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Reversing impatience: Framing mechanisms to increase the purchase of energy-saving appliances

Mariateresa Silvi *, Emilio Padilla Rosa

Department of Applied Economics, Universitat Autònoma de Barcelona, Spain

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ABSTRACT

Most environmental decisions involve intertemporal trade-offs, in that they require foregoing immediate gratification for the sake of future environmental quality. One such example is investing in energy efficiency, which entails an initial upfront cost in exchange for a future stream of energy and economic savings. Our experiment explores the role of individual temporal preferences in the decision to invest in energy conservation. We report results from a study on a nationally-representative sample of 2010 United States adults. Participants chose between appliances that differed solely in price and operating costs. We manipulated the salience of energy costs and primed participants with future-oriented messages. Our treatments increased energy-efficient choices by 24 percentage points compared with the status-quo scenario. Present-oriented individuals are less likely to purchase energy-efficient appliances but loss-framed messages that highlight the opportunity cost of inefficient appliances diminish the effect of impatience on refrigerators choice.

1. Introduction

The majority of individuals do not invest in energy efficiency even when the long-run economic benefits outweigh the upfront additional costs of the initial investment (Schubert and Stadelmann, 2015), a paradox known as the energy-efficiency gap. The societal relevance of the missed potential energy savings is threefold: It represents long-term loss of available income for households,[1] it contributes to global warming,[2] and it negatively affects public health.[3]

We investigate energy investments as a type of temporal dilemma since they require individuals to pay a larger sum immediately in order to enjoy a larger stream of economic savings in the future. In particular, we examine whether individuals can be induced to act more patiently and choose energy efficient devices through framing messages that highlight the opportunity costs of choosing less efficient electric appliances. We further investigate the role of individual temporal preferences in energy investment decisions and whether their impact on choice can be influenced through changes in the choice context. Temporal preferences, the tendency of individuals to be either focused more on the present or on the future, are an underexplored dimension in the literature on energy conservation. By definition, present-oriented individuals discount future well-being at a higher rate; therefore, we expect them to be less likely to invest in energy-saving appliances, since that typically involves a higher price paid today and lower electricity bills over the lifetime of the appliance.

The literature on the energy-efficiency gap has identified the underlying causes of the under-adoption of energy-saving appliances: limited information, cognitive biases, financial constraints, attention deficits, preferences for other appliance attributes, uncertainties about future energy savings, and individual time preferences (DEFRA, 2010; Epper et al., 2011; Newell and Siikamäki, 2015; Allcott and Taubinsky, 2015; Gerarden et al., 2015; Schubert and Stadelmann, 2015). The majority of empirical studies have focused on information and cognitive deficits (Schubert and Stadelmann, 2015), but their experimental treatments reached mixed results and interventions which, at best, yielded only modest efficiency increases (OECD, 2017). Policy measures

* Corresponding author.
E-mail addresses: mariateresa.silvi@uab.es (M. Silvi), emilio.padilla@uab.es (E. Padilla Rosa).

[1] Granade et al. (2009) estimated the energy-efficiency gap in the United States economy to be worth $1.2 trillion in potential energy savings against an upfront capital cost of $520 billion.

[2] Electricity and heat generation from fuel combustion are currently the largest sources of CO_2 emissions from fuel combustion globally (42% of the total in 2016) according to the International Energy Agency (2021).

[3] Particle pollution from burning fossil fuels for electricity generation in the United States contributes to nearly 15,000 premature deaths a year (Goodkind et al., 2019).

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focused on information and training typically have reached energy savings of about 2% (Rivas et al., 2016). In this paper, we focus on individual time preferences and explore whether their effect on choice can be influenced to induce greater energy savings beyond simple information provisions.

When an inefficient appliance is purchased because the individual is inattentive to or incapable of computing future operating costs, displaying this information alongside the product price can effectively help increase energy-efficient purchases. However, when the reason for such a purchase is that individuals have present-oriented time preferences, displaying such information per se will not produce any effect (DEFRA, 2010). Enzler (2013), Newell and Siikamäki (2015) and Schleich et al. (2019) have found that present-oriented time preferences are associated with higher discounting of future energy savings. Yet, the role of pure time preferences and the extent to which they can be influenced to help close the energy-efficiency gap have not been fully explored.

In this paper, we report results from a sample consisting of 2010 United States (US) adults. Participants were subjected to randomized treatments showing alternative framings of two refrigerators' energy requirements. Our core treatments display information regarding the energy consumed by each refrigerator in either i) kWh/year; ii) estimated electricity cost in US$ over the lifetime of the appliance; or iii) estimated electricity cost in US$ over the lifetime of the appliance with the addition of a message warning about the comparative future economic loss *(or gain)* compared to the alternative. With the scope of testing the power of our treatments in a more realistic choice environment, where a richer array of appliance attributes beyond purchase price and electricity consumed are listed, we repeat our core treatments by adding refrigerator images, total and freezer capacity, and color finish specifications to the choice cards. The purpose is to test whether our core treatments are equally effective even when this additional information on the choice cards is competing for the participants' attention. These differences, which are marginal and such that the participant should be indifferent to them, are randomly assigned to either the more or the less efficient appliance.

Performing a randomized experiment enables us to infer any causality nexus between the treatment and the resulting outcomes. This is because the experimental setting allows us to control the exact choice context and because the sample of participants in each group can be assumed to be homogeneous, thanks to full randomization. In addition, regression analysis helps us to control for other sources of individual heterogeneity which may affect the results.

To date and to the best of our knowledge, no study has focused on the temporal salience of operating costs relative to the capital costs. Nor has the choice context been explicitly framed as one between two sequences: one that promises long-term energy savings in exchange for a price premium paid in the present and one that grants immediate economic savings which are offset in the long term through higher energy consumption. This framing effect has never been tested in an environmental product choice context, nor has its effect been tested on individual temporal preferences. We show that the number of energy-efficient appliances chosen increases as a consequence of this framing.

The remainder of the paper is organized as follows: Section 2 synthesizes the most relevant empirical studies to date; Section 3 describes the data and methods; Sections 4 and 5 show and discuss results; and Section 6 concludes with key messages and policy implications.

2. Literature Review

There is an abundant body of literature, starting in the 1980s, that has measured how individuals supposedly trade off upfront capital and future operating costs by deriving implicit discount rates from purchase choices. These observed discount rates are typically much higher than the interest rate individuals would be charged for borrowing capital, to the extent that they have been deemed "irrationally high" (Hausman, 1979). Implicit discount rates obtained in this way vary widely across appliance categories, from 7% to 17% for lightbulbs to 39%–300% for refrigerators (Schubert and Stadelmann, 2015). However, such discount rates may reflect considerations beyond cost optimization, for example, risk or uncertainty aversion—i.e., to the fact that the future savings from electricity may actually not materialize, the inability to finance the purchase of the more efficient appliance, or preference for other appliance attributes such as dimensions or appearance as shown in Fig. 1. Hence, these discount rates cannot be considered as reflecting pure temporal preferences (Gerarden et al., 2015). In addition, a number of deviations from the expectations of neoclassical economics have been found to influence energy efficiency choices, including status-quo bias, present bias myopia or bounded rationality (Cattaneo, 2019). Therefore, a number of interesting questions remain unanswered, such as: What is the contribution of pure time preferences to the energy-efficiency gap? To what extent does myopic preferences drive these abnormally high discount rates? Can we influence energy-saving product choices by manipulating label information on the salience of intertemporal costs and benefits?

Research has shown that individuals largely ignore ancillary costs (such as maintenance or operating costs) when making investment decisions (Allcott and Wozny, 2014; DEFRA, 2010). Half of vehicle buyers admit to not considering fuel costs in their purchase decisions (Allcott, 2011), and buyers often disregard the price of ink cartridge replacements when purchasing a printer (Hall, 1997). Individuals are also unable to estimate the energy usage of their appliances and the costs associated (Attari et al., 2010; Epper et al., 2011). Even when salient to the buyer, information regarding the running costs of energy-efficient appliances can be hard to process (OECD, 2017). Most energy labels, such as the European Union's energy-efficient rating system, indicate the efficiency of the appliance relative to similarly sized counterparts and estimated annual *kWh* consumption (Rohling and Schubert, 2013). Evidence from experimental studies, however, shows that consumers focus mostly on the former. This can induce buyers into the "energy-efficiency fallacy," the tendency to infer the amount of energy required by an appliance from its energy rating (Waechter et al., 2015a; Waechter et al., 2015b) rather than from the estimated *kWh* usage. For the same reason, consumers may end up buying appliances that are efficient but also consume more because they are bigger—which is the "volume-effect" (Stadelmann and Schubert, 2018). Furthermore, the estimated annual *kWh* usage is not easily translatable into economic terms. This would require the consumer to retrieve the price he or she pays for a *kWh* of electricity and compute the potential cumulative savings from running an appliance over the years relative to the initial price for each appliance he or she is considering buying. The non-availability of such information and the cognitive effort associated reduces the likelihood that energy savings will be considered preeminently in the purchase decision (Blasch et al., 2019). For these reasons, *kWh* per year is considered an opaque characteristic (DECC, 2014).

A few recent field experiments manipulated appliance labels by explicitly including the economic cost of operating the appliance. The effects were, however, inconclusive: this intervention led to a modest increase in the purchase of energy-efficient tumble dryers and washer driers, but it was ineffective or in some cases, it even decreased the purchase of energy-efficient refrigerators in different experiments (Kallbekken et al., 2013; Department of Energy and Climate Change, 2014; Schubert and Stadelmann, 2015). More specifically, Kallbekken et al. (2013) deployed a redesigned efficiency label showing estimated lifetime operating costs for tumble dryers and fridges-freezers. They found no statistically significant effect for fridges-freezers and a 4.9% reduction in average energy use for tumble dryers (the energy savings were only 3.4% when the effect of staff training was excluded). The authors concluded that this type of intervention would be effective only for appliances for which the energy cost constitutes a major portion of the total lifetime cost. A field experiment by the UK Government's Department of Energy and the Behavioral Insights Team added a tag on top of the EU energy-efficiency label displaying estimated lifetime

