Enhancing Persuasive Features of Behaviour Change Support Systems: The Role of U-FADE

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Abstract. The introduction of Behaviour Change Support Systems (BCSS) has enhanced the ability of utilizing computing technology and information systems for changing or altering human behaviour or attitude. Yet, some existing BCSS applications are faced with limitations that impede their effective use because they become obsolete as user needs change during it use. The Unified Framework for Analysing, Designing and Evaluating persuasive systems (U-FADE), has been introduced to address these limitations. However, the framework has not been applied in the development of any BCSS application. This research evaluates the U-FADE by applying its design principles to an existing weight management application (ObiMo Pet). Our findings support claims that U-FADE is capable of facilitating BCSS development. It was also observed that by applying the framework, extra system features are identified which may possibly enhance the persuasiveness of the application.

Keywords: Persuasive Technology, Behaviour Change Support, Captology, Unified Frameworks

1 Introduction

Behaviour change support systems (BCSS) combine properties of interpersonal interaction and mass communication to change or alter behaviour or attitude [1, 2]. It is capable of adapting to individual differences and it has a better potential for changing behaviour and/or attitude. This is because, it is capable of employing both animated and non-animated objects to persuaded its users [3].

Its effectiveness and increase use in areas of healthcare [4, 5], leisure and recreation [6], energy saving [7, 8], IS security [9], etc. has resulted in the emergence of newer challenges and research opportunities in Information Systems design. Currently, design methodologies continue to be one of the greatest challenges in BCSS research. According to Wiafe and Nakata [10] most existing BCSS applications do not follow appropriate methods during the design phase and therefore become obsolete with time. This is mainly due to the fact that existing frameworks or design approaches do not provide adequate information that can be used for analysing and designing such applications to address the changing needs of users.

Nevertheless, recently the Unified Framework for Analysing, Designing and Evaluating persuasive systems (U-FADE) [11] has been proposed to provide an

effective means of solving existing challenges associated with the design of BCSS applications. The framework incorporates key concepts from existing persuasive design models such as the Functional Triad [12], the Behaviour Wizard [13], the 3-Dimensional Relationship between Attitude and Behaviour (3D-RAB) model [14] and the Persuasive System Design (PSD) model [2] to address design challenges associated with current design methods. While it has been demonstrated conceptually that U-FADE provides a better and a more compressive approach for BCSS analysis and design [11], the framework has not been applied in developing any application to ascertain its practicality yet.

This research therefore seeks to evaluate U-FADE, using a weight management system. Precisely, the objective is to identify whether the application of U-FADE will facilitate design and also enrich the selection of persuasive features. As such, the steps in U-FADE were used to redesign an existing mobile application known as ObiMo Pet [15] and our findings are presented below as follows: a general overview of the framework is presented first, followed by the research approach used, after this the processes for redesigning, discussions and conclusions were presented.

2 Overview of the Unified Framework for Analysing, Designing and Evaluating Persuasive Systems

The Unified Framework for Analysing, Designing and Evaluating persuasive systems (U-FADE) formalizes BCSS design process by addressing changing needs of users during the design of persuasive systems [11]. It is comprised of: analysis of the Persuasion Event, selection of Persuasion Strategy, identification of System Features needed to promote persuasion, Development and Implementation of the persuasive system and the Evaluation of Behaviour Change success. Wiafe [11] explained that the main benefit of using U-FADE is its ability to provide a thinking guide for both novice and expert persuasive system developers. The framework explores the problem space by identifying variations in a user's cognitive dissonance state and the situational (or environmental) context to guide designers to select persuasive features for specific target users. The Event analysis stage consists of Use and User context analysis: a concept borrowed from the PSD model [2]. However, the framework emphasises on the need to identify internal and external factors that affect individuals to change or maintain their behaviour.

The next step in *Event* analysis is *Use* context analysis. This considers BCSS application design in relation to formal and informal behaviour change factors. It argues that, designers need to consider both formal and informal activities within their immediate environment that may interact or influence potential users to change their behaviour. Here, Natural Attitude or Behaviour Change (NABC) takes into account activities within an environment that changes an individual's behaviour or attitude naturally [11]. Issues relating to culture, social norms, beliefs, ethics, commitments and values among others are of paramount interest. Arguably, these issues are

exceptionally essential for BCSS designs since their sole objective is to alter behaviour or attitude.

