

Persuasive Appliances: Goal Priming and Behavioral Response to Product-Integrated Energy Feedback

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Abstract. Previous studies have shown the embedding of feedback dialogue in electronic appliances to be a promising energy conservation tool if the correct goal-feedback match is made. The present study is the first in a series planned to explore contextual effects as moderators of both the goal and the feedback. Tentative results are reported of a study where two different levels of alternative goals (related/unrelated) are primed and compared as to theory predictions of their motivational strength. Results suggest enhanced performance when an action-related goal is primed, however, more participants must be included before final conclusions can be drawn.

1 Introduction

Over the more than three decades following the 1973 energy crisis, research results have converged to support the following statements regarding household energy conservation, 1) curtailing household energy conservation has become as important as cutting industrial energy conservation because, unlike industrial use, home use is increasing 2) changes in human behavior are needed because energy efficiency through technology is not enough to meet cutback requirements, and 3) energy use feedback can work to support household conservation behavior if certain conditions are met. The present study focuses on the advancement of feedback techniques using human-machine interactive dialogue embedded in everyday household appliances.

The embedding of dialogue is done by designing a meaningful display of energy feedback for the consumer through the interface of the household appliance *and providing the means for the user to respond to the feedback before committing to proceed with the action*. It is this ability of product-integrated feedback to allow the user to immediately investigate other actions and their resulting energy consequences before making a final choice that makes it unique among electronic feedback devices. It is also this sort of simple dialogue between the user and the machine that can serve as a foundation for the development of more elaborate dialogues using, for example, smart agents that can learn about individual users and direct the energy use behavior of each person in a household accordingly.

Our own series of empirical studies have helped to refine the technique of presenting product-integrated feedback by examining moderators to feedback such as speed of

presentation, age and gender of users, personality variables, and type of feedback such as monetary, kWh, cumulative or action specific. Prior studies have also led to the conclusion that energy use feedback is most effective if the user first sets, or is assigned, a specific (e.g. 10%) conservation goal, e.g., [1,2]. The present study explores the role of primed alternative personal goals as moderators of a specific action-related goal to save energy. According to Locke and Latham's [3] goal setting theory personal goals can mediate the effects of externally derived goals, such as assigned goals. This is because personal goals are assumed to be the most immediate and conscious motivational determinants of action [4]. However, whether the mediating effects of personal goals are positive or negative can be determined by the context.

A recent study by Shah and Kruglanski [5], predicted that the effects of an alternative goal depend on how closely it is related to the focal goal. Four experiments were carried out that varied different aspects of the accessibility of alternative goals (related/unrelated) and their motivational strength. The authors concluded that the priming of an alternative goal that was facilitatively related to the focal goal enhanced both performance and strategy development. Priming a facilitatively unrelated goal had the opposite effect. However, other research has suggested that it is not the relatedness of the alternate goal to the focal goal but the level of abstraction that is most important. Using a meta-analysis of feedback studies to support their proposed Feedback Intervention Theory, Kluger and De Nisi [6] concluded that one important function of feedback was to help direct and maintain attentional focus, and thus cognitive resources, at the focal goal level. In their view, related goals lie along a vertical continuum from task learning goals at the bottom to meta-level, or abstract goals about the self, at the top. Thus, if a focal goal was to save energy by performing a conservation action, such as turning off the lights, the activation of an alternative goal at a higher level such as "I want to be a conserver" will draw attention away from the action related goal and impede performance by, for example, making the user forget to turn off the switch.

The present study has been designed to test whether there is a difference in focal goal performance in an energy saving task between two distinct levels of abstraction of two primed goals, both related to the focal goal. According to [5], both primed goals should enhance performance but according to Kluger and De Nisi [6], only the goal related to the task performance level will improve performance. Priming the more abstract related goal should impede performance. However, such testing is not straightforward and many complexities must first be addressed, thus the reported design and data are tentative – to be confirmed and expanded at a later date. Because many individuals might already be conserving energy as much as they can, it is possible that the data from the simulated everyday task of the experiment, where only a limited amount of energy can be saved, will show a ceiling effect. Priming alternative goals at different and *specific* (personal and action-related) levels of abstraction and providing an appropriate neutral and control condition is also a delicate undertaking and requires extensive piloting.

2 Method

Participants. Participants were 103 adult residents of the Eindhoven city region of the Netherlands recruited by a door to door mailing in two residential areas. These

areas were considered to be similar to most areas of the city in regards to environmental behaviors as assessed by a previous study [7].

Design. An A-B design with a control variable was used. Three levels of the treatment variable were assigned to three groups of participants. A fourth group did the experiment with no goal level being primed. The treatment variable was goal level whereby participants were primed to activate one of the three goal levels; meta level (pertains to self), action level (pertains to a specific action), and neutral. Environmental attitude was identified as a control variable and was determined using the General Environmental Behavior scale by Kaiser [7]. The dependent variable was the percent change score in energy consumption before versus after goal priming.

