Decision Drivers to Facilitate Lower-Polluting Consumer Choices

Magali Delmas

Institute of the Environment Anderson School of Management

University of California—Los Angeles

delmas@ucla.edu

October 2, 2023

Final Report

Prepared for the California Air Resources Board

Disclaimer

The statements and conclusions in this Report are those of the contractor and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

Table of Content

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

This study uses behavioral science to develop recommendations for incentivizing lower-polluting consumer choices. To achieve this, we first sought to understand the motivations that underpin consumers' choices of higher-polluting products and services. We used the Green Bundle framework as a guide to evaluate and synthesize the published research literature on statistically significant behavior interventions for promoting environmentally conscious consumer choices. We analyzed a decade of research published between 2012 and 2023, focusing on behavioral interventions that reduce polluting consumption behavior and reported quantitative data. We found that successful interventions often emphasize private benefits, such as higher product quality, financial incentives, and positive social aspects, rather than solely focusing on environmental benefits. One way policymakers can promote sustainable consumption is through public education campaigns that highlight the individual advantages of eco-friendly choices. These campaigns can leverage multiple communication platforms, including websites, social media, and advertisements, to educate consumers about the personal benefits of sustainable practices, such as cost savings and improved health. By enhancing consumer awareness and knowledge, these initiatives empower individuals to make informed decisions that align with their interests. In addition to developing policy recommendations, we used framing, a tool from behavioral science to design experiments that evaluate the efficacy of different email message wordings in increasing research seminar attendance behavioral intentions. We found that combining altruistic and self-interest motivations was the most effective approach. We conclude that policymakers and organizations should communicate information about the personal benefits of eco-friendly behavior, design communication messages that incorporate a combination of altruistic and self-interest motivations, and enhance the visibility of green behavior to others to encourage more sustainable and less polluting consumer actions. This study's findings can inform policymakers and organizations in developing effective policies and communication strategies to promote eco-friendly consumer behavior.

EXECUTIVE SUMMARY

Background

A major issue today is overconsumption, which has been connected to the global environmental crisis (MacKinnon, 2021; Waters, 2021). Increased consumption tends to negate the positive environmental effects of technological advancements (Haberl et al., 2020), necessitating that lifestyle changes accompany technological progress (Wiedmann et al., 2020). Altering behavior and consumption patterns can significantly decrease energy usage and related emissions (Edenhofer et al., 2014). The 2022 Intergovernmental Panel on Climate Change (IPCC) report emphasizes the importance of socio-cultural factors—such as individual choices, behavior, lifestyle changes, social norms, and culture—in driving demand-side mitigation efforts. The IPCC report suggests this includes shifting demand towards sustainable consumption, teleworking, adopting diets that reduce food waste and overconsumption, and engaging in energy-saving social practices. We devised a framework to investigate consumer behaviors most relevant to the adoption of lower-polluting products. This framework outlines the concepts prevalent in the existing literature and the underlying assumptions regarding drivers of pro-environmental consumer behavior. It serves as a guide for our evaluation and synthesis of the statistically significant published research literature. By comprehending strategies that have successfully influenced consumer behavior towards eco-friendliness, we are better equipped to formulate policy recommendations that encourage environmentally conscious consumer choices.

Objectives and Methods

This research develops recommendations, based on behavioral science, for better information-based interventions to facilitate lower-polluting product and service choices by consumers. Secondly, it designed a communication campaign informed by insights from the systematic review.

Our search terms were selected to identify research focusing on statistically significant behavioral interventions that promote environmentally conscious consumer choices. We specifically targeted interventions such as field experiments, nudges, and randomized controlled trials, as we sought to understand how behavior could be influenced through these approaches.

We analyzed a decade of research by searching the Web of Science for articles published between 2012 and 2023. Our inclusion criteria encompassed studies that investigated methods for reducing polluting consumption behavior and reported statistically significant quantitative data. The postdoctoral researcher independently reviewed all titles and abstracts from the search results, consulting the full article text when abstracts were insufficient for making an inclusion decision. They then classified each article as either included or excluded. Similarly, teams of two or three research assistants independently completed the full assessment process, met to discuss and resolve discrepancies in their classification decisions, and reached a final consensus.

This consensus was then compared with the postdoctoral researcher's classification decision.

To analyze the data, we employed the Green Bundle framework, which emphasizes the importance of recognizing the private benefits that consumers gain from making environmentally-friendly purchasing decisions. It underscores that sustainable consumption behaviors are often driven by a combination of environmental and private benefits, and both of these factors must be considered to promote sustainable consumption effectively. Private benefits can include things like convenience, cost-effectiveness, social status, and personal satisfaction. By considering the private benefits that consumers derive from sustainable products, the Green Bundle framework helps to create a more nuanced understanding of consumer behavior. It recognizes that consumers make decisions based on a range of factors beyond just environmental considerations and that these factors can be leveraged to encourage sustainable consumption.

Accordingly, we coded the specific private benefit information used to alter consumer behavior. Additionally, we conducted two experiments on Amazon Mechanical Turk (MTurk) to evaluate the efficacy of various email message phrasings in increasing hypothetical research seminar attendance.

Results

Our analysis of the studies aligns with the Green Bundle framework, which posits that successful interventions typically emphasize private benefits rather than solely focusing on environmental or planetary advantages. Quality, financial, and social aspects were the most frequently employed behavior change techniques. The quality category within the Green Bundle pertains to actual or perceived consumer benefits of a product and reduced costs associated with selecting eco-friendly items or adopting a sustainable behavior. Financial aspects involve monetary savings or rebates obtained through behavior changes. Social factors concern the social status gained by purchasing and consuming products endorsed by in-group members or adhering to social norms and expectations. Less frequently used interventions include information about health benefits (such as those associated with vegetarian or organic food) and emotional returns (such as being in a positive mood). Our findings suggest that effective interventions often highlight private benefits, while the few studies that do not, rely on hypothetical or self-reported data. Studies relying on self-reported behavior are generally considered to be less reliable or of lower quality compared to studies that report actual behavior because self-reports are subjective and susceptible to biases, social desirability, memory distortions, and individual interpretation, whereas direct observation or measurement of actual behavior provides more objective and accurate data.

Implementing policies that showcase the financial benefits of environmentally friendly behavior can be a successful approach. Enhancing the visibility of green behavior to others and designating green options as the default can significantly influence people's actions, leading to more frequent green choices. To summarize, the Green Bundle framework emphasizes taking a more comprehensive approach to sustainable consumption by considering private benefits. Information policy strategies that highlight private benefits and make green options visible and accessible can encourage sustainable choices. However, the emphasis on the specific private benefits depends on the type of behavior being targeted. For example, public transportation will have different private benefits than food.

For our second objective, we devised a communication campaign to enhance CARB's capacity to widely disseminate its funded research findings. The first experiment's results did not demonstrate any positive effects of using "don't miss out" and "human connection" phrasings for increasing the intention to attend a hypothetical online research seminar. These wordings were inspired by common business practices—fear of missing out and loss aversion. In contrast, the second experiment, which was directly informed by insights from the systematic review, emphasized the importance of combining egoistic and altruistic motivations. The phrase "We need your insights, inputs, and ideas" significantly increased intention to attend a hypothetical online research seminar. While we recognize that this phrasing might not apply to research seminars presented to the public, where CARB doesn't seek input, it might be more applicable to in-house seminars. These results further underscore the relevance of the Green Bundle framework in modifying behavior across various domains.

Conclusion

The Green Bundle framework, which is supported by the reviewed studies, suggests that effective interventions should incorporate information about both private benefits and environmental benefits, rather than relying solely on the latter. However, the studies analyzed do not explicitly investigate the exact distinction between public and private benefits, as they did not take into account the significance of the Green Bundle framework. Consumers are frequently unaware of the personal benefits associated with greener behavior. Providing information about quality, social status, health, financial advantages, and emotional returns can encourage more sustainable and less polluting consumer actions. Utilizing a combination of altruistic and self-interest motivations can effectively drive behavior change in some cases. Designing communication messages that incorporate this blend can be an efficient way to modify consumer behavior. As an example, our suggested message, "We need your insights, inputs, and ideas," exemplifies how these motivations can be effectively employed to increase participation in research seminars.

FRAMEWORK FOR RESEARCH INTO CONSUMER BEHAVIOR: THE GREEN BUNDLE

One major problem today is overconsumption, which has been linked to the planet's environmental crisis (MacKinnon, 2021; Waters, 2021). Because increasing consumption has counteracted environmental impact improvements from improved technology (Haberl et al., 2020), lifestyle changes must complement technological advancements (Wiedmann et al., 2020). Changing behavior and consumption patterns has the potential to substantially reduce energy use and associated emissions (Edenhofer et al., 2014). According to the 2022 Intergovernmental Panel on Climate Change (IPCC) report, socio-cultural factors (which are associated with individual choices, behavior, lifestyle changes, social norms, and culture) play an important role in demand-side mitigation efforts. According to the IPCC report, this includes shifting demand towards sustainable consumption (e.g., intensive use of long-lasting repairable products), teleworking, dietary shifts to avoid food waste and overconsumption, and social practices that result in energy savings. The current review examines the effectiveness of existing successful interventions to reduce overconsumption behavior.

While other literature reviews have examined how to promote sustainable behavior, they have not emphasized the importance of private or personal benefits for encouraging eco-friendly behavior. In contrast, our literature review utilizes the Green Bundle framework, which highlights the significance of considering both environmental and private benefits to promote sustainable consumption. By utilizing this framework, which serves as a unifying principle for understanding this literature, we can gain a more comprehensive understanding of how to encourage eco-friendly behavior. For example, Abrahamse et al. (2005) looked at intervention studies aimed at household energy conservation and found that the majority of the research focused on changing individual knowledge or perceptions about energy use with little focus on financial rewards. Steg and Vlek (2009) provided an overview of how environmental psychologists have studied interventions aimed at promoting pro-environmental behavior. They underscored the significance of employing experimental designs and measuring actual behavior, while also emphasizing the need for interdisciplinary collaboration, as environmental problems encompass ecological, technological, and socio-cultural dimensions in addition to psychological factors. Byerly et al. (2018) reviewed 160 experimental interventions relevant to environmental impact and found that providing information about social norms and altering decision contexts can promote environmentally friendly actions, particularly regarding water conservation, sustainable land management, and decreased meat consumption. Rau et al. (2022) concluded that the most effective interventions combine multiple intervention types (e.g., improved infrastructure, education, feedback) or make sustainable options the default.[1] A recent review by Constantino et al. (2022) considers the use of social norms for climate action.

---

[1] Rau et al. also reported that their "results show that most interventions only have small positive effects or none at all" (p. 1). However, this assertion appears unsubstantiated given that no effect sizes are reported in either the paper or supplementary materials. In the summary table of results from Rau et al., most entries are marked with either "+" or "++". These symbols indicate outcomes that align with beneficial effects; with "+" denoting statistically nonsignificant results and "++" representing statistically significant ones.

None of these articles, however, consider the fundamental importance of private or personal benefits, beyond economic rewards, for increasing green purchasing behavior. Our use of the Green Bundle framework addresses this research gap as a new way of conceptualizing this line of research and predicts that interventions will be less successful if they focus purely on benefits to the planet and not benefits to the consumers themselves.

In this project, we conduct a literature review of studies that found successful strategies for how to decrease polluting consumption behavior based on this framework. Our primary question is what are the recently published behavioral interventions that successfully make use of information about private benefits when trying to encourage lower-polluting consumer choices?

