the impact of persuasive software features on potential change in their behavior and the effectiveness of rehearsal feature. Upon completion of each scenario, participants were presented with a short online structured questionnaire mainly aiming at the perceived usefulness of the system.

#### **Semi-Structured Survey**

Upon completion of the trial, a semi-structured questionnaire was distributed among the participants (with seven closed and one open question) to obtain feedback regarding usability, UI design and persuasive features. The closed/structured questions were designed to obtain information about UI, engagement, ease of use, influence of rehearsal, self-monitoring and

goal-setting persuasive features. Seven statements using Likert Scale with a range from "Strongly agree" to "Strongly disagree" followed each question. Finally, the participants were provided an opportunity to give feedback and remarks about their experiences with the system through an open text field.

#### **Expert Evaluation**

The researchers performed expert evaluation (where one or more specialists evaluate a system against a defined list of design principles). It is similar to heuristic evaluation that is commonly applied in usability engineering with an aim to identify usability issues/problems and testing interactive information systems [6]. The PSD model was used while the artifact was evaluated since the model provides a framework for designing as well as evaluating persuasive systems.

### **Results and Discussion**

The aim of this study was to evaluate the Soothing Sleep system before launching a pilot study. We adopted a mixed approach to evaluate various design and usability aspects of the system including real user interaction as well as expert evaluations. Participants provided valuable feedback both in terms of design improvements and theoretical settings for the pilot study. For instance, while the participants identified goal setting but it was suggested that the users should have an option to set their own goals.

Given the small data size, we opted to calculate the central tendency of each response. For this purpose, we measured the median to establish the middle score of the data set. The reasons for selecting

median at this point of the research, where we had predefined continuous data set on a scale of 1-7, therefore using other measures such as modes would not provide appropriate results and median is an appropriate measure [7] for ordinal data set.

The results from the *expert evaluations* focused on the intent, the event and persuasion strategy. It was concluded that the intent of the system developer was clearly specified. The event relates to understanding the user, the technology and the use situation context. In the expert evaluation, it was agreed that the system was aimed for individuals with sleep problems. According to the PSD model, the message and route formulate the persuasion strategy. While content focuses on augmented information, route highlights the significance of the medium through which a persuasive message is delivered. Evaluators agreed that there was a fairly compact presentation of persuasive message. Generally, it was agreed that the system (persuader) used direct route for persuading users i.e. attempting to convince users through reason and logic.

All the participants of the *focus group* generally approved the system. With the limited number of participants and given the short period of the trial, strong statistical analysis could not be performed. Nevertheless, gathered data provides valuable propositions to augment the system.

## **Conclusion and Future Research**

This paper describes design and evaluation of an information system that was built upon the PSD Model and theories of Goal-setting and Social Identity were incorporated in the design process. The system was devised in a way that it supported users to overcome unhealthy sleep habits mainly through rehearsal with additional features such as self-monitoring. We are encouraged by the findings thus far and will continue our research. Research into health BCSSs is gaining momentum and has reported positive outcomes. We plan to carry out a longer pilot study in a controlled setting, and then to extend our work in a way that the Soothing Sleep system could be developed into a fully functional BCSS. We also aim to refine the system based on users' feedback and with psychological experts to conduct a longitudinal study.

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