Designing, Modeling and Evaluating Influence Strategies for Behavior Change Support Systems

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Abstract. Behavior change support systems (BCSS) research is an evolving area. While the systems have been demonstrated to work to the effect, there is still a lot of work to be done to better understand the influence mechanisms of behavior change, and work out their influence on the systems architecture. The papers of the second BCSS workshop aim at filling this gap. They test existing influence strategies and suggest new ones, develop evaluation methods of influence strategies, and introduce systems architectures that support novel influence strategies.

1   Introduction

An emphasis of research in Behavior Change Support Systems or BCSS (Oinas-Kukkonen 2010a, 2010b, 2013) is that technology, information, and people involved in behavior change interventions shouldn't be studied in isolation. The three components of a BCSS combine into an entity that should be studied as a whole to produce meaningful insight as the interaction of the components is the gist of the behavior change support phenomenon. This also implies that should one component change, the others will have to adjust. We are currently living through such a major re-adjustment: Ongoing technological advances and fundamental recent changes in the scientific picture of man, his motivations, and behavior control mechanisms, call for continuing adjustments in the theory behind and application of behavior change support systems.

Technological advances that reduce the size of information and communication technology (ICT) and make it globally interconnected both challenge and open up opportunities for researchers of behavior change support systems. ICT is becoming increasingly ubiquitous and embedded in objects of the everyday life, contributing towards humanizing those technologies (Oinas-Kukkonen & Oinas-Kukkonen 2013). We can carry ICT with us and can even wear it. Mobile services, in particular, are designed to be consumed instantly, anytime, and anywhere (Chae and Kim 2003). Technology is also becoming increasingly aware of the context of its use (see e.g. Wang, Huang et al. 2011), which opens up unprecedented opportunities to identify opportune situations to help people change their adverse behaviors or maintain desired behaviors. In particular,

mobile technologies can, increasingly, connect to personal devices monitoring the individual's physical states. Hence, it is not surprising that there is a growing interest in applying behavior change support systems for a variety of interventions. This also means that there is growing demand for academic knowledge instructing how to apply high-tech instruments for behavior changing interventions ranging from health and security to climate change, and more.

Effective persuasion is based on deep understanding of *human information processing*, and that understanding is currently undergoing profound changes. Recent research in cognitive psychology suggests that automatic and largely autonomous processes that interpret and select information play a leading role in most behaviors: Perception, evaluation, and even choice have non-conscious roots (for a recent review, see e.g. Custers and Aarts 2010). Interestingly, this means that consciousness plays perhaps a relatively minor role in controlling behaviors. These insights promote a shift in application of persuasive strategy: In persuasive systems design more attention should thus be given to support more directly behavior change rather than only attempting to influence a person's beliefs, attitudes, and intentions. Relative importance of information content in persuasion is in the decline while more direct influences to behavior are in the rise. Development of new influence strategies is badly needed. Both the theory and practice of identifying and assessing the effectiveness of persuasion and behavior change is in need of re-development to make them embrace the emerging view of human information processing: In particular, measurement techniques and instruments that rely less on personal judgment of persuasiveness are needed.

The aforementioned trends put increasing pressure on BCSS researchers. Growing need for behavior change support systems means that the researchers should start consolidating their research efforts to be able to offer easy to apply instructions to their growing audience with limited background in BCSS. To meet the demand, several theoretical areas should be targeted. First, the recent developments in relevant consumer technologies (i.e. ICT, personal health technology) and in cognitive psychology should be better integrated in the BCSS paradigm in the form of strategies of influence. Second, BCSS design methods and tools should be advanced to a level at which BCSS people with limited background in the field could apply the BCSS paradigm in designing effective behavior change support systems. Finally, evaluation tools for the BCS systems need to be validated to ensure the performance of the systems in real-life applications.

2   Advances in BCSS research

The papers of the BCSS2014 workshop address three timely issues in design and development of effective behavior change support systems: identification of effective influence strategies of BCSS, evaluation methods for BCSSs, and new tools to define and construct BCSS architectures. We will next highlight, in brief, the key ideas behind the papers included to the Proceedings of the workshop.

