

# Practical Examples of Mobile and Social Apps using the Outcome/Change Design Matrix

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**Abstract.** Behavior Change Support Systems (BCSSs) have emerged as a promising research area to study behavior change, directing interest into the software artifact. This research paper aims to provide practical examples of mobile and social applications using the Outcome/Change (O/C) Design Matrix in developing and evaluating BCSSs and conducting systematic research on BCSSs.

**Keywords:** Behavior Change Support Systems, persuasive technology, Outcome/Change Design Matrix, social influence

## 1 Introduction

Building upon the vital work of Fogg [1], Oinas-Kukkonen [2, 3] has underlined the significance of Behavior Change Support Systems (BCSSs) as an object of study within the field of persuasive technology. BCSSs vary from conventional persuasive systems because they are incorporated with additional software features including continuous accessibility and social support, unobtrusiveness, ease of use, and improved dialogue between the users and the system [3]. A typical persuasive system is, even if perhaps in simplified form, a stand-alone application used as a tool to detect a potential change in users' attitudes and/or behaviors. On the contrary, a BCSS is a comprehensive socio-technical platform that provides extended support using a combination of software features and psychological theories, it facilitates users by setting/altering their goals, provides stronger and meaningful user-system interaction and an option for social interaction with other users of the same system [3].

It should be noted that the purpose of the paper is not to distinguish persuasive systems from BCSSs as such. All BCSSs inherently have persuasive mechanisms. What makes a BCSS distinct is users' voluntariness and empowerment to set/change their objectives/target behaviors [3]. In addition, they can use the system according to their needs without being interrupted and with an option to share progress with fellow users. At any point of time, a user will be able to return to the system if a need arises. The persuasive software feature selection and implementation will need to be done attentively and rigorous iterations will be

required. Briefly speaking, to design an effective BCSS, vigilant understanding and anticipation is essential, i.e. what type of outcome and change the system is intended for; this has been signified as the Intent in the PSD Model [4].

The Outcome/Change (O/C) Design Matrix has the potential to benefit researchers in identifying varying design goals and persuasive strategies that are required for developing BCSSs with a specific focus on how to support A-Change, B-Change or C-Change (attitude change, behavior change, compliance, respectively). Surprisingly, there is little research about intended outcomes while developing and examining BCSSs. The descriptions of what the researchers and developers aim to change in users' behaviors and/or attitudes are either missing or loosely stated in most of the available literature [17]. There are several challenges that can be identified in the field of BCSSs. For example, a key task is to unequivocally identifying anticipated change in users. Hence the O/C Design Matrix is proposed to address this vital issue. Another challenge is to have a clear idea of the intended outcome for the users. The prevalent trend in research on behavior change is C-Change and/or B-Change [17], however it is attitudes that direct how people act in real life. Furthermore, there is room for more social influence features to be incorporated in BCSSs at present.

In this paper, we have highlighted some of the key challenges relating to the design and development of BCSSs. Further, we provide practical examples for the O/C Design Matrix [2, 3] as a valuable framework that can help designers and researchers of mobile and social applications to overcome the discussed challenges.

## 2 Background

System designers, health professionals and computer science researchers need to perform meticulous analyses when implementing persuasive software features, for instance, self-monitoring, reminders, virtual rewards, rehearsal, and social recognition, into BCSSs. A key dynamic of a BCSS is to thoughtfully plan and implement strategies that convey persuasive message/s to target users. As outlined by Oinas-Kukkonen and Harjumaa [4], it is critical that the designers appreciate the sensitivity of the Use Context and User Context. In simple words, Use Context tackles issues that relate to the objectives of the users in general, i.e. what do the users want to achieve by using the BCSS, whereas User Context underlines the ambitions, inspirations and routines of individual users. Understanding these dynamics will further qualify designers to develop effective BCSS platforms.

It is worth noting that the primary objective of a BCSS is not to expose temporary behavior change. On the contrary, it is a socio-technical platform augmented with persuasive software features that will support users to have an enduring interaction with the system thereby bringing in the element of stickiness and improving task adherence [3, see also 12]. Further, it effortlessly fits into users' everyday schedules [5, 6] with components that provide prolonged support during and after the behavior change process. Effective BCSSs will provide an opportunity to highlight potential changes in peoples' behaviors and/or attitudes in accordance with the intent of the system designers and behavior change researchers.