Overall, we find that information about private benefits is commonly used for making behavior more environmentally friendly. These benefits and costs, however, need not be substantial from a purely economic perspective. In this review, we describe many of the psychological benefits and costs that are effective for changing consumer behavior. Establishing social norms that green behavior is commonplace and making green options the default are two critical psychological considerations for policymakers. These can be used as an alternative to regulation for changing behavior.

We developed a framework for research into consumer behaviors that would be most applicable to the purchasing of lower-polluting products. The framework describes the concepts used in the literature and the likely drivers of consumers' pro-environmental behaviors. It is used to guide our assessment and synthesis of the published research literature. By understanding strategies that have effectively changed consumer behavior to be more environmentally friendly, we are better positioned to develop policy recommendations to encourage lower-polluting consumer choices.

Some surveys have shown that consumers are often convenience-oriented and unlikely to expend additional effort to buy green products (Bearse et al., 2009; Ricci et al., 2018). Additionally, consumers may believe that eco-labeled products are of lower quality, leading to a decreased likelihood of purchasing them (Delmas et al., 2016). They may also be less likely to buy an eco-friendly product if they believe the product was specifically designed to be environmentally friendly (Newman et al., 2014). This perception may stem from the assumption that manufacturers prioritize eco-friendliness over product quality. To address this challenge, some businesses have adopted a Trojan Horse approach to green marketing, where environmental benefits are not the primary focus of marketing efforts (Križanová et al., 2013). Instead, the emphasis is placed on personal benefits from the consumption and use of eco-friendly products. By highlighting the private benefits of eco-friendly products, such as cost savings or improved health outcomes, businesses can increase consumer interest and encourage sustainable consumption. This information is also likely to be useful for policymakers such as CARB, who can launch public education campaigns or eco-label programs to emphasize the private benefits of sustainable consumption. The Green Bundle framework delineates some of the key personal benefits that can be obtained by consumers going green. The key personal benefits that can be emphasized to consumers in this framework are: quality, social status, health, financial benefits, and emotional returns. (See Figure 1).
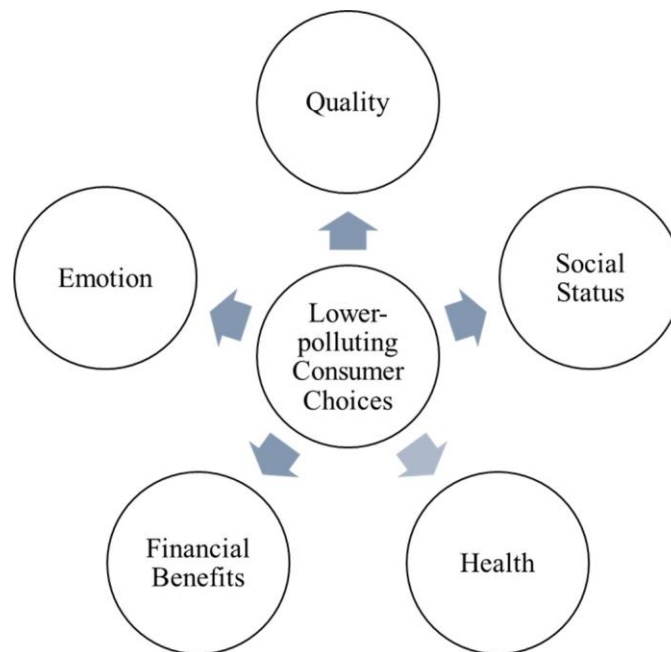
Figure 1: The co-benefits of lower-polluting consumer choices

Quality broadly refers to a product meeting or exceeding consumer expectations and requirements. It is essential to address any misconceptions that consumers may have about eco-friendly products potentially sacrificing quality to achieve environmental sustainability goals. Some of the most successful campaigns have focused on quality rather than on eco-friendliness. Compare the success of Tesla, which promoted its electric vehicles by focusing on elegant designs and performance with Nissan Leaf, which focused on global warming, collapsing glaciers, and wandering polar bears. The Leaf advertisement played right into the notion that consumers might need to sacrifice quality for the greater good, while Tesla's communication did not (Delmas & Colgan, 2018).

Social status is the relative standing or position in a group of people (Brooks & Wilson, 2015). People generally try to behave in line with expectations and seek approval from others. One way that people can increase their social status is by behaving in accordance with social norms, which are the rules and standards that guide and constrain social behavior (Cialdini & Trost, 1998).

When people perceive their behavior as being out of line with others, they often modify it accordingly. One popular approach to changing behavior, therefore, is to provide information about how one's behavior compares with that of others (Allcott, 2011).

Promoting the health benefits associated with eco-friendly products is another compelling driver of green consumption behavior. For example, health is also a significant motivating factor when it comes to choosing organic products. By emphasizing the health benefits associated with consuming organic food and using organic personal care products, consumers can be encouraged to make eco-friendly choices. Indeed, conventional agriculture often involves the use of

synthetic pesticides and fertilizers that can leave residues on food. By opting for organic produce, individuals can reduce their exposure to potentially harmful chemicals, promoting better health and well-being. By educating consumers about the potential risks of conventional farming practices and the private benefits of organic alternatives, purchasing behavior can be positively influenced towards supporting organic products for the betterment of personal and community health.

Providing information on monetary savings is perhaps the most obvious way to encourage the purchasing of lower-polluting products. One challenge of using monetary savings is that savings from lower-polluting products often come over time rather than being immediate. Buying a car or appliance that uses less electricity will result in monetary savings over time, but these items often have higher upfront costs. People perceive immediate benefits as more valuable than future benefits, a process known as temporal discounting. Ways of restructuring the problem such as using leases or using loans that are repaid with future savings can encourage the purchasing of eco-friendly products that have up-front costs that are higher than conventional products (Rai & Sigrin, 2013; Yang et al., 2019).

Emotional experiences can be an important driver of consumer behavior (Pluta-Olearnik & Szulga, 2022). Maya Angelou famously said that "people will forget what you did, but people will never forget how you made them feel."[21] For example, Dawn dishwashing liquid appeals to emotion in its commercials that feature the use of the product to clean oil off of animals after the BP oil spill in the Gulf of Mexico. Other companies use emotional appeals by showcasing their charitable donations and the good that the company will do when someone buys its product. These emotional experiences allow consumers to feel empathy and a greater sense of connection with the product.

Information on these private co-benefits is contrasted to information focusing exclusively on the environmental benefits, which is only a public benefit. The proposition of the Green Bundle is that information on the public benefit is less effective at impacting purchasing behavior for lower-polluting products than information bundling private co-benefits with the environmental public benefits. It is important to recognize that some of these informational interventions have the potential to alter the experience of product consumption. Rather than merely providing information about the product, certain treatments, such as emotionally appealing advertisements or those that create a sense of elevated social status from using the product, actively modify the product experience itself.

SYSTEMATIC LITERATURE REVIEW OF EXISTING INTERVENTIONS

The literature review is a systematic examination of current interventions that are successful at encouraging environmentally friendly consumer choices with a particular focus on reducing pollution (e.g., electricity/natural gas/water, food, transportation, clothing). This review aims to identify the key factors that contribute to the success of such interventions, as well as pinpoint gaps in the existing literature and identify areas that require further research.

---

[2] Angelou, M. [@DrMayaAngelou]. (2018, September 2). *I've learned that people will forget what you said, people will forget what you did, but people will never forget* [Tweet]. https://twitter.com/DrMayaAngelou/status/1036327789488734208

The results of this review are valuable for policymakers, organizations, and researchers working to promote sustainable consumption patterns and address the pressing issue of pollution.

Methods

Literature Search

Our search terms were chosen to identify research that focuses on behavioral interventions to facilitate lower-polluting consumer choices. We specifically aimed to focus on interventions such as field experiments, nudges, and randomized control trials because we were interested in how behavior could be changed through interventions (see list of search words in Appendix 1).

Articles were identified by searching the Web of Science for the years 2012–2023, thus analyzing a decade of research. Both abstracts and keywords were searched. Additionally, the included articles were restricted to peer-reviewed articles that appeared in the Social Sciences Citation Index (SSCI); were articles rather than review articles; appeared in the Environmental Sciences, Environmental Studies, Green Sustainable Science Technology, Economics, Business, Management, Behavioral Sciences, or Psychology Web of Science Categories; appeared in the Business Economics, Psychology, or Behavioral Sciences research areas. Articles appearing in journals with Journal Citation Indicators (JCIs) less than one (the average JCI in a category) were also excluded.

Inclusion and Exclusion Criteria

We included studies that examined how to decrease polluting consumption behavior.3 To be included, the article needed to report quantitative rather than purely qualitative data. Studies that solely involved participants located in countries listed as low- and middle-income by the World Bank were excluded because the consumption of affluent households is by far the greatest factor in global environmental impacts (Wiedmann et al., 2020). This is because this study is aimed at providing information for high-income countries, in which the impacts of interventions may differ from low and middle-income countries Additionally, we excluded articles that measured the environmental impact of a behavior without considering ways of changing that behavior or factors associated with that behavior. For example, a study showing which types of consumer products generate the most pollution but does not consider how to change purchasing behavior of those products would be excluded. Results were excluded if they were not statistically significant. This means that if a study reported on multiple interventions and only one intervention led to significant changes, we reported only the significant results.

Review Methods

Under the supervision of the lead author, the postdoctoral researcher independently read all titles and abstracts from the search results and also consulted the full article text when abstracts were too vague to make an inclusion decision. He classified each article as being included or excluded based on this initial assessment. Teams of two or three research assistants also independently completed the same initial assessment process. The research assistants met independently from

---

[3] Studies that examined factors that are correlated with polluting behavior are analyzed in the Appendix but are not included in the main analyses.

the lead author to discuss and resolve any discrepancies in their classification decisions, and the research assistants came to a final consensus. The research assistant's consensus was then compared with the lead author's classification decision. The inter-rater reliability for these classification decisions was 91% agreement with Cohen's kappa = 0.82. The lead author then met with the research assistants to discuss and resolve any discrepancies. After reading the full text of the articles determined to be included based on this initial screening process (98 out of 232 articles), an additional 20 articles were excluded. Although our search strategy was designed to capture all relevant articles, we identified seven additional articles through hand-searching reference lists and contacting experts in the field. These articles were screened against our eligibility criteria and included in the review. This left a total of 85 articles that were fully coded. Fourteen of these articles, however, were removed from the primary analyses because they were entirely correlational, which limits their applicability to informing behavioral interventions. Correlational studies are unable to establish a cause-and-effect relationship, which is crucial for designing interventions aimed at modifying behavior. If a paper reported multiple interventions and only one produced significant results, we focus solely on the significant outcomes. Adopting this method tends to result in the selection interventions with larger average effect sizes compared to not using such criteria. For a detailed explanation on how choosing based on statistical significance can lead to considerably larger sets of effect sizes, refer to Figure 4 in Wilson et al. (2020).

To analyze the data, we used the Green Bundle framework, which emphasizes the importance of considering private benefits to consumers in addition to environmental benefits. We, therefore, coded the extent to which the articles used information about private benefits to change consumer behavior.

Results

All coded data are available at https://osf.io/srphg/

Type of Dependent Variable

As shown in Table 1, the most commonly studied type of dependent variable is electricity/natural gas/water (42%). This is likely to be a frequently studied area because utility companies already have meters installed to monitor the usage of these products for billing purposes. Food is another frequently (25%) studied area of consumer purchasing, followed by transportation (17%), other (13%), and clothing (3%).

