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# CONSIDERING USER ATTITUDE AND BEHAVIOUR IN PERSUASIVE SYSTEMS DESIGN: THE 3D-RAB MODEL

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## **Abstract –**

*As in any technology systems, analysis and design issues are among the fundamental challenges in persuasive technology. Currently, the Persuasive Systems Development (PSD) framework is considered to be the most comprehensive framework for designing and evaluation of persuasive systems. However, the framework is limited in terms of providing detailed information which can lead to selection of appropriate techniques depending on the variable nature of users or use over time.*

*In light of this, we propose a model which is intended for analysing and implementing behavioural change in persuasive technology called the 3D-RAB model. The 3D-RAB model represents the three dimensional relationships between attitude towards behaviour, attitude towards change or maintaining a change, and current behaviour, and distinguishes variable levels in a user's cognitive state. As such it provides a framework which could be used to select appropriate techniques for persuasive technology.*

*Keywords: Behaviour change, cognitive dissonance, persuasive technology*

# 1 Introduction

Persuasive technology offers a potential for substantially improving social interventions on attitude and behaviour. However, lack of appropriate methodologies for designing persuasive technologies has been an impediment to its effective development. Törning and Oinas-Kukkonen (2009) observed that many of the existing persuasive technologies do not make clear the fundamental methods or theories used in their design or do not have one at all. Currently, one of the promising approaches is the application of behavioural theories from social psychology when developing persuasive systems (Harjumaa and Oinas-Kukkonen, 2007), however this raises the following questions:

- Are theories from social psychology directly applicable to persuasive technology designs?
- Do such theories lead to a systematic method of designing persuasive systems?
- Do such methods take into account the variety of types of users who might have different needs and would go through changes in needs when they reach different stages towards target behaviour?
- Are there any appropriate methodologies for selecting the appropriate techniques from social psychology for its development?

Although researchers continue to investigate these questions, not many successful contributions have been made. A key research contribution is the persuasive systems design (PSD) framework (Oinas-Kukkonen and Harjumaa, 2008), which has provided a step towards a systematic development of persuasive technologies. Using the PSD framework, Harjumaa et al. (2009) and Räisänen et al. (2010) demonstrate that designers can combine this framework with other methods from social psychology to enhance design effectiveness. That notwithstanding, the PSD framework does not explicitly address the differences in user needs and how persuasive systems should adapt to different and changing user needs as users progress towards target behaviour.

In this paper, we present a model called 3D-RAB. The purpose of this model is to identify and categorize different types of users in relation to the target behaviour so that suitable approaches can be identified and applied in the design of persuasive technology for each type of users. Users may also undergo changes during the process of persuasion towards target behaviour and which would result in changes from one type to another. The types of users are based on various levels of cognitive dissonance states, which are used to categorize users by assessing a user's attitude towards change or maintaining the change, his or her attitude towards the target behaviour and the current behaviour. It suggests that there are various levels of cognitive dissonance and the classification and identification of target users provide a possibility of employing different approaches to persuasion. The proposed model does not limit itself to automated persuasive systems but also be applicable to non-automated behavioural change programmes.

The remainder of the paper is structured as follows. Section 2 contains related work and literature, and Section 3 presents states in behaviour changes leading to the development of the model in Section 4. This is followed by a discussion in Section 5 relating to the uses of the model. Section 6 concludes the paper and discusses future work.

## 2 Related Research

This section is presented in two parts. The first is a review of existing models for the design of persuasive systems. In particular the PSD framework and Fogg's "35 behavioural grid" (Fogg, 2009a) are discussed. The second part introduces the theory of cognitive dissonance (Festiger, 1957, Aronson, 1997) which serves the basis for the proposed model.

### 2.1 The Persuasive Systems Design Model

The Persuasive Systems Development,(PSD) framework (Oinas-Kukkonen and Harjumaa, 2009, Oinas-Kukkonen and Harjumaa, 2008) is currently the most comprehensive approach to the development and evaluation of persuasive technologies. It considers a number of theories and facilitates the use of appropriate theory or theories for developing persuasive technologies. It

structures persuasive technology analysis into three main steps: (i) understanding key issues behind persuasive system, (ii) analysis of the persuasive context, and (iii) design of the persuasive qualities (figure 1).