Next, Planned Attitude or Behaviour Change (PABC) is considered. Wiafe [11] explained that PABC consists of existing approaches that are used on target users to change their behaviour or attitude intentionally. This may include automated and non-automated approaches. These existing activities (i.e. NABC and PABC) must be emphasised and designers may select strategies to support existing activities that are promoting target behaviour. In essence, they must reinforce the existing overt or covert persuasion. Additionally, it proposes steps that guide designers to identify system features by focusing on incremental changes as suggested by Oinas-Kukkonen and Harjumaa [2]. Transitions that involve attitude-changing states must use logical arguments (elaborated messages) to ensure a long-term change, whereas heuristics (peripheral messages) must be used for short-term behaviour change.

In U-FADE, designers are encouraged to identify a list of familiar hardware and select those that the application can be deployed on. In this process, they must pay particular attention to cost, environment and obtrusiveness of the technology they chose. As such, the introduction of a new hardware should be considered or used only when the application cannot be administered effectively on an existing familiar hardware.

The framework also provides a guide on how the 28 system features proposed by Torning and Oinas-Kukkonen [16] may support either elaboration or peripheral message routes [11]. The approach is based on findings from the *Use* and *User* analysis. It also consists of a Transition Description Card which provides a template for summarising all the activities performed to enable the designer to focus on the relevant issues relating to the targeted behaviour change. Finally, it proposed steps that can be used to evaluate the change so as to enable designers to fine-tune system features to address changing needs of users.

As already mentioned, the unified framework (U-FADE) has been proven conceptually or theoretically to facilitate BCSS development. However, it has not been empirically demonstrated. The next section is a discussion of the research approach used to assess the appropriateness and benefits of using U-FADE for designing behaviour change support systems.

3 Research Settings

In design science research, the designed artefact must map adequately to the real world, solve a problem and must be demonstrated [17]. Hence to investigate whether the framework is useful practically, it is necessary for it to be applied to develop a BCSS application. Consequently, U-FADE was applied to the development of a BCSS application that seeks to encourage its users to reduce the amount of calorie intake and manage their weight. Purposely, it was used to reassess an existing application known as ObiMo Pet. In this sense, the objectives of ObiMo Pet were used as the basis for analysis using U-FADE and the resultant design was compared to ObiMo Pet. The study focused on staff of the Accra Polytechnic which is a tertiary

institution based in Accra, Ghana. Below is a brief description of the target population and the application used for the study.

3.1 Target Population

As stated earlier, the Accra Polytechnic is a tertiary institution located in Accra the capital of Ghana. It is the first polytechnic to be established in the country in 1949 as Accra Technical School. Later, it was renamed as Accra Polytechnic and was given a tertiary status in 1993. Currently, it offers Higher National Diploma (HND) programmes in science and engineering, fashion design, social science, hotel catering and institutional management, etc. It has a staff population of over 600.

Due to her keen interest in issues relating to health of her staff, the institution has built a state of the art gymnasium that is available to the staff. In addition, seminars on healthy lifestyles are organized regularly to refresh staff on the need for maintaining good health by the Hotel Catering and Institutional Management department. The Institution also boasts of a strong staff welfare association that seeks to promote social welfare activities within the institute. Amidst all these efforts, the ratios of overweight and obese persons continue to increase.

3.2 The ObiMo Pet

Obimo Pet is a weight management system designed to manage calorie intake and physical activates of individuals who are obese. It employs persuasive strategies to motivate it users to maintain a healthy lifestyle as they cater for a virtual pet of their choice. It provides it users with healthy physical activities and diet plans that aim to support them to lose weight. As they adhere to suggestions provided by the application they earn points that can be used to decorate their virtual pets. Also, it gives recognition to users who have the healthiest and most decorated pet in the virtual community. This serves as a motivating factor to encourage users to compete as they seek to accomplish the target behaviour. The Mobile version of the application enables users to track and monitor their performance in real-time.

The application uses 6 main system features to promote behaviour change. These are; rewards, suggestions, tailoring, recommendations, competition and personalization. The designers of ObiMo Pet used the semiotic approach to information systems development as the foundation for analysis and design.