Table 1: Type of Dependent Variable

Type of Dependent Variable	Number of Articles	% of Articles
Electricity/Natural Gas/Water	30	42%
Food	18	25%
Transportation	12	17%
Other	9	13%
Clothing	2	3%
Total	71	100%

Level of Analysis

Most articles focus on behavior at the micro (e.g., individual) or meso (e.g., household) levels rather than on the macro (e.g., community) level (see Table 2). Studies coded as *community* examine the behavior of multiple people who are not confined to a particular business or household. Just like distinguishing between *individual* and *household*, the critical factor for distinguishing *individual* and *community* is whether the behavior can be directly linked to a person.

Table 2: Unit of Analysis

Unit of Analysis	Number of Articles	% of Articles
Individual	42	59%
Household	24	34%
Community	5	7%
Total	71	100%

Methodology Used

Most of the research relies on actual behavioral measures, are field studies, have a no-intervention control group, and are "true" experiments with random assignment rather than quasi-experiments without random assignment. Indeed, most articles had direct measures of behavior (68%) as opposed to self-reported behavior or behavioral intentions (Table A1). Articles categorized as measured behavior involve behavior that is directly assessed by researchers or an external source (e.g., a utility company), rather than relying on participants' reports. On the other hand, articles categorized as self-reported behavior gather information about specific behaviors directly from study participants (e.g., a survey completed by participants). Lastly, articles categorized as behavioral intention gather data by employing hypothetical questions or simulations. Over half of the articles (56%) also had field studies that were completed in the real-world (Table A3) and used random assignment (Table A4). In addition, approximately half of the interventions were completed in a day or less (48%) and very few (14%) took longer than a year (Table A2).

Green Bundle Behavior Change Technique

Table 3 shows the percentage of articles that used the different behavior change techniques in the Green Bundle framework. Quality, social, and financial were the most frequently used techniques. Note that some articles used multiple techniques, which is why the number of articles using each technique is greater than the total number of articles of 71. In contrast to the use of private benefits, 8% of articles focused exclusively on benefits to the planet or environment.

Although relatively infrequent, we will reconcile the existence of these studies later in this section.

Table 3: Green Bundle Behavior Change Technique

Behavior Change Technique	Number of Articles	% of Articles
Social	23	26%
Financial	22	25%
Quality	21	24%
Health	12	14%
Environmental only[4]	7	8%
Emotion	3	3%
Total	71	100%

---

[4] Environmental only refers to information that is only emphasizing the benefits of the product for the environment (i.e. not private co-benefit).

Social

The most commonly used approach to encourage environmentally-friendly consumer behavior is social (see Table 4). People seek social status by purchasing and consuming products that are approved by in-group members (Sherif, 1936; Brooks & Wilson, 2015). *Descriptive norms*, which provide information about what other individuals typically do, are the most common approach used to influence behavior. This includes information on the frequency of product or service use or the amount of electricity consumed by households similar to one's own.

Conveying social norm information about what other people are doing is a way to suggest which actions are appropriate in specific situations (Cialdini & Trost, 1998). For example, a randomized field experiment found that placing descriptive norm information about keeping the temperature low next to the thermostat led to an 8%–15% decrease in the hotel room temperature heat setting (Idahosa & Akotey, 2021). Displaying descriptive norm information publicly through posters, with green (red) stickers indicating whether a room's energy usage was below (above) average, led to a 20% reduction in electricity consumption, while providing this information privately didn't have a significant effect (Delmas & Lessem, 2014).

However, providing a descriptive norm on the hotel buffet saying that "75% of our guests eat our salad leaves and our tomatoes because locally grown" was ineffective at changing behavior compared to a health message about their "salad leaves and…tomatoes grow[ing] up naturally without the use of pesticides" (Cozzio et al., 2020, p. 272).

Unlike descriptive norms, which simply describe what other people do, injunctive norms define behaviors that are either socially approved or disapproved (Schultz et al., 2007). However, injunctive norms are used less frequently than descriptive norms. For example, in a university restaurant study, offering smaller portions and asking people to help the kitchen team avoid food waste led to a 10%–19% increase in the percentage of people who wasted no food (Lorenz-Walther et al., 2019). By requesting help from consumers, the action was implied to be socially desirable. In another study (Hanss & Böhm, 2013), participants were presented with information on significant environmental and socio-economic issues, highlighting the human contribution to these problems. The message conveyed that even though certain behaviors may be prevalent, they are socially undesirable. This approach resulted in an 18% increase in sustainable grocery purchases. However, the intervention had effects on domestic and seasonal products and ecological foods but did not affect resource-saving and ethical consumption. Therefore, the results were driven by differences between the intervention and control groups in two of the product categories. Additionally, in a personal interview, researchers emphasized pro-environmental injunctive and descriptive norms of various environmentally-relevant behaviors, leading participants to report an increased frequency of 25 environmentally-friendly actions related to water, waste, transportation, and energy (Verplanken & Roy, 2016).

In one article (Ro et al., 2017), social *competition* was used to promote behavioral change by having players compete in teams to earn points for their sustainable actions, resulting in a 4% reduction in electricity consumption.

In another article (Baca-Motes et al., 2013), a *goal* was employed to encourage environmentally-friendly behavior among hotel guests. Guests were asked to commit to these behaviors and given a lapel pin to publicly display their commitment, resulting in a 28%-45% increase in towel reuse.

Other articles used the concept of *social influence* in a broad sense to change behavior. Presenting a photo of a face next to a request for people to purchase environmentally friendly cleaning products,

lead to a 23% increase in consumer preferences for environmentally friendly cleaning sprays (Bodur et al., 2015). By having a person draw attention to eco-labeled bananas, the proportion of eco-labeled bananas purchased increased by up to 192% (Kristensson et al., 2017). During one study (Lanzini & Thøgersen, 2014), participants were offered positive verbal praise for purchasing eco-friendly products. However, the authors found that this approach was less effective in promoting green shopping behavior compared to a monetary incentive.

While social norms are commonly used in behavioral interventions, there are some issues to consider. There is also the potential for unintended consequences, such as backlash or resistance to the perceived pressure to conform (Schultz et al., 2007). People may feel that their freedom to choose has been taken away, and this could lead to negative attitudes toward the behavior being promoted. Another issue we encountered in the reviewed studies is the effect on other non-targeted behaviors, which is often referred to as spillover. This is exemplified by Tiefenbeck et al., 2013, who provided descriptive norm information and feedback about weekly water usage. This study successfully reduced the targeted behavior of water usage by 6%. However, the intervention also resulted in a 6% increase in electricity usage. This finding illustrates the importance of targeting behaviors that are likely to have the greatest impact on the environment because other non-targeted behaviors might be adversely affected.

Table 4: Different Elements of Social

Elements of Social	Number of Articles	% of Articles
Descriptive norm	12	52%
Social influence	6	26%
Injunctive norm	3	13%
Competition	1	4%
Goal public display	1	4%
Total	23	100%

In conclusion, social motivation can be an effective way to promote environmentally-friendly behavior in consumers. This can be achieved through descriptive and injunctive norms, social influence, social competition, and goal-setting approaches. Descriptive norms, which inform people about what others typically do, are the most commonly used approach. Injunctive norms, which define socially approved or disapproved behavior, are used less frequently. One possible explanation for a lack of studies using injunctive norms is that researchers do not have to have any knowledge about specific communities' views toward protecting the planet to provide descriptive norms. Providing injunctive norms, on the other hand, requires researchers to know which communities value this behavior, which can vary depending on factors like political affiliation (Costa & Kahn, 2013). Overall, promoting socially desirable behaviors through social influence can lead to significant

changes in consumer behavior. However, while social norms can be an effective tool for promoting behavior change, they should be used with caution to ensure they are effective and not counterproductive. For example, the spillover effect should also be considered, as targeting one behavior might inadvertently affect other non-targeted behaviors.

Financial

Framing and/or changing the financial benefits of green behavior is another popular way of changing consumer behavior. For example, providing information about the annual energy costs of using lightbulbs lead to a 27% increase in how much consumers were willing to pay for energy efficient light bulbs (Min et al., 2014). Proposed changes in the price of gasoline and diesel through a European carbon tax were modeled with up to a 13% decrease in fuel emissions in some countries due to reduced fuel usage when prices are higher (Zimmer & Koch, 2017).

One important consideration is if changes are framed as being a gain or a loss. Loss aversion refers to the tendency of individuals to feel the pain of losses more strongly than the pleasure of equivalent gains. This is because the fear of loss triggers a stronger emotional response and creates a sense of urgency to avoid negative outcomes. However, the potential effectiveness of loss aversion is not always confirmed. For example, electricity plans framed as offering bonuses for achieving electricity savings targets are more attractive to consumers than plans framed as incurring penalties for failing to achieve electricity savings targets (Mahmoodi et al., 2018).

Financial information or incentives are sometimes paired with social information. One field experiment (Weber et al., 2017) provided social norm information on electricity usage and offered cash prizes for households that ranked the highest in shifting electricity usage to solar production hours. This intervention resulted in a 5% increase in the proportion of electricity that a household used during hours when electricity came from solar rather than less environmentally friendly sources. Membership in particular social groups can also be an important consideration when designing interventions to change green behavior. One field experiment (Costa & Kahn, 2013) found that providing information about electricity usage social norms, feedback, and ways to save money was more effective at reducing electricity usage for political liberals (2.4% decrease) than conservatives (1.7% decrease). Political conservatives were also more likely to opt out of receiving this information and to report disliking receiving the information.

As shown in Table 5, the studies that employed financial incentives were divided into two categories: *Rebates/Discounts/Surcharges* and *Savings*. Rebates/Discounts/Surcharges encompass additional costs or benefits that can modify the cost-benefit analysis beyond the standard financial savings derived from reducing usage. Conversely, the Savings category is centered on providing more information regarding the benefits associated with environmentally-friendly behaviors, rather than directly altering the costs and benefits.

Table 5: Different Elements of Financial

Elements of Financial	Number of Articles	% of Articles
Savings	13	59%
Rebates/Discounts/Surcharges	9	41%
Total	22	100%

Offering discounts on the adoption of solar hot water and photovoltaic systems led to a 10% reduction in household electricity usage (Havas et al., 2015). Offering a salary bonus to the housekeeping staff for reducing the replacement of towels/toiletries led to a 6% reduction in the number of shampoo bottles used by hotel guests (Knezevic Cvelbar et al., 2022). Time-of-use electricity pricing has an impact on the amount of electricity consumed during different periods of the day and can incentivize increased usage when energy is generated from renewable sources (Liang et al., 2021).

Providing information about the savings that naturally come from reducing consumption can also have a modest impact on altering behavior. Having posters and banners in public places saying "save energy, save money" resulted in a 0.4% reduction in residential electricity consumption during the public media campaign (Agarwal et al., 2022). People are also more likely to (hypothetically) choose fuel-efficient vehicles when cost information is provided over a longer time horizon of 100,000 miles rather than 100 or 15,000 miles (Camilleri & Larrick, 2014).

Providing information about savings, however, may not be adequate to prompt individuals to switch their purchasing behavior to energy-efficient appliances since people tend to underestimate the value of future energy savings. According to one study (Newell & Siikamäki, 2014), this underestimation amounts to approximately one-third of the actual savings. This suggests that additional benefits, such as rebates, might be especially necessary for changing purchasing behavior. One recent field experiment found that providing monetary savings information was not uniformly effective at increasing purchases of many energy-efficient products (del Mar Solà et al., 2023). The researchers observed that conveying financial information led to a significant increase in purchases of A++ rated washing machines and dishwashers, particularly when this information is disseminated by sales personnel or supplemented with an additional label. However, none of the interventions boosted the purchase of A+++ rated washing-machines and dishwashers. The analyses conducted in this study were not pre-registered, and the results could not have been anticipated beforehand. Consequently, it remains unclear why the dissemination of energy savings information might be effective for certain product types, but not for others.

