

iParrot: Towards Designing a Persuasive Agent for Energy Conservation

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Abstract. Computational agents can motivate people to change their behaviour towards energy use in a home setting. In this paper, we investigate the design and evaluation of the iParrot, an intelligent agent that helps to persuade family members to conserve energy in their home. The iParrot was designed as a concept in the form of a video prototype with two conditions. The results from the evaluation show that people will comply with the advice from such an agent for energy conservation if the agent is friendlier.

1 Introduction

Energy conservation is a crucial and critical issue in today's modern society. Due to the improper management of electrical appliances in households, substantial energy is being wasted. Research results show that energy consumption in households is increasing day by day and changes in human behaviour are needed to save energy rather than just depending on technology. A behavioural coaching mechanism may help family members to change their behaviour towards energy saving. Persuasive technology has been deployed to motivate people to help them in behavioural change. For instance, direct feedback on energy conservation at home can help in a positive behavioural change [3, 4]. Even computer games have been used to grow environmental awareness and to enhance energy usage patterns [1].

Our goal is to design a persuasive agent that can encourage energy conservation in a home setting by offering feedback, advice, praise, and providing incentives. The feedback will be given in such a way that users perceive it to be supportive rather than dominating or possessive (controlling). Hence, characteristics of the agent are important prior to deploying it for persuasive means. There are factors that might influence the development of a successful user-agent relationship, for instance the agent's attractiveness, perceived competence, types of messages, persistency, etc. It is important to investigate the effect of user-agent interaction especially when the relationship is established for persuasive purposes.

A life-like embodied agent can help to change people's attitudes and behaviours [3]. Life-like agents can be seen as social actors [5] and consequently persuasion theories [7] were used in designing our persuasive agent: the iParrot. In this study, we wanted to investigate whether and under which conditions a user would comply and rely on the advice of the social agent. In particular, we focused on the role of friendliness of the agent.

2 Experiment

Participants. In total we had 30 participants (18 male and 12 female) divided equally over each condition. The participants were recruited through our personal network and email listing.

Design. The experiment was conducted as a simple two conditions between participants design. The friendliness of the iParrot (personality of the agent) was hence the independent variable. The main hypotheses were: (1) energy conservation advice from the iParrot agent seen as friendly will be rated more trustworthy than an unfriendly agent, and (2) energy conservation advice from the iParrot seen as competent will result in better compliance than an incompetent agent. For the experiment, we used two different variants of the video, which characterized our independent variable. We also wanted to explore gender effects, if any, and hence this outlined our second independent variable. In order to evaluate and measure trust and friendliness of the iParrot, a questionnaire was adapted from the scales (7-point Likert) devised by Warner and Sugarman [6]. The items from the questionnaire were also embedded with some dummy items. Besides a quantitative question (one 7-point item - 'I will comply with such a robot/agent'), a qualitative comment question was added to determine the compliance of the subjects with the iParrot's personality.

Procedure. The experiment was conducted either online or in a laboratory setting. In the second case, the facilitator welcomed the participant in the laboratory and left the laboratory before the participant started the experiment. For both cases a set of instructions was outlined, which the subjects read carefully before starting out with the experiment. Moreover, for both cases the video was shown on the online YouTube interface. Each participant was given a particular type of video to view (each video lasted for approximately 5 minutes), followed by the questionnaire.

Apparatus and Materials. The videos were role-plays simulated by the researchers. The iParrot was a paper mock-up of a parrot and was depicted as the social agent. For both videos the scenarios and storyline used were identical, however, the personality of the iParrot was varied distinctly with regards to its friendliness.

Each video consisted of three scenes, each scene dealt with a different aspect related to energy conservation. The storyline was built around a character who owned the iParrot. The first scene portrayed the character leaving a television on standby mode and leaving the room. The second scene illustrated a similar situation, in which the character was shown to go for a nap leaving a laptop on standby mode. In the third scene, a conversation was demonstrated between the iParrot and the character regarding a competition related to energy conservation amongst the neighbourhood, in which the iParrot was shown to congratulate the character on being victorious in the

competition. For each video type, the personality of the iParrot was modified. For Video A the iParrot was portrayed as a highly persistent agent (via various means) and at the same time having a rather annoying voice of a parrot. For example, in the case of the first scene, the iParrot would simply repeat what was being shown on the television, even though the television was on standby mode. The character was shown not to pay heed; the iParrot would then call on the character's cell phone and repeat the feed from the television on the phone. For the second scene the iParrot would generate the sound of typing on a keyboard in order to emphasize its persistence. For the last scene, the voice of the iParrot was the major persistent element. For Video B the iParrot was brought forward as more soft, calm (in voice), and less persistent. It did not employ the use of any of the drastic measures used in Video A.