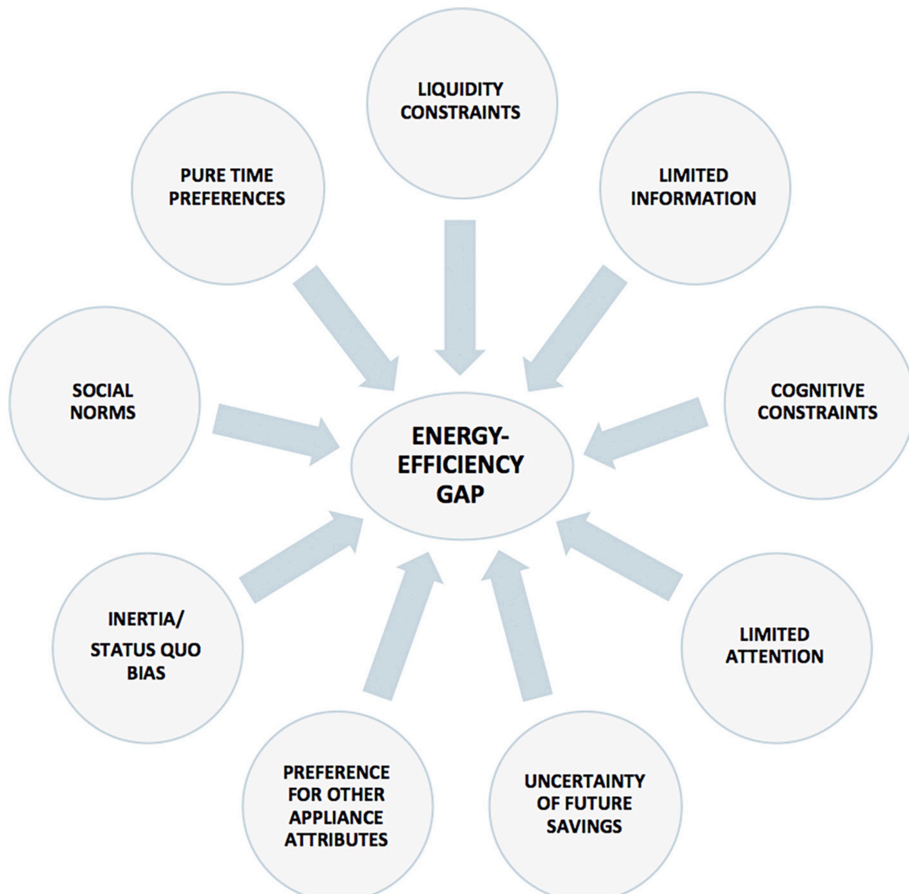

Fig. 1. Causes of the energy-efficiency gap.
(Source: own elaboration based on the authors' literature review)

electricity costs for combined washer-dryers, washing machines and dryers in 19 electronics stores across the country. They monitored sales in 19 other stores of the same chain that were exposed solely to the EU energy-efficiency label as the control group (Department of Energy and Climate Change, 2014). The experiment yielded a 0.7% reduction in the energy consumption of washer-dryers sold to the treatment group and no significant effect for the two other appliances. A cost–benefit analysis from a nationwide adoption of the intervention revealed that despite the limited impact of the treatment, the benefits from avoided CO_2 emissions would vastly outweigh its low implementation costs. In 2015, an online experiment commissioned by the Swiss Federal Office of Energy conditioned the online purchases of freezers, vacuum cleaners, tumble dryers and televisions with two alternative energy labels. Buyers were either exposed to the standard EU energy label or to another displaying i) the lifetime operating costs expressed as losses or gains relative to the average of all appliances; and the ii) annual electricity cost from running the appliance, expressed as a color-coded scale comparing products of the same typology. Both labels led to higher purchases of energy-efficient appliances compared with the baseline scenario with no label. The energy-cost label was slightly more effective in reducing average energy consumption for tumble dryers compared with the EU energy label (by an additional 1.6 percentage points), but both had no effect on the purchase of freezers. The EU label was instead twice more effective than the energy-cost label in reducing energy consumption (−10.2% against −4.5%) from the purchase of efficient vacuum cleaners (Schubert and Stadelmann, 2015). In a hypothetical experiment, Skourtos et al. (2021) found that displaying the annual operating costs on energy labels of refrigerators did not affect choices, because the annual differences in operating costs were relatively low.

As these studies show, providing information on operating costs can, in some cases, lead to modest efficiency increases, particularly if operating costs are high relative to the total lifetime costs. But it can be ineffective or even counter-effective if the operating costs are quite low, such as for small appliances (e.g., vacuum cleaners) or if they are expressed in annual differences. These limited effects may be due to the fact that merely showing operating costs is not enough to influence individual temporal preferences. To this purpose, we manipulate the information on present and future costs by making the intertemporal dimension of choice more obvious to the prospective consumer. Our experiments recreate the status quo—where electricity consumption information is expressed in *kWh*, but we also reproduce the treatments of the experiments mentioned above—merely translating electricity consumption in economic terms—in order to use these results as benchmarks against which to evaluate our own treatments. This enables us to compare with previous experiments but also to investigate whether manipulating the information in a way that makes the intertemporal trade-off more explicit can increase the choice of energy-efficient appliances beyond merely expressing the energy consumed in monetary terms.

Behavioral studies aimed at depicting a realistic understanding of intertemporal choice have highlighted two opposing prevailing intertemporal preferences (Berns et al., 2007). On the one hand, they showed individual preferences for immediate gratification. On the other hand, a lesser-known strand in the literature has shown that individuals have a preference for improving outcomes, i.e., saving the best for later (Loewenstein and Prelec, 1991; Loewenstein and Sicherman, 1991; Chapman, 2000; Frederick et al., 2002). While the former strand of literature depicts individuals as shortsighted and present-biased, the latter proposes that they are patient and forward-looking. The implications for energy-saving investments are straightforward. The former approach suggests that they are unlikely to occur because individuals positively discount future energy and monetary savings, whereas the latter depicts a more optimistic view, suggesting that people can anticipate the future benefits of energy-saving investments and make sacrifices in the present with that perspective. While neoclassical economic theory postulates that individual time preferences are constant in eliciting the same choice options, regardless of the way they are framed (Tversky et al., 1988), a variety of framing effects have been found to affect intertemporal choice (Lewis, 2018). As Ebert and Prelec (2007) observed, the temporal dimension has an "optional status," in that it can be pushed into the background or become a key concern depending on aspects of the choice situation. This makes sensitivity to time extremely susceptible to manipulations, such that simply drawing people's attention to time can eliminate present bias (Goodman et al., 2019; Lewis, 2018). The variability in reported discount rates between and within product categories, mentioned at the beginning of this section, would seem to suggest that discount rates are indeed malleable and sensitive to framing (DEFRA, 2010).

In particular, our experiments are inspired by two well-documented framing effects, *hidden-zero framing* and *delay/speed-up asymmetry*. The *hidden-zero framing* explicitly expresses that in the future, the individual will be getting nothing or even losing from choosing immediate gratification. By unveiling the otherwise hidden opportunity costs of impatience, the effect of this framing was found to reverse temporal preferences and induce more forward-looking choices in several experiments (Loewenstein and Prelec, 1993; Read et al., 2005; Magen et al., 2008; Wu and He, 2012; Scholten et al., 2016; Read et al., 2017) and to reduce implicit discount rates (Faralla et al., 2017). In the *delay/speed-up asymmetry* framing, individuals are either asked to delay immediate gratification or to anticipate a later reward; evidence shows that people discount more under the first condition (Weber et al., 2007). This strand of research suggests that evoking forward-looking thoughts in the choice process (such as recalling the future electricity savings of a more efficient appliance) can lead to less impatient choices. Frederick and Loewenstein (2008, p. 233) concluded that individuals possess various cognitive patterns which "may be evoked or suppressed by subtle contextual features" and that pairing events in a sequence may encourage individuals to consider emotions they may have otherwise not included in the decision process. These studies suggest that simply changing the construal of alternatives without changing their actual value has an impact on our ability to make optimal intertemporal decisions (Magen et al., 2008).

To our knowledge, only three studies analyzed the relationship between pure temporal preferences and the energy-efficiency gap. In two hypothetical online experiments, Enzler (2013) and Schleich et al. (2019) found that individuals who were more present-oriented were less likely to choose energy-efficient options. In a similar setting, Newell and Siikamäki (2015) found that the US energy label that shows the estimated operating costs of running different electrical appliances is less effective on individuals who discount more future outcomes. These authors show that present-focused time preferences are associated with higher discounting of future energy savings, and that leads to underinvestment in energy efficiency. If time preference has a role in determining the adoption rate of energy-efficient appliances, and if it is not an innate and immutable individual characteristic but can instead be influenced (Chapman, 1998), then it should be possible to increase energy-efficient investments through framing manipulations.

3. Methods

We developed our hypothetical experiment in three stages. We first conducted a pilot of the experiment on undergraduate students at a Spanish University to understand how they approached and processed large purchases decisions and how to make the hypothetical choice more realistic and easier to relate to. The information collected was used to define the choice card design and refine the textual messages. Second, we tested the two core treatments on energy consumption information on another 224 undergraduate students, the results from this test are included as Annex 1. Third, we run the actual experiment on a nationally representative sample of the US population. The experiment was awarded funding and implemented through the Time-Sharing Experiments for the Social Sciences (TESS), a program financed by the US National Science Foundation (NSF).[4] The sample used for the experiment consisted of 2010 adults (51.6% female, mean age = 48.3 years) from an AmeriSpeak pre-screened pool of participants who were invited to respond to a survey online between June and August, 2020.

3.1. Experimental Design and Additional Data Requirements

Participants chose between two refrigerators, an energy efficient one—here in the article referred to as green—and an otherwise identical, less efficient alternative—gray. We defined the context as a refrigerator replacement decision and the choice as being between two appliances that the participant had hypothetically pre-selected among various models. Participants were told that the two refrigerators differed solely in price and energy consumed and that they were otherwise equal. The experiment followed a 2 × 3 factorial between-subjects design: one factor defining alternative framings of the appliances' energy requirements and the other factor pertained to the number of attributes shown for each refrigerator.

The energy consumption factor had three levels:

i. *Control:* cards showing the purchase price and the annual electricity usage in *kWh* of each appliance. This level reproduces the status quo.
ii. *Treatment 1 (T1):* cards showing the purchase price and the annual electricity cost for the expected lifetime of each appliance. This level reproduces what has been done in the earlier literature, in both field and hypothetical experiments. This enables us to compare our own treatment (T2) below, against previous findings.
iii. *Treatment 2 (T2):* cards showing the purchase price, the annual electricity cost for the expected lifetime of each appliance, and an additional "patience-inducing" message on each card showing the lifetime loss (avoided loss) in electricity cost compared with the more efficient (less efficient) appliance. The message mentions the date by which such loss (gain) would be realized, potentially engaging participants into anticipating their future emotions in that regard.

The second factor had two levels:

i. *High focus on electricity consumption:* cards showed only price and electricity consumption for each appliance, which reflects the standard practice of hypothetical choice experiments in this field.
ii. *Low focus on electricity consumption:* cards showed also additional appliance features such as total capacity, freezer capacity, color, and an image. These additional features varied marginally such that participants would be expected to be indifferent to them, and they were randomly assigned to either the energy-efficient or inefficient option. The purpose of adding these features was to mimic a more realistic choice environment where several appliance features are presented to the prospective buyers; and to test whether the effectiveness of our treatments would diminish when more information

[4] TESS contracts NORC at the University of Chicago, a research institution that uses AmeriSpeak, a nationally representative probability-based panel composed of US adult residents. TESS-funded experiments in the economics field include Taubinsky and Allcott (2013) and Davis and Metcalf (2016).

competed for the user's attention, which is similar to what was done in Andor et al. (2020).

