THE EFFECT OF GOAL SETTING STRATEGY AND RESIDENTS' GOAL COMMITMENT ON HOUSEHOLD ELECTRICITY CONSUMPTION IN SINGAPORE

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ABSTRACT

Goal commitment is a critical construct in understanding the relationship between goals and behavioral performance in the field of energy conservation. However, little has been done to investigate goal commitment in relation to electricity-saving performances in household goal-setting treatment. This paper seeks to re-contextualize the associations of goal commitment with electricity saving performance in households and provide meaningful discussion and explanation to the findings observed. A field experiment was conducted to investigate the effect of goal setting strategy on household electricity consumption in Singapore. In particular, interventions of assigned and self-set goal setting types were compared. Residents' goal commitment was also accessed to understand the relationship between goals and electricity-saving performance. The results revealed a significant positive correlation between self-reported goal commitment and self-set goal choice. However, no significant relationship was found between self-set goal choice and electricity savings. It was also found that goal commitment has no significant relationship with electricity savings when goal difficulty was not a moderator, as in assigned goal group.

Keywords: goal setting, self-set goal, goal commitment, electricity savings, energy behavior, intervention strategy

1. INTRODUCTION

There is a repeated year-on-year increase in total electrical energy consumption in Singapore, with 76.3% of total electricity consumption attributed to contestable consumers (i.e., industrial sectors) and the remaining 23.7% associated to non-contestable consumers in the year 2017. Within these non-contestable consumers, households contributed 62.1% of the electricity usage. Moreover, the yearly increase in Build-To-Order (BTO) flats in Singapore will result in a further rise in household electricity consumption if no effective interventions are being put in place to improve the situation quickly.

Goal setting intervention, as a promising tool to trigger energy saving behaviors for households, has been applied in the field of energy conservation in residential sector. However, failure in goal setting strategies often entails a lack of commitment by subjects to achieve the goal (Locke & Latham, 1990). Self-set and assigned goal settings are the two goal setting types that have been widely explored. Yet, there had been several mixed findings with regards to their effectiveness on energy-saving performance. For instance, Latham et al. (1991) discovered self-set goal setting to be more effective than assigned goal setting, while other studies found no significant difference between self-set and assigned goal setting types in terms of their electricity saving performances (McCalley & Midden, 2002). Studies in the field of energy conservation have attributed this differences in performances to personality variables, such as social orientation (McCalley & Midden, 2002), demographic influences (Poortinga, Steg, Vlek & Wiersma, 2003), goal difficulty levels (Loock, Staake & Thiesse, 2013), goal specificity as well as design of feedback (Scott et al., 2011).

However, little is known that whether goal commitment construct can be used to explain the differences in energy-saving performance in households under assigned and self-set goal setting. Thus, this study seeks to fill up this research gap in the context of

Singapore. Specifically, this study aims to investigate whether goal commitment can be used to understand the different performances in electricity-savings under goal setting intervention. Through a field experiment in residential communities in Singapore, assigned and self-set goal setting types are compared and examined. Self-reported goal commitment was also analyzed to find its association with self-set goal choices and electricity savings.

2. METHODOLOGY

2.1 Hypothesis development

The existing knowledge about assigned and self-set goal setting types have revealed mixed findings pertaining to which intervention is more effective in promoting energy savings in households. For assigned goal setting, medium-level default goals were found to be most effective in promoting significant energy savings. In a self-set goal setting, the provision of contextual goals is vital to allow participants to select realistic goals. The provision of feedback with goal setting is also most effective in achieving significant energy savings. Moreover, frequent feedback is found to be more effective in reducing energy usage as compared to feedback with long intervals. Goals should also be specific to contribute to a significant reduction in energy consumption.

Goal commitment is a crucial construct in understanding the relationship between goals and task performance. Goal difficulty is a moderator of goal commitment and goal performance, and challenging goals often bring about higher commitment and better performance than easy goals. The nine-item self-report scale developed by Hollenbeck, Williams & Klein (1989) was the most widely used measures of goal commitment. Lastly, goal setting intervention is found to be effective in promoting energy–saving behaviors.

Thus, the two main hypotheses of this study are as summarized below. They seek to provide a novel understanding of how goal commitment is associated with self-set goal choices and electricity savings.

H1: Individuals who reported higher goal commitment set more difficult goals in self-set goal setting.

H2: Individuals who reported higher goal commitment achieve higher electricity savings.

2.2 Research design and data collection

A field experiment was conducted in residential communities in Singapore for this study. This experiment involves a pre-treatment phase, goal setting intervention, and a monitoring phase. The two types of goal setting interventions studied are assigned and self-set goal setting. Electricity meter readings were collected weekly and goal setting feedback was released. The three groups in this study are the assigned goal group, self-set goal group and control group.