In summary, framing financial incentives and benefits can be an effective way of promoting green behavior. Providing information about financial savings can also lead to modest shifts in behavior, but it may not be sufficient to prompt individuals to switch to energy-efficient appliances. Combining financial incentives with social norms and group membership considerations can increase the effectiveness of interventions. However, more research is needed to understand the complex factors

that influence the effectiveness of financial incentives in promoting green behavior.

Quality

The Green Bundle category of *quality* refers to the perceived consumer benefits of a product as well as lower consumer costs of selecting a green item or behaving more sustainably. This is in line with the marketing literature that includes the following attributes to describe product quality: performance, durability, reliability, safety, usability, aesthetics, functionality, compatibility, and maintainability (e.g. Garvin, 1987). Increasing the perceived value of environmentally friendly items and lowering any transaction costs of purchasing those items can change behavior to be more environmentally friendly.

Consumers often perceive environmentally friendly options as being of lower quality, less available, or requiring personal sacrifices and changes to daily routines (Gallastegui, 2002; Peattie & Crane, 2005). Effective approaches to changing consumer behavior often involve countering these notions. For example, emphasizing the quality features of more expensive, greener clothing by calling them "durable" increased purchasing intentions by 73% (Sun et al., 2021). High-quality items sometimes need to be experienced for consumers to appreciate the quality of an item.

Allowing potential customers to test drive electric vehicles (and therefore experience their quality) increased electric vehicle purchasing intentions by 11% (Brückmann, 2022).

Table 6: Different Elements of Quality

Elements of Quality	Number of Articles	% of Articles
Usability/Convenience	10	48%
Taste	5	24%
Performance	3	14%
Choices	1	5%
Comfort	1	5%
Durability	1	5%
Total	21	100%

Several different elements constitute quality. These include *usability*, *taste*, *performance*, *convenience*, *purity*, *choices*, *comfort*, and *durability*. Table 6 shows the number of articles that make use of these different elements of quality. *Usability* is one component of quality that refers to how easily people can make use of a product in practice (Shackel, 2009). Default options (Goldstein et al., 2008) that are automatically selected or made especially easy for people to select can shift behavior in a more environmentally friendly direction. Making more renewable energy contracts the default, leads to a

45% increase in choices of more renewable home energy sources (Momsen & Stoerk, 2014). People are also influenced by the default choice of room lighting, which could be lighted either by natural sunlight or artificial overhead lighting (Heydarian et al., 2016). Default options, however, are not guaranteed to be effective, and one study found no reduction in car energy use from activating the eco-driving mode by default because people countered the eco mode by pressing harder on the car accelerator pedal (Kutzner et al., 2021). Providing visual plus auditory feedback for hard braking and acceleration in a gamified phone app resulted in 7% more energy-efficient driving behavior (Degirmenci & Breitner, 2023). Visual feedback alone, however, was not effective at making driving behavior more energy efficient. The auditory feedback made the app more enjoyable while driving, and therefore made it more effective at changing driving behavior. Setting default energy-saving goals for consumers can also be effective at reducing electricity usage. However, it is important to ensure that the default goals are not set too low or too high in comparison to a self-determined goal, as this can negatively affect behavior (Loock et al., 2013). Automatically checking the green energy source option for a household energy plan results in significantly more households (0.62% vs. 5.58%) purchasing green energy (Ebeling & Lotz, 2015).

People may also be more likely to choose a product that is believed to have a better *taste*, which is a strong motivating factor for people to buy organic products (Magnusson et al., 2001). Beliefs about taste can have a greater influence on taste perceptions than the actual taste itself (Bernard & Liu, 2017). Organic labels are one factor that can influence quality perceptions of meat and meat substitutes (Apostolidis & McLeay, 2016). Labeling buffets as organic can increase the number of salad leaves and tomatoes taken by diners (Cozzio et al., 2020). Sharing new vegetarian recipes with customers can lead to an increase in their purchases of fruits and vegetables (Bauer et al., 2022). One potential explanation is that the recipes make these foods more appealing and flavorful compared to consuming them on their own. It might also be that cognitive effort was reduced for customers who did not come with a clear shopping list and needed inspiration. Consistent with the idea that individuals buy organic products for their personal benefits, such as taste, a study by Limnios et al. (2016) that used choice experiments, discovered that consumers who typically purchase organic apples are generally not willing to pay more for apples with a lower environmental impact. In contrast, those who do not typically buy organic apples were willing to pay a slightly higher price for apples with a lower environmental footprint. The study suggests that consumers who usually buy organic produce are not necessarily motivated by environmental concerns, but rather by other personal benefits of organic products. The people who regularly bought organic products seemed to care *less* about the environment than people who did not regularly buy organic products.

Environmentally friendly products can outperform conventional ones, especially in the case of electric vehicles. According to research, electric vehicles offer superior performance due to their instant torque, enabling them to accelerate faster than traditional vehicles even from a stationary position. This translates to a more responsive and nimble driving experience when using an electric vehicle. Offering test drives of electric vehicles can boost customers' readiness to buy them, as it allows individuals to experience firsthand the enhanced driving performance features and appreciate them (Bruckmann, 2022). Energy-efficient home improvements (e.g., insulation, cavity walls) can have higher performance and therefore result in lower household gas consumption, though the reduction in gas use did not last in the long run (Peñasco & Anadón, 2023). Making energy-efficient home improvements can substantially enhance the performance of a home's heating and cooling systems, leading to decreased energy consumption and reduced greenhouse gas emissions. By upgrading to high-efficiency HVAC systems, insulating walls and attics, and sealing air leaks, a home's overall energy performance can be improved, thereby reducing the amount of energy required

to maintain a comfortable indoor temperature. This translates to lower utility bills for homeowners and a more pleasant and comfortable living environment. Intelligent transport systems can make driving more efficient, thereby reducing fuel used while idling (Cheng et al. 2020).

Other aspects of quality include *choices*, *comfort*, and *durability*. Having a greater number of vegetarian meals on the menu increases the number of vegetarian meals sold by as much as 79% (Garnett et al., 2019). More options mean that every customer will be more likely to find an option that better matches their preferences. Increasing perceptions of *comfort* (such as learning about bus shelters that have a cover to protect from rain and wind) increase intentions to use sustainable transportation (Manca et al., 2020). Describing clothing as durable leads to increased purchase intentions of those products (Sun et al., 2021).

In conclusion, the concept of quality is comprised of various elements such as usability, taste, performance, convenience, choices, comfort, and durability. Default options that are automatically selected or made easy to select can influence behavior in a more environmentally friendly direction. Replacing old appliances with energy-efficient ones and providing visual and auditory feedback can result in lower electricity usage and more energy-efficient driving behavior. Beliefs about taste can greatly influence taste perceptions, making organic labels an influential factor in quality perceptions of food products. Offering a variety of options and increasing perceptions of comfort and durability can also lead to more sustainable consumption behaviors. Therefore, understanding and implementing these various elements of quality can be effective in promoting more environmentally friendly choices and behaviors.

Health

Consumer behavior can be shifted towards lower-polluting products by focusing on the health benefits of going green. These health benefits can be personal benefits aimed directly at the individual consumer, or they can be broad benefits that affect everyone in a community, including those individual consumers who are part of the community and can also enjoy these benefits. We also include the increasingly popular mindfulness interventions in the health category. Table 7 shows the number of articles that fall into these different health categories. Emphasizing *direct health benefits* can be a useful way of changing eating behavior. Multiple studies used information about the negative health impacts of eating meat. A 50-min lecture that emphasized the health benefits of reduced meat consumption, resulted in a 5% decrease in purchases of meals with meat at campus dining facilities (Jalil et al., 2020). In one online study (Carrico et al., 2018), individuals self-reported consuming less red meat after being informed of the cardiovascular health risks associated with its consumption. In another study, however, people were not willing to pay significantly more for sustainably produced beef or plant-based meat after getting information about the health and environmental impact of meat (Katare et al., 2022).

Two studies fell into the *broad health benefits* category. Email messages emphasizing air pollution and health impacts associated with energy use resulted in an 8% decrease in electricity usage, while those emphasizing financial benefits did not result in a significant change in electricity usage (Asensio & Delmas, 2015). Another study told people about health-related issues associated with pollution and found an 18% increase in sustainable grocery purchases (Hanss & Böhm 2013). This intervention, however, incorporated elements from other Green Bundle categories as well so it is unclear how much of the effect can be attributed to the health information specifically.

Two other studies (Stanszus et al., 2019; Geiger et al., 2020) used mindfulness-based interventions.

Neither showed significant changes in sustainable food or clothing consumption behavior. Our present review, therefore, does not find any evidence of mindfulness being an effective way of changing consumer behavior.

Table 7: Different Elements of Health

Elements of Health	Number of Articles	% of Articles
Direct health benefits	8	67%
Broad health benefits	2	17%
Mindfulness	2	17%
Total	12	100%

In conclusion, research has shown that emphasizing the health benefits of green products can be an effective way to shift consumer behavior towards lower-polluting products, particularly when it comes to reducing meat consumption. However, the effectiveness of this approach may vary depending on the context and the specific products being promoted. While our systematic review could not find successful interventions that focus on broad health benefits and mindfulness-based approaches in our sample, incorporating elements from other Green Bundle categories may enhance their effectiveness.

Overall, further research is needed to better understand how to effectively leverage health-related messaging to promote sustainable consumption.

Emotion

Studies did not tend to use emotion to a large extent. As shown in Table 8, two of these studies used guilt, and one used positive emotions. One study (Zwicker et al, 2020) used information about plastic's impact on CO2 and global warming, which was designed to elicit guilt. This was shown to increase willingness to pay for a bio-based plastic bottle, but the decisions were hypothetical so it is unclear if people would be as willing to reduce any feelings of guilt when an actual cost is involved. Another study (Hanss & Böhm, 2013) used guilt by giving people information regarding major environmental and socio-economic problems and how humans are the major cause. This information (which was also paired with broad health information) resulted in an 18% increase in sustainable grocery purchases. One study (Sarkar et al., 2022) was designed to increase positive mood in participants by having people engage in physical exercise (300 jump ropes or 300 basketball dribbles). The researchers found that customers were more likely to choose a sustainable product after exercising. This intervention was based on the idea that exercise increases the release of dopamine in the brain, which therefore increases mood (Chaouloff, 1989).

Table 8: Different Elements of Emotion

Elements of Emotion	Number of Articles	% of Articles
Guilt	2	67%
Positive	1	33%
Total	3	100%

In conclusion, while studies have not heavily relied on emotions, there is some evidence to suggest that guilt and positive mood can be effective in promoting sustainable consumption. Further research is needed to determine the long-term effectiveness of these interventions and their applicability in real-life purchasing decisions.

