Using Computational Agents to Motivate Diet Change

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Abstract. Computational agents which make use of behaviour change models have the potential to help motivate people to change problematic behaviour. The importance of emotion simulation in behaviour change agents is discussed, along with an overview of a behaviour change model (the Transtheoretical Model [1]) that computational agents can make use of. Experiments that will investigate these areas further (within a nutritional domain) are then described.

1 Introduction

Obesity is a major issue in today's world. According to a report published by the National Audit Office in 2001 [2], one in five English adults are clinically obese, with nearly two-thirds of men and over half of women being either overweight or obese. The report (conservatively) estimated that in 1998, obesity was the cause of 30,000 deaths and 18 million absent days from work. Furthermore, the report estimated that the financial cost of obesity treatment to the UK National Health Service (NHS) was around £0.5 billion and possibly £2 billion to the wider economy. These figures seem to represent a world wide trend in the effects of obesity on society. Computers have been used in a variety of ways in an attempt to help people change unhealthy behaviour, but very little research has concentrated on whether autonomous computer agents can help motivate significant behaviour change.

In this paper, we will discuss the importance of incorporating emotion simulation into computational agents which attempt to help motivate people to change their behaviour. An overview of a widely used behaviour change model will then be provided and followed by a description of the experiments that we are planning to conduct over the next few months.

2 Using Emotion Simulation to Motivate and Persuade

Computational agents are often designed with the ability to *express* emotion. These expressions of emotion can be made through a variety of different channels including textual content, speech (synthetic and recorded), and facial expressions. A number of studies have illustrated that we can accurately and reliably

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identify the emotional expressions of computational agents, but very few have concentrated on the psychological impact that these expressions of emotion have on users. One of the few studies which has concentrated on this was completed by Brave et al. [3], who found that embodied blackjack-playing agents, which were empathetic to the user (through the use of facial expressions and textual content), were rated by subjects to be more likeable, trustworthy and caring than agents which were not empathetic toward the user. However, it is still unknown how *strong* these responses are. In human-human interaction, we are more likely to act on the advice of somebody we like and trust, than someone we dislike and distrust [4]. Does the same principle apply in human-computer interaction (HCI)? If we generally rate emotionally expressive agents as more likeable and trustworthy, can they persuade and motivate people more effectively than unemotional agents?

One related study was conducted by Bickmore and Picard [5], who developed an embodied exercise advisor named Laura, which attempted to help people improve the amount of exercise they did through building a strong working relationship with them over the period of a month. Results showed that while subjects tended to increase their levels of exercise when participating in the experiment, they often went back to their old exercise habits after the experiment.

3 The Transtheoretical Model (TTM)

The TTM [1] is the most widely used behaviour change model and works on the premise that behaviour change involves moving through a number of stages before change is achieved. The stages of the model are precontemplation (when people have no intention of changing their behaviour), contemplation (when people intend to change within the next six months), preparation (when individuals intend to take action within the next month), action (when people have done something to change their behaviour within the past six months) and maintenance (when people have maintained the desired change for at least six months).

The model also defines other constructs including change processes (activities that are used to help progress through the stages), decisional balance (the ability to weigh the pros and cons of changing a behaviour), and self-efficacy (the confidence felt about performing an activity). The model suggests that stage-matching (linking the right process with the right stage) will increase the probability that a person will effectively move through the different stages of change. Linking the wrong process with a stage increases the likelihood that people will relapse into their previous behavioural patterns. The TTM has been applied to a number of different health behaviours (including smoking and eating) and there is evidence to suggest that it is effective across a variety of behaviours (e.g. [6]).

Attempts to automate behaviour change techniques through the use of different media (e.g. desktop computers and mobile devices) with respect to nutrition have had varying degrees of success (e.g. [7]). Future studies need to investigate whether behaviour change models that have been successfully used in human-human interaction, could also be effectively used by autonomous agents.

4 Experiments

The first experiment will take place over the coming weeks and will examine whether a synthetic nutritional coach has the ability to motivate people to eat more healthily. The main hypotheses are: (1) an emotionally expressive coach will be perceived as more likeable, trustworthy and caring than an unemotional coach (2) subjects who interact with an emotional coach will feel more motivated to change their eating habits than subjects who interact with an unemotional coach. We also intend to conduct a similar experiment over an extended period of time where subjects will be asked to have multiple interactions with the coach to examine the long-term effects on peoples' eating behaviour.

4.1 Subjects

A number of studies have found that undergraduates generally tend to have poor diets which are low in fibre and high in fat (e.g. [8]). Therefore, students at the university will be invited to enlist as subjects and randomly assigned to one of two different conditions: emotion and no emotion. In the emotion condition, the agent's voice will range widely in pitch, tempo and loudness and its facial expressions will match the emotion it is expressing. For the no emotion condition, the voice will vary little in pitch, tempo and loudness and the same neutral facial expression will be used throughout the interaction. The dialogue and type of (human) voice used in both conditions will remain the same. Only subjects who are in the contemplation stage of change will be chosen for two reasons: (1) subjects in different stages would require a tailored interaction which could influence results (2) people in this stage are already likely to have some motivation to improve their diet. Assessment of which stage a subject is at will be completed via the use of a questionnaire prior to the experiment starting.

4.2 Procedure

The main processes emphasised in the contemplation stage of change include consciousness raising (increasing awareness), dramatic relief (emotional arousal regarding behaviour), environmental re-evaluation (how the current behaviour affects other people) and self re-evaluation (self reappraisal), with the main goal of the stage to build confidence for change and to achieve a commitment to change. To emphasise these processes, the interaction will follow that of a standard (human) nutritional coach-client interaction (e.g. [9]), with the agent: (1) introducing itself and attempting to build rapport with the subject (2) clarifying both its own and the subject's role (3) enquiring about the subject's diet history and current eating habits (4) discussing the pros and cons of the subject's current diet and in changing their diet (5) discussing different options that the subject has for changing their diet and offering practical tips (6) getting an initial commitment to change from each subject and terminating the interaction effectively. Subjects will be able to respond to the coach's questions by selecting from a list of pre-scripted responses. They will also be informed that they can view educational pages about maintaining a healthy lifestyle for as long as they desire and

that they can return anytime within the next month to look at the educational resources provided. Subjects will then be asked to complete an online questionnaire which will be based on the Working Alliance Inventory (WAI)[10]. Finally, subjects will be debriefed in an attempt to elicit more qualitative information about their perceptions of the interaction.

Subjects' answers to the WAI questions will be used to analyse their perceptions of the agent. Motivation to change eating habits will primarily be measured through four behavioural measures: (1) the amount of time spent viewing the educational content provided (2) the number of educational pages viewed (3) the number of suggested healthy recipes viewed, printed or saved (4) the number of times subjects return to the website to view the resources provided.

5 Conclusion

The experiments proposed in this paper will make an essential contribution to the development of intelligent agents that attempt to help motivate people to change their unhealthy eating habits. Results from each experiment will deepen our understanding of how we respond to emotion simulation and whether computational agents can make effective use of behaviour change models.

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