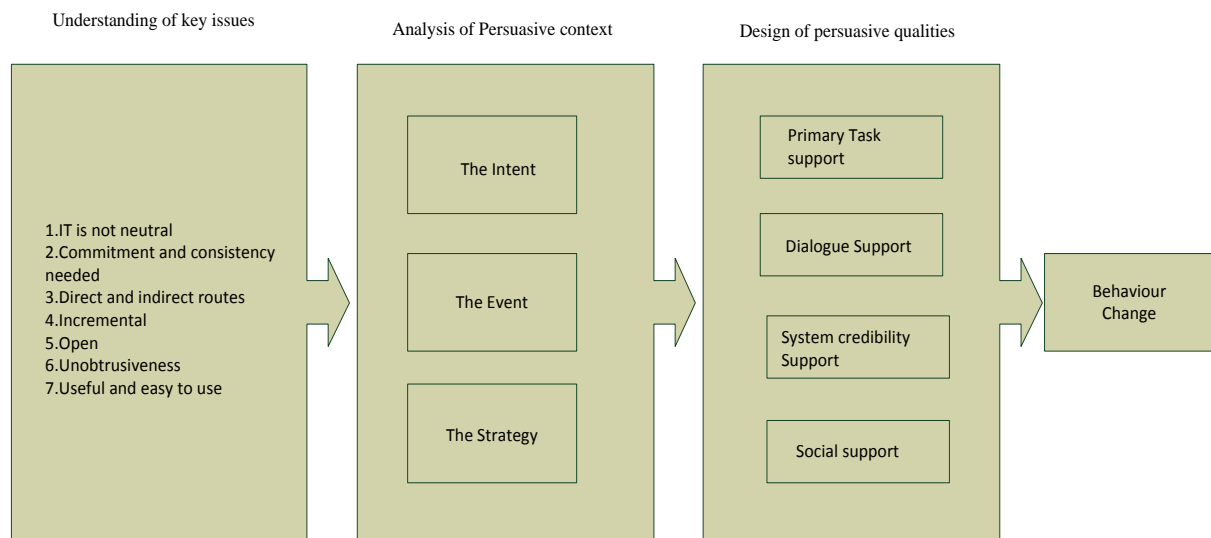


Figure 1: The Persuasive Systems Development framework (Oinas-Kukkonen and Harjumaa, 2009)

The first two steps of the model facilitate designer's understanding of the key issue or problems and the persuasive context respectively while the third step focuses on the persuasive qualities of the system. With 28 distinct design principles, it organized the persuasive qualities of the system into four categories: primary task support; dialogue support; system credibility; and social support. It advocates that by understanding the Intent, Event and Strategy, a designer can formulate the appropriate persuasive techniques needed for an effective persuasive systems design (Oinas-Kukkonen and Harjumaa, 2008; Oinas-Kukkonen and Harjumaa, 2009). This leads to the identification of persuasive qualities which can lead behaviour change.

It suggested some persuasive qualities which encompass the essential techniques applied in social influence and the persuasive technology tools proposed by Fogg (1997). However, there is a limitation on how one understands the intent and event in order to develop a strategy. This information was not explicit in the framework and as such limits its use.

However, the 35 behavioural grid (Fogg, 2009a) can be considered to be useful in the analysis of the intent and event. In the 35 behaviour grid, there are five main types of behaviour which are: performing a new behaviour; performing an existing behaviour; increasing behaviour; decreasing behaviour and stopping behaviour. In addition, there are seven schedules in behaviour which he described as: one time behaviour; continuous behaviour; periodic behaviour; behaviour of predicted schedule; behaviour on cue; behaviour at will and behaviour that is always performed. This combines to form a grid of behaviour which can be used to categorize behaviour change, hence making it useful in the analysis of intent and context stage of the PSD framework. However, the model fails to address the cognitive state of the user as well as the existence of possible transitions between states, which is considered as important aspects in behaviour change interventions (Festiger, 1957; Radhakrishna and Saxena, 2005; Aronson, 1997). As such, there is the need to identify approaches that can be used to suggest transitions during a change interventions based on an analysis of users' changes in attitudes and behaviour. This is where the theory of cognitive dissonance becomes useful.