Measurements. Before proceeding, a manipulation check of the three priming conditions was carried out. Three scenarios, each consisting of a series of slides made up the three priming conditions; one designed to prime a meta-level goal concerning the participants' personal desire to preserve the environment, another, an action level goal concerning specific actions to save energy and thus the environment and the third was to be neutral, and thus should not activate an environmental goal. Thirty participants were asked to view all the scenario's then asked to answer which statement best represents their thoughts regarding the slide show; "Concern for the environment", "Saving energy", "Appreciate your environment" or "Nothing". The first answer represents a meta-level goal, the second an action level goal and the last two represent a neutral goal. Each scenario was found to prime the intended goal level with little or no overlap. Participants rated the metalevel scenario as presenting "Concern for the environment" ($\chi^2 = 30.20, p < 0.00$), the action level scenario was rated as "Saving energy" ($\chi^2 = 42.40, p < 0.00$). Finally the neutral scenario was rated almost equally as either representing "Appreciate your environment" or as presenting "nothing". These results indicate that the scenarios primed distinct answers representing the goal level that was intended.

Procedure. Participants were randomly assigned to each of the four conditions and asked to "do these washes as you would at home" by completing several simulated washing trials on a computer. The simulated washing machine panel was a copy of a current state-of-the-art model with the addition of an energy meter that provided participant's with kWh feedback for each of their chosen wash programs. The program explained each step of the experiment, and was operated by the mouse. Participants were first required to complete 10 washing trials, the last six of which were used to determine each individual's baseline energy consumption. Participants in any of the three implicit goal activation conditions were then shown the corresponding slide show and told that this was to pass the time while the computer was saving. One slide show was about the environment in general, stating that it can be improved by being a conservationist, another gave practical tips to save energy along with slides of light switches being turned off etc., and lastly a neutral show that was designed not to prime environmental goals, displayed photos of the university and its surroundings. Finally, the control group received just a blank screen telling them to wait while the computer was calculating. Next, all participants were asked to set an energy conservation goal (explicit goal) of 0, 5, 10, 15 or 20 percent. Twenty more washing trials followed and were used to determine savings by comparing mean

kWh per wash to that of the baseline trials. Following the task trials, the GEB [7] questionnaire was administered. The final part of the experiment consisted of some general background questions.

3 Results and Discussion

The average percent change score was calculated using the mean kWh per wash of the six baseline setting trials and the final twenty washing trials. Energy saving scores were 13.61% for the meta-level treatment, 18.58% for the action level, 17.25% for the neutral level, and 10.43% for the control condition. The score of the so-called neutral condition indicated that neutrality was violated, and as there was a pure control group, it was decided to drop the neutral group data from analysis. ANOVA was used to test for significant differences between the three remaining groups. As income level had been found to be a significant predictor of the GEB behavioral score ($F(4, 102) = 2.44, p=.05$), indicating that it would have an effect on energy saving it was included as a fixed factor. The main effect for the percent of savings was found to be significant ($F(2, 77) = 4.04, p=.02$). A simple contrast was performed resulting in no significant difference between the primed meta-level alternative goal and the control condition and a significant difference ($p=.01$) between the action level goal condition and the control. The outcome in terms of theoretical interpretation is, however, not clear cut. One would expect from FIT [6] that priming an alternative action related goal might increase performance because it helps to maintain attention at the action level but the significant savings in the action goal condition could also be interpreted as support for Shah and Kruglanski [5] because a closely related goal appears to enhance performance. However, if they are correct, then both primed goals should enhance performance. A closer look at the data reveals that the contrast between the meta-level and the control nearly reached significance ($p=.06$). This tips the scales somewhat away from an FIT interpretation, however, it is not appropriate to speculate further on the tentative results but rather to concentrate on how the design and analysis might be further improved.

In considering the sample, a convenience sample of two neighborhoods in close proximity to the university was used. Answers to the short questionnaire at the end of the experiment suggest that the participants were mostly retired people with rather higher incomes and larger homes than the average city resident. The high income group was particularly concentrated in the action level priming group. McCalley & Midden [2] found that persons with higher incomes were less likely to be concerned with energy conservation than other groups. Data collection will therefore continue with a focus upon attaining a better balanced sample. Furthermore, there was a significant negative correlation ($p=.003$) between participants' scores on the GEB and how much energy they used per wash in the six baseline setting trials. This outcome indicates that people who scored high as conservers on the GEB were already saving energy before the experimental treatment and therefore were subject to a ceiling effect whereby they could not save more energy despite a high motivation. This will be taken into account after more data is collected and time allows a more in-depth analysis.

Although the results are not as robust as desired, the percent savings are as great or greater than other recent comparable feedback intervention experiments, e.g., [8], where savings rarely reached over ten percent. This replicates earlier successful results of the product-integrated goal plus feedback design [2].

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