It is obvious that emerging technologies are being used to facilitate behavior and/or attitude change. Yet, limitations are also apparent in prevailing research [see e.g. discussions in 7, 8]. What are needed for the discipline of BCSSs are rigorous evaluation techniques [see e.g. 9]. It would be fairly hard to design a single comprehensive and unified framework for evaluating the success of BCSSs. Nevertheless, it is promising to see several methodologies in available literature, for instance Fogg [10] and Consolvo et al. [11]. We propose using the O/C Design Matrix [2, 3] for evaluating these systems.

The O/C Design Matrix [2,3] enhances the evaluation process by focusing on change type: whether the users comply with the newly acquired behavior (C-Change), whether the change takes place in users' behaviors (B-Change), or the users receive support from the system in order to change her attitude rather than behavior only (A-Change). Formation (F-Outcome), Alteration (A-Outcome) or Reinforcement (R-Outcome) are the three expected outcomes that will help researchers ascertain the efficacy of a BCSS. For instances, consider formation of a behavior (F/B), e.g. start going to gym, altering of a behavior (A/B), e.g. reduce or quit smoking (A/B), or reinforcement of a attitude (R/A), e.g. continuing to resist smoke cravings.

### 3 Practical examples of mobile applications through the O/C Design Matrix

Based on our previous work [9], we have mapped a number of selected mobile applications to O/C Design Matrix. Interestingly, we found that a high majority of the applications were clearly designed with intent to bring a change in peoples' behaviors, but only a few (and that too not explicitly) targeted compliance, i.e. supporting users to conform to newly acquired behaviors/attitudes. Additionally, Table 1 demonstrates the practical implication of the O/C Design Matrix in designing and evaluating BCSSs.

We have attempted to explain the O/C Design Matrix with relevant examples. It is not surprising that several of the described systems/application examples can arguably be allocated to multiple cells. However, we have assigned examples to particular cells primarily based on the target change and outcome in users: (1) *QuitPal* has been allocated to F/C because the apparent intention is to help users conform to a new behavior, (2) *AngerCoach* has been placed under A/C because its objective is to guide people through a change process and equip them with skills to sustain the change, (3) *WaterWorks* has been categorized under R/C because it targets people who already have a desirable behavior however they need support in continuing to perform accordingly, (4) *HealthyHabits* has been placed under the F/B category because it aims to assist people in forming new habits, (5) *NHS Quit Smoking* is being categorized as A/B because it is designed to help users break undesirable habits, (6) *MoodKit* belongs to the R/B category because it targets reinforcement of desirable behaviors, (7) *LiveHappy* is placed under F/A because it aims to support people to form new attitudes, (8) *T2 Mood Tracker* has been categorized under A/A for the fact that it aims to help people alter existing attitudes and (9) *Awareness Lite* has been placed under the R/A category because

it intends to help users with positive attitudes conform to their attitudes. Although we have made comprehensive evaluations of each example, we acknowledge that several applications can possibly be placed under multiple cells.

**Table 1.** Analyzing BCSSs with the O/C Design Matrix

<b>Outcome/Change</b>	<b>C-Change</b>	<b>B-Change</b>	<b>A-Change</b>
<b>F-Outcome</b>	Forming a compliance (F/C) <i>QuitPal</i> not only helps users stop smoking but also supports people conform to new routine i.e. not smoking. It provides reminders, health milestone alerts, tips to overcome cravings and personalized videos from loved-ones.	Forming a behavior (F/B) <i>HealthyHabits</i> supports people to form desirable habits for example eating healthy food.	Forming an attitude (F/A) <i>LiveHappy</i> encourages people to form positive attitudes, keep a record of emotional patterns and try to improve mood through virtual coaching.
<b>A-Outcome</b>	Altering compliance (A/C) <i>AngerCoach</i> supports people overcome angry behaviors. Users are guided through the change process through expert videos as software feature.	Altering a behavior (A/B) <i>NHS quit smoking</i> app supports users to alter smoking habits. The aim of the app is to support smokers through the process of gradually becoming a non-smoker.	Altering an attitude (A/A) <i>T2 Mood Tracker</i> helps users to monitor emotional experiences such as stress and anxiety.
<b>R-Outcome</b>	Reinforcing compliance (R/C) <i>WaterWorks</i> supports people conform to consume desirable amount of water by providing visual graphics for motivation and goal achievement.	Reinforcing a behavior (R/B) <i>MoodKit</i> helps people sustain positive moods through learning how to be in control of their lives. It allows people to set their goals and provides personalized content and access to expert publications.	Reinforcing an attitude (R/A) <i>AwarenessLite</i> supports users feel positive through inspirational quotes based on how the users are feeling.