Participants were randomly assigned to one of the resulting six groups. Table 1 summarizes the six conditions and illustrates the actual choice cards participants were presented with.

After the experimental session, all participants responded to the same post-experiment questionnaire, which included three sections:

i) a text asking for the percentage of electrical appliances out of the total they had bought in the previous three years that had the Energy Star certification[5];
ii) one question where they had to rate on a Likert scale of 0–5 how representative five statements were of them. These items were taken from the Consideration of Future Consequences Scale (Strathman et al., 1994), a scale which was used to measure individual temporal preferences and that was adopted in previous similar studies (Enzler, 2013); and
iii) a matrix where they had to rate how much they agreed on a Likert scale of 0–5 with a statement declaring that individuals can play an important role in protecting the environment. This question is the same used in the Eurobarometer survey and it is normally interpreted as a measure of ascription of personal responsibility to take care for the environment.

Several variables with socio-demographic data about participants, as well as their political views, saving habits, living conditions, and calculus abilities that had been gathered by the National Opinion Research Center (NORC) in previous surveys were made available to the researchers. The full survey and additional screenshots of the experiment are included as Annex 2.

3.2. Appliance Choice

We chose refrigerators, among other electric appliances, for the following four reasons. First of all, refrigerators are among the most energy-consuming appliances in the household; therefore, operating costs over the lifespan of the appliance are quite significant. Second, refrigerators are running all the time, and therefore we can reliably estimate the energy they consume independent of usage patterns, unlike air conditioners or dryers, where household size or the local climate would hamper these estimations. Third, refrigerators are the most common energy-intensive appliances. Hence, this hypothetical experiment is directly relatable to a high number of participants. Fourth, previous research shows that individuals discount the future cost of operating refrigerators at a much higher rate than any other appliance (between 39 and 300%) (Train, 1985; DEFRA, 2010; Epper et al., 2011), thus indicating a high potential for behavioral intervention.

3.3. Appliance Characteristics

In the literature, an energy-efficiency gap exists if there is an energy-efficient product that is cheaper in terms of total lifetime costs (adding capital and lifetime energy-running costs) than other less efficient equivalents, yet it is not purchased (OECD, 2017). Consistent with the literature (Newell and Siikamäki, 2015), to represent the trade-off between a higher purchasing price and lower energy consumption, one appliance has a lower purchase price but a higher energy cost, such that the difference in energy costs is higher than the difference in purchasing costs. More specifically, the capital cost of the inefficient appliance x_a is lower than that of the efficient x_b, but its yearly operating costs y_a are higher than those of the efficient appliance y_b. Hence, over the lifetime of the appliance, the operating cost savings from running the efficient appliance—discounted by the rate r, the opportunity cost of capital—outweigh the initial difference in their capital costs.

$$x_a < x_b\ y_a > y_b \rightarrow \delta^t > 1 \rightarrow \sum_{t=0}^{T} (y_a - y_b)\delta^t > (x_b - x_a) \tag{1}$$

where $\delta^t = 1/(1+r)^t$ is a discount factor representing the value of one unit of currency, delayed by one year, given the rate faced by the consumer for borrowing and lending money. To ensure that each refrigerator option is realistic, we determined the range of operating costs and the range of purchase prices in a way that matches the actual range of appliances currently available in the US market. To determine the appliances' *purchase prices,* we selected a mid-sized refrigerator typical of the reference market[6] and analyzed the appliances available within this capacity range in the online catalogues of the three chief appliance retailers at the time of the survey (Sears, Best Buy, and Lowe's). This helped determine an initial range of prices. Within these ranges of prices:

i. The price of the less efficient appliance was fixed at the maximum within the 1st quartile of prices observed in the market for that capacity range. That price was $1099.99.
ii. The price of the more efficient appliance was calculated as 25% more expensive relative to the price of the other product. That price was $1373.99.

This pricing methodology is similar to a study commissioned by the European Commission (IPSOS, 2014). The two prices obtained with this methodology appear to be good estimates as they fall slightly below and slightly above the national averages, respectively. More specifically, according to the US Bureau of Labor Statistics, the yearly expenditure on refrigerators per household was on average US$83 in 2018 (US Bureau of Labor Statistics, 2020). Multiplying this sum by the average lifespan of non-commercial refrigerators, leads to an average appliance price that is between the two prices estimated.

The *range of estimated energy consumed in kWh* corresponds to the range available on the US Energy Guide label for all similar models available in the market. To calculate *yearly operating costs,* we multiplied the extremes of this range for the most up-to-date national average price of electricity per *kWh* in the country at the time of the survey, taken from the US Energy Information administration website (US$0.13/*kWh,* March, 2020 figure) (US EIA, 2020). ***Lifetime operating costs in US$*** were calculated by multiplying the yearly operating costs by the average years of duration. Lifetime operating costs were not discounted, because the intent of the exercise was to let individuals apply their own discount rate in full. We deemed imposing a discount rate and explaining the concept of discounting to laypersons to unnecessarily complicate and distort responses as results from focus groups in Kallbekken et al. (2013) also demonstrate. This choice is consistent with the literature (Kallbekken et al., 2013; DECC, 2014; Stadelmann and Schubert, 2018). After reviewing different estimates of the *average years of duration for residential refrigerators* in the US, we chose the estimate from the latest analysis available on the topic, undertaken by the E.O. Lawrence laboratory at the Berkley University (Lutz et al., 2011). Differently from earlier estimates which rely on informal manufacturers' experiences (US AIS, 2000), Lutz et al. (2011) combined residential survey data with manufacturer data on historical shipments. The authors conclude that the average lifespan of a refrigerator in the US is 19.7 years, which we rounded up to 20 years for simplicity in the experiment.

[5] Energy Star is a voluntary certification system in use in the United States. Electrical appliances need to have passed a series of efficiency tests established by the Environmental Protection Agency in order to bear the Energy Star yellow sticker.

[6] We determined that side-by-side, stainless steel models with ice makers within 24–25.1 cubic feet would be a good average model of reference.

Table 1
Matrix summarizing the 6 experimental conditions.

	Factor 1: Electricity cost framing		
Factor 2: Competing attributes	kWh: annual electricity usage in kWh	Electricity cost: the total electricity cost in US$ for the expected lifetime (20 years) of each appliance	Electricity cost loss: the total electricity cost in US$ for the expected lifetime (20 years) of each appliance. An additional message showing the lifetime loss (avoided loss) in electricity cost compared to the more efficient (less efficient) appliance.
Only purchase price and electricity consumption	Control: group 1	Group 2	Group 3
Purchase price and electricity consumption + Additional attributes	Group 4	Group 5	Group 6

Control: group 1

	Refrigerator A	Refrigerator B
Price	$1373.99	$1099.99
Electricity consumed	608 kWh/year	825 kWh/year

Group 2

	Refrigerator A	Refrigerator B
Price	$1373.99	$1099.99
Electricity consumed	$1591/20 years	$2158/20 years

Group 3

	Refrigerator A	Refrigerator B
Price	$1373.99	$1099.99
Electricity consumed	$1591/20 years You avoid losing $567 in energy costs through 2040.	$2158/20 years You lose $567 in energy costs through 2040.

Group 4

	Refrigerator A	Refrigerator B
Image		
Price	$1373.99	$1099.99
Electricity consumed	608 kWh/year	825 kWh/year
Total capacity	24.6 Cubic Feet	24.4 Cubic Feet
Freezer capacity	8.9 Cubic Feet	8.9 Cubic Feet
Color finish	Stainless Steel	Metallic Steel

Group 5

	Refrigerator A	Refrigerator B
Image		
Price	$1373.99	$1099.99
Electricity consumed	$1591/20 years	$2158/20 years
Total capacity	24.6 Cubic Feet	24.4 Cubic Feet
Freezer capacity	8.9 Cubic Feet	8.9 Cubic Feet
Color finish	Stainless Steel	Metallic Steel

Group 6

	Refrigerator A	Refrigerator B
Image		
Price	$1373.99	$1099.99
Electricity consumed	$1591/20 years You avoid losing $567 in energy costs through 2040.	$2158/20 years You lose $567 in energy costs through 2040.
Total capacity	24.6 Cubic Feet	24.4 Cubic Feet
Freezer capacity	8.9 Cubic Feet	8.9 Cubic Feet
Color finish	Stainless Steel	Metallic Steel

3.4. Hypothetical Bias

It is possible that choices made in a hypothetical environment may differ from choices in the real world. For instance, individuals may be unable to accurately represent their preferences if given a hypothetical scenario they had never experienced. Alternatively, they may not engage enough with experimental choices when they are not going to bear any consequences in real life. Experimental economics typically addresses this limitation by adding real incentives to experiments, thereby linking real consequences to the hypothetical environment. Unfortunately, compensating participants with economic sums proportional to the amounts mentioned in our experiment was financially unfeasible with such a large number of participants.

However, there is no reason to believe that the hypothetical bias would have affected a specific treatment group more strongly. Rather, we think that if there was any hypothetical bias, it should have affected all groups equally. In this sense, we expect the relative differences in the outcome variables of the different groups to be potentially comparable with what they would be in a real world context. Likewise, studies comparing hypothetical choice settings with revealed preference approaches have shown that treatment effects tend to be of the same size (Carson et al., 1996; Ebeling and Lotz, 2015) or significantly correlated (Attanasi et al., 2018). Finally, to check for hypothetical bias, we analyze answers to the question regarding how many energy-efficient electrical appliances participants had purchased in the last five years. Comparing these answers with experimental choices allows us to detect potential hypothetical biases. An additional advantage of survey experiments, compared with a field experiment, is that they allow us to tightly control the decision environment, and they provide a vast array of information on our participants. This enables us to identify and disentangle various elements that concur with the end result and unveils the behavioral mechanisms defining individual choices.

3.5. Outcome Variables and Analysis

Differences between the choices of the treatment groups revealed the effectiveness of performing the two treatment manipulations against the baseline scenario in the promotion of energy-saving investments. The main outcome variable is the percentage of individuals choosing to purchase the energy-efficient (green) appliance over the less efficient (gray) one. Based on these percentages, we are able to calculate the estimated energy savings generated from each treatment, had such appliances been purchased in the real world.