3.3 Design Objectives

The U-FADE approach for developing BCSS applications was used for requirements gathering and analysis with specific emphasis on the following objectives:

- To identify the distribution of cognitive dissonance levels of potential users so that the behaviour change support system will target specific and appropriate user needs
- To identify existing activities that may promote weight loss or impede weight gain of potential users
- To identify system features or properties that are useful for the development of such an application
- To identify appropriate hardware or device for the proposed BCSS application

Our study aimed at persuading staff of Accra Polytechnic to change their behaviour towards weight gain. Particularly, it aimed at targeting a weight loss between 3 and 5 pounds a week, and consumption of 2300 calories a day. We however acknowledge that the actual amount of calorie intake and calorie burnt is over simplified in this study; since the values normally varies according to the individual's gender, type of work or activity level, age, body weight, etc.

Additionally, we also acknowledge that although U-FADE suggests the reassessment of user behaviour to evaluate incremental behaviour change, this was not considered as part of the objectives of this study. The next section reports our findings from the analysis conducted using U-FADE.

4 Integrating U-Fade for Re-Development

4.1 Event Analysis

As proposed by U-FADE, the first stage in the analysis process is the User context analysis. Here, a questionnaire was developed to collect data and classify users into the various cognitive states as proposed by the framework. The classification was based on variations in cognitive dissonance of users' attitude and behaviour (i.e. Attitude Towards Target Behaviour, Attitude Towards Change or Maintaining Behaviour, and Current Behaviour) in relation to food menu goals (calorie intake) and exercise or workout goals (calories burnt). The target behaviour was considered as maintaining a Body Mass Index (BMI) value between 18.5 and 25.

A pilot study was first conducted to test the clarity and consistency of the questions on the questionnaire and the suggested amendments were made. Finally, the questionnaire was distributed to staff members of the target Institution. One hundred and seventeen responses were received after one month of distribution of the questionnaires. Three questions each were asked to measure respondents' Attitude Towards Target Behaviour (ATTB) and Attitude Towards Change or Maintaining Behaviour (ATCMB) in order to ensure reliable and consistent responses. Cronbach's alpha with reliability coefficient of 0.7 was used to check for reliability. Respondents were classified into positives or negative ATTB, ATCMB or Current Behaviour (CB) by computing the averages of the numerical values they assigned to each question in

the questionnaire. The distribution of cognitive dissonance states for the 117 responses received is presented in Table 1.

From Table 1, thirty-nine (33%) respondents were identified to be in state 1; meaning they are in the "ideal" state and with all things being equal they are expected to continue to maintain a BMI that is between 18.5 and 25. However majority of the respondents were found to be in states that need a change in either attitude (ATTB/ATCMB) or behaviour (CB). None of the respondents was in state 7, i.e. no staff was identified to have a BMI that is not between 18.5 and 25, and also do not believe that they should maintain a BMI value between 18.5 and 25 but would want to change.

Table 1. Distribution of cognitive dissonance state observed.

State	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Responses	39	12	0	6	42	6	0	12	117
Per cent (%)	33	10	0	5	35	5	0	10	100

Likewise, no respondent was in state 3, where Current Behaviour is positive, Attitude Towards Maintaining Current Behaviour is positive, but Attitude Towards Target Behaviour is negative. Forty-two respondents were identified to be in state 5. These are individuals who do not have BMI between 18.5 and 25, but believe that there is a need for them to change their current BMI values. According to Wiafe, et al. [14] these users experience a strong form of cognitive dissonance which serve as a motivating factor for changing their behaviour. Table 1 indicates that, the potential users of the system are experiencing different forms of cognitive dissonance levels. This therefore suggests that it will require different persuasive system features or properties to persuade them [11]. Although U-FADE argues that persuasive systems or technologies should ensure that they provide specific persuasive features for all states, for the purpose of this study only users in state 5 were considered.

As suggested by the framework, the next stage of the analysis is to collect information regarding the Use context (i.e. Planned Attitude or Behaviour Change and Natural Attitude or Behaviour Change). Informal interactions, interviews and discussions were used to gather relevant information pertaining to this. Eight observations were identified to impact staff attitude and behaviour in relation to maintaining a healthy BMI. The observations and associated suggested persuasive features identified to be appropriate for users in state 5 are summarised in Table 2.

Societal norms and culture, availability and access to technology, the existence of staff association, among others were identified to be some of the key things that can be used to inform the design of the BCSS application.

Table 2. Selected system features identified to promote weight management for the target population.