Planet and Environment

In contrast to the Green Bundle framework, seven of the studies aimed to change consumer behavior by focusing only on the implications for the planet or environment without specifically focusing on private benefits to the consumer. For instance, traffic light signaling was used to indicate the effect of a meal on the environment (i.e., green means low, yellow means medium, and red means high), resulting in an increase in hypothetical low-carbon emission meal choices by 17% (Osman & Thornton, 2019) and low-carbon emission meat dishes at a university restaurant by 12% (Brunner et al., 2018). People reported a 20%–30% increased willingness to reduce air and car travel specifically to reduce carbon emissions after COVID lockdowns (O'Garra & Fouquet, 2022). This paper presented survey data from UK car drivers and air travelers' willingness to reduce travel behavior post-Covid to minimize or avert the impacts of climate change. The research reveals that individuals who claim to have "more time to do creative things" since the COVID-19 lockdowns are more likely to express a willingness to voluntarily reduce their travel. Furthermore, they observe that higher-income travelers consume and pollute considerably more than others, but there is little variation in the level of voluntary reductions across different income levels. This suggests that addressing the excessive consumption associated with affluence should be a priority in policies aimed at facilitating a low-carbon transition. Having green logos to indicate environmental friendliness increased preference ratings for fashion products by 18% (Lee et al., 2020).

However, it is crucial to note that only one of these studies (Brunner et al., 2018) measured actual consumer behavior. The other studies all relied on behavioral intentions or self-reported behavior, which can be influenced by social desirability bias. Participants may make their behavior appear more socially acceptable without incurring any costs associated with actual behavior change. Therefore, if

people are not changing their behavior and instead changing their reporting of behavior, the private benefits that are fundamental to the Green Bundle framework are not needed to offset any additional (perceived) costs.

This reliance on self-reported measures for studies using environmental messaging is in contrast with the studies using Green Bundle framing which relied more on measured behavior. Measured behavior involves directly assessing how the green behavior changed, while self-reported behavior involves participants reporting their behavior, which cannot be independently verified. Behavioral intention means that participants report how they think they would behave in different hypothetical scenarios. Table 9 shows the number of articles that used each behavioral measure for the different Green Bundle categories.

Table 9: Behavioral Measure Associated with Each Behavior Change Technique

Behavior Change Technique	Measured Behavior	Self-Reported Behavior	Behavioral Intention	Total
Social	17	4	2	23
Financial	16	2	4	22
Quality	14	1	6	21
Health	8	4	0	12
Emotion	2	0	1	3
Environmental only	2	1	4	7
Total	59	12	17	88

In addition, one important consideration when using information to indicate environmental friendliness is that people need to trust that the purported environmental impact is accurate. Companies can have the incentive to engage in the practice of greenwashing (Delmas & Burbano, 2011) where they mislead consumers about the environmental impact or benefits of products or services. For example, any increased preference for lower-polluting products would be eroded by public perceptions that the information about the environmental benefit of the product is misleading. This also exemplifies another reason for using the Green Bundle approach that pairs private benefits with environmental benefits because people can more readily determine if private benefits are credible. Indeed, environmental benefits can be considered credence goods, that is to say, products or services whose quality or characteristics are difficult to evaluate even after consumption. In the case of environmental benefits, consumers often rely on information provided by producers or third parties to assess the environmental impact of a product or service. Consumers may not have the necessary expertise or access to detailed information to accurately evaluate the environmental benefits

associated with a particular product or service. As a result, they must trust the claims made by producers or rely on eco-labels, certifications, or other forms of verification to make informed decisions. People are therefore less likely to tune out the environmental messaging because of widespread skepticism.

The credence nature of environmental benefits can create challenges in the marketplace. It can be difficult for consumers to distinguish between genuinely environmentally friendly products and those that make misleading or unsubstantiated claims. This can lead to a lack of trust and consumer skepticism. To address this issue, regulations, standards, and certification systems have been developed to provide consumers with more reliable information about the environmental attributes of products and services (Gorton et al., 2021). These mechanisms aim to increase transparency and ensure that environmental claims are backed by credible evidence. While we don't review this literature here, it shows the challenges associated with effective eco-labeling strategies. While the goal of eco-labels is to reduce information asymmetry between producers and consumers over the environmental attributes of a product or service. However, by focusing on this information asymmetry, rather than on how the label meets consumer needs, eco-labels may sometimes send irrelevant, confusing, or even detrimental messages to consumers. For example, the environmental message could be interpreted by consumers as a sign of low quality (Delmas & Lessem, 2017). Overall, the credence nature of environmental benefits underscores the importance of accurate and trustworthy information to enable consumers to make informed choices and support environmentally sustainable options.

In summary, studies that focused solely on the environmental impact without considering private benefits were able to elicit some reported behavior change, but the reliability of self-reported behavior needs to be considered.

Greenwashing can undermine the effectiveness of environmental labeling. The Green Bundle framework's inclusion of private benefits with environmental benefits has more demonstrated empirical evidence in the studies we included in the review.

Results Summary

In our literature review, we found that promoting environmentally-friendly behavior can be facilitated by a combination of social, financial, quality, health, and emotion factors. Our results are summarized in Table 10, below, we provide a summary of the results of our literature review for the different elements of each bundle category – social status, financial, quality, health, and emotion – and how they can be used to promote environmentally-friendly behavior. While the efficacy of specific interventions was described in the result section, this summary does not include specific ranges of efficacy per category as these vary by context and the dependent variables are too different to be normalized.

Under the social category, for example, the elements include descriptive norms, social influence, injunctive norms, competition, and social status based on the public display of goals. Descriptive norms refer to communicating what is typically done in a given situation, while injunctive norms refer to communicating what ought to be done. Social influence and competition can be leveraged to encourage individuals to adopt sustainable behaviors by highlighting the positive social status that comes with doing so. Goal-setting approaches can help individuals visualize and work towards adopting sustainable behaviors.

Our review also found that for publicly visible interventions, savings framing, ease of adoption,

positive messaging that encourages conservation rather than overconsumption, and mood improvement are key factors of success in promoting sustainable behaviors. Publicly visible interventions, such as posting signage or hosting community events, can be effective in increasing awareness and promoting the adoption of sustainable behaviors.

Offering substantial savings, such as through incentives or tax breaks, can motivate individuals to adopt sustainable behaviors. Making sustainable behaviors easy to adopt, such as through convenient access to recycling facilities, can also increase adoption.

Positive messaging is important for promoting sustainable behaviors, as in general individuals are more likely to respond to positive reinforcement than negative criticism (Skinner, 1953). Highlighting the benefits of sustainable behaviors, such as improved health or a cleaner environment, can also be effective in promoting adoption. Finally, improving the mood of consumers, such as through the use of music or a pleasant environment (Västfjäll, 2002, Spies et al., 1997), can increase the likelihood of adopting sustainable behaviors.

Table 10: Literature Review Summary

	Social Status	Financial	Quality	Health	Emotion
Different elements of each bundle category	Descriptive norm	Savings	Usability/Convenience	Direct health benefits	Guilt
	Social influence	Rebates/Discounts/Surcharges	Taste	Broad health benefits	Positive
	Injunctive norm		Performance	Mindfulness	
	Competition		Choices		
	Goal		Comfort		
			Durability		
Frequency of studies in this area	23	22	21	12	3
Behavioral measure	Majority measured behavior	Majority measured behavior	Majority measured behavior	Majority measured behavior	Majority measured behavior
One good example	Publicly displaying norm information on posters (Delmas & Lessem, 2014)	Provide long-term costs or savings—e.g., 1 year vs. 1 month, 100,000 miles vs. 100 miles (Camilleri & Larrick, 2014)	Make lower-polluting options the default (Momsen & Stoerk, 2014)	Describe health benefits of vegetarian or organic (Jalil et al., 2020)	Exercise can improve mood and sustainable purchasing (Sarkar et al., 2022)
Key factors of success	Publicly visible to others	Savings should seem substantial to individual targeted	Make it easier to go green	Personal health benefits when possible	Positive mood

Discussion

Overconsumption is the strongest determinant of increased global environmental and social impact (Wiedmann et al., 2020), and reducing consumption plays an important role in demand-side climate change mitigation efforts (IPCC, 2022). Understanding how to create effective behavioral interventions for reducing consumption is therefore critical to reducing this environmental impact. Effective interventions use information about private benefits to change consumer behavior and reduce consumption.

The most frequently used type of behavior change technique is social, and these were almost always in the form of descriptive norms that conveyed information about others' behavior. According to the Green Bundle framework, social status benefits. Social status is defined as " the perceived or actual standing of an individual relative to others on a dimension of social relevance (e.g., traits, economic standing, abilities)" (Rose & Vogel (2020), p. 4754). The effectiveness of different social norm information on changing behavior would therefore be expected to vary as a function of how much people are being observed (or think they are being observed) by others. For example, Delmas and Lessem (2014) found that publicly posting the relative standing of different residence hall rooms' electricity consumption was effective to reduce electricity usage in contrast to the same information provided privately to the individuals. The ineffectiveness of private messaging might be explained because this experiment did not involve any monetary rewards. The students are not paying their electricity bill separately but rather as part of their residence fees. This is in contrast to most utility bills that would contain similar social norm information about households' consumption relative to neighbors' consumption. Monetary incentives such as reduced electricity bills can enhance the influence of private information. However, these incentives may also diminish the reputation-based signal of conservation, as individuals might be perceived as conserving solely to save money.

If people behave in line with social norms simply because they believe that they are being observed by others, this is known as public compliance (Festinger, 1953). Public compliance typically occurs when behavior can be publicly observed, regardless of whether or not individuals privately accept that others' behavior is the right thing to do (Aronson et al., 2013). However, if individuals do privately accept that the descriptive norm information represents the correct way to behave, the behavior would be likely to occur regardless of how much the behavior can be observed by others. For instance, if someone determines that adopting more environmentally friendly practices is morally correct after receiving social norm information, they would subsequently be inclined to maintain such behavior even when it cannot be publicly observed.

Behaving in a manner consistent with personally held beliefs ties into the debate about whether people behave prosocially due to altruistic or egoistic motivations. Pure altruism, is driven solely by a concern for the well-being of others, while egoist behavior is motivated by self-interest. It is important to note that behavior that appears purely altruistic on the surface can often be influenced by egoistic motivations as well. According to Andreoni (1990), social pressure, guilt, sympathy, or simply a desire for a 'warm glow', which stems from the self-esteem boost derived from improving the welfare of others, may play important roles in the decisions of individuals to make donations to privately provided public goods, such as charity. Egoistic motivations for pro-social behavior are the basis of the Green Bundle framework, which states that seeking self-benefits is a powerful driver of pro-social behavior. These prosocial self-benefits have been described as gaining praise, enhancing self-image, improving mood, avoiding sanctions for norm

violations, avoiding guilt, and avoiding shame (Batson et al. 2011).

Findings from the studies we examined are broadly in line with the Green Bundle framework, which states that successful interventions generally use information about private benefits rather than focusing solely on benefits to the planet or environment. Only one study (Brunner et al., 2018) measured actual consumer behavior and utilized only environmental benefits (in the form of color-coded carbon footprint labels). Although not directly examined by the authors, the effect could be due to people wanting to avoid any social stigma from purchasing items marked as environmentally unfriendly at an urban university cafeteria. Any decisions where an item is purchased and displayed publicly would be more likely to fall in line with social norms. Examining differences between in-store and online purchases—which may be less subject to social desirability decisions—would be an area worth further exploration. Critically, these decisions need behavioral measures because the current literature already suggests that hypothetical online decisions still show patterns consistent with social desirability defined as behaving in a manner that is consistent with what is perceived as desired by salient others (Kuncel & Tellegen, A. (2009). Although, perhaps these patterns of online decisions could be due to enhancing self-image or improved mood rather than avoiding sanctions for norm violations.

One additional consideration that is worth further study is whether sustainable consumption that enhances self-image or improves mood could be undermined by explicitly referring to these private benefits. In other words, the purchase provides these private benefits to consumers only to the extent that people are not overtly aware that their true motivation is for egoistic rather than altruistic reasons. Perhaps behavioral interventions that strongly imply these private benefits without making them explicit would be ideal in this type of scenario.