A total of three surveys were given out throughout this study. The first survey was given out during the recruitment of participants. Participants had to fulfill some criteria to be eligible for the study. Firstly, participants were asked to share with the research team their household utility bills and allow their electricity meter readings to be to monitored every week. Secondly, participants were asked to share personal information such as name, contact number and other sensitive demographic details. Lastly, the participant has to be living in a 4-room or 5-room HDB flat and they must be the household member who spends the most extended amount of time at home or the one who pays the utility bills. Demographic and household information, as well as self-reported electricity conservation behavior questionnaire were asked in this survey. The six-item questionnaire adopts a 5-point Likert scale as seen in Fig 1. It is used to understand the usage patterns of household appliances in order to measure the frequency of electricity conservation actions.

In survey two, household utility bills were requested to calculate baseline consumption. Travel details were

Electricity Conservation Behavior of Household
Instructions. Please indicate the frequency of the following electricity conservation actions in your family, by using the following scale:
1=Never   2=Rarely (1-2 days/month) 3=Sometimes (1-2 days/week)
4=Usually (3-4 days/week) 5=Always (Everyday)
_____ 1. Set the air conditioning above 25°C.
_____ 2. Use timer settings to control air conditioning (on/off).
_____ 3. Cool down hot food before storing in fridge.
_____ 4. Turn lights off when nobody is in the room.
_____ 5. Turn off home appliances (e.g. TV, computer) when not use.
_____ 6. Turn on water heater only when necessary. Turn it off and unplug when it is not in use.

Fig 1 Electricity Conservation Behavior of Household

also enquired to ensure participants were at home during the study to reflect actual consumption patterns. Goal commitment scale questionnaire was also asked. Three different surveys were designed for the control group, assigned goal group and self-set goal group respectively. This is because goal setting intervention message was incorporated into survey two.

The nine-item self-report commitment scale developed by Hollenbeck and colleagues (1989) was modified to fit the context of an energy conservation goal (see Fig 2). It adopts a 7-point Likert scale and measures the level of commitment towards an energy conservation goal set for the family.

Goal Commitment Scale - Energy saving goal commitment
Instructions. Please imagine that you are setting an energy saving goal for your family. Please indicate your agreement with each of the following statements regarding the goal of conserving energy using the following scale.
1 = Strongly disagree   2 = Disagree   3 = Slightly disagree
4 = Neutral   5 = Slightly agree   6 = Agree   7 = Strongly agree

_____ 1. It is hard to take the goal of conserving energy seriously.

_____ 2. It is unrealistic for me to expect to conserve energy.

_____ 3. It is quite likely that the goal of conserving energy will need to be revised, depending on how things go.

_____ 4. Quite frankly, I don't care if I conserve energy or not.

_____ 5. I am strongly committed to pursuing the goal of conserving energy.

_____ 6. It wouldn't take much to make me abandon the goal of conserving energy.

_____ 7. I think the goal of conserving energy is a good goal to have.

_____ 8. I am willing to put forth a great deal of effort to conserve energy.

_____ 9. There is not much to be gained by trying to conserve energy.

Fig 2 Goal Commitment Scale

Survey three was given out after the final electricity meter reading was collected and it marked the end of the research study. Participants were asked the same electricity conservation questionnaire as in survey one, to measure if there were improvements in behavior after the study. Overseas travel details of household members during the experiment period was also asked for data cleaning purposes.

Goal setting intervention message was incorporated into survey two as aforementioned. Goal setting message was provided after the goal commitment scale questionnaire to ensure that the level of goal commitment reported would not be affected by the intervention. In assigned goal setting, 10% medium-level difficulty goal was chosen because it was concluded to be the most effective in achieving significant energy savings (Loock et al., 2013). In the self-set goal setting, participants were asked to choose a goal that ranges from 5-25%. Contextual information was also given to guide participants during goal setting as it was found to encourage more realistic goals to be set (Scott et al., 2011).

Weekly goal-setting feedback was provided to the two treatment groups. It allows them to monitor their weekly consumption performance against their target consumption. Weekly baseline refers to the weekly average usage from the previous three months before the study. Target consumption to save is calculated by multiplying the percentage goal set with the weekly baseline usage.

Fig 3 shows an example of weekly feedback which is presented in the form of bar graphs. The first bar from the left represents the baseline usage and the orange horizontal line represents the target consumption every week. In order to reach their goal, participants should keep the weekly usage bars below the orange line.
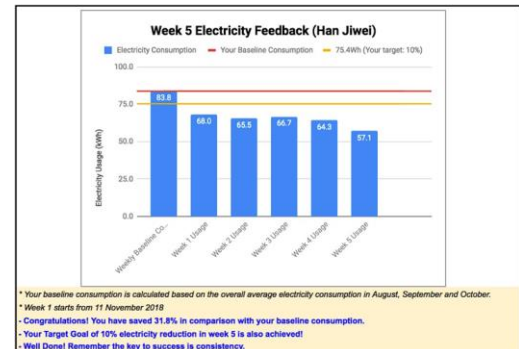

Fig 3 Example of weekly feedback

Positive messages were also included in the feedback message if participants had reached their goal and consumed less than baseline. Participants who did not reach their goal or consumed more were also encouraged to keep on trying, because it was found that negative feedback can result in avoidance behavior (Krenn et al., 2013).