Observation	Description	System feature		Implementation
		Elaboration	***Peripheral***	
Societal norms	Ghanaians perceive overweight people as wealthier and rich: this serves as a negative impact on the target behaviour	Cooperation	Social facilitation	The system should provide a platform for discussion to counter the notion associated with being overweight
Hotel Catering and Institutional Management department	There is a nutrition and home science unit at the institute with scholars in nutrition	Authority		The system should display endorsement of the department for the weight management app
		Suggestion	Social role	An avatar of one of the renowned scholars in the unit should be used to suggest healthier menus
Intellectual and competitive environment	This is an educational institution made up of intellectuals who prefer to demonstrate that they can march their peers		Social comparison Competition	The system should provide a means for peers to compete
Staff association	There is an association for staff of Accra polytechnic employees: they meet regularly to discuss their welfare		Normative influence	The system should provide a means to make users know that the target behaviour is a collective goal
Expensive and Poor Healthcare facilities	Healthcare cost is becoming expensive and in addition there are few healthcare facilities in the country		Reminders	The system should provide a means of reminding users of the increasing cost of healthcare and poor medical facilities
Rising cost of food prices	The cost of food prices continuous to increase due to high inflation		Suggestion	Suggest alternative cheaper and healthier menus
Gymnasium	The availability of a state of the art gym serves as a positive impact to the target behaviour Some staff also believe that they are taxed indirectly to maintain the gym		Reminder	Prompt staff to use the gym regularly since they believe they are paying for its maintenance
		Social Role	Suggestion	An avatar of the gym instructor should be used to suggest exercise schedules

4.2 Persuasive Strategy

The selection of technology must aim at identifying the most convenient hardware that is readily available, affordable and also familiar to potential users of the system. Hence a mobile device was considered to be appropriate since all staff owns mobile devices. This was realised during the Use analysis.

According to U-FADE , users with a positive ATTB and ATCMB who perform negative behaviour (not maintaining a between 18.5 and 25) are more likely to change if peripheral messages are used [11]. Thus, the peripheral route was considered to be the most appropriate channel for persuading.

4.3 Selection of System Features

In Table 2, some system features were identified to supports elaborated messages. However these features were not considered appropriate for the study. This is because we limited our design to users with the right attitude; hence there is no need to change their attitude. Rather, emphasise is to be given to peripheral messages that promotes behaviour change. Social role, competition, normative influence, suggestions and reminders were identified to be appropriate for promoting behaviour change in this situation. Social role was identified based on the fact that there is a nutrition and home science unit within the Hotel Catering and Institutional Management department at the Institute. This unit employs scholars in nutrition. Since the staff are familiar with their colleagues who are experts in areas of nutrition and wellbeing, they are more likely to accept persuasive messages from an avatar (a virtual nutrition scholar) of one of their colleagues who is an experts in the field.

<table>
<tr><td colspan="2">Transition: 5 → 1</td></tr>
<tr><td colspan="2">Target Behaviour: Users are to have a BMI value between 18.5 and 25</td></tr>
<tr><td>Type of Change: Behaviour</td><td>Type of Message: Peripheral</td></tr>
<tr><td colspan="2">Assumptions: All users at this state did not migrate from any previous state</td></tr>
<tr><td colspan="2">Constraints: None</td></tr>
<tr><td rowspan="2">List of possible paths: 5 → 1</td><td>Selected path: 5 → 1</td></tr>
<tr><td>Previous state: None</td></tr>
<tr><td colspan="2">Description of Previous state: Not Applicable</td></tr>
<tr><td>Selected system features:
Social Role, Normative Influence, Competition
Suggestion, Reminders, Social Facilitation
Social Comparison</td><td>Selected technology:
Mobile Device</td></tr>
<tr><td colspan="2">Comments: None</td></tr>
</table>

Figure 1. Transition Description Card for Transition 5 → 1

Likewise, the existence of a staff welfare association at the Institute promotes normative influence; consequently, normative influence was considered as an appropriate system feature. Refer to Table 2 for the list of system features identified and its associated justification for the selection of these features.

As required by the framework, a Transition Description Card (TDC) was completed for transition 5 → 1 (i.e. changing users with the right attitude but a negative behaviour). The assumptions, the type of change, the type of message, constraints, etc. are highlighted on the TDC for the specific transition. Figure 1 is the TDC for transition 5 → 1 that was realised during analysis.