The Green Bundle framework and the studies examined in this review support the idea that increasing consumer awareness of private benefits such as quality, social status, health, monetary savings, and emotional returns are important for successfully making consumer behavior more environmentally friendly and reducing overconsumption. Information interventions based on this framework can complement technological improvements to reduce pollution and the harmful environmental impact of overconsumption.

Recommendations

Green Bundle framing interventions have emerged as an effective tool to promote sustainable consumption patterns by emphasizing the private benefits that environmentally friendly products can provide. These interventions aim to promote the adoption of sustainable behaviors by leveraging the psychological principles of decision-making. However, there are important factors that need to be considered before implementing these strategies. These factors include both product attributes and situational context.

When implementing these interventions, it is important to consider the specific needs satisfied by the product category. Appeals that closely match these needs are more persuasive for consumers than less relevant appeals as shown in the marketing literature more generally (Schmidt, 1999). For example, emotional value will be highly salient for consumers when purchasing items with experiential characteristics because of the complementarity between the emotionally driven purchase experience and the value source (D'Souza et al., 2007). In contrast, for product categories that are functional, functional attributes and rational thoughts dominate the decision-making process. Therefore, complementarities will be best when the environmental attributes

enhance the performance of a product (e.g., increased efficiency).

While we didn't find studies specifically testing the combination of the different elements of the Green Bundle, it is possible that combining the elements of the Green Bundle, such as quality and social, could enhance their effectiveness in promoting environmentally-friendly behavior. For instance, by highlighting the exclusivity or premium nature of environmentally-friendly products, they can attract consumers who value high status. However, it is important to note that some combinations of the Green Bundle categories might have the opposite effect, such as combining emotion and money, which can work against each other. Therefore, one needs to be careful in combining the different categories of the Green Bundle.

The relevance of sustainability benefits also varies depending on the situational context. The perception of functional, social, health, or emotional benefits associated with sustainability is moderated by situational aspects. For example, health benefits from environmental improvements may be more important during critical junctures in consumers' lives (Delmas & Colgan, 2018). Consumers may become more aware of the connection between environmental damage and health when starting a family, having children, or getting sick and wanting to understand the cause.

Another important factor is the social or cultural context. Framing interventions could be more effective when the environmental benefits are emphasized in situations where there is high public awareness of environmental issues (Bolderdjik et al., 2013; Whitmarsh & O'Neil, 2010; Schultz et al., 2005). In contrast, private co-benefits would be more persuasive when the decision-making context is personal, and the consumer has a strong sense of identity associated with the product. For example, a person who identifies strongly as an environmentalist may be more motivated to purchase a product that has environmental benefits, even if the private co-benefits are minimal.

The articles in this literature review are derived from developed countries, but many of the interventions described have relevance for other economic or cultural contexts. Monetary savings and durability are two attributes that are particularly relevant for consumers in developing countries. However, stated motivations are not always what drives conservation behavior—we need to be careful with overgeneralizations. For example, Chen et al. (2017) asked about 2,000 Indians living in urban areas what motivated them to conserve energy. Money was the most frequently cited motivation. Health was among the least common motivations. Overall, for respondents who stated they engage in energy conservation behaviors, 84 percent cited saving money and only 9 percent of respondents cited the health of themselves or their family as a motivating factor for engaging in energy conservation.[5] However, when the researchers provided Indian households with real-time information about their electricity usage framed in terms of cost savings, they didn't conserve energy. When the issue was framed in terms of air pollution, on the other hand, they reduced usage significantly. Despite statements to the contrary, the health benefits of saving energy were a better motivator. Similar results were seen in the United States, showing that similar motivations sometimes work across cultures. The context matters, but it needs to be carefully assessed in each information campaign.

Our approach focuses on the importance of emphasizing private benefits to motivate the adoption of lower-polluting products. The existing literature provides some evidence supporting this idea, although few studies have directly compared private benefits with and without public benefits. Consequently, it is challenging for us to draw definitive conclusions regarding the

---

[5] This was calculated as the number of respondents who cited each motivation divided by the number of respondents who engage in any energy conservation behavior always or often.

circumstances in which private incentives should complement or substitute public benefits. In light of this, we propose several hypotheses that require empirical testing.

Behavioral science research suggests that financial incentives may crowd out altruism. In such cases, it may be more effective to solely highlight the private benefits of environmentally friendly products. Additionally, individuals may harbor doubts about the actual effectiveness of green products. Questions may arise regarding whether these products genuinely deliver the claimed environmental benefits or if the claims are exaggerated. Concerns about the overall environmental impact of green products, such as their carbon footprint throughout the lifecycle, can shape people's perceptions and skepticism. Sometimes, environmental information can send irrelevant, confusing, or even detrimental messages to consumers, particularly when it detracts from addressing consumer needs. For instance, in the wine industry, an environmental message might be misinterpreted as an indication of low product quality (Delmas & Lessem, 2017).

In cases where environmental benefits are difficult to communicate and may confuse consumers, it is best to avoid mentioning them altogether. This is what 2/3 of eco-certified wineries in California have done by letting the quality of their wine speak for itself (Delmas & Grant, 2014), and what Tesla did by emphasizing performance over environmental benefits. Despite criticism of electric cars emitting more carbon in states that rely on coal for electricity generation, Tesla's sales continued to dominate the market with 65% of the market share in 2022 (S&P Global Mobility, 2022).

Furthermore, as we mentioned earlier, trust is crucial for effective communication of public benefits. If consumers lack trust in these public benefits, it may be more advantageous to focus on private benefits. This is supported by the fact that consumers' reluctance to purchase green products can be attributed, in part, to skepticism regarding corporate environmental claims (Furlow, 2010).

This skepticism can be rooted in various factors. Firstly, individuals may question the motives of corporations in promoting their environmental initiatives, suspecting profit-driven or marketing strategies rather than genuine environmental concerns. This skepticism is fueled by instances of "greenwashing," where companies make misleading or exaggerated environmental claims (Lyon & Montgomery, 2015; de Freitas Netto, 2020). Secondly, mistrust can stem from doubts about the transparency and accuracy of information provided by corporations. Consumers often struggle to verify the truthfulness of environmental claims, leading to skepticism. Moreover, past incidents of corporate environmental misconduct, pollution, or unethical practices contribute to general suspicion. Such incidents erode trust and cause consumers to question the credibility of corporate environmental claims.

To overcome this reluctance, companies need to provide transparent and reliable information about their environmental initiatives and product claims. Third-party certifications, independent audits, and comprehensive reporting can help build trust and credibility. Open communication channels and consumer engagement can address knowledge gaps and alleviate concerns. Ultimately, companies must demonstrate their commitment to sustainability and substantiate their environmental claims with concrete evidence to counteract general suspicion surrounding corporate environmental claims. However, it is important to acknowledge that contested environmental claims can pose challenges in this regard.

In situations where private benefits are minimal, developing effective interventions for consumers becomes more limited. In such cases, it may be more beneficial to create policies that encourage manufacturers to change their products rather than solely relying on consumer

behavior change. However, if manufacturers produce environmentally friendly products with lower quality, these products are unlikely to gain significant market share. Hence, incentivizing manufacturers to develop products that provide both environmental and private benefits would be preferable.

Our examination of the literature reveals the significance of emphasizing private benefits to incentivize the adoption of lower-polluting products. However, the literature lacks extensive research comparing private benefits with and without public benefits, making it challenging to determine when these incentives should complement or substitute each other. Various factors such as skepticism, concerns about product effectiveness, and trust in corporate claims impact consumer perceptions and decision-making. To overcome these challenges, transparent and credible information, third-party certifications, and active consumer engagement are vital. Additionally, interventions may need to focus on both manufacturers and consumers, incentivizing the development of environmentally friendly products that offer compelling private benefits. Ultimately, a multi-faceted approach is necessary to effectively promote sustainable consumption and drive positive environmental change.

In conclusion, the reviewed literature has shown that behavioral interventions that leverage private benefits have proven to be effective in reducing overconsumption. Specifically, social norms that convey information about others' behavior are the most commonly used behavior change technique, and effective interventions focus on private benefits such as social status, improved health, and monetary savings. While emotion was also considered a viable option in some studies, because there were fewer studies, there was less information on the context under which this element would be applicable. In summary, the Green Bundle framework provides a useful framework for understanding the principles that underlie effective interventions. To implement these strategies successfully, it is important to consider the specific needs satisfied by the product category and the situational context. Behavioral interventions can complement technological improvements in reducing pollution and the harmful environmental impact of overconsumption.

While we identified effective interventions that use information about private benefits to change consumer behavior and reduce consumption, there are still areas that need further exploration. For example, we pointed out that it is important to consider the specific needs satisfied by the product category when implementing Green Bundle framing interventions. The situational context is also crucial when considering the perception of functional, social, health, or emotional benefits associated with sustainability. Therefore, further research is needed to examine the effectiveness of Green Bundle framing interventions in different product categories and situational contexts, both in-store and online, to understand how to promote sustainable behaviors effectively. It is also important to investigate how sustainable consumption that enhances self-image or improves mood could be undermined by explicitly referring to these private benefits. Further studies could also investigate the moderating role of social or cultural context on the effectiveness of Green Bundle interventions. These studies, along with testing the combination of different motivators, could provide important insights into how to design effective interventions for reducing overconsumption and promoting sustainable behaviors.

Conclusion and Policy Implications

Overall, we recommend taking the Green Bundle approach that frames consumer benefits for lower-polluting choices. Providing information about the various benefits such as quality, social status, health, financial benefits, and emotional returns can be one way to make consumer behavior greener and lower-polluting.

Implementing policies that enable consumers to easily view any financial savings associated with green behavior can be an effective strategy. Additionally, mandating the labeling of environmentally friendly items as "green" or items with a high environmental impact as such could also be a way to influence behavior, especially when consumers observe the decisions made by others. It is crucial to closely monitor the impact of these policies to ensure that they reinforce green social norms and not the opposite. Green labeling can amplify existing environmental attitudes, making some social norms more apparent to others. If certain communities do not already have pro-environmental attitudes, changing these attitudes may be a critical step before promoting environmentally unfriendly behavior in the community.

Policies that increase the perceived private benefits and lower the costs of going green are expected to be the most likely to be successful. These costs and benefits, however, do not always need to be substantial from a purely economic perspective. Behavioral science research can help policymakers to better understand the psychological costs and benefits. For example, setting green options as the default can substantially change behavior toward the default option. Even though the cost of switching in terms of effort is generally low, the psychological cost of switching can be substantial.

Policymakers can launch public education campaigns that emphasize the private benefits of sustainable consumption. These campaigns can utilize various channels, such as websites, social media, or advertisements, to inform consumers about the cost savings, health advantages, and other personal benefits of eco-friendly choices. By increasing awareness and knowledge, consumers can make more informed decisions that align with their interests. For example, they can highlight the cost savings associated with driving electric vehicles such as lower operating costs, reduced maintenance needs, and cheaper electricity compared to gasoline. Or the enjoyable driving experience with instant torque, responsive performance, and quieter operation. Or better describe the incentives and rebates offered by governments and jurisdictions to make electric cars more affordable, providing additional financial benefits to owners. They can also establish labeling or certification programs for eco-friendly products, similar to energy labels. These labels can highlight the private benefits, such as cost savings or health improvements, associated with using the certified products. For example, a label on a cleaning product can indicate that it is environmentally friendly, non-toxic, and contributes to better indoor air quality.

