Exerting Behavioral Economics to Household Energy Use

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ABSTRACT
It is a critical, lasting for years between scholars to research the ways to effectively enforce energy conservation plans. Even though individuals have received environmental protection education to some extent, they were still unable to effectively implement the knowledge or awareness into pro-environmental behaviors. Inadequate access to affordable or sustainable green energy services deprived households of opportunities for a better life. The discrepancy between the assumption of our disciplines appeared very large indeed so that usual economic models or utility-maximizing functions cannot explain the irrational behaviors. Therefore, modern economists have turned their attention to the concept of cognitive bias. In parallel, private families were the main target of behavioral intervention. Households can save energy in two ways: First, they can make voluntary changes to their energy consumption, such as reducing lighting use. Second, they can change their buying behavior and invest in energy efficiency, such as buying energy-efficient air conditioners. Both purchasing decisions and consumption behaviors can be achieved through policy interventions with the help of behavioral economists and psychologists. In this paper, the author discussed several major psychological factors which deviate human behaviors the best interests, and brought corresponded behavioral interventions to solve bias. While the field of behavioral economics has provided some evidence for interventions, the author will focus on those that are particularly relevant to the context of energy saving. All the measures were based on rigorous reasoning and experiments. Understanding these psychological phenomena can help institutions to design cost-effective and satisfactory solutions, encouraging consumers to correctly and effectively use green energy.

Keywords: *Behavioral economics, Behavioral interventions, Cognitive bias, Energy consumption, Energy conservation.*

1. INTRODUCTION

Plans to mitigate climate change have moved up the political agenda around the world. Household energy conservation has emerged as a major challenge and opportunity for researchers, practitioners, and policymakers. Annually, environmental groups have repeatedly stressed the importance of raising awareness to enforce sustainable energy practices, as residential energy consumption accounts for a large proportion of gas emissions in industrialized countries. Human beings have always assumed that they make informed decisions, and these choices were highly intellectual and consistent with their expected payback on their investments. However, everyday life showed that humans were not perfectly rational creatures. Consumer behavior, for example, was incredibly complex. It was not only unconventional but also unpredictable. When dealing with unusually complex or similar options, people tended to deviate from rational choice models of human behavior, which results in individuals missing out on huge opportunities or benefits. People always believed that they know about green practices (conducting renewable products, sustainable resources, low-carbon technologies, public transportation, etc.) and were consciously putting these into environmental actions, but according to reports of worsening environmental pollution and analysis of human nature, this was not the case. Most households did not reliably convert environmentally friendly knowledge to real actions when buying goods or using services that negatively impact the environment. Many families still relied heavily on non-renewable resources, under-use public transport, fail to recycle, and engaged in other everyday activities that harm the environment — activities that individuals themselves may acknowledge as "wasteful" , and economists consider sub-optimal. Even if countless consumers possessed adequate

knowledge and determination to act in green manners, they would frequently shift their behaviors in undesirable directions, especially over the long run [8].

The paper reviews the basic knowledge of three cognitive biases and the effectiveness of corresponded behavioral interventions to induce energy-saving actions. The author investigates cognitive biases such as loss aversion, social norms, and present bias. On the other hand, this paper focuses on behavioral interventions, like social comparison, commitment devices, and smart default. Contents of the paper proceed as follows: In the subsequent section, the researcher elucidates and clears away obstacles that affect people to make rational decisions while discussing how interventions could change or avoid the non-rationality of households when facing various social contexts. Part 3 and 4 are the conclusion and the final acknowledgment.

2. APPLYING BEHAVIORAL ECONOMICS AND PSYCHOLOGY TO ARTICULATE AND SOLVE CURRENT CHALLENGES OF ENERGY CONSERVATION

Based on the usual economic education procedure, professors and students mainly focused on the Neoclassic economic model which aimed at maximizing the profits or utilities in the market or pursuit better equilibrium between demand and supply sides; Keynesian cross model, a simple closed-economy model in which income is determined by expenditure; Solow model that looks at the calculations of economic growth and the standard of living in the long run. The above models all have the same characteristic, that is, human behavior or market behavior is rational so that people always strive for or seek better profits with sufficient or relevant information. In stark contrast to this assumption, there was growing evidence that consumers systematically make choices that defy clear logic. Therefore, the major step for solving environmental problems is to understand cognitive biases from human perspectives. A comprehensive review of all cognitive biases is beyond the scope of this article, but the author will present some classic examples to illustrate the impact of behavioral science. All of the ideas are particularly relevant to the ongoing energy conservation issues.