3 Results and Discussion

Firstly, in order to adjudicate if the subjects understood and comprehended the difference between the two video conditions we performed a simple t-test comparison of means of the Unfriendly-Friendly item in the questionnaire. A significant difference was found between the two means of the item from the questionnaire scale ($t(-2.046) = -1.054, p = .05$). This confirmed that the participants in fact did perceive the difference with respect to friendliness between the two video scenarios (item mean of unfriendly video = 4.18, item mean of friendly video = 5.23).

The second part of our results evaluated the effect of gender as the second independent variable in our study. An Analysis of Variance (ANOVA) was executed in which gender and video type were the independent variables, and Unfriendly-Friendly, Untrustworthy-Trustworthy, and Perceived Competence were the measurements. Perceived Competence was taken as the mean of the following three items from the questionnaire: Ignorant-Knowledgeable, Irresponsible-Responsible and Unintelligent-Intelligent, (Cronbach Alpha = 0.709). Gender was found to have a significant influence on Perceived Competence ($F(1.772) = 5.487, p = .027$). The same setup was repeated for a user's compliance with the advice of the iParrot. Both gender and video type were found to have a significant effect on the willingness to comply with the iParrot, ($F(11.416) = 4.293, p = .048$) and ($F(13.974) = 5.255, p = .030$), respectively.

Lastly, we conducted a correlation analysis between our two dependent variables: Unfriendly-Friendly and Untrustworthy-Trustworthy; a relationship that extended from our hypothesis. A significant correlation was observed between the two variables ($r = 0.530, p = .003$). This ascertained the fact that the two main elements of our study, i.e. friendliness and trust, were significantly correlated and that subjects tended to trust an agent that was more friendly. Our quantitative results indicate that friendliness and trust indeed had an influence on people's willingness to comply with a social agent. Firstly, subjects did perceive the subtle difference between levels of friendliness, and secondly, they exhibited a tendency to comply with a rather friendlier agent. Therefore, we conclude that persuasiveness could have a cause-effect relationship with friendliness. By designing a friendly agent, indirectly, persuasiveness can be achieved. Gender was an interesting result: males tended to

comply with the iParrot agent significantly more often than females (compliance mean of males = 4.56, compliance mean of females = 3.58).

During the laboratory experiments and online surveys, we extracted several valuable comments from the participants. Nearly all subjects appreciated the motivation of the design and expressed awareness towards energy conservation. Subjects stated a willingness to comply with the advice from such a parrot but they did not wish for it to be too dominant. From the qualitative remarks, we ascertained that the voice of the iParrot (or any social agent for that matter) is an important factor, as participants commented that the voice of the iParrot should be more cordial. Respondents had mixed reactions about switching the iParrot off. Generally, if the iParrot would show an unfriendly and annoying behaviour, people would tend to switch it off more often. Others commented that the iParrot should interpret and identify the mood and context of the owner and switch itself off automatically.

The results from this study were obtained from a limited number of participants. However, the conclusions from this study suggest that there is potential in the deployment of a social agent in order to assist and persuade humans in energy conservation. Future exploration would be along the lines of building a more tangible and functional prototype of the iParrot and testing other persuasive factors such as trust and value similarity of the agent.

References

1. Bang, M., Torstensson, C., Katzeff, C.: The PowerHouse: A persuasive computer game designed to raise awareness of domestic energy consumption. In: IJsselsteijn, W.A., de Kort, Y.A.W., Midden, C.J.H., Eggen, J.H., van den Hoven, E.A.W.H. (eds.), *PERSUASIVE 2006*. LNCS, 3962, New York, Springer Verlag (2006) 123-132
2. Fogg, B. J.: *Persuasive Technology: Using Computers to Change What We Think and Do*. Morgan Kaufmann Publishers, San Francisco, CA (2003)
3. McCalley, T., Kaiser, F., Midden, C. J. H., Keser, M., Teunissen, M.: Persuasive appliances: Goal priming and behavioural response to product-integrated energy feedback. In: IJsselsteijn, W.A., de Kort, Y.A.W., Midden, C.J.H., Eggen, J.H., van den Hoven, E.A.W.H. (eds.), *PERSUASIVE 2006*. LNCS, 3962, New York, Springer Verlag (2006) 45-49
4. McCalley, L. T., & Midden, C. J. H.: Energy conservation through product-integrated feedback: The roles of goal-setting and social orientation. *Journal of Economic Psychology*, 23-5 (2002) 589-603
5. Reeves, B. and Nass, C.: *The Media Equation: How people treat computers, television, and new media like real people and places*. Cambridge University Press, New York, 1996.
6. Warner, R.M. and Sugarman D.B.: Attributes of Personality Based on Physical Appearance, Speech, and Handwriting. *Journal of Personality and Social Psychology*, 50-4 (1996) 792-799
7. Zimbardo, P. G. and Leippe M. R.: *The Psychology of Attitude Change and Social Influence*. McGraw-Hill, New York (1991)