SURVEY OF THE TARGET AUDIENCE

Introduction

The California Air Resources Board funds and hosts online research seminars on a variety of topics. Despite the importance of the research findings presented in many of these seminars, they are not as widely attended as they could be. Approximately, 5000 people receive email invitations to these research seminars, but only ~100 people attend. One of the main advantages of online seminars is their convenience and accessibility. Unlike in-person seminars that require attendees to potentially travel long distances, online seminars can be accessed from anywhere with an internet connection, making them accessible to people from all over the world. Additionally, online seminars can be more environmentally friendly, as they do not require any travel.

Despite the benefits of online research seminars, they might not have the same perceived limited availability as in-person seminars. In-person seminars generally have one set date and time, which creates a sense of urgency for attendees to plan and attend. The limited availability can motivate attendees to prioritize this event over other items on their to-do lists. In contrast, online seminars that are recorded and available to watch later can be watched at any date and time. This could lead to procrastination and the seminar never being made a high priority. People might not attend the seminar at the scheduled time because they know it will be available later. After missing the live-online seminar, they might forget to watch the recording and lose interest over time.

Online research seminars also lack much of the human connection element of in-person events. In-person seminars provide an opportunity to interact with the presenters and other attendees, wherein attendees can exchange ideas, build relationships, and potentially discover new collaboration opportunities. In contrast, online seminars mostly rely on one-way interactions where the presenter speaks to the audience without much opportunity for feedback or interaction with other audience members. Even when organizers encourage audience participation, potential attendees may not be aware of the advantage of attending the seminar live at the scheduled time rather than waiting to watch a recording later. Nevertheless, behavioral science can provide tools to improve attendance at these seminars.

Recent work in the behavioral sciences literature suggests that "reserved" framing can be a powerful tool for increasing virtual conference registrations. One study found that emails saying that an early registration discount is "reserved for you" significantly increased conference sign-ups (Bogard, Fox, & Goldstein, 2021). Other work has demonstrated that text messages saying that a flu shot is "reserved for you" is an especially effective way to increase flu vaccination rates (Milkman et al., 2021). This type of wording implies that the product or service is not available to everyone, which creates a sense of urgency and scarcity.

Based on this literature, we proposed that CARB emails could use messaging to imply limited availability, such as: *We have reserved a spot for you to see the researchers present their work.*

After consulting with CARB staff, however, we were informed that this message would not be possible to use because CARB as a state agency would not want to imply that its research

seminars are available to only some people and not to everyone. We, therefore, considered other ways to modify the wording of research seminar emails to increase attendance.

One reason that people may not attend online seminars is that they lack the urgency of in-person seminars because they are recorded and available to watch at any time after the event.

Individuals tend to be loss-averse (Brown et al., 2021; Kahneman & Tversky, 1979; Tom et al., 2007) and may feel a sense of loss if they are unable to attend an event that they are interested in. However, if they know that a recording of the event will always be available, they may no longer feel loss by not attending. Another related psychological driver of behavior is the fear of missing out (Akbari et al., 2021; Tandon et al., 2021).

One way of attempting to create a sense of urgency would be to say: *Don't miss your chance to see the researchers present their work*. This statement, however, is likely to be undermined by people's knowledge about previous seminars being recorded and available to watch later. People would be unlikely to believe that they are missing their chance to see the researchers present their work when a recording will be made available later.

The other reason that people may not attend online seminars is that they lack much of the human connection element of in-person events. According to Anderson and Chen (2002), "the motivation that is perhaps most regularly identified as a basic human motivation is the need for human connection" (p. 625). The presence or absence of social connections can impact an individual's cognitive processes, emotional states, and actions (Baumeister & Leary, 1995; Leary et al., 1995; Markus & Kitayama, 1991; Smith, Murphy, & Coats, 1999; Waytz et al., 2013).

One way to increase this human connection element would be to say: *This is your chance to interact with the researchers and ask your questions*. Potential attendees may feel more motivated to attend the online seminar if they are assured of a more interactive and engaging experience rather than simply being talked at in one-way communication. Moreover, such interactions would only be available during the live scheduled meeting and would not be possible for those who opt to watch the recorded version later. A sense of urgency can therefore be added to this human connection message by saying: *Don't miss your chance to interact with the researchers and ask your questions*. The human connection element would be available for only a limited time even if a recording of the seminar is available on-demand after the fact.

Experiment 1

To get additional information about the effectiveness of these different email wordings, we ran a study on Amazon's Mechanical Turk (MTurk). We preregistered this study at https://aspredicted.org/WGF_DT7.[6]

Method

Participants

A total of 1,241 participants were tested using MTurk. Some participants (235) answered the pre-

---

[6] Given the data patterns that were observed, the preregistered analyses are not especially informative. For purposes of transparency, however, we will still report them in the results section below.

registered attention-check question incorrectly and were excluded. Participants were each paid $0.50 for completing the task. The sample size was determined based on the objective of achieving at least 80% power to detect an effect size of Cohen's d = 0.05. The data were collected from May 19, 2022 through May 28, 2022.

Materials and procedure

After agreeing to the statement about informed consent from the UCLA Office of the Human Research Protection Program (OHRPP), all participants were asked to:

Imagine that you receive an email for an upcoming online research presentation on a topic that interests you. Each email begins with a slightly different message. Please rate each of these messages on how likely you would be to attend the research presentation after reading each message.

Participants then rated their likelihood of attending for each of the following statements. This was done with a slider that could be set to a value from 1–100. Each statement is labeled in parentheses afterward for purposes of describing the conditions to readers; participants were not shown this label.

1. This is your chance to see the researchers present their work. (Control)
2. This is your chance to interact with the researchers and ask your questions. (Human Connection)
3. Don't miss your chance to see the researchers present their work. (Don't Miss Out)
4. Don't miss your chance to interact with the researchers and ask your questions. (Human Connection + Don't Miss Out)
5. We have reserved a spot for you to see the researchers present their work (Reserved)
6. We want to make sure you're reading this; please place the slider between the values of seventy and eighty. (Attention Check)

All statements were presented on the same page. The order for each statement was randomized for each participant except the Attention Check statement, which was always presented last.

Results

The two main a priori comparisons of interest were: (1) Control vs. Human Connection + Don't Miss Out and (2) Reserved vs. Human Connection + Don't Miss Out. A paired-samples t-test showed that the likelihood of attending ratings did not differ significantly for the Control (M = 64) and Human Connection + Don't Miss Out (M = 63) conditions, t(1005) = 1.684, p = .092. The likelihood of attending ratings did not differ significantly for the Reserved (M = 63) and Human Connection + Don't Miss Out (M = 63) conditions, t(1005) = 0.552, p = .581. A Bayesian paired-samples t-test using the default Cauchy distribution with the scale of 0.707 as the prior, gives 24.187:1 odds in favor of the null hypothesis. Figure 2 shows the average ratings for how likely a person thought they would be to attend the online research presentation for the different email wording conditions that were tested.
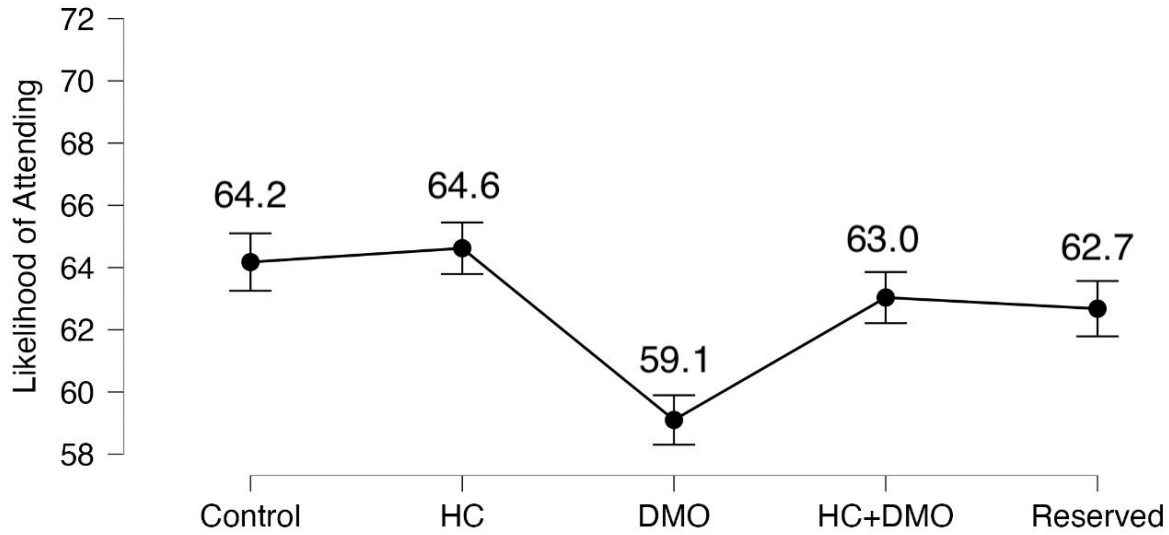
Figure 2: Average likelihood of attending ratings given to the different email wording messages used in Experiment 1. Error bars represent 95% confidence intervals. HC: Human Connection; DMO: Don't Miss Out

Table 11: Post-hoc Comparisons for the Different Email Wording Messages.

		Mean Difference	SE	t	p_{bonf}
Control	HC	−0.445	0.614	−0.725	1.000
	DMO	5.075	0.614	8.260	< .001***
	HC+DMO	1.140	0.614	1.856	0.635
	Reserved	1.498	0.614	2.438	0.148
HC	DMO	5.520	0.614	8.985	< .001***
	HC+DMO	1.585	0.614	2.581	0.099
	Reserved	1.943	0.614	3.163	0.016*
DMO	HC+DMO	−3.934	0.614	−6.404	< .001***
	Reserved	−3.577	0.614	−5.822	< .001***
HC+DMO	Reserved	0.358	0.614	0.582	1.000

Note. P–value adjusted for comparing a family of 10
* p < .05, ** p < .01, *** p < .001

To check that the observed results were not mainly due to within-subject contrast effects, we examined only the initial statement that was presented to each participant. Similar to the previous analysis, none of the statements showed a significant increase in the likelihood of attending ratings compared to the Control condition (see Figure 3). And once again, the Don't Miss Out wording performed the worst.
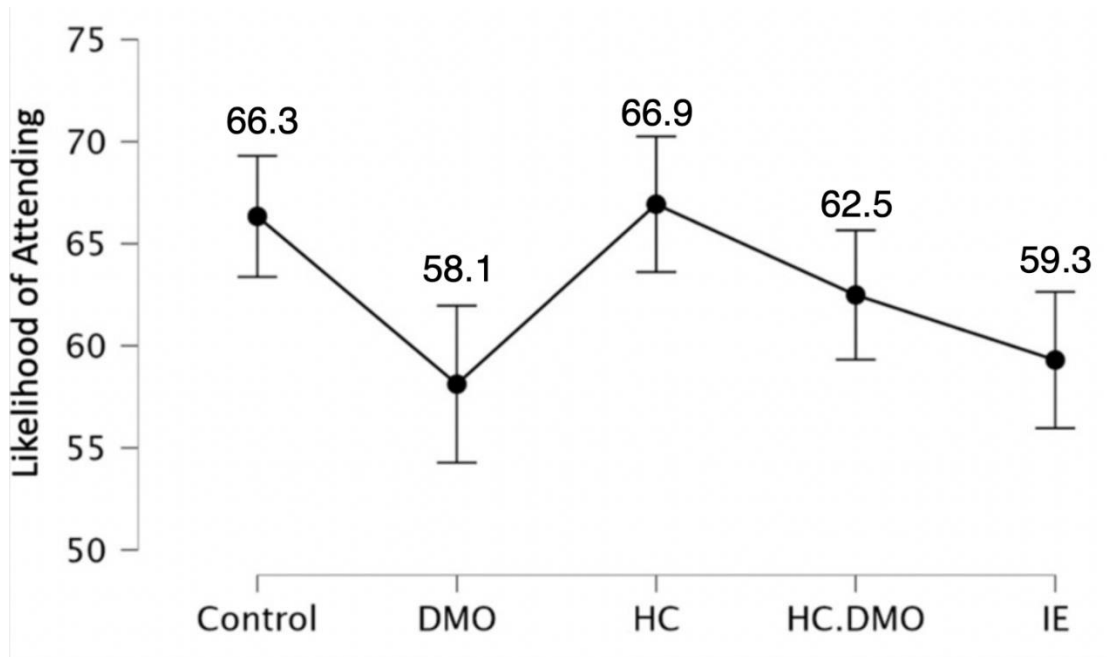
Figure 3: Average likelihood of attending ratings given to the first statement presented in Experiment 1. Error bars represent 95% confidence intervals. HC: Human Connection; DMO: Don't Miss Out

Discussion

None of the email wording messages that were tested significantly increased the likelihood of attending ratings compared to the Control condition. While the research team did not intend to use the exact wording in the Don't Miss Out condition (as not missing out seemed suspicious when a recording would be available later) the current widespread usage of this phrase makes the result a bit perplexing.