Another prime target of prompting behavior change in people is to support them through the entire process with a special focus on A-Change so that the outcome is improved self-confidence. Bandura [14] highlights this as self-efficacy. According to Bandura [14], self-efficacy establishes whether people are truly prompted to make an effort towards behavior change, and enhanced confidence and self-efficacy is the key for people to overcome hurdles in the process, tackle unpleasant incidents and continue newly acquired behaviors. Bandura’s psychological approach further strengthens the argument about the significance of A-Change in BCSS research.

## 4 Practical examples of social applications through the O/C Design Matrix

In an effort to conceptualize, design and implement BCSS, several aspects need detailed and thorough consideration. In our previous work [9], we evaluated selected mobile applications for well-being and it was surprising to find that social influence features were rarely found in the evaluated applications.. Software features that include social influence can potentially increase users’ motivation. This is because users can not only monitor their own progress but also see how their fellow users are performing [4]. To further highlight the importance of social support it is worth noting that many recent trends in persuasive technologies are based on social networking.

**Table 2.** Mapping social influence features with the O/C Design Matrix.

<b>Outcome/ Change</b>	<b>C-Change</b>	<b>B-Change</b>	<b>A-Change</b>
<b>F-Outcome</b>	Scenario: Motivating people to conform to an active lifestyle. Intended Change: Encouraging users to overcome sedentary lifestyles. Potential feature: Social Comparison	Scenario: Supporting users not to start smoking. Intended Change: Keeping users away from unhealthy behaviors. Potential feature: Social Facilitation	Scenario: Helping users to overcome anxiety and stress. Intended Change: Supporting users to achieve stress free life. Potential feature: Social Learning
<b>A-Outcome</b>	Scenario: Supporting users to overcome violent attitudes. Intended Change: To bring a gradual change in users’ angry attitudes. Potential feature: Normative Influence	Scenario: Encouraging users to stop eating junk food. Intended Change: Supporting users to eat healthy and gradually get rid of eating unhealthy food. Potential feature: Recognition	Scenario: Encouraging users to have a positive attitude towards life. Intended Change: Helping users to overcome negative feelings. Potential feature: Cooperation
<b>R-Outcome</b>	Scenario: Helping users to comply with their new habit of not overusing alcohol. Intended Change: Supporting users to sustain newly adopted habits. Potential feature: Social Learning	Scenario: Motivating users to continue going to the gym regularly. Intended Change: Encouraging users to continue performing desirable behaviors. Potential feature: Competition	Scenario: Supporting people to continue to look at the positive aspects of life. Intended Change: Gradually guiding users to appreciate positive aspects of their lives. Potential feature: Recognition

The effect of intended change and outcome and whether social influence features could be used in accordance with that are represented in Table 2. For example, social comparison, social learning and recognition have persuasive powers [cf. 4, 16]. Social comparison allows users to compare their performance with other users; social learning allows people to observe how others overcome difficulties in conforming to new routines/behaviors and recognition encourages users to gradually change their behavior. To further demonstrate the significance of social influence features in BCSS, we have mapped some hypothetical scenarios within each cell of the O/C Design Matrix (see Table 2).

The O/C Design Matrix can be a valuable framework that can help behavior change researchers in identifying the context of use as well as desired outcome/s. Additionally, social influence features can be carefully drawn, mapped and incorporated to support the users of a BCSS.

## 5 Conclusions

Idealistically, a BCSS would offer long-lasting support to the users, and the intended change in the target audience would very much delineate the design and architecture of a BCSS. This would correspondingly help create more persuasive user experiences [cf. 13].

One of the major recent advances in developing BCCSs is to vigilantly employ the O/C Design Matrix [2] in the design and evaluation process. As discoursed above, there are nine distinct yet interrelated paradigms defined in the O/C Design Matrix. In general, system designers and researchers are encouraged to be clear in terms of what do they aim to accomplish through the BCSS at hand.

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