To establish the determinants of energy-efficient choices, we estimate logit regressions of the form:

$$Y_{(i)} = \beta \bullet \text{Treatment}_{1(i)} + \gamma \bullet \text{Treatment}_{2(i)} + \delta \bullet \text{FOS}_{(i)} + \theta \bullet \text{Treatment}_{1(i)} \bullet \text{FOS}_{(i)} + \vartheta \bullet \text{Treatment}_{2(i)} \bullet \text{FOS}_{(i)} + \mu \text{Attr}_{(i)} + \text{a}_{(i)} + \varepsilon_{(i)} \quad (2)$$

where $Y_{(i)}$ is our dependent variable. It is a 0–1 dummy variable set to 1 participant *i* chose the green appliance, and 0 otherwise.

$FOS_{(i)}$ stands for Future Orientation Scale. It is a 5–25 scale measuring individuals' temporal orientation; the higher the value, the more future-oriented the individual is. Additionally, we look for interaction effects between the treatments' variables and $FOS_{(i)}$.[7]

$\mu Attr_{(i)}$ is a 0–1 dummy variable set to 1 if the participant could see additional appliance attributes in the choice cards, such as image and total capacity, and 0 otherwise.

$a_{(i)}$ is a vector consisting of individual-level and state-level socio-

[7] FOS was constructed by summing answers on a 1–5 scale to 5 questions measuring individual future orientation.

demographic controls as well as a control for individual environmental orientation. These controls increase the precision of our estimates and correct for the slight socio-demographic imbalances observed between groups. The controls included are:

i. Demographic controls: sex, age, race, education, employment status, marital status, State, religion, church attendance, ideology, party ideology, and financial literacy.
ii. Household characteristics controls: home type, household size, telephone service type, metropolitan area dummy, and internet availability.
iii. Economic indicators: household income scale, three dummy variables capturing whether the person expects their economy to worsen in a year, whether the person saves systematically a portion of income, and whether the person pays rent for his or her home.
iv. Environmental orientation: whether the person feels he or she can play a role in caring for the environment, on a 1–5 scale.

4. Results

In this section we include results organized by topic, combining results from our econometric analysis with qualitative analysis.

While random assignment of participants to groups presumably leads to homogenous groups, we calculated descriptive variables of the sample by group to ensure that these groups were balanced (Table 2). Groups were homogenous, as the *p*-values of the ANOVA test of equal variances (for the continuous variables) and the *p*-value of the Kruskal-Wallis test (for the ordinal variables) show.

4.1. Effect of Treatment on Appliance Choice

We start with a graphical representation of our key results. The variable of interest across all groups is the percentage of participants picking the green appliance. As shown in Fig. 2, the proportion of participants choosing the green appliance increases from 57% (in the control group) to 72% in T1 and to 75% in T2 when the survey displays only the appliance prices and electricity requirements.

The same upward trend from Control to T2 is repeated when additional appliance features are shown to the participants (from 47% to 71%). However, the percentage of green choices is always lower compared with the case in which these additional features are not shown. Introducing more appliance features clearly reduces the participants' focus on energy efficiency, leading to a greater proportion of energy-inefficient choices. Even in this context, which mimics more closely a real-life choice environment, T1 and T2 appear to be particularly effective, with a 17- and 24-percentage point increase in green refrigerator choices, respectively, compared with the control group. A Kruskal-Wallis H test was conducted to determine if the likelihood of choosing the green appliance was different for the three conditions. The test showed that there is a significant association between treatment and appliance choice. There is a statistically significant difference in the likelihood of choosing the green appliance between the three groups ($\chi 2$ (5) $= 57.756$, $p = 0.0001$).

We calculated the total kWh/year that would be consumed under the Control and T2 scenarios (with additional appliance features) by taking into account the percentage of individuals choosing green appliances in those conditions, and we found that total kWh consumption decreases by 7.15%. Considering that 12.4 million refrigerators were sold in the US in 2019 (AHAM, 2020), we calculated the potential energy savings that could be generated on a national scale, assuming that choice was restricted to these two models. We estimated energy savings worth 642.6 million kWh/per year for the refrigerators sold in a given year. Hypothetical experiments are believed to be better suited to provide qualitative rather than quantitative insights (Epper et al., 2011). In order to establish a comparison between our hypothetical experiment and the field experiments mentioned in the literature section, we compared the decrease in kWh consumption they achieved with our T1—which reproduces the treatments provided by these experiments in a hypothetical scenario—. The decrease in kWh achieved in our T1 totals 5% (when additional appliance attributes are included) or 4.5% (when choice-cards only mention price and electricity cost). In the field experiments testing the same treatment as in T1, the decrease in kWh obtained ranged between 0 and 4.9%, depending on the experiment and the appliances being considered. So, while we cannot reliably predict the size of the effect that T2 would have in a field or real world scenario, we can nonetheless observe that the effect of our T1 falls withing the range observed in field experiments. As such, we could expect that T2 could produce effects that are commensurate in size to our experimental results.

The results of our econometric estimations are reported in Table 3. In column 4, we find that both T1, i.e., merely expressing energy cost in total € over 20 years of use, and T2, i.e., adding a message highlighting the relative future losses compared with the other appliance, are both statistically significant at the 99% confidence level (controlling for demographic and household characteristics). The coefficients show that being in either group increases the likelihood of choosing the green appliance, compared with the control group. These results are robust regardless of whether socio-demographic controls and household characteristic controls are included (columns 2–4). In column 8, we compute marginal effects based on the equation in column 7, and we find that being in T1 increases the probability of choosing the green appliance by 16.6%, while being in T2, increases the likelihood of choosing the green appliance by 19.7%. Both estimates are statistically significant at the 99% confidence level. Pseudo-R^2 reaches 10%. This level of R^2 is similar to that of other papers in the field and is considered an acceptable level, given the complexity of human behavior (Langbein, 2015). Based on the qualitative and quantitative evidence presented, we are able to conclude that T2 is statistically more effective than T1 in increasing energy-efficient choices.

Participants who visualized additional information on the refrigerators—beyond price and electricity requirements—were less likely to choose the efficient appliance. We thus interpret this result as the consequence of a distraction from electricity consumption information. The additional refrigerator characteristics (image, total refrigerator capacity, and color) varied minimally between appliances and were randomly associated with either the green or gray appliance. We thus expected that participants would be indifferent to these differences. To check for this hypothesis, in column 5, we include dummy variables capturing whether individuals chose refrigerators with Image A, stainless steel color, a marginally smaller total capacity, and smaller refrigerator capacity. We find that only the coefficient for smaller freezer size is statistically significant and has a negative sign, signaling that a preference for a slightly larger freezer explains a small part of the above result. Yet, we notice that adding these controls to the regression does not alter the findings previously discussed; the other coefficients maintain their sign and size. Electricity prices in the US, vary widely across States. At the time of the survey they ranged between US$0.09/*kWh* in Oklahoma to US$0.32/*kWh* in Hawaii. We thus added State level kWh electricity price as an independent variable in our model but did not find a statistically significant effect, and we thus did not report this regression. It is to be expected, however, that the effect of T1 and T2 would be even more pronounced in countries with higher electricity prices, should operating costs be calculated using local prices as opposed to the national average, an expectation which is line with findings from Davis and Metcalf (2016).

4.2. Effect of Temporal Orientation on Appliance Choice

The temporal preferences survey allowed us to construct a continuous scale FOS, with higher values indicating that participants are more future-oriented. Fig. 3 below shows the proportion of energy efficient

Table 2
Main descriptive statistics of the sample by group.

Variables	Control. with additional features	Control	T1. with additional features	T1	T2. with additional features	T2	*p*-value form *F* test
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Median age	46.95 (0.905)	48.74 (0.923)	47.91 (0.923)	47.60 (0.951)	49.76 (0.949)	49.05 (0.939)	0.294
Female (%)	51%	53%	54%	49%	50%	53%	0.8572
Income (1 v. low–18 v.high)	9.75 (0.229)	9.75 (0.214)	9.71 (0.230)	10.26 (0.211)	10.10 (0.248)	10.16 (0.220)	0.322
Education	9.57 (0.150)	9.55 (0.153)	9.42 (0.159)	9.62 (0.166)	9.61 (0.173)	9.45 (0.169)	0.934
Future Orientation Score (FOS)	17.87 (0.198)	17.78 (0.198)	17.77 (0.205)	18.15 (0.196)	18.29 (0.183)	18.24 (0.179)	0.192
Individual Responsible for the environment (1 agree–5 disagree)	4.29 (0.278)	4.35 (0.271)	4.37 (0.292)	4.40 (0.291)	4.32 (0.296)	4.10 (0.052)	0.973
In the next years my income will worsen (%)	56%	56%	57%	58%	53%	58%	0.888
Energy Star purchases (%)	39.63% (2.53)	35.86% (2.42)	38.75% (2.52)	40.32% (2.56)	34.68% (2.47)	38.11% (2.49)	0.575
N. participants	344	352	327	328	323	336	

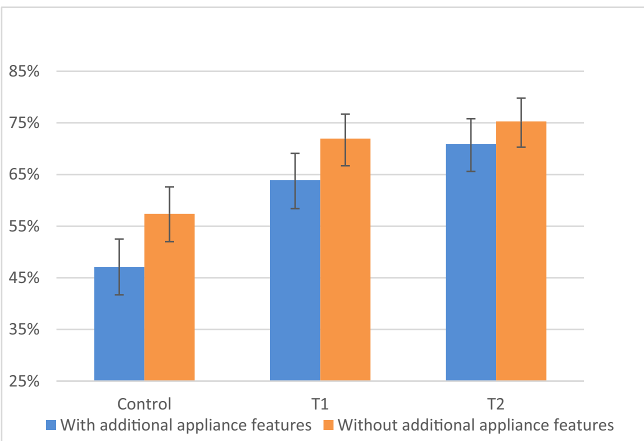

Fig. 2. Proportion of energy-efficient choices per condition.
(Source: own computations based on own experimental data on 2010 US adults. Error bars show confidence intervals at 95% level.)

choices made by individuals clustered by their FOS quartiles. Data show that higher FOS scores (more patient individuals) are associated with a greater proportion of energy efficient choices. This pattern is, however, more obvious for individuals in the control group and in T1. From Fig. 3, we can also conclude that T2 is the most effective treatment for the most present-biased and the most forward-looking individuals alike (Q1–Q3). However, for individuals in the top quartile, T1 is slightly more effective than T2 when the additional appliance features are not present. Econometric analysis in Table 3 further confirms that more future-oriented individuals are more likely to choose the efficient appliance for every additional point in the FOS scale, the coefficients are statistically significant with positive sign at 0.01 significance level.