2.1 Loss aversion

Amos Tversky and Daniel Kahneman were the first cognitive psychologist and behavioral economist to bring about the idea of Loss aversion. The ideology mainly emphasized a tendency of weighing losses more heavily than equal-sized gains, which means when people making a decision, the sense of loss is far more intensive than the satisfaction of gaining [13]. According to the research study from Daniel Kahneman, the scholar generated a value function instead of a utility function from prospect theory to explain loss aversion in more detail [23]. As shown in the figure1, there is a gain or loss relative to the reference point, which is the zero point sitting in the middle. Economists perceived the value of gain or loss geometrically, diminishing sensitivity away from the original point, and the slope of the convex curve is much steeper (about twice) than the concave curve indicates that losses loom lager than gains. loss aversion concludes that the person who lost $10 will lose more satisfaction, while the same person will gain more satisfaction from a $10 windfall.

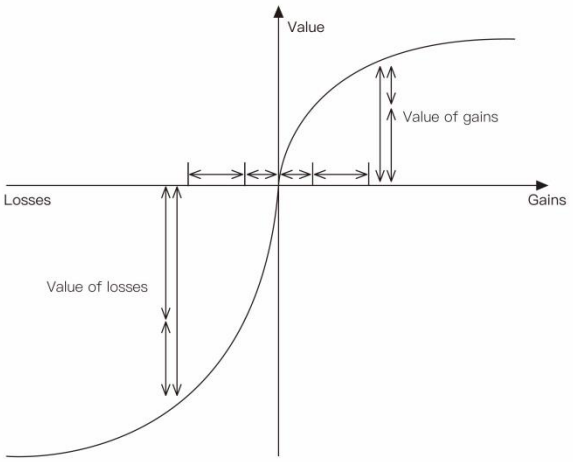

Figure1. Value function of Prospect theory

(Kahneman & Tversky, 1979) [12]

To effectively reduce energy consumption, the practitioners could avoid presenting energy-saving information stressing the benefits of saving energy, but focus on costs related to energy-wasting behaviors and emphasize how specific green activities and pro-environmental action can stop or offset the future or happening lost. In other words, the environment protection information network can frame green knowledge in terms of avoiding prospective costs and losses, making the information more attractive and stimulating [22]. Because of loss aversion, loss-framed advertising could generate a great influence on individuals' minds than gain-framed one. For example, if the community members want to motivate households to install a new energy-efficient equipment, it is better to state that 'you are currently losing $10 per quarter by using old air conditioner' than 'you could save $10 per quarter from equipping our new green products'. Additionally, 'You are now losing $20 annually by not turning off your water tap when showering' is likely to be more motivating than stating, 'You could save $20 per year by turning off your water tap'. Framing recommendations in terms of loss rather than gain may be more noticeable and salient[8].

Consumers focus on costs. However, individuals in a state of severe stress or difficulties might maintain the status quo in the prospect of losses to reduce the likelihood of facing further negative consequences [20].

For example, when choosing more energy-efficient but riskier technologies, individuals may overcome loss aversion and thus keep using less energy-efficient devices to avoid losses. The cause of the situation can be explained by prospect theory. Based on the reasoning above, the author assumed that the reference point is located in the middle so that decisions are solely influenced by loss aversion negatively or positively. Nevertheless, if households set their reference points on the convex side at the beginning, individuals will experience more regret when a decision going worsen than maintaining it. As a result, people might prefer to do nothing and stick to the default.

To compensate that, the authors suggest that policymakers provide "smart defaults" options that would make it faster for people to access green technologies or easier to sign up for environmental protection programs[11]. In Malta, for example, households are required to actively claim energy subsidies, but a large number of vouchers go unclaimed each year under the scheme. This may be due to the need for individuals to be active in changing the status quo. As a result, the government has revised the scheme that individuals identified as vulnerable categories can now be automatically enrolled in the voucher scheme and earn credits through their service provider [6]. In general, for people already living in harsh circumstances, changing defaults can be a forward-looking strategy and push households‘ life to the bright side.

2.2 Social norms

Conforming to the social norms means that the households or firms would be influenced based on attitudes or behaviors from the big social context, in contrast to usual economic models that the decision-making process is completely rational. Many studies showed since individuals had limited cognitive capacity, human brains automatically made use of simplifying heuristics to process information, and one of the most powerful cognitive shortcuts was to follow social norms [4]. For instance, people measured or evaluated their level of happiness or utilities in comparison with others’ performance. Moreover, as reflected in the tendency to conform by herd behavior, merely conveying a descriptive norm, such as describing how most people behave in a given situation, can inspire conformity [19]. The author applied two experiments of group deliberation to deeply explain the impact of the cognitive bias.

Under the background of a college, students wanted to decide which of three candidates was the best suited to the position of union. The observers gave the information that strongly favored Candidate A. In some groups, all members had all of the information about the candidates, and In other groups, each member received only a subset of the information that supported Candidate A.

