

# Prerequisites for Successful Measuring of Ambient Persuasive Technology

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## ABSTRACT

The area of ambient persuasive technology looks very promising in multiple ways. Yet, it also faces with challenges. Thus far the major weakness in research into ambient persuasive technology has been that the behavior change support systems have been described in such a coarse manner that it has been very difficult to demonstrate what actually caused the change, or to generalize the findings. This paper will discuss prerequisites for successful measuring of ambient persuasive technology. The O/C Matrix and the PSD Model are suggested as vehicles to better frame the research. These methodological research aids can be used in a variety of research and development settings ranging from studying full-fledged commercial systems to evaluating software specifications for systems under development.

## Author Keywords

Persuasive technology, behavior change support systems, behavioral outcomes, behavioral change.

## ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. Behavior change support systems.

## INTRODUCTION

Ambient persuasive technology [20] has become an important research area and a wide variety of applications have been developed embodying it [1,3,4,5,6,17,18,19,22]. The key construct and object of study within this research area is a Behavior Change Support System [12]:

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*A behavior change support system (BCSS) is an information system designed to form, alter or reinforce attitudes, behaviors or an act of complying without using deception, coercion or inducements. [12]*

BCSSs are inherently transformative, deliberately attempting to cause a cognitive and/or an emotional change in the mental state of a user to transform the user's current state into another planned state. Empirical BCSS research provides a unique opportunity for quantifying measures for system success. This requires explicitly stating the aim of the system, how the success was to be measured, and the extent to which the system succeeded in achieving this measure. It has to be explicitly defined what really takes place through the software system to be able to demonstrate to what extent an outcome change is really due to the system, or a feature or a set of features in it. For this reason, sound ways of defining the systems and their goals clearly are needed. Otherwise, it will be difficult or perhaps even impossible to demonstrate any results from the BCSS or to translate lessons learned from the results into related problem and application domains. [12]

This paper will suggest a research process model for studying ambient persuasive technologies and applications. Two important steps preceding the actual measurement of behavioral change are to utilize the O/C Matrix [12] and the PSD Model [9] to better grasp the intent, structure, functionality, and content of the software system under investigation.

## RESEARCH PROCESS MODEL

We suggest a five-step process model for carrying out research on behavior change support systems (Figure 1):

1. Select the theoretical basis for research [2,8].
2. Analyze the intent through the O/C Matrix [12].
3. Analyze the BCSS through the PSD model [9].
4. Measure the behavior change.
5. Explain the change through the theories, the O/C Matrix, and the PSD Model.

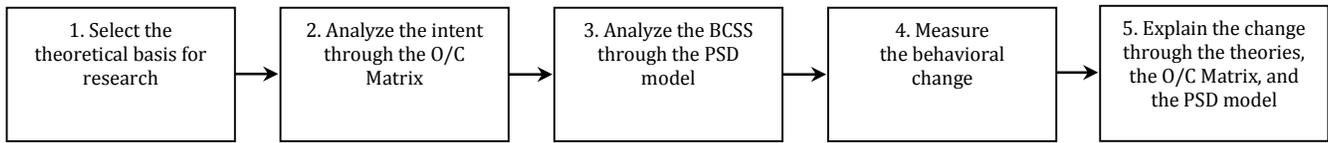


Figure 1. Experimental research model for BCSSs.

**ANALYZING THE INTENT THROUGH THE O/C MATRIX**

There are three types of behavioral changes, namely a change in an act of complying, a behavior change, or an attitude change, and these may be called respectively C-, B- and A-Change [12]. With a *C-Change*, the goal of the behavioral change is simply to make sure that the end-user complies with the requests of the system. The goal of systems supporting a *B-Change* is to elicit a more enduring change than simple compliance once or a few times. The goal of systems supporting an *A-Change* is to influence the end-users’ attitudes rather than behavior only.

Three potential, successful voluntary outcomes are the formation, alteration, or reinforcement of attitudes, behaviors or complying; these may be respectively called as F-Outcome, A-Outcome, and R-Outcome [12].

	<i>C-Change</i>	<i>B-Change</i>	<i>A-Change</i>
<i>F-Outcome</i>	Forming an act of complying (F/C)	Forming a behavior (F/B)	Forming an attitude (F/A)
<i>A-Outcome</i>	Altering an act of complying (A/C)	Altering a behavior (A/B)	Altering an attitude (A/A)
<i>R-Outcome</i>	Reinforcing an act of complying (R/C)	Reinforcing a behavior (R/B)	Reinforcing an attitude (R/A)

Table 1. O/C Matrix [12].

A matrix can be constructed from the intended outcomes and the types of change. See Table 1. When researching or developing a BCSS, it should be carefully considered which of these nine different goals the application is aimed at. The persuasion context may change dramatically when moving from one slot to another. Different persuasive goals and strategies will be needed for applications supporting different types of changes.