Wondering whether the effect of individual temporal preferences depended on condition, we calculated the marginal effects of being included in T1 or T2 for each additional unit increase in the FOS score (Fig. 4, calculated in the equation in column 7, Table 3). The effect of being included in T1 and T2 positively contributes to the likelihood of choosing the efficient appliance (compared to the Control group). T2 is more effective than T1 for each FOS score level. The effect of both treatments is stronger on individuals with lower FOS scores and it diminishes as FOS increases. This finding matches the intuition that individuals who are already future-focused do not need as many reminders of the future consequences of choosing immediate gratification.

Additionally, we conducted a one-way ANOVA analysis to stablish whether there is a statistically significant difference in the FOS score between individuals who choose the green appliance and the gray appliance in each treatment group. Table 4 shows average values (for treatments excluding additional appliance features) and standard errors in parentheses. In all groups, individuals choosing the green appliance have higher FOS scores on average. However, the FOS score differentials are significantly narrower in T2, 46% and 42% less compared with the differences in the Control and T1 groups, respectively. These differences are statistically significant at the 0.01 and 0.1 significance level, as the *p*-values from F-tests in the last column indicate. This is also consistent with results from the Spanish pilot. We consider the narrow gap in FOS scores for T2 as an indication that reminding individuals about the future implications of the available choices with a priming message manages to partly control for pre-existing individual temporal preferences, possibly by convincing some impatient individuals to choose the efficient, more expensive refrigerator.

This effect, however, is not confirmed when additional appliance attributes are displayed, as Fig. 5 below graphically illustrates. This suggests that the presence of a wider array of appliance features may water down the effects of T1 and T2 on temporal orientation. We also estimated interaction terms between FOS and T1 and T2. In both cases, however, the coefficients were not statistically significant (Table 3, columns 10 and 11).

4.3. Effect of Treatment on Other Individual Characteristics

In column 6 of Table 3, we include the four economic controls and the environmental-orientation control previously mentioned, plus two dummies equal to 1 if the participant identifies to some extent with the Republican Party and if he or she could solve a basic percentage calculus. Of these additional variables, only identifying with the Republican Party has a statistically significant coefficient, with negative sign. This might be due to the well-documented climate-change skepticism of conservatives and a possible politicized perception of energy savings as a Democratic Party trait. This interpretation is consistent with Gromet et al. (2013) who found that politically conservative individuals are less in favor of energy-efficient investments.

We estimated a minimal response time for understanding the whole survey as requiring about 4 min. We thus repeat the regression in column 6 to exclude participants who completed the survey in less than 4 and 9 min, respectively (columns 7 and 9). If we restrict the analysis to answers that took more than 4 min, the coefficient for environmental orientation is statistically significant at the 0.05 significance level and has a positive sign. The R^2 also increases, and the model contributes to

Table 3
Regression output.

Variables	Appliance choice (Logit)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7) dur > 4 min.	(8) Marg.eff.	(9)dur > 9 min.	(10)	(11)
Treatment 1: operating costs info	0.647*** (0.148)	0.649*** (0.147)	0.671*** (0.151)	0.701*** (0.151)	0.710*** (0.150)	0.713*** (0.150)	0.835*** (0.177)	0.166*** (0.032)	0.192 (0.365)	0.106 (0.694)	0.702*** (0.151)
Treatment 2: operating costs info+patience-inducing message	0.877*** (0.151)	0.882*** (0.152)	0.877*** (0.155)	0.904*** (0.155)	0.885*** (0.155)	0.926*** (0.155)	0.997*** (0.180)	0.197*** (0.032)	0.729*** (0.047)	0.906*** (0.154)	1.213 (0.771)
FOS	0.053*** (0.018)	0.051*** (0.018)	0.059*** (0.019)	0.057*** (0.019)	0.058*** (0.019)	0.056*** (0.019)	0.053*** (0.021)	0.011*** (0.004)	0.146*** (0.047)	0.046** (0.023)	0.062** (0.022)
FOS*T1										0.033 (0.038)	
FOS*T2											−0.017 (0.041)
Additional appliance attributes		−0.455*** (0.124)	−0.467*** (0.128)	−0.477*** (0.128)		−0.478*** (0.128)	−0.313*** (0.145)	−0.066** (0.030)	−0.821*** (0.335)	−0.475*** (0.128)	−0.475*** (0.128)
Image A dummy					0.005 (0.167)						
Stainless steel dummy					−0.250[a] (0.159)						
Smaller freezer					−0.329** (0.162)						
Smaller total capacity					0.181 (0.167)						
Pessimist beliefs about future income (dummy)						0.090 (0.132)	0.101 (0.152)	0.021 (0.032)	0.436 (0.312)		
NoSave (dummy)						−0.259* (0.160)	−0.198 (0.184)	−0.043 (0.040)	−0.207 (0.364)		
Income						0.007 (0.020)	0.004 (0.023)	0.001 (0.004)	0.003 (0.045)		
Rent (dummy)						0.002 (0.204)	0.008 (0.211)	0.001 (0.044)	−0.282 (0.438)		
Republican Party (dummy)						−0.368** (0.175)	−0.493*** (0.200)	−0.107*** (0.044)	−0.135*** (0.444)		
Environmental Values						−0.004 (0.009)	0.177** (0.075)	0.037** (0.015)	0.059** (0.024)		
Financial literacy (dummy)						−0.193 (0.181)	−0.226 (0.204)	−0.048 (0.204)	−0.390 (0.395)		
Demographic controls	N	N	Y	Y	Y	Y	Y		Y	Y	Y
Households characteristics controls	N	N	N	Y	Y	Y	Y		Y	Y	Y
Observations	2010	2010	2006	2006	2006	2006	1576		476	2006	2006
Pseudo R-squared	0.032	0.041	0.094	0.100	0.102	0.105	0.140		0.290	0.102	0.099
p-value *F* test	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000

Standard errors in parentheses.
Demographic controls include sex, age, race, education, employment status, marital status, State, religion, church attendance, ideology). Households characteristics controls include home type, household size, telephone service type, metropolitan area dummy, and has internet dummy.

[a] *p*-value *F* test nearly statistically significant at 0.111.
* Significant at <0.10.
** Significant at <0.05.
*** Significant at <0.01.

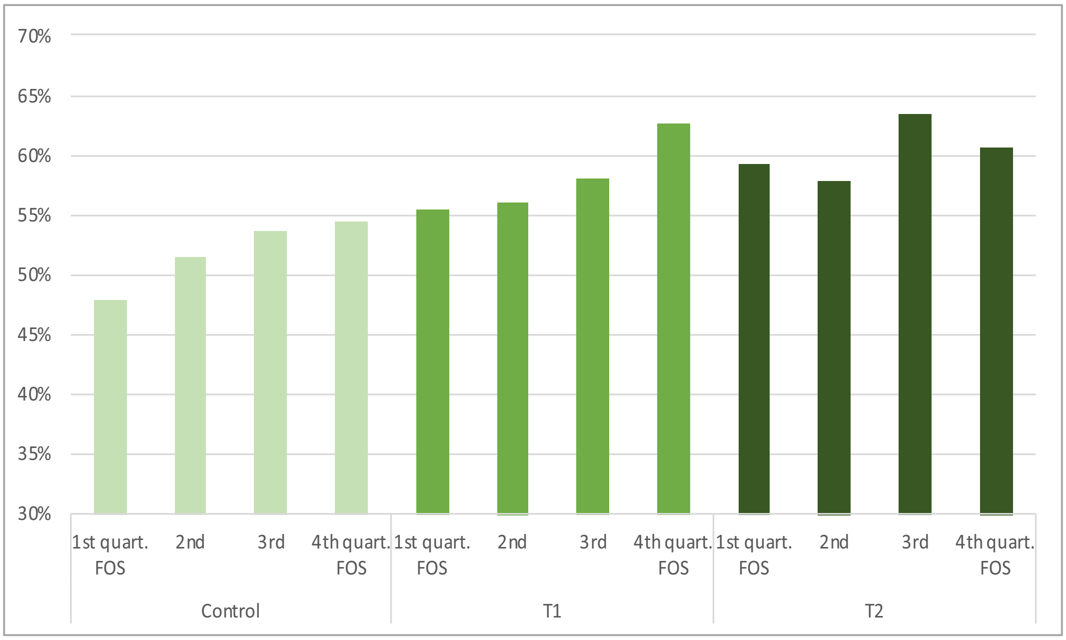

Fig. 3. Proportion of energy-efficient choices by FOS quartile, per condition. (Source: own computations based on experimental data)

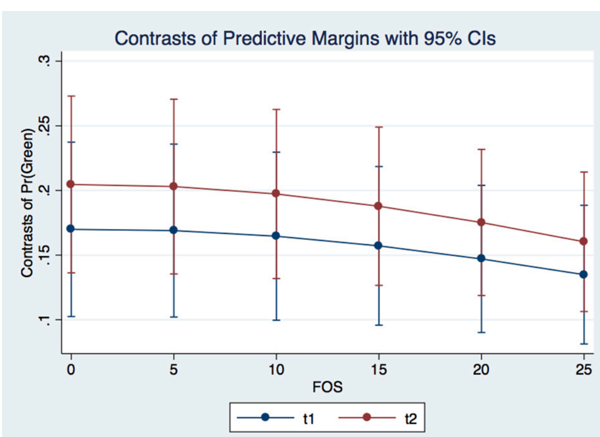

Fig. 4. Marginal effect of being included in T1 and T2 on the likelihood of choosing the energy-efficient appliance (compared to the Control group), by FOS score.
(Source: own computations based on experimental data. Predictive margins with 95% confidence levels.)

Table 4
Average Future Orientation Scores FOS per condition and choice (without additional features).

	Participants choosing gray	Participants choosing green	Difference	Average FOS per condition	*F* test and its *p*-value
Control	16.98 (0.331)	18.37 (0.248)	1.39	17.78 (0.203)	11.71 0.000
Treatment 1	17.23 (0.338)	18.52 (0.235)	1.29	18.16 (0.196)	8.95 0.003
Treatment 2	17.67 (0.380)	18.43 (0.202)	0.75	18.24 (0.179)	3.33 0.068
Totals	17.23 (0.205)	18.44 (0.131)	1.21	18.05 (0.112)	25.62 0.000

explaining 14% or 29% of the observed variations in the response variable in columns 7 and 9, respectively.

We further investigate whether being in a particular treatment group affects the relevance of other variables. This can help explain the underlying mechanisms that lead one treatment to be more successful in promoting energy efficiency, compared with others. We thus rerun the regression in (6), splitting the sample by treatment condition. We first run the regressions split by the three conditions, Control, T1, and T2, without the additional appliance attributes (Table 5, columns 12–14). We start by noting that R^2 rises from 10.5% (6) up to 40% with split regressions (14). This indicates that there are significant changes in the variables affecting choice in each treatment group. Indeed, FOS is the only variable that is statistically significant, with positive signs across all conditions while a series of coefficients changes sign or loses/gains statistical significance.