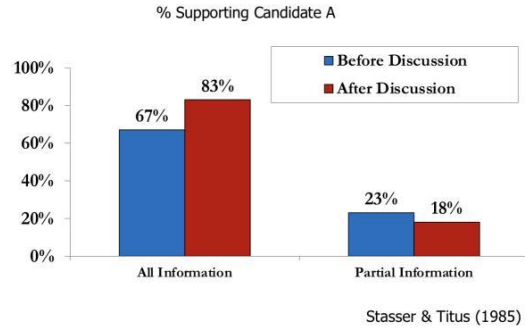

Figure 2. The result of the first experiment (Effects of grouping on the people’ behavior) [21]

According to the results shown, groups inclined to favor a particular conclusion and tended to polarize after the discussion. Why is that? Before the author makes the conclusion, let’s see the second experiment. Group of four people were asked to generate as many ideas (in 15 minutes) as possible to solve complex problems. Half of the groups worked together to generate ideas, and half of the “groups” worked separately. The outcomes are revealed as below:

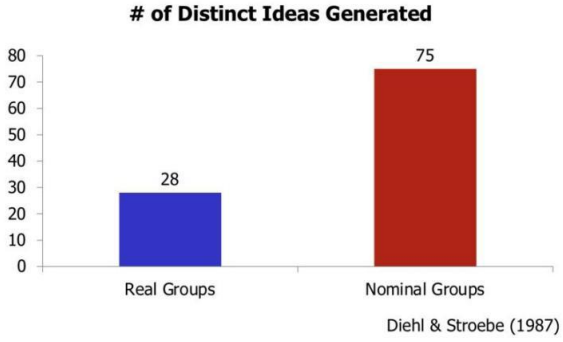

Figure 3. The result of the second experiment (Comparisons between Real Groups and Nominal Groups) [7]

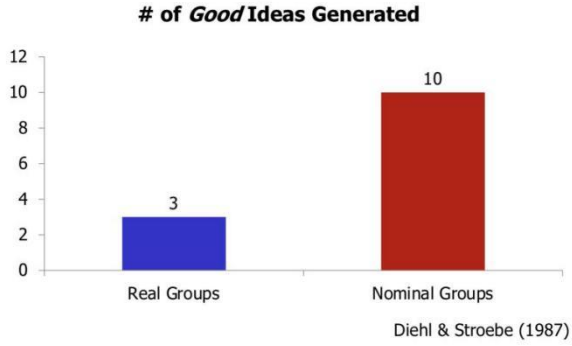

Figure 4. The result of the second experiment (Comparisons between Real Groups and Nominal Groups) [7]

After brainstorming, the “groups” which worked independently could achieve more diverse and sound ideas, comparing with another two control groups. Individuals might not be able to make decisions that are best for them within a group because the thinking of one

member tended to affect the thinking of the whole team. Furthermore, people were reluctant to voice dissenting opinions (especially they were of lower status). Therefore, In group settings, the tendency of the group to favor one course of action was taken as evidence that the group must be right. The natural human mind precipitated people to follow social norms. Individuals sometimes cannot adopt effective decisions because they perceive these measures as deviating from prevailing and socially acceptable behaviors in their reference group. For example, they might be reluctant to use updated energy-efficient technologies for fear of being stigmatized by their reference group as pretentious. Similarly, individuals might fail to engage in energy-saving behaviors, such as taking fabric bags for shopping to reduce the usage of plastic. Doing this would carry a greater risk of being stigmatized as over-frugal life.

However, there is a behavioral intervention called social comparison, which utilizes human naturals to withstand the psychological bias brought by social norms. To be more specific, social comparison can correct wrong beliefs about one's own consumption behavior in comparison to others [8]. Therefore, the interference is easily employed when some households underestimate their actual energy consumption level compared to real environmentally friendly consumers.

Functionally, there are two mechanisms to spark potential energy conservation behaviors by using social comparison. Comprehensive studies reinforced the effectiveness of the idea, which can motivate pro-social and altruistic moves. Firstly, social comparisons evoke feelings of competition [1]. The measure is especially useful to deal with the households which consumption level is placed above the average or below some thresholds. As an example, consumers (belonging to the most efficient 10% of costumers) received descriptive normative messages, which compared household's energy usage to the neighborhood, revealed sustainable energy-saving behaviors, and used significantly less energy than just received energy-saving 'tips' [2]. Furthermore, under uncertainties, individuals may implicitly assume that others have more information about socially expected behavior, and thus take others' behavior as a guide. People tend to adapt their behaviors from prevailing orientations [3]. Instead of conveying social approval for green actions, telling consumers that people of the same age or salaries are equipping new solar water heaters or LED light bulbs can motivate them to comply with these positive "energy-saving" norms and reduce their consumption accordingly. As a result, since social norms can often inspire cooperation and affect behavior on the large scale, It can be positively leveraged to solve big societal challenges [1].