5 Findings And Discussions

The analysis facilitated the selection of a specific target group which is well defined as compared to the original application. In ObiMo Pet the system was not designed for any particular target group. Precisely, in ObiMo Pet it was assumed that the issue of weight management is generic and thus the designers did not deem it necessary to identify target specific issues. The framework facilitated the identification of a particular group of users (those in state 5) as the majority. Consequently, it focused its persuasive activities and system features on this type of users. Although one can argue that the other groups of users also need attention, this characteristic of the U-FADE enables the designer to plan or target majority of the population.

Again, even though the analysis focused on users in state 5, it identified seven system features. However five of them were not the same as the ones used in ObiMo Pet. The seven features observed were social role, normative influence, competition, suggestion, social facilitation, social comparison and reminders as compared to tailoring, competition, rewards, suggestions, recommendation and reminders. Out of these, suggestions, competition, reminders were common to both, whereas Social facilitation, Social comparison, Social role and Normative influence were not present in ObiMo Pet.

One may therefore argue that ObiMo Pet's failure to identify these features may be due to the fact that it did not adopt an appropriate approach to analyse the design of the BCSS application. Rather, the designers used a generic analysis and design methodology (the semiotic approach) that is used for Information Systems development. More importantly, the approach used for analysing and designing of ObiMo Pet failed to identify these features although the application targeted a larger population as compared to the target users for this analysis. This therefore suggests that using generic Information Systems design methods should not be encouraged in BCSS development.

Also, all the suggested system features seek to promote an existing condition that favours the target behaviour or refute an existing believe or perception that impedes the performance of the target behaviour. This was not the same in the case of ObiMo Pet. This is to say that, the selection and use of system features was aimed at targeting only behaviour change. Although some features were identified, they were not

considered to be appropriate since Table 2 explained that they are more appropriate for attitude change (elaboration) rather than behaviour change (peripheral). ObiMo Pet did not provide any substantive justification for the selection and use of the persuasive features. It appears that the designers used an arbitrary approach in the selection process: a practice that is common to some of the existing BCSS applications.

Apart from the selection of system features, one crucial issue appears to be largely ignored in BCSS designs. This relates to how system features are implemented. It was observed that although some system features used in ObiMo Pet were also identified during the analysis, they were implemented differently. For example, In ObiMo Pet, reminders were used to remind users of their daily activities whereas in the analysis it was observed that reminders should be used to make staff to use the gym regularly since they pay for the service indirectly. Hence in ObiMo Pet, reminder is used for elaborated messages (targeting attitude change) whereas it is used for peripheral messages (targeting behaviour change) in the proposed system. Similarly, suggestion and competition are implemented differently.

With respect to hardware selection, the analysis advocated for the use of a mobile devices, however in ObiMo Pet both mobile and PC were used to implement the application. Again, there was no justification for the need of a PC interface for a weight management system. As observed from the analysis, majority of the users would be comfortable using an app on a mobile device. It is however important to state that ObiMo Pet considered a larger audience as compared to what was used for the study. Hence, there is the possibility that the use of a PC may be relevant for other target groups that were not considered in this study.

6 Conclusion

In this paper we have demonstrated the practicality of the Unified Framework for Analysing and Designing persuasive systems. The design principles of the framework were tested on the objectives of a persuasive weight management system (ObiMo Pet) which works on both mobile and static devices. This system motivates overweight and obese users to follow a weight management plan.

After comparing the system features realised from our analysis, our observations supported the claim that there are variations in cognitive dissonance of users. Users were found in six out of the 8 listed states proposed by Wiafe, et al. [18]. It was also observed that by applying the U-FADE, new system features were identified.

However, our findings indicate that the framework fails to provide the exact messages that should be used for persuasion, rather it provides specification for the message: suggesting instance in which peripheral messages would be appropriate and those that will require elaboration. That not withstanding, it can be inferred that the U-FADE approach to BCSS development helps to identify system features that can be used to enhance applications. However, the study cannot conclude that the introduction of additional system features to ObiMo Pet will make it more effective, since there is no empirical evidence to support such a claim. It is therefore

recommended that, future research should investigate the relationship between the number of persuasive features and the persuasiveness of an application. This is to say that, the proposed system must be implemented and evaluated in terms of its effectiveness in changing user behaviour.

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