The relevance of the economic variables varies widely in the three treatments. Having negative expectations about future income decreases the chances of choosing green in the control group (statistically significant coefficient with a negative sign); but it is not statistically significant in T1, and it increases the likelihood of green choices in T2 (statistically significant coefficient with a positive sign). We observe the same pattern for individual who live in a rented home (*Rent*). Likewise, people who do not save systematically are less likely to buy the green appliance in T1 but are more likely to buy it in T2. Higher income levels are associated with more green choices in T1 and T2 (statistically significant coefficient with a positive sign) but not in the control group. It thus appears that the loss-framed message in T2 nudges individuals who are worried about their income or who are usually unable to save towards the concrete possibility of saving in the future through an energy-efficient appliance. Some of these coefficients are, however, significant only at the 0.1 significance level confidence level, probably due to the smaller sample size for these split regressions.

Identification with the Republican Party negatively affects green choices in the control group and in T1 only. It is possible that the loss-framed message in T2 might dilute the perception of energy efficiency as a political matter by reframing it more strongly as a purely economic matter. Ascription of personal responsibility to care for the environment is statistically significant only in T2. Perhaps, mentioning a date in the future in T2, induced individuals who held pro-environmental attitudes

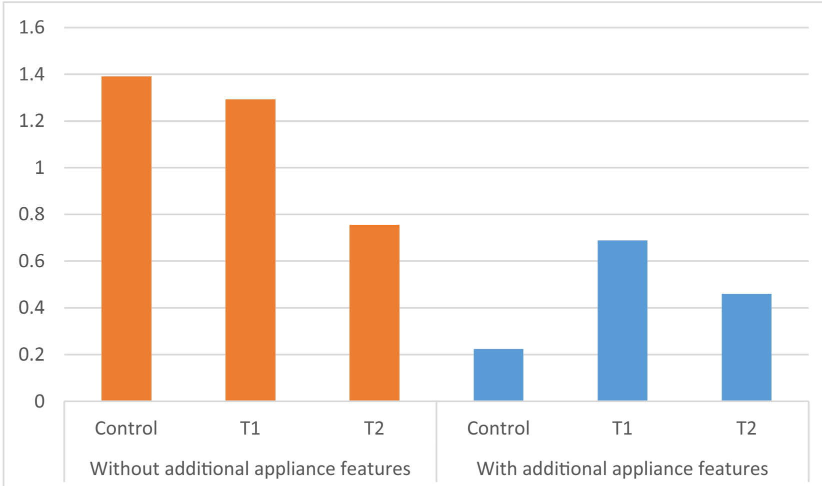

Fig. 5. Difference in average FOS between gray/green choices, by condition.
(Source: own computations based on experimental data)

Table 5
Split regression output.

Appliance choice (Logit)						
Variables	(12)	(13)	(14)	(15)	(16)	(17)
	Contr, no attr.	T1, no attr.	T2, no attr.	Control	T1	T2
FOS	0.183*** (0.052)	0.128*** (0.057)	0.195** (0.101)	0.055* (0.034)	0.101*** (0.035)	0.137*** (0.042)
Additional appliance attributes				−0.545*** (0.216)	−0.680*** (0.247)	−0.344 (0.263)
Pessimist beliefs about future income (dummy)	−0.649* (0.391)	−0.425 (0.489)	1.048* (0.562)			
NoSave (dummy)	−0.096 (0.475)	−1.312* (0.526)	1.172* (0.648)			
Income	−0.078 (0.067)	0.133* (0.077)	0.148* (0.086)			
Rent (dummy)	−0.850* (0.459)	0.036 (0.622)	2.313*** (0.771)			
Republican party (dummy)	−1.326*** (0.535)	−1.616*** (0.622)	−0.324 (0.691)			
Environmental values	0.050 (0.123)	0.295 (0.264)	0.650** (0.288)			
Financial literacy (dummy)	−0.128 (0.520)	0.904 (0.622)	1.044 (0.817)			
Demographic controls	Y	Y	Y	Y	Y	Y
Households characteristics controls	N	N	N	Y	Y	Y
Observations	329	286	272	679	634	618
Pseudo R-squared	0.312	0.338	0.400	0.165	0.214	0.180
p-value *F* test	0.000	0.000	0.000	0.000	0.009	Missing

Standard errors in parentheses.
Demographic controls include sex, age, race, education, employment status, marital status, State, religion, church attendance, ideology). Households characteristics controls include home type, household size, telephone service type, metropolitan area dummy, and has internet dummy.
* Significant at <0.10.
** Significant at <0.05.
*** Significant at <0.01.

to anticipate also the non-financial consequences of choosing the gray appliance. We hypothesize that this may have contributed to activate the effect of pro-environmental orientation in the decision process. When we run regressions by Control, T1, and T2 conditions without distinguishing whether the participants visualized additional attributes (columns 15–17), we find that in T2, the coefficient for Additional Attributes is not statistically significant. The result suggests that the loss-oriented message in T2 helps to contrast the cognitive noise introduced by the additional appliance features.

As an external validity test, we checked whether hypothetical choices made in the experiment were associated with participants' real-life choices by asking them to report the percentage of Energy Star-rated appliances they had bought out of their total relevant purchases in the previous three years. Fig. 6 below shows that the proportion of participants choosing the green appliance[8] slightly increases with the percentage of Energy Star appliances they had previously bought. For

[8] This graph includes only choices made in the Control group and in T1, since they represent more closely the status quo in US retailer shops, and they are thus the experimental conditions that are most comparable to the conditions US residents encounter when buying appliances. While electricity requirement information in shops is usually presented in *kWh* (mirroring the control group), all electrical appliances also come with a mandatory Energy Label that shows the estimated cost of operating the appliance for a year in US$ (somewhat similar to T1). Participants who did not buy any appliance in the previous three years, who replied with an absolute number rather than a percentage, or who skipped the question were excluded from the count, thus reducing the count to just 606 observations.

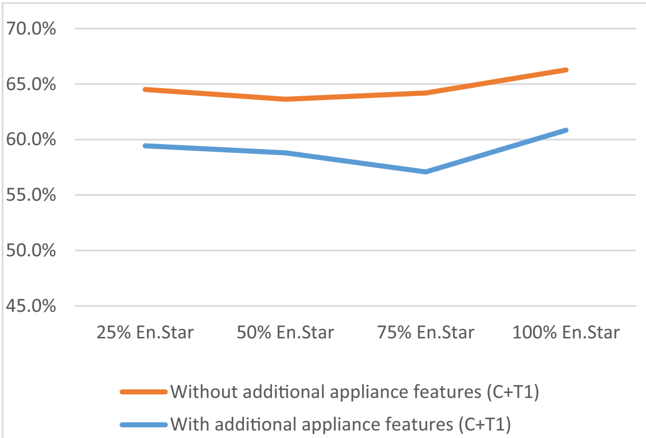

Fig. 6. Proportion of energy-efficient choices and Energy Star purchases, by condition.
(Source: own computations based on experimental data)

example, 64% of the people who purchased less than 25% of Energy Star products chose the green appliance in the experiment compared with 66% of those who bought only Energy Star appliances (for treatments excluding additional appliance features). Results from a Kruskal-Wallis H test, however, showed that the association between how many Energy Star rated appliances had been purchased in the past and appliance choice was not statistically significant. Nonetheless, we cannot rule out that the hypothetical decisions that subjects made in our hypothetical scenario are related to some extent to their real-life behavior in similar decision domains.

5. Discussion

These experiments analyzed the role of pure time preferences in the decision to invest in energy efficiency. They tested whether individuals could be nudged to be more patient and make more energy-efficient choices, which typically deliver higher environmental and economic benefits in the long run.

A nationally representative sample of 2010 US adults faced a hypothetical purchase choice consisting of two refrigerators that differed solely in capital price and electricity consumed. The more efficient refrigerator was more expensive to purchase but cheaper to operate compared with the inefficient alternative. However, the overall total lifetime cost was cheaper for the efficient appliance. The treatments consisted of alternative framings of the appliances' energy requirements, showing the information expressed in either i) *kWh*/year (Control); ii) total electricity cost in US$/€ for the product's lifetime (T1); or iii) adding to lifetime cost a loss-framed message about the relative loss (or savings) of each appliance at a given date in the future (T2).

The literature on *hidden-zero framing* and *delay/speed-up asymmetry* states that individuals' temporal preferences can be influenced by contextual features that highlight the hidden opportunity costs in the choice situation or by evoking forward-looking thoughts. These features can potentially inspire alternative cognitive patterns that can improve individuals' ability to optimize their intertemporal decision making. Our core treatment T2 leverages these findings by highlighting the long-term economic losses with a message.

Previous experiments that displayed only electrical appliances' yearly or lifetime operating costs found either limited increases or even decreases in energy-efficient purchases. This might be due to the fact that energy-inefficient choices are in part driven by temporal preferences rather than by an information deficit. For example, Newell and Siikamäki (2015) found that displaying yearly operating costs has less effect on present-biased individuals.

While T1 reproduced the treatment from previous field experiments in the literature, T2 goes beyond the simple provision of energy-efficiency information, as it nudges individuals by making the hidden temporal component of the choice context a key concern in the decision process. T2 reaches the highest proportion of individuals choosing efficient appliances. The incremental effect compared with T1 is 7 percentage points. This results were in line with results from the Spanish pilot (in Annex 1), where T2 outperformed T1 by 6 percentage points. The fact that T2 outperforms T1 in both experiments, despite the use of two very different samples, suggests that nudging temporal preferences rather than merely informing about energy-cost implications works better for increasing energy-efficient choices. It also signals that there are concrete opportunities to increase energy-efficient purchases with simple and cost-effective framing interventions. Our treatment simultaneously lightens the cognitive load faced by perspective buyers—by computing the relative long-term convenience of the efficient appliance—; it leverages loss aversion, it promotes identification with one's future self—by mentioning a date several years into the future—. While the experimental design does not allow us to disentangle the single contribution of each of these components to the increase in energy-efficient choices, we do observe that our treatment affects the extent to which present-focused preferences are activated in the decision process.

We separately assessed individual temporal preferences using research-validated scales that employ a series of qualitative questions to construct an index identifying individuals on a spectrum between present-oriented and forward-looking. We used elements of the Zimbardo Future Orientation Score for the Spanish sample and the Consideration of Future Consequences Scale for the US sample. Qualitative and econometric analysis showed that in both samples, individual temporal preferences influence energy-efficiency choices. Present-oriented individuals were less likely to choose efficient appliances, whereas people who chose energy-efficient appliances had higher FOS scores. However, this difference did not equally apply to all treatment groups. The difference in FOS between those who chose the green and those who chose the gray appliance was nearly half in T2, compared with the control group. This finding was consistent in both the Spanish and the US sample. In addition, in the Spanish sample, econometric outputs showed that temporal orientation affected refrigerator choice only in the Control group, although this result was not replicated in the US sample. We interpret these findings as an indication that the treatments, T2 and partly T1, reduced the influence of pre-existing temporal preferences on energy-efficient choices. T2 was the most effective treatment for both the bottom and the top FOS quartiles of the US sample when several appliance attributes were shown. These results would seem to suggest that there is relationship between temporal orientation and energy-efficiency decisions. Pre-existing individual temporal preferences affect the likelihood that the individual will buy efficient appliances. However, this paper reinforces the idea in the literature that individual temporal preferences can be activated or pushed to the background by the choice architecture in place.