## 2.2 Cognitive dissonance theory

People have a motivational urge to minimize dissonance by changing their attitudes, beliefs, and behaviours, or by justifying or rationalizing them (Festiger, 1957; Aronson, 1997). Two cognitions are

considered to be in dissonance if one opposes the other, creating an unpleasant psychological tension. The foundation of this theory is based on the fact that in order to eliminate dissonance, an actor can change his belief, action or perception of an action. The theory focuses on attitude, and explains that people attempt to ensure that their actions and attitude are in harmony (Griffin and McClish, 1991). Hence by combining cognition with motivation, attitude can be predicted (Brehm and Cohen, 1962). Changing an actor's behaviour will result in attitude change since new attitudes are formed to justify behaviour. People adjust their attitudes to fit new behaviours (Aronson, 1997) in order to reduce or eliminate the "tension of dissonance". It is this "tension of dissonance" that motivates us to change either our behaviour or belief, in an effort to avoid the associated distressing feeling (Griffin and McClish, 1991). Moreover, one's effort to reduce dissonance can be achieved by adding more consonant beliefs that outweigh the dissonance belief, changing the dissonance belief or reducing the importance of the dissonant belief. There are two main factors that affect dissonance: the dissonance belief and the importance attached to the belief (Kearsley, 1999). As humans, we feel discomfort in holding incongruous beliefs and actions and these serve as a strong persuasive tool (Festinger, 1957, Aronson, 1997). Hence persuasion per se cannot be simply achieved by educating persuadees on new and refined beliefs, rather it is a result of intrapersonal event occurrences of incongruence, between our attitudes and behaviour which creates a change of either beliefs or behaviour (Dainton and Zelly, 2005).

In developing a systematic approach to designing persuasive systems, understanding the users is an important step. Otherwise an unsuitable approaches to persuasion could be applied, e.g., trying to change user's attitude towards the target behaviour when he or she already has that attitude or forcing to change behaviour which might be perceived as coercive. Since the focus of persuasive technology is on achieving target behaviour, we attempt to characterize and categorize users based on the aspects of cognitive dissonance theory outlined above.

In the remainder of this paper, the cognitive dissonance theory is used to establish the cognitive states of users during the design and implementation of a persuasive technology. We argue that cognitive dissonance can be on different levels, which when studied carefully, can be used for selecting appropriate persuasive techniques. Also, these levels of dissonance provide information concerning possible natural transitions that exist as a result of natural phenomenon

### **3 States in behaviour change**

What cognitive dissonance theory focuses on is the relationship between behaviour and attitude. In the context of persuasive technology this corresponds to the behaviour of users and their attitude towards the target behaviour. However, in order to consider the users' willingness to change their behaviour towards the target behaviour or to maintain the target behaviour, there is a need to consider their attitude towards the change itself. In other words, having the "right" attitude by itself is not sufficient; even if they agree to the target behaviour they may not like the change that is involved in turning their positive attitude into positive behaviour. Hence we propose the following three factors to be considered: attitude towards target behaviour (ATTB), attitude towards changing/maintaining current behaviour (ATCMB) and current behaviour (CB). Even though most existing persuasive technologies concentrate on behaviour change, little contribution and discussion has been made on attitude towards change in behaviour or maintain the change in relation to the target behaviour and the attitude towards the target behaviour. The following explains how these factors can be used in determining the cognitive dissonance state of the user and how it can be used to define the persuasive system context.

#### **3.1 Attitude towards target behaviour (ATTB)**

Attitude towards target behaviour (ATTB) can be defined as the like or dislike for the target behaviour and it can be positive, negative or neutral. The Theory of Planned Behaviour, (TpB) (Ajzen, 1991), one of the most widely used theories for addressing causes of diverse human behaviour focuses on context-specific attitudes in defining behaviour and it evolved from the Theory of Reasoned Action

(TRA) (Fishbein and Ajzen, 1975). It predicts intentions as opposed to behaviour (Kantowitz et al., 1996) and explains how behavioural beliefs produce favourable or unfavourable attitude towards behaviour (Ajzen, 1991). One's attitude towards behaviour however is not always consistent with his current behaviour, and this may be due to external factors.