2.1   Evaluation of BCSS

In their paper, de Jong and associates (2014) evaluate constructs developed for measuring perceived persuasiveness in technology. They find that, in general, the different measures line up with the data obtained with Perceived Persuasiveness Questionnaire (PPQ). However, the relationship between perceived persuasiveness (cf. Oinas-Kukkonen 2010b) and actual use rates of the persuasive technology, obtained by analyzing log-data, appears to be much more problematic. In sum, the authors conclude that their analysis demonstrate that the PSD model (Oinas-Kukkonen and Harjumaa 2009) generates consistent results, when measured using different methods.

Caon and co-authors (2014) describe at conceptual level the Virtual Individual Model that will be integrated to the PEGASO system through an ontology-based virtualization. The aim of the project is to develop a system that is sensitive to characteristics of the individual and the interaction context and capable of using this information to dynamically select opportune tailored interventions. The PEGASO model is integrated to the system through an ontology-based virtualization.

Rao (2014) reports about her work on developing evaluation tools to assist the design of persuasive game systems. The paper argues for applying persuasive design principles to games design when behavior change is the fundamental end of the game. The paper suggests that it is important to include gamification in a discussion about persuasion through games, because persuasive strategies play a central part in gamification design. Rao suggests that the Persuasive Systems Design (PSD) model (Oinas-Kukkonen and Harjumaa 2009) can be used in game design to identify specific characteristics of game systems that affect categories of persuasive structures such as credibility and personal involvement.

2.2   Influence Strategies of BCSS

Unal and colleagues (2014) examine users' compliance to persuasive messages in mobile application recommendation domain and explore how persuadability of users affects their compliance. The authors motivate their research by noting that the rapid growth in mobile application market means a significant challenge to find interesting and relevant applications for users. They find that subtle methods of persuasion are more effective than obvious persuasive messages at creating compliance. Also, persuadability is an important determinant on individual's compliance to recommendations.

Orji (2014) explores gender effects on the strategies for persuasiveness of BCSSs. They identify that there is a need to adapt persuasive approaches to various user characteristics and go on to test if gender is among the characteristics that should be taken into account when designing individualized persuasive strategies. The author concludes that gender-dependent approaches would generally be more appropriate for designing BCSSs that will effectively promote health behavior changes than the one-size fits all approach.

Gkika and Lekakos (2014) test whether certain persuasive strategies, especially in the form of recommendation explanations, can affect user's adoption of recommendations. The authors argue that explanation is an important aspect of

recommendation that may make targeted people more open to accept a recommendation. They find that an individual's intention to consume a recommendation good is increased if the item is accompanied with a persuasive explanation.

2.3   BCSS Design

Alahäivälä and his co-authors (2014) aim at breaking out the black-box thinking in persuasive systems design. They present a software design pattern for giving rewards as a way of persuasive human-computer dialogue in BCSS. They argue that by developing software architectures and software design patterns, BCSS research can be enhanced from proof-of-concepts to concrete software development guidelines. The paper provides BCSS research with an intricate implementation level view of the software development aspects of BCSSs.

Wartena and company (2014) discuss the issue of bridging the healthcare and designer point of views to intervention. They argue that social systems development around the BCSS would benefit from better understanding of the interaction between the user, mediator, social system and the socio-technical system involved. They present a game-architecture inspired design approach for BCSSs, and go on to demonstrate the benefits in the design process of combining four archetypal modes of use: trigger, intervention, assessment, and participation.

Burrows and her colleagues (2014) discuss BCSS design in the domain of climate change and using social and digital media technologies to influence users to change their energy consumption behavior. They seek to understand how information about users may be utilized within the development of persuasive technologies and BCSSs. The authors identify how values, lifestyle aspects, and energy consumption behaviors may be modelled to BCSS to deliver relevant and personalized information and knowledge that can influence behavior change.

3   Discussion

All in all the outlook of the BCSS field is promising. Persuasive technology and behavior change support systems research are in the position of giving back to practitioners and other fields of academic inquiry rather than just consume ideas sourced from the important reference disciplines. To make this happen, though, the field will have to amalgamate the recent findings in cognitive and other psychology and the technological advancements in ICT in its existing body of knowledge on how to apply information systems to persuade people change their behaviors.

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