Hypothetical experiments in energy efficiency typically elicit preferences by showing only price and electricity requirements. This may raise the question of whether individuals can focus on energy efficiency as much in a real-choice environment where appliances are described with a wide array of features (appliances are described with a range of 40–70 features on US retailer websites and 10–30 on Spanish retailer websites). To increase the resemblance of our experiment to a real-choice setting, in the US experiment, we repeated the experiment by adding additional appliance features, such as color, total capacity, freezer capacity, and images. These features were randomly assigned and varied marginally between appliances, such that the participant should have been indifferent to them. However, we found that individuals in these latter treatments were less likely to choose the energy-efficient appliance. Nonetheless, we noted that T2 was still the treatment with a higher proportion of energy-efficient choices. Displaying additional appliance features diminishes the individual's attention to energy efficiency, but T2 succeeded in giving visibility to the consequences of choosing inefficient appliances. This finding is particularly relevant for policy: Giving prominence to the opportunity costs of appliance energy requirements might counter the distraction represented by multiple appliance features. However, the extent of this distraction may be higher in markets where a high number of appliance attributes are shown, such as the US market.

Economic indicators clearly influenced choice: household wealth, the availability of savings and difficulty paying bills were determining factors in appliance choice. This was somewhat predictable, since individuals need the financial means to pay the price premium that comes with energy efficiency[9]. However, qualitative analysis of people's explanations for their refrigerator choices in the Spanish pilot revealed two opposing attitudes towards economic constraints and appliance choice. Some participants felt that since they feared their future income might worsen, it would be best to save money immediately by buying the cheaper appliance. Other participants felt that saving in the long term through lower electricity bills would help them cope with a possibly lower income in the future. We thus investigated, whether the effect of individual economic situation on appliance choice was mediated by the treatments participants had been subjected to.

Split regression analysis in the Spanish and US sample showed that people that had no savings, who were economically worse-off, who lived in a rented home or who expected their income to decrease in the future were less likely to choose the green appliance if they had participated in the control group or T1. While participants in T2 with the same characteristics were more likely to choose the green appliance compared to the others. In the Spanish sample, the interaction term between economic pessimism and T2 was close to statistical significance ($p = 0.111$) and had a positive sign.[10] This result suggests that in the status quo, where electricity requirements are expressed in *kWh*, people worried about their future income may be tempted to follow a saving-now strategy and choose the cheaper, less energy-efficient appliance. In contrast, participants in T2 received a loss-framed message which reframed the more expensive, efficient appliance as an opportunity to lower their future electricity expenses and to better cope with a lower income in the future.

In the US sample, we extended the analysis to political identities and found that identifying to some extent with the Republican Party was negatively associated with the likelihood of choosing the efficient appliance, even when controlling for income and future orientation. However, this relationship was not statistically significant when the analysis was restricted to individuals in T2 and individuals who had been subjected to treatments displaying additional appliance features. Climate change is currently a highly politicized topic in the US, and it is possible that energy saving is seen as a Democratic Party interest, which would explain the Republican Party subsample's reluctance to choose the efficient appliance. However, we interpret our result as an indication that when the energy-efficiency information is framed in terms of personal economic losses (T2) or when energy efficiency information is dispersed among other appliance features (color, size, etc.), political views are not activated in the decision process. It suggests that labeling energy efficiency as climate-friendly may cause counterproductive reactions from individuals identifying with the Republican Party, and it highlights the potential for future research. This view is supported by Gromet et al. (2013), who found that conservatives were less likely to buy energy-efficient lightbulbs if they were labelled with environmental messages. Overall, findings in the two experiments were consistent with each other despite obvious differences in the sample demographic and socio-cultural characteristics, different electricity prices and appliance markets.

6. Conclusions

The experiments conducted in this paper prove that there is a strong correlation between individual pure time preferences and the likelihood they will invest in energy efficiency. Results suggest that pure temporal preferences play a role in explaining the energy-efficiency gap, and they can help to clarify why field experiments that provided information on the running costs of different appliances have not been as effective as had been hoped for in closing the energy-efficiency gap.

While the literature has traditionally considered temporal preferences as given and constant across domains, more recent experimental evidence suggests that intertemporal choice is sensitive to subtle variations in the choice architecture (Frederick and Loewenstein, 2008). More specifically, within the same individual, there coexist contrasting sets of preferences and cognitive patterns that are activated by specific cues. Pairing two events as part of a sequence (such as the time of purchase and future electricity payments) invites individuals to evoke emotions they may otherwise not have experienced and may induce them to make more forward looking choices by shifting their psychological perspective forward (Loewenstein and Prelec, 1991).

Findings in this paper corroborate the idea that temporal preferences can be activated or attenuated within a given choice context and that framing techniques can be leveraged to induce intertemporal choices that are both economically optimal in the long term for the individual and for the climate. In this paper, simply highlighting the long-term hidden costs of choosing an energy-inefficient appliance by a given date into the future with loss-framed language increased energy-efficient choices up to 24 percentage points when compared with the baseline scenario and by 7 percentage points when compared with just displaying lifetime operating costs, as done in the previous literature. We hypothesize that the effectiveness of the treatment is delivered through two mechanisms: It lowers impatient choices by lowering the effect of impatient individuals' default temporal preferences, but it also redirects the attention of income constrained individuals towards energy-efficiency as a money saving strategy. For the US market, part of the effectiveness of the treatment was also due to the fact that mentioning the economic convenience of energy-efficient products neutralized the negative effect of conservative political views of climate-friendly initiatives.

The main policy implication of this paper is the suggestion to introduce temporally oriented nudges to increase energy-efficiency uptake and foster other pro-environmental behaviors. Our nudge can support economically constrained individuals to make choices that will help them to save money in the long term.

Random assignment in the experimental setup ensures there is a causal relationship between our treatments and the percentage of energy-efficient appliances chosen. The findings were consistent across two very different population samples and different appliance markets. This suggests that this simple and cost-effective nudge may be applicable to different socio-cultural contexts. The main limitation in our experiment concerns the lack of variation in the refrigerators' price and operating costs and the limited variation of the other attributes. While our choice was dictated by parsimony—i.e. the need to contain the total number of permutations within a given sample size—we recognize that varying the price and the operating costs would have enabled us to define marginal effects and to assess the effectiveness of our treatment on a wider range of appliances. Another limitation to our research is the lack of real incentives for participants. Future research could address both limitations by replicating this experiment in a field setting, it would validate our findings and effect sizes while extending the number and the levels of appliance attributes considered. Our nudge was designed for application in an online environment. As an extension of this paper, one could test its introduction at different steps in the purchase process

[9] In addition, also renting one own's living quarters impacted choice, which is also to be expected considering that homeowners may expect to spend more time in their homes and hence exploit their appliances for a longer time.

[10] Results from the Spanish pilot are included as part of Annex 1.

to identify the moment that makes it most effective. Additional future research avenues in relation to this paper include the application of a similarly inspired nudge towards other pro-environmental behaviors by highlighting their opportunity costs. (International Energy Agency, 2021)

Declaration of Competing Interest

The auhtors declare no compeiting interest.

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Appendix A. Supplementary data

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References

Allcott, H., 2011. Consumers' perceptions and misperceptions of energy costs. Am. Econ. Rev. 101 (3), 98–104. https://doi.org/10.1257/aer.101.3.98.

Allcott, H., Taubinsky, D., 2015. Evaluating behaviorally motivated policy: experimental evidence from the Lightbulb market. Am. Econ. Rev. 105 (8), 2501–2538. https://doi.org/10.1257/aer.20131564.

Allcott, H., Wozny, N., 2014. Gasoline prices, fuel economy, and the energy paradox. Rev. Econ. Stat. 96 (5), 779–795. https://doi.org/10.1162/REST_a_00419.

Andor, M.A., Gerster, A., Sommer, S., 2020. Consumer inattention, heuristic thinking and the role of energy labels. Energy J. 41 https://doi.org/10.5547/01956574.41.1.mand.

Association of Home Appliance Manufacturers (AHAM), 2020. Total Unit Shipments of Refrigerators in the US. Retrieved July 8, 2020, from. https://www.statista.com/statistics/220111/unit-shipments-of-refrigerators-and-freezers-in-the-us/.

Attanasi, G., Georgantzís, N., Rotondi, V., Vigani, D., 2018. Lottery- and survey-based risk attitudes linked through a multichoice elicitation task. Theor. Decis. 84 (3), 341–372. https://doi.org/10.1007/s11238-017-9613-0.

Attari, S.Z., DeKay, M.L., Davidson, C.I., Bruine de Bruin, W., 2010. Public perceptions of energy consumption and savings. Proc. Natl. Acad. Sci. 107 (37), 16054–16059. https://doi.org/10.1073/pnas.1001509107.

Berns, G.S., Laibson, D., Loewenstein, G.F., 2007. Intertemporal choice – toward an integrative framework. Trends Cogn. Sci. 11 (11), 482–488. https://doi.org/10.1016/j.tics.2007.08.011.

Blasch, J., Filippini, M., Kumar, N., 2019. Boundedly rational consumers, energy and investment literacy, and the display of information on household appliances. Resour. Energy Econ. 56, 39–58. https://doi.org/10.1016/j.reseneeco.2017.06.001.

Carson, R.T., Flores, N.E., Martin, K.M., Wright, J.L., 1996. Contingent valuation and revealed preference methodologies: comparing the estimates for quasi-public goods. Land Econ. 72 (1), 80–99. https://doi.org/10.2307/3147159.

Cattaneo, C., 2019. Internal and external barriers to energy efficiency: which role for policy interventions? Energy Efficiency 12, 1293–1311. https://doi.org/10.1007/s12053-019-09775-1.

Chapman, G.B., 1998. Sooner or later: The psychology of intertemporal choice. In: Medin, D.L. (Ed.), The Psychology of Learning and Motivation: Advances in Research and Theory. Academic Press, San Diego, CA, US, pp. 83–113.

Chapman, G.B., 2000. Preferences for improving and declining sequences of health outcomes. J. Behav. Decis. Mak. 13 (2), 203–218. https://doi.org/10.1002/(SICI)1099-0771(200004/06)13:2<203::AID-BDM317>3.0.CO;2-S.