Weekly meter readings were collected from participants to monitor their weekly electricity consumption and to tabulate feedback. "WhatsApp" messenger is used for communication purposes between the research team and participants. Weekly goal-setting feedback was also distributed via WhatsApp and acknowledgement should be obtained from participants to make sure they had read the feedback. After data cleaning, 100 participants were remaining. 33 participants were in the control group, 33 in the assigned goal group and 34 in the self-set group. Besides, the four variables studied in this paper are the percentage of electricity savings per capita, goal commitment scale, self-set goal choice, and electricity consumption behaviors.

3. RESULTS AND DISCUSSION

3.1 Assigned versus Self-Set Goal Setting

Objective one seeks to compare the effectiveness of assigned and self-set goal setting on electricity savings. The treatment groups were first compared with the control group in terms of baseline and intervention consumption. Following, the two treatment groups were to detect for a significant difference in their electricity savings.

The actual electricity consumption before and after the intervention is compared using the Wilcoxon signed-rank test. A non-parametric test was chosen because the normality test revealed that electricity consumption was not normally distributed. The test result revealed that intervention consumption was significantly lower than baseline usage for all three groups. Table 1 presents the results of the test together with effect size calculation.

Table 1 Wilcoxon Signed-Rank Test (Intervention-Baseline)

Test Statistics	Control	Assigned Goal	Self-Set Goal
Z	-4.301	- 4.038	-4.078
Asymp. Sig. (2-tailed)	.000	.000	.000

This finding is peculiar because the control group was not supposed to be affected in the absence of any intervention. It could be due to the Hawthorne effect which resulted in behavioral changes in response to being monitored or assessed. This effect was unable to be accounted for due to the time constraint of study. Further, a large within-group variance could be attributed to energy-savings related to holidays or due to end of year weather effects. When within-group variances are significant, large sample size would be needed to increase statistical power. Some other possible explanations could be the small sample size, short observation period, unreported overseas travel, as well as uncontrolled interferences like weather effects.
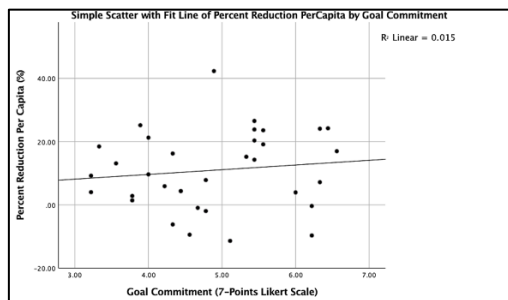

Fig 4 Scatter plot with fit line of percentage savings per capita against goal commitment scale

Both assigned and self-set goal setting groups had achieved electricity savings during the intervention period. Hence, to assess the effectiveness of the goal setting types in promoting electricity savings, the Mann-Whitney test was used to detect for a significant difference. The results revealed that the percentage savings per capita of assigned goal group (Mdn = 9.65) *did not* differ significantly from self-set goal group (Mdn = 14.92), U=509.0, z = -0.652, p>0.05. This could mean that the two goal setting types did not result in a significant difference in electricity savings.

3.2 Associations of Goal Commitment with Self-Set Goals and Electricity Savings

Objective two seeks to investigate the associations of goal commitment with self-set goal choice and electricity savings. It serves to find out if goal commitment can be used to explain the different goal choices set by self-set goal participants and the subsequent effect it has on electricity savings. In addition, objective two attempts to investigate if goal commitment could be used to explain the differences in electricity savings amongst assigned goal participants who were allocated the same goal difficulty level. H1 and H2 are the hypotheses to be tested.

Spearman's Rho test revealed that there is a significant positive correlation between self-reported goal commitment and self-set goal choice, r_s = .438, p (2-tailed) > 0.01. Therefore, H1 is proven to be true.

It was also found out that self-set goal participants favored easy goals over difficult goals as the majority of them set 5-10% goals. This is in line with the finding by Scott et al. (2011), however not in accordance to the findings in other literatures which concluded that self-set goal subjects were found to set more difficult goals (Latham et al., 1978).

Spearman's Rho was used to test the association of self-set goal choice and percentage of electricity savings per capita. The test revealed that there is no significant relationship between goal choice and percentage reduction per capita, r_s = -.198, p (2-tailed) > 0.05.

Further, it was discovered that with 10% medium-level goal, not all participant households achieved electricity savings, but those with 5% easy-level goal had all achieved electricity savings.

Spearman's Rho revealed that there is no significant relationship between goal commitment and percentage savings per capita, r_s = .179, p (2-tailed) > 0.05. Fig 4 presents the scatterplot to illustrate the association. Therefore, H2 is rejected.

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