In cognitive dissonance theory, the direction of influence between attitude and behaviour is not prescribed. Hence, in order to minimise the dissonance people might change their attitude to match their behaviour, instead of changing their behaviour to match their attitude. As such, as for the relationship between attitude and behaviour, cognitive dissonance theory can be considered to be more generic than TpB or TRA.

In the design of persuasive technologies it is appropriate to define positive attitude towards target behaviour as "attitude in favour of the target behaviour". For instance, in the case of a smoking cessation intervention, a person can be considered to have a positive attitude towards the behaviour "not smoking" if he or she likes the idea of, and believe that it is not good to smoke and negative otherwise. For the purpose of simplicity, attitude towards target behaviour in this research is considered to be either positive or negative.

### **3.2 Attitude towards changing/maintaining current behaviour (ATCMB)**

Attitude towards change or maintaining behaviour (ATCMB) is a measure of agreement or disagreement of a person in relation to a particular change or maintenance in behaviour and can be positive, negative or neutral. This measure is considered to be positive when a user agrees to change to the target behaviour or maintain the current behaviour in the case where current behaviour is the same as target behaviour. It is negative otherwise. ATCMB provides information on a person's readiness to change, or to maintain an existing behaviour respectively. Consider again the case of smoking cessation. In some cases there are individuals who believe that smoking cigarette is not good (positive ATTB), however do not want to stop smoking (negative ATCMB). A person may for some reason not be currently smoking, however they do not agree to maintain their current state of non-smoking within the near future. This provides interesting information about the characteristics of individuals which can be considered in designing persuasive technologies. Self-efficacy plays a key role in this measure as people who feel they have less ability or confidence to accomplish a task normally develop a negative attitudes towards change or maintaining change (Prochaska and DiClemente, 1986). This is not normally reflected in their attitude towards the behaviour. Self-efficacy has been found to be an important determinant of the choice of activities in which people engage, how much of the energy they expend on such activities, and the degree of persistence they demonstrate in failure and/or adversity (Oldenburg et al., 1999). For instance, past experiences (personal and from others) contribute to one developing a negative or positive attitude towards a change or maintaining a behaviour. Consider someone who has witnessed a friend or a family relation who suffered serious complications after quitting smoking (this might only be a perception). As a result of this experience, this individual may develop a resistance to change though he may have a positive attitude to "not smoking". In some cases an individual may start to smoke in order to reduce stress, even though he believes that smoking is also physically harmful. As such this factor plays a key role in a behaviour change approaches.

### **3.3 Current Behaviour**

Current behaviour (CB) is defined as the existing action of a person in relation to the environment, which can be conscious or subconscious, overt or covert, voluntary or involuntary. In terms of persuasive technology, the current behaviour could be one that should be changed to the target behaviour, or that should be maintained if it is the target behaviour.

In order to measure behaviour there is a need to have a reference point for the measurement. This is to say that behavioural measurement should always be personalised and not generalised. In smoking cessation for example, one addict may be smoking 100 cigarettes a day whereas another smoke 10 a day. In such a case if both of them reduce their smoking by 10 cigarettes a day, this will mean that one

has achieved a complete change (stopped smoking), whereas the other has attained relatively smaller level of change (reduced smoking). The question is on the efficiency. From initial glance it appears that the one who has stopped smoking completely has achieved the greatest success; however the amount of effort in both instances might not be the same; i.e. it might be easier for a light smoker to stop smoking 10 cigarettes than a heavy smoker to doing the same. This is another area of persuasive technology design that needs attention. For simplicity, we measure behaviour to be positive or negative based on our definition of the target behaviour. As such, a person is considered to have a positive behaviour if his/her current behaviour is the same as the target behaviour in question.