**ANALYZING THE BCSS THROUGH THE PSD MODEL**

The Persuasive Systems Design model [7,9], or more briefly the PSD, is the state of the art approach for researching and developing BCSSs. According to the PSD model, careful analysis of the persuasion context (the intent, event, and strategy of persuasion) is needed to discern opportune and/or inopportune moments for delivering the message(s). See Figure 2.

The PSD model also defines software characteristics for BCSSs and describes them under four categories, namely primary task support, computer-human dialogue support, perceived system credibility, and social influence. (Many design aspects in developing BCSSs are general software design issues rather than specific to BCSSs only.) The design principles of the primary task category focus on supporting the carrying out of the user’s primary activities. Design principles related to human-computer dialogue help move towards achieving the goal set for using the BCSS. The perceived system credibility design principles relate to how to design a system so that it is more believable and thereby more persuasive. The design principles in the social influence category describe how to design the system so that it motivates users by leveraging social influence.

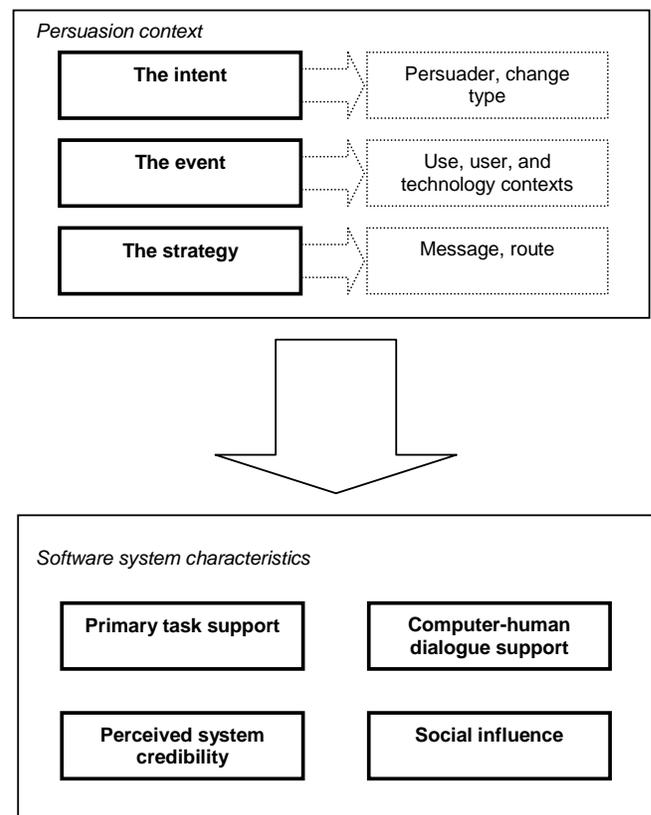


Figure 2. PSD model [9].

Examples of using the PSD as a part of evaluating the success of persuasive technology can be found in [3,4,5,16,19]. Many types of research on software system features have been conducted. The most researched features

have been tailoring, tunneling, reduction, and self-monitoring (representing the primary task category), suggestion (for supporting human-computer dialogue), surface credibility (in support of perceived system credibility), and social comparison, normative influence, and social learning (relating to social influence) [21].

### CHALLENGES IN MEASURING THE BEHAVIOR CHANGE

Essential research issues that relate to the ultimate question, i.e. how to measure the change, include: How to measure C-, B- and A-Changes? What are the similarities and differences in measuring C-, B- and A-Changes? What are the connections between the different kinds of changes? How do the BCSSs developed for C-, B- and A-Changes differ from each other? Similar questions regarding measuring, connections and differences naturally should be tackled also regarding the F-, A- and R-Outcomes. Moreover, it should be understood how the experiments can be conducted in such a manner that it will be really possible to pinpoint a change to have been caused by a BCSS, or even more precisely, by a specific software feature in it. An additional important research issue relates to the changes that take place in user's goals or in the technological platform which the BCSS has been built upon in between starting and ending the measurement.

### CONCLUSIONS AND DISCUSSION

In current research, there seems to be a tendency of describing the software systems and the persuasion context at too general a level. Black-box thinking of the software systems with no actual description of what was implemented and how may make the research results obsolete.

When describing a persuasive system, a very clear description of not only the application but also the technology context is needed. After all, in many cases much of the success or failure of an application can be attributed to the fluent navigation and smooth interaction arising from the technological infrastructure rather than to the design of the system. The O/C Matrix and the PSD Model may help in doing this more effectively.

In the future, designer bias and ethical issues will need more attention. Also the needs of underprivileged users such as the elderly and the children should be better addressed [10,11].

Even if many research efforts have already been conducted on behavior change support systems, we are still in early steps of research into measuring their outcomes and understanding how they relate to social media systems [13] and new forms of science [14,15].

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