Davis, L.W., Metcalf, G.E., 2016. Does better information lead to better choices? Evidence from energy-efficiency labels. J. Assoc. Environ. Resour. Econ. 3 (3), 589–625. https://doi.org/10.1086/686252.

DEFRA, 2010. Behavioural Economics & Energy Using Products: Scoping Research on Discounting Behaviour and Consumer Reference Points. Final Report. London.

Department of Energy and Climate Change, 2014. Evaluation of the DECC/Jhon Lewis Energy Labelling Trial. DECC, London. Retrieved from. http://files/2081/John_Lewis_trial_report_010914FINAL.pdf.

Ebeling, F., Lotz, S., 2015. Domestic uptake of green energy promoted by opt-out tariffs. Nat. Clim. Chang. 5, 868–871. https://doi.org/10.1038/nclimate2681.

Ebert, J.E.J., Prelec, D., 2007. The fragility of time: time-insensitivity and valuation of the near and far future. Manag. Sci. 53 (9), 1423–1438. https://doi.org/10.1287/mnsc.1060.0671.

Enzler, H.B., 2013. Future Orientation and Energy Saving - Subjective Discount Rates and Consideration of Future Consequences as Predictors of Environmentally Responsible Behavior. Zurich.

Epper, T., Fehr-Duda, H., Schubert, R., 2011. Energy-Using Durables: The Role of Time Discounting in Investment Decisions.

Faralla, V., Novarese, M., Ardizzone, A., 2017. Framing effects in intertemporal choice: a nudge experiment. J. Behav. Exp. Econ. 71, 13–25. https://doi.org/10.1016/j.socec.2017.09.002.

Frederick, S., Loewenstein, G.F., 2008. Conflicting motives in evaluations of sequences. J. Risk Uncertain. 37 (2–3), 221–235. https://doi.org/10.1007/s11166-008-9051-z.

Frederick, S., Loewenstein, G.F., O'Donoghue, T., 2002. Time discounting and time preference: a review. J. Econ. Lit. XL, 351–401.

Gerarden, T., Newell, R.G., Stavins, R.N., 2015. In: Stavins, Robert N. (Ed.), Assessing the Energy-Efficiency Gap (Faculty Working Paper Series No. 2015–04). https://doi.org/10.2139/ssrn.2554735. Cambridge, Mass.

Goodkind, A.L., Tessum, C.W., Coggins, J.S., Hill, J.D., Marshall, J.D., 2019. Fine-scale damage estimates of particulate matter air pollution reveal opportunities for location-specific mitigation of emissions. PNAS 116 (18), 8775–8780. https://doi.org/10.1073/pnas.1816102116.

Goodman, J.K., Malkoc, S.A., Rosenboim, M., 2019. The material-experiential asymmetry in discounting: when experiential purchases Lead to more impatience. J. Consum. Res. 46 (4), 671–688. https://doi.org/10.1093/jcr/ucz017.

Granade, H.C., Creyts, J., Derkach, A., Farese, P., Nyquist, S., Ostrowski, K., 2009. Unlocking Energy Efficiency in the U.S. Economy. McKinsey & Company, Stamford, CT.

Gromet, D.M., Kunreuther, H., Larrick, R.P., 2013. Political ideology affects energy-efficiency attitudes and choices. Proc. Natl. Acad. Sci. U. S. A. 110 (23), 9314–9319. https://doi.org/10.1073/pnas.1218453110.

Hall, Robert, 1997. The Inkjet Aftermarket: An Economic Analysis. Stanford University.

Hausman, J.A., 1979. Individual discount rates and the purchase and utilization of energy-using durables. Bell J. Econ. 10 (1), 33–54. https://doi.org/10.2307/3003318.

International Energy Agency, 2021. CO_2 Emissions Statistics. Retrieved March 8, 2019, from. https://www.iea.org/statistics/co2emissions/.

IPSOS & London Economics, 2014. Study on the Impact of the Energy Label and Potential Changes to it – on Consumer Understanding and on Purchase Decisions ENER/C3/2013-428 Final Report (October). (141). Retrieved from https://ec.europa.eu/energy/sites/ener/files/documents/Impact of energy labels on consumer behaviour.pdf.

Kallbekken, S., Sælen, H., Hermansen, E.A.T., 2013. Bridging the energy efficiency gap: a field experiment on lifetime energy costs and household appliances. J. Consum. Policy 36 (1), 1–16. https://doi.org/10.1007/s10603-012-9211-z.

Langbein, L., 2015. Public Program Evaluation: A Statistical Guide (First). Routledge, London.

Lewis, A., 2018. The Cambridge Handbook of Psychology and Economic Behaviour, 587. Cambridge University Press.

Loewenstein, G.F., Prelec, D., 1991. Negative time preference. Am. Econ. Rev. 81 (2), 347–352. Retrieved from. http://www.jstor.org/stable/2006883.

Loewenstein, G.F., Prelec, D., 1993. Preferences for sequences of outcomes. Psychol. Rev. 100 (1), 91–108.

Loewenstein, G.F., Sicherman, N., 1991. Do workers prefer increasing wage profiles? J. Labor Econ. 9 (1), 67–84. Retrieved from. http://www.jstor.org/stable/2535114.

Lutz, J.D., Hopkins, A., Letschert, V., Franco, V.H., Sturges, A., 2011. Using national survey data to estimate lifetimes of residential appliances. HVAC R Res. 17 (5), 726–736. https://doi.org/10.1080/10789669.2011.558166.

Magen, E., Dweck, C.S., Gross, J.J., 2008. The hidden zero effect: representing a single choice as an extended sequence reduces impulsive choice. Psychol. Sci. 19 (7).

Newell, R.G., Siikamäki, J., 2015. Individual time preferences and energy efficiency. Am. Econ. Rev. 105 (5), 196–200. https://doi.org/10.1257/aer.p20151010.

OECD, 2017. Tackling Environmental Problems with the Help of Behavioural Insights. OECD Publishing. Retrieved from. http://www.oecd-ilibrary.org/environment/tackling-environmental-problems-with-the-help-of-behavioural-insights_9789264273887-en.

Read, D., Frederick, S., Orsel, B., Rahman, J., 2005. Four score and seven years from now: the date/delay effect in temporal discounting. Manag. Sci. 51 (9), 1309–1448.

Read, D., Olivola, C.Y., Hardisty, D.J., 2017. The value of nothing: asymmetric attention to opportunity costs drives Intertemporal decision making. Manag. Sci. 63 (12), 4277–4297. https://doi.org/10.1287/mnsc.2016.2547.

Rohling, M., Schubert, R., 2013. Energy labels for household appliances and their disclosure format: a literature review. In: IED Working Paper, 21 (10).

Schleich, J., Gassmann, X., Meissner, T., Faure, C., 2019. A large-scale test of the effects of time discounting, risk aversion, loss aversion, and present bias on household adoption of energy-efficient technologies. Energy Econ. 80, 377–393. https://doi.org/10.1016/j.eneco.2018.12.018.

Scholten, M., Read, D., Sanborn, A., 2016. Cumulative weighing of time in intertemporal tradeoffs. J. Exp. Psychol. Gen. 145 (9), 1177–1205. https://doi.org/10.1037/xge0000198.

Schubert, R., Stadelmann, M., 2015. Energy-using durables: driving forces of purchase decisions. Front. Energy Res. 3 (7), 1. https://doi.org/10.3389/fenrg.2015.00007.

Skourtos, M., Damigos, D., Tourkolias, C., Kontogianni, A., 2021. Efficient energy labelling: the impact of information content and style on product choice. Energy Efficiency 14, 58. https://doi.org/10.1007/s12053-021-09950-3.

Stadelmann, M., Schubert, R., 2018. How do different designs of energy labels influence purchases of household appliances? A field study in Switzerland. Ecol. Econ. 144 (August 2017), 112–123. https://doi.org/10.1016/j.ecolecon.2017.07.031.

Strathman, A., Gleicher, F., Boninger, D.S., Edwards, C.S., 1994. The consideration of future consequences: weighing immediate and distant outcomes of behavior. J. Pers. Soc. Psychol. 66 (4), 742–752. https://doi.org/10.1037/0022-3514.66.4.742.

Taubinsky, D., Allcott, H., 2013. The Lightbulb paradox: using behavioral economics for policy evaluation. In: NBER Working Papers, 19713, pp. 1–51. Retrieved from. http://www.stanford.edu/group/SITE/SITE_2013/2013_segment_6/2013-segment_6_papers/allcott.pdf%5Cnfile:///Files/77/77A46F55-D2CA-4553-AFEC-2F1CF4A29C30.pdf.

Train, K., 1985. Discount rates in consumers' energy-related decisions: a review of the literature. Energy 10 (12), 1243–1253. https://doi.org/10.1016/0360-5442(85)90135-5.

Tversky, A., Sattah, S., Slovic, P., 1988. Contingent weighting in judgment and choice. Psychol. Rev. 95 (3), 371–384. https://doi.org/10.1037/0033-295X.95.3.371.

US Appliance Industry Saturation, 2000. 23rd Annual Portrait of The U S Appliance Industry Saturation. In: Appliance Magazine, 57, pp. 83–110. Retrieved from. https://www.tib.eu/en/search/id/BLSE%3ARN084175500/23rd-Annual-Portrait-of-The-U-S-Appliance-Industry/.

US Bureau of Labor Statistics, 2020. Consumer Expenditures in 2018. Retrieved July 8, 2020, from. https://www.bls.gov/opub/reports/consumer-expenditures/2018/home.htm.

US Energy Information Administration, 2020. Electric Power Montly. Retrieved July 8, 2020, from. https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a.

Waechter, S., Sütterlin, B., Siegrist, M., 2015a. The misleading effect of energy efficiency information on perceived energy friendliness of electric goods. J. Clean. Prod. 93, 193–202. https://doi.org/10.1016/J.JCLEPRO.2015.01.011.

Waechter, S., Sütterlin, B., Siegrist, M., 2015b. Desired and undesired effects of energy labels - an eye-tracking study. PLoS One 10, e0134132. https://doi.org/10.1371/journal.pone.0134132.

Weber, E.U., Johnson, E.J., Milch, K.F., Chang, H., Brodscholl, J.C., Goldstein, D.G., 2007. Asymmetric discounting in intertemporal choice. Psychol. Sci. 18 (6), 516–523. https://doi.org/10.1111/j.1467-9280.2007.01932.x.

Wu, C.-Y., He, G.-B., 2012. The effects of time perspective and salience of possible monetary losses on intertemporal choice. Soc. Behav. Personal. Int. J. 40 (10), 1645–1653. https://doi.org/10.2224/sbp.2012.40.10.1645.