By considering the values for the three factors above, ATTB, ATCMB, and CB, in terms of positive and negative in relation to the target behaviour, we can characterize a user based on his or her attitude and behaviour towards the target behaviour, i.e., the goal of persuasion. In the next section, we describe a model that represents a state-space that users would traverse in the process of persuasion based on the value changes for each of these factors.

#### 4 The 3D-RAB Model

The three factors identified in the previous section, namely ATTB, ATCMB and CB, provides three aspects, or “dimensions” of change in users’ cognitive states. Based on this, we propose a model that represents the 3-dimensional relationship between attitude and behaviour (3D-RAB). The model enables the persuader (designer) to categorise users into groups based on levels of cognitive dissonance states during a behavioural intervention. In total, 8 categories of user state were identified (see figure 2) according to the parametric permutation of values (positive/negative) for each of the dimensions, after which the various states are analysed in order to ascertain possible transitions for persuasion. Moreover, the model shows the states which are stable and unstable and explains how users in unstable states can transit to other states due to factors that may or may not include persuasion.

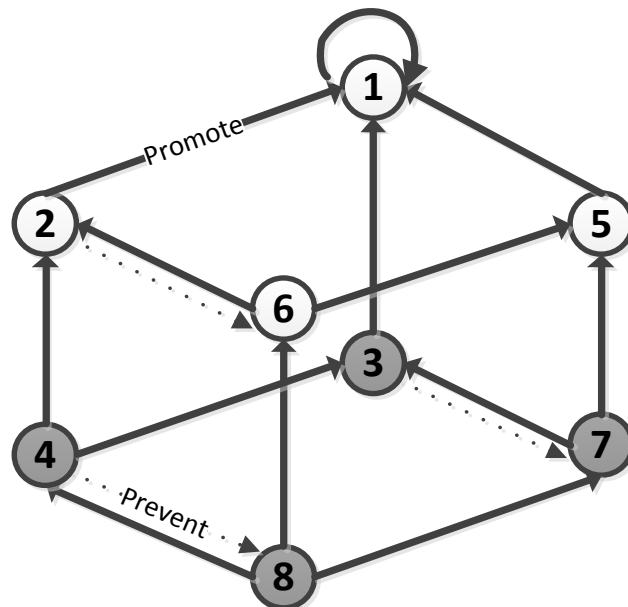


Figure 2: Possible state transitions in 3D-RAB

From figure 2, the 8 states and their relationship were analysed by considering cognitive states, possible target states, and states that have the tendency to shift in order to eliminate or reduce dissonance. This relationship is presented in table 1 and based on the theory of cognitive dissonance the following variations in cognitive dissonance were made: i) strong cognitive dissonance; ii) moderate cognitive dissonance; iii) weak cognitive dissonance and iv) no cognitive dissonance.

| State | Current behaviour (CB) | Attitude towards target behaviour (ATTB) | Attitude towards maintaining/ changing target behaviour (ATCMB) | Cognitive dissonance | Stability    | Expected natural state transition tendency | Targeted state towards persuasion |
|-------|------------------------|--|---|----------------------|--------------|--|-----------------------------------|
| 1     | +                      | +  | +   | None                 | Stable (+)   | 1  | 1                                 |
| 2     | +                      | +  | -   | Weak                 | Unstable (+) | 1  | 1                                 |
| 3     | +                      | -  | +   | Moderate             | Unstable (-) | 7  | 1                                 |
| 4     | +                      | -  | -   | Strong               | Unstable (-) | 8  | 2 or 3                            |
| 5     | -                      | +  | +   | Strong               | Unstable (+) | 1  | 1                                 |
| 6     | -                      | +  | -   | Moderate             | Unstable (-) | 8  | 2 or 5                            |
| 7     | -                      | -  | +   | Weak                 | Unstable (-) | 8  | 3 or 5                            |
| 8     | -                      | -  | -   | None                 | Stable (-)   | 8  | 4 or 6 or 7                       |

