



Behavioral Economics and Energy Conservation – A Systematic Review of Non-price Interventions and Their Causal Effects

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ABSTRACT

Research from economics and psychology suggests that behavioral interventions can be a powerful climate policy instrument. This paper provides a systematic review of the existing empirical evidence on non-price interventions targeting energy conservation behavior of private households. Specifically, we analyze four nudge-like interventions referred to as social comparison, commitment devices, goal setting, and labeling in 44 international studies comprising 105 treatments. This paper differs from previous systematic reviews by solely focusing on studies that permit the identification of causal effects. We find that all four interventions have the potential to significantly reduce energy consumption of private households, yet effect sizes vary immensely. We conclude by emphasizing the importance of impact evaluations before rolling out behavioral policy interventions at scale.

1. Introduction

Climate change mitigation programs are on the political agenda worldwide. As a result of ambitious CO₂-reduction goals, policymakers are increasingly interested in non-price interventions targeting private household energy consumption. Research from both economics and psychology has shown that behavioral interventions – also referred to as nudges – can be powerful tools in shaping people's behavior in a variety of domains (see, among others, the influential publication by [Thaler and Sunstein 2008](#)).¹ Non-price measures are relatively inexpensive to implement and do not interfere with people's choice sets as strongly as, for example, taxes or bans on certain products. Consequently, policy makers are now exploring nudges as a cost-effective approach for reducing energy consumption ([Allcott 2015](#)). If proven effective, these interventions could be established as integral and complementary components of climate change policy ([Allcott and Mullainathan 2010](#), [Benartzi et al. 2017](#)). This is why researchers are increasingly interested in understanding the effect of non-price measures on residential energy consumption.

This paper presents findings of a systematic review on the

effectiveness of behavioral interventions to induce energy conservation. We study the following four interventions: social comparison, commitment devices, goal setting, and labeling. Furthermore, the review focuses on causal in contrast to correlational effects. To this end, we only include those studies that employ an empirical estimation strategy enabling the identification of a *causal* relationship between a policy intervention and consumption behavior. To our knowledge, this is the first study that systematically reviews all published results from behavioral economics and related areas of research that are based on a rigorous evaluation of causal effects.

Our study builds on a few earlier reviews that only focus on a subset of our interventions. Many of these point to potential problems of including effects from correlational studies in their sample, i.e. studies that are not able to disentangle causation from correlation. [Abrahamse et al. \(2005\)](#) evaluate the effectiveness of some interventions aiming to encourage households to reduce energy consumption. They conclude that information has an influence on knowledge, but does not necessarily result in behavioral changes or energy savings. Rewards have effects on energy conservation, but they are rather short-lived. Feedback, in particular when it is given frequently, can also be effective.

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¹ The facts that the book “Nudge” ([Thaler and Sunstein 2008](#)) has already been cited more than 9000 times (Google Scholar, checked 11/15/2017) as well as that Richard Thaler won the Nobel prize “for his contributions to behavioral economics” in 2017 ([Nobelprize.org 2017](#)) can be seen as two indicators of a growing academic interest in behavioral interventions.

More recently, Karlin et al. (2015) conducted a meta-analysis on the effect of feedback on energy usage. They conclude that feedback is effective but with significant variation in effects. Furthermore, Delmas et al. (2013) analyze the effect of information strategies on energy savings and find a substantial reduction effect on average. However, in a similar vein as Abrahamse et al. (2005), they conclude that the effect diminishes with the rigor of the study, indicating potential methodological issues in the considered literature. In particular, none of the existing reviews takes into account whether the considered studies apply a method that has the potential to identify the causal effect of the intervention, which is critical to the question of its policy relevance (Imbens and Wooldridge 2009).

Consequently, our systematic review differs from previous research by solely focusing on studies that have the potential to identify causal effects between the intervention and the outcome. Furthermore, we include articles published up to May 2017 in working paper series as well as peer-reviewed journals to provide the most comprehensive and up-to-date account of research in economics and psychology. This is particularly important because there has been a growing number of high-quality studies in the recent past. Hence, our review comprises several very recent large-scale randomized controlled field experiments. As an additional contribution, our systematic review is the first to account for labeling as a non-price intervention, which has been applied worldwide on a large scale and potentially affects millions of household decisions each year.

The paper proceeds as follows. In the subsequent section, we define and motivate the four considered interventions. Section 3 explains the methodology of the systematic review. In Section 4, we synthesize and discuss the results. Section 5 concludes with recommendations for researchers and policy makers.