Undoubtedly, social norms are context-specific [9]. Thus, practitioners need to be careful when presenting green information. If people prescribe undesirable behaviors with respect to energy conservation, the outcomes can be detrimental. Households unintentionally ignore green actions because they interpret specific "environmental-unfriendly" behaviors as socially accepted, leading to disengagement with climate change mitigation[17].

2.3 Present bias

Present bias was the most prevailing behavior broadly studied by researchers. It also contributed to irrational behaviors of humans, a perception that the values of the goods are depreciating regarded with the distance in time [15]. Economically, people triggered by present bias will mainly prefer the options that generate immediate benefits, even delay gratification could provide better utility outcomes. As an example of the street experiment, participants were asked to select a financial reward between 'received $100 now' or '$150 six months later', and a great number of citizens chose immediate financial reward but a smaller amount [16]. There are plenty of daily examples of the cognitive bias, which display the tendency that the more distant the delayed reward, the more people discount its value. Individuals understand the benefits of fitness, quitting smoking, or drying out, but most of them eventually choose the immediate outcomes, such as relaxing on the couch [10].

The impact on energy saving is deleterious, especially to the households living in the condition of poverty and stress. Vulnerable families exhibit a more extreme preference for rapid profits because, in contexts with scarce resources, individuals who borrow too much or save too little might face limited and poor financial decisions. For instance, in the market, solar water heaters are more expensive than an old-fashion gas geyser, but in the long term, using solar-powered heaters can be more cost-effective. However, poor families are afraid to buy expensive but energy-efficient products because of pressing budget concerns, constraining them to fully appreciate the delayed benefits. Household energy use is the main target of behavioral intervention and the main source of environmental pollution, so if families lived in the poverty unable to manage their energy bills or equipped green products, the energy-saving battle will never end.

Commitment devices have been testified as a sound behavioral intervention tool to help vulnerable households [6]. The purpose of employing commitment devices is to set mechanisms that allow people to make promises and carry out plans that they want to take tomorrow. The commitment can be oral promises or written pledges to themselves or the public for saving energy or conducting environmentally friendly behaviors. Households enrolled in the program can make the promise, for instance, 'I will reduce my electric and water bills 5 percent in next 3 months.' The commitment not only sets the exact variables and numbers to their plan,

but also points out a deadline for themselves [24]. Combining the commitment device with the goal-setting can automatically push the guarantors to reach the desired level of performance with a self-motivated and positive attitude. Alternatively, commitment devices can be effectively combined with the measure of mild penalty to improve the living environment of vulnerable households from supervising under external pressure like institutions and groups [6]. The real-life application includes that the practitioners can motivate poor families to save more money by creating "dedicated accounts", overseeing by banks or green groups[5]. When people pledge to join the program, they have to reach a certain level of saving each month. In order to prevent behaviors like early withdrawal from target households, external examiners will set mild penalties specifically. A field experiment was conducted in Chile to test the effect of allowing individuals to publicly announce their savings goals and the amount of money they put into private accounts each week. This intervention effectively increased savings by 65% [14]. Furthermore, When committed, the behavior creates social norms [1]. Public commitments can create expectations by others, which can foster the target to complete the pledge. Also, loss aversion from prospect theory mentioned in Part 2.1 can also help practitioners to ensure the effectiveness of commitment devices since the achievement provides a sense of accomplishment, while failure creates bigger dis-utility, even if the goal level is externally set [18].

3. CONCLUSION

To cope with problems of energy conservation, this paper mainly analyzed the measures to predict and address the complexity of human behaviors. When classic economic models cannot help researchers to understand customers' value, irrationality, and purchasing patterns, behavioral economics and psychology are successfully combined to decode and solve the behaviors deviating from these rational and profit-maximizing modes. All the cognitive biases, like loss aversion, social norms, and present bias, were constantly overlooked by practitioners and policymakers seeking to promote energy efficiency and conservation so that to develop strategies that encourage renewable and sustainable energy use, policymakers have to possess the capability to enact corresponded behavioral interventions to bridge the gap between consumers' energy-related actions and pro-environmental value. According to the article, one psychological bias can be alleviated by another bias or fixed by several different non-price interventions separately. Present bias, for example, can be overcome through commitment devices in aid of social norms and loss aversion. Undoubtedly, countless cognitive biases blocked our progress of ongoing climate mitigation plans, but future studies will be extended. The consistent efforts from economists will encourage more households to get rid of energy poverty and pursuit a more efficient life.

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