Table 1: Relationships in the 3D-RAB

Strong cognitive dissonance is formed when there is a very strong disagreement between one's attitude (either ATTB or ATCMB) and behaviour and it results in a strong unpleasant psychological tension with a greater probability that one may change his attitude or behaviour in order to eliminate the dissonance. At such a state the user experience a very uncomfortable cognition state that he or she recognises the need for a change in attitude, behaviour or behavioural beliefs. Whereas a weak dissonance is formed when the disagreement between one's attitude and behaviour is weak and though there is a form of dissonance it is insignificant and thus does not create strong psychological tension. When a moderate dissonance is formed, there is disagreement between one's attitude and behaviour; however the extent of unpleasant psychological tension experienced in this case is relatively moderate, hence the urge to change attitude or behaviour is not strong enough. In the case of no cognitive dissonance, one's attitudes agree with his behaviour and there is no psychological tension. This variation in dissonance creates both stable and unstable states which can be positive or negative in relation to the target behaviour. In positive unstable states natural and environmental phenomenon can easily influence one to change either his attitude or behaviour to favour the target behaviour whereas it is vice versa for the case of negatively unstable state. See table 1. The state in which attitude is neutral is excluded in this analysis due to the fact that it does not provide interesting information for analysis.

#### 4.1 Reinforcement States

In States 1, 2, 3 and 4 the target users are already performing the target behaviour. However, the model reveals that though they are performing the behaviour they have variable levels of cognitive dissonance which can result in changing their behaviour in the future. From table 1, State 1 is the ideal state; this is the target of the designer or persuader. All factors are positive and there is little or no need to persuade since there is no cognitive dissonance. The individual is in a stable state and thus persuasive approaches should focus on reinforcing all 3 factors. In State 2, even though the user has a positive behaviour and attitude towards behaviour, his attitude towards maintaining the behaviour is negative, as such approaches applied at this stage should focus on moving the user to State 1(stable state). At this state the target user experiences a dissonance due to the fact that his attitude towards the maintaining the current behaviour does not conform to his attitude towards behaviour and his current behaviour. Even though the level of dissonance is considered to be weak and there is a greater tendency that he/she will change his attitude towards maintaining the current behaviour to be positive, external factors plays a key role in this change. Hence, reinforcement methods should focus on immediate environment in order to prevent the user eventually moving to State 6, which requires more effort in persuasion.



In State 3 the challenge is to move the user to State 1. In this case persuasive methods should focus on promoting the transition from State 3 to State 1 while preventing natural tendency to move the user to State 7. However, users in this state experience a moderate form of dissonance (see Table 1) and even though the individual is performing the behaviour, he/she is negatively unstable and thus can stop performing the positive behaviour in order to eliminate his/her dissonance.

Users in State 4, experience a strong form of cognitive dissonance as their actions are not in consonance with their attitude in any form. One way for the user to resolve the dissonance is to change their positive behaviour to a negative one, i.e., a natural tendency that can make them stop performing the behaviour and move to State 8 where it will be the least desirable state in terms of persuasion, and a step back which makes the process of persuasion more difficult. Hence, persuasive methods should aim at moving users to State 2 or 3 with care since inappropriate methods can easily result in a boomerang effect (users moved to state 8). Reinforcement methods should focus more on attitude towards target behaviour and attitudes towards maintaining the target behaviour.

## 4.2 Changing

Stages 5, 6, 7 and 8 involve actual change in behaviour since user's current behaviour are negative in terms of target behaviour. Nonetheless, it can be observed that there are situations in which users in these states require special attention. For instance, in State 5, users have a strong cognitive dissonance, but this dissonance creates a positive instability, and this is where most behaviour interventions are targeted. Users in this state have a positive attitude towards the target behaviour, believes that a change in current behaviour is good; however they are not performing the target behaviour (see Table 1). In Fogg's (2009) behaviour model this group can be seen as those with less motivation, or no trigger. For instance most smokers admit that smoking is bad, believes that they need to change but continues to smoke. Since they are not performing the target behaviour, persuasive technology design tools should focus on changing their behaviour and thus target State 1.

In State 6, cognitive dissonance is moderate, however there is the urge for one to change his/her attitude towards the target behaviour in order to eliminate the dissonance and thus environmental factors may make him transit to State 8. As already discussed, an individual may change his/her beliefs in order to conform to his behaviour so as to eliminate his unstable cognitive state. As such, persuasive approaches should focus on transforming the individual to State 1, with a transit through either State 2 or 5. Designers should be careful, particularly by paying attention to external factors as these will contribute a great deal to the success of behaviour change.