2. Behavioral Interventions and Energy Conservation

A considerable percentage of annual emissions in industrial countries is induced by residential energy consumption. In addition, private households are a prime target for behavioral interventions (Karlin et al. 2015). Households may conserve energy in two ways: First, they can change their consumption of energy services, for example by reducing lighting use. Second, they can modify their purchasing behavior and invest in energy efficiency, for example by buying a highly efficient washing machine.² Both, the purchase decision and the consumption behavior, can be targeted by policy interventions. Non-price interventions are usually justified with so called internalities, i.e. externalities that the agent imposes on herself by making suboptimal choices, measured by her own experienced utility (Chetty 2015).

According to Allcott (2016), six main internalities are responsible for consumer mistakes in the domain of energy conservation: present bias, bias toward concentration, biased beliefs, costly information acquisition, exogenous inattention, and endogenous inattention. Our study selected those non-price interventions that are most common and suitable to address each of these internalities (see Table 1).³ The resulting four non-price interventions and the internalities they address are explained in more detail below.

2.1. Social Comparison

Social comparison refers to the process of giving households information about their energy consumption in relation to the

² The purchase of an energy efficient appliance will ultimately result in reduced energy consumption when expected energy savings are not completely offset by an increase in the use of the appliance, which is known as the rebound effect (see, for instance, Frondel and Vance, 2013).

³ A further important intervention in this regard is feedback. Yet, because the comprehensive study of Karlin et al. (2015) provides a recent account of the existing research on the intervention, we do not consider this intervention in our review.

Table 1
Internalities and chosen interventions.

Externality	Chosen intervention(s)
Present bias	Commitment devices and goal setting
Bias toward concentration	Labeling
Biased beliefs	Social comparison and labeling
Costly information acquisition	Labeling
Exogenous and endogenous inattention	Labeling

consumption of comparable households. Such a comparison is closely connected to also receiving feedback about one's own behavior. The chosen reference group should be relevant for the treated household (Abrahamse et al. 2005) and can be, for instance, consumers of the same energy provider or households within the same postcode-level. Moreover, the choice of the reference level is important: the household's consumption can either be compared to the average consumption level of the reference group or to a more ambitious group, e.g. the most efficient 10%.

Social comparison addresses *biased beliefs* about one's own consumption behavior in comparison to others. For example, a person might consider herself an environmentally friendly energy consumer and underestimate her actual consumption level when compared to other consumers. This biased belief can be corrected by a social comparison.

The potential energy conservation effect of a social comparison might be triggered by three phenomena. First, many people exhibit reference dependent preferences (Kahneman 2003). Accordingly, social norms can constitute a reference point. Complying with these norms increases most individuals' utility whereas deviating from it typically leads to disutility caused by social disapproval (Schubert and Stadelmann 2015). Second, in situations of uncertainty, individuals may use other peoples' behavior as orientation by implicitly assuming that those others have more information about the socially desired behavior (Allcott and Mullainathan 2010, see also Delmas et al. 2013). Consequently, people tend to adjust their actions according to the prevalent group behavior. Third, social comparisons evoke feelings of competition (Abrahamse et al. 2005). This is especially important when the household's consumption level lies above the average or above some threshold that the household perceives as desirable (for example, belonging to the most efficient 10% of costumers).

2.2. Commitment Devices and Goal Setting

Commitment devices are “a set of interventions that allow individuals to lock themselves today into the action that they want to take tomorrow” (Allcott and Mullainathan 2010, p. 2). Examples of commitment devices are oral or written pledges or promises to conserve energy (Abrahamse et al. 2005). The commitment can either be a promise to oneself, or alternatively be made public. Goal setting combines commitment with a concrete reference point. Instead of pledging to conserve energy, a household specifically promises, for instance, “to reduce energy consumption by 10 percent within the next year”. Not only setting a reduction level but also a deadline for achieving this goal facilitates an evaluation of success or failure. This increases pressure but also motivation by making satisfaction conditional on a desired level of performance (van Houwelingen and van Raaij 1989). A goal can be chosen by the household itself (being a form of commitment device) or be externally set (for example by institutions).

The idea behind voluntarily binding one's own future behavior is that some people are aware that they sometimes have time-inconsistent preferences (O'Donoghue and Rabin 1999). For instance, as O'Donoghue and Rabin (2008) point out, many people procrastinate, sometimes to the extent that the desired action is never taken. This distortion of one's own preferences is induced by *present bias*, the

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