A weak cognitive dissonance is characterised with users in State 7 as they only have a positive attitude towards change in behaviour and attitudes towards target behaviour being positive. Here, the target is more likely to change their attitude towards change due to natural tendencies and thus persuasive systems should both aim at preventing natural occurrence from changing their attitude on the change as well as changing the other two factors. From Table 1, it can be observed that target users can be transformed to State 1 through either State 3 or 5.

The last and perhaps the most difficult target for change are those in State 8, even though this state is uncommon, it is characterised with no cognitive dissonance. Users in this state have formed strong beliefs about their behaviour thus making it extremely difficult to change them. Since there is a need for a complete change in all 3 factors, methods can be applied to move them from their current state to State 4, 6, or 7 and progress through to State 1.

## 5 Discussion

In any successful behaviour change, cognitive states of individuals has an impact on the success of the planned change (Prochaska and DiClemente, 1986). Therefore, the ability of a designer to identify all states and plan adequately has an impact on the success on the persuasive technology. Figure 2 and Table 1 suggest that persuasive technology should follow a stepwise approach in its persuasive

methods. The model provides information on possible transition which may need special attention since the state may be negatively unstable (see Table 1). Often, persuasive technology designers ignore the possibility of the design dissuading the user on the target behaviour.

Also it can be observed that there may be situations where dissonance creates natural “pulls” or “pushes” towards the target behaviour. Hence, without persuasion or persuasive technology, environmental and economic effects can act on dissonance to change behaviour. This information can be useful during design and evaluations of persuasive technology, because it provides information on the level of difficulty in persuasion.

The model is still at the theoretical stage and would require further examination. The analysis carried out using the model shows all possible states based on the permutation of positive and negative values. Although all states are theoretically possible, not all of them may be realistic. The same can be said about the state transitions. This would depend on the actual persuasive technology scenario to which the model is applied. If states and state transitions that are not probable or realistic can be identified, this reduces the problem space to be covered in the process of persuasion. Another issue is the method of determining which state the users are in. Assessing the current behaviour can be done objectively through observation or through self-declaration such as a diary, but attitudes are notoriously difficult to measure. One method is to devise a set of questionnaires that assesses the attitudes. However this would require an empirical study.

The model is not intended to be a prescriptive model. Rather it provides a way to explore the problem space in the process of persuasion. In order to make it practically useful, we are investigating the development of a catalogue of existing persuasive technologies and techniques that support or inhibit the state transitions. In this way, the designers will be able to choose from various approaches in persuasive technology to design the persuasion process, and devise solutions where no existing approaches are appropriate. In any case, as argued earlier, the use of the model is intended to provide a systematic approach to the design of persuasive systems, taking into account various and changing user needs towards persuasion.

## **6 Conclusion and future work**

This paper has presented a model showing the relationship between attitude and behaviour (3D-RAB), and shown that by analysing current behaviour in terms of target behaviour, attitude towards behaviour and attitude towards change or maintaining behaviour, a designer can analyse the persuasive context during a persuasive technology design. It is a contribution to the existing approaches in persuasive technology development (Fogg, 2009a; Fogg, 2009b; Oinas-Kukkonen and Harjumaa, 2009).

Also it can be observed that the model is applicable in non-automated behavioural change interventions since it provides information on one’s cognitive states. However, there is the need for further studies to be conducted to validate the model. Issues on trivial and non-trivial transition should be considered. Also other potentials of the 3D-RAB model should be investigated. For instance there is the need to identify specific persuasive technology tools which can be applied to a particular target group, based on their cognitive states. In addition, while the 3D-RAB model is purposefully aimed at analysing behavioural change interventions, there is the need to ascertain its applicability in attitudinal change analysis, since the cognitive dissonance theory argues that a change in behaviour may result in a change in attitude (Festinger, 1957; Brehm and Cohen, 1962). Moreover, there is need to conduct further research investigating how other intrapersonal factors such as personality traits and cognitive styles can contribute to an effective use of the model.

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