"Don't miss" wording is a popular marketing strategy used in email communications to increase consumer action. A quick search of our email inboxes showed the phrase "don't miss" being used in the past year by scholarly societies like the Association for Psychological Science as well as large businesses like Disney, Zoom, and Spotify. Either these organizations are all currently making the same mistake in their marketing communications, or the hypothetical nature of the survey questions (or the context of this situation) provides a misleading account of its effectiveness. Interestingly, despite its wide popularity in email communications, carefully controlled studies of its effectiveness are noticeably absent from the published academic literature.

Although no studies appear to have directly examined the effect of "don't miss" wording on customer engagement, the widespread use of this strategy by businesses and the academic literature on Fear of Missing Out (FOMO) suggests that it could be an effective way to motivate behavior. Previous work on FOMO suggests that people high in FOMO will often take actions such as increased social media engagement (Alt, 2015) and increased cell phone checking behavior (Hoetjes, 2013). However, these findings rely on correlations with scales that determine differences in individuals, meaning that people who exhibit high levels of FOMO take

these actions. This is different from FOMO marketing appeals, which aim to increase FOMO for everyone, and the specific product or service being marketed.

Unlike the widely studied self-initiated FOMO-driven behaviors that differ between individuals, marketing efforts rely on externally-initiated FOMO appeals (Hodkinson, 2019), such as email messages telling people not to miss out. This difference may help explain the gap in the academic literature on the effect of "don't miss" wording, despite its widespread use by marketers (Walsh, 2015; Mediaweek, 2015). Published research has mainly focused on FOMO as an important individual differences factor (Prybylski et al., 2013), rather than examining how it may vary over time within a single person.

Experiment 2

Experiment 2a

Although the use of "don't miss out" wording in marketing communications and the literature on FOMO suggest its effectiveness in increasing engagement, our Experiment 1 email wording choices did not receive additional support from the MTurk study. Thus, we chose to pilot test an additional way of wording online research seminar invitation emails that could potentially be used by CARB. The wording we test is: *We need your insights, inputs, and ideas*.

The Experiment 2 wording makes use of both egoistic and altruistic motivations, which can encourage people to want to help (Batson, 2010). The altruistic motivation comes from people wanting to be helpful, and the egoistic motivation comes from people feeling like they have something important to contribute.

The wording also uses alliteration (repetition of initial sounds at the beginning of two or more closely positioned words). The phonological overlap in alliteration helps people process messages more easily, which, leads to more positive evaluations and influences choices (Davis et al., 2016).

Method Participants

A power analysis conducted with G*Power revealed that a sample of 199 participants is required to achieve 80% power in detecting a small effect size of $dz = 0.2$. We therefore had the goal of obtaining 199 participants. A total of 204 participants were tested using MTurk. Participants were each paid $0.50 for completing the task.

Materials and procedure

After agreeing to the statement about informed consent from the UCLA Office of the Human Research Protection Program (OHRPP), all participants were asked:

Imagine that you receive an email for an upcoming online research presentation on a topic that interests you. Each email begins with a slightly different message. Please rate each of these messages on: How likely would you be to attend the research presentation after reading the message?

Participants then rated their likelihood of attending for each of the following statements. This was done with a slider that could be set to a value from 1–100. Each statement is labeled in parentheses afterward for purposes of describing the conditions to readers; participants were not shown this label.

    1.   Come see the researchers present their work. (Control)

2. We need your insights, input, and ideas. (Experimental)

Each statement was presented on a separate page. The order of presentation was randomized for each participant.

Results

The likelihood of attending ratings was significantly higher for the Experimental (71) wording than for the Control (68) wording, $t(203) = 2.11$, $p = .036$. Figure 4 shows the average ratings given for the two conditions.
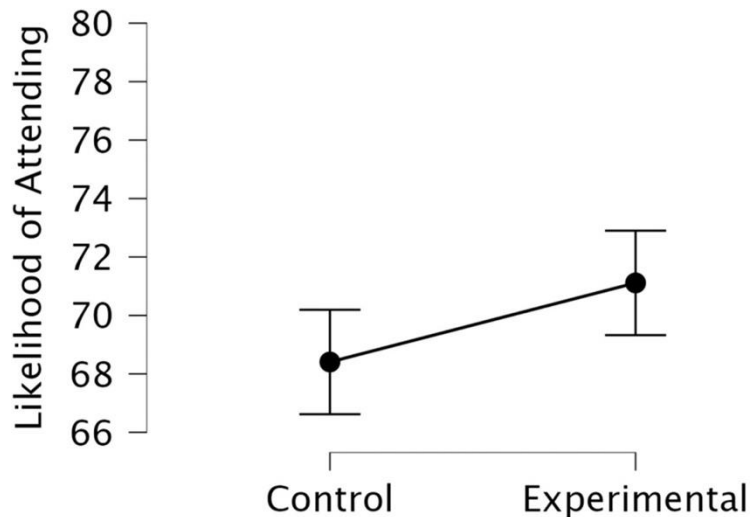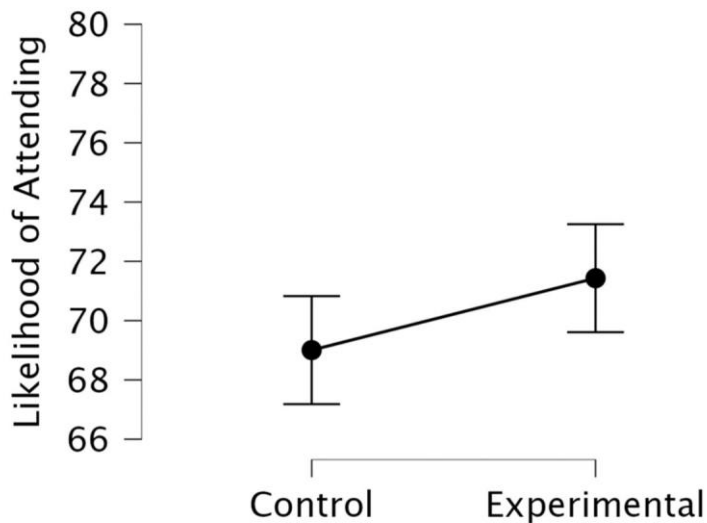

Figure 4: Average likelihood of attending ratings given to the different email wording messages used in Experiment 2a. Error bars represent 95% confidence intervals.

Experiment 2b

The email message wording was identical to Experiment 2a. However, instructions to participants differed slightly, and the two messages appeared on the same webpage (like in Experiment 1).

Method

Participants

A power analysis conducted with G*Power revealed that a sample of 199 participants is required to achieve 80% power in detecting a small effect size of $dz = 0.2$. We therefore had the goal of obtaining 199 participants. A total of 199 participants were tested using MTurk. Participants were each paid $0.50 for completing the task. The experiment did not use an attention check question because the attention check question did not seem to reduce noise in the previous experiment. The sample size was chosen to be approximately the same as in Experiment 2a. Participants from Experiment 1 and Experiment 2a, as identified by MTurk ID, were not eligible to participate. The data were collected on November 18, 2022.

Materials and procedure

After agreeing to the statement about informed consent from the UCLA Office of the Human Research Protection Program (OHRPP), all participants were asked to:

Imagine that you receive an email for an upcoming online presentation where researchers will present their work on a topic that interests you.

Each email begins with a slightly different message.

How likely would you be to attend the research presentation after Reading the message? From very unlikely (0) to very likely (100)

Participants then rated their likelihood of attending for each of the following statements. This was done with a slider that could be set to a value from 1–100. Each statement is labeled in parentheses afterward for purposes of describing the conditions to readers; participants were not shown this label.

1. Come see the researchers present their work. (Control)
2. We need your insights, input, and ideas. (Experimental)

All statements were presented on the same page. The order of the two statements was randomized for each participant.

Results

Likelihood of attending ratings was numerically higher for the Experimental (71) wording than for the Control (69) wording, but this difference was not statistically significant t(198) = 1.858, p = .065. Figure 5 shows the average ratings given for the two conditions.

Figure 5: Average likelihood of attending ratings given to the different email wording messages Combined Experiment 2 Results

The pattern of results was the same for Experiments 2a and 2b. However, only one of the two

experimental runs yielded a statistically significant result. By applying Fisher's method to combine the p-values from Experiment 2a and 2b, we found evidence suggesting a significant difference in at least one of the treatment effects between the Experimental and Control wording, X^2 (4) = 12.12, p = .017. Pooling the data from Experiments 2a and 2b and running a paired t-test on the pooled data points to an overall effect of the treatment, $t(402)$ = 2.8, p = .005. We did not compare all-at-once vs. separate pages because these were two different experiments, and participants therefore were not randomly assigned to condition.

The findings from Experiment 2 suggest that incorporating a "We need your insights, input, and ideas" message in email communications can increase the probability of attendance at research seminars. This phrasing encourages individuals to believe they possess valuable insights and ideas that can benefit others, fostering a sense of importance in their contributions. This approach aligns with the Green Bundle framework, which emphasizes the combined impact of altruistic and egoistic motivations as a potent force for changing behavior.

COMMUNICATION CAMPAIGN PROPOSAL

After multiple meetings with CARB partner network such as CalRecycle, and Access Clean California to seek potential opportunities to develop campaign proposals, we decided, in collaboration with CARB staff, to devise the campaign outlined below to increase participation in CARB research seminars. This seemed more aligned with achieving CARB's direct goals and to be developed during the timeframe of the contract.

Proposed experiment

Based on the academic literature and our MTurk pilot studies, we propose that CARB uses one of the following wording options developed to increase participation in its research seminars.

1) Don't miss your chance to interact with the researchers and ask your questions.

2) We need your insights, input, and ideas.

CARB's email list has approximately 5,000 individuals, but the attendance rate for each research seminar is only around 2% of the total number of email recipients. Attendance therefore could be improved by using one of the above messages at the beginning of the email invitation. While we understand that the public final research presentations are geared towards presenting final research rather than seeking feedback from the audience, we offer this option that could still be applicable to internal research seminars.

Pre-registration for the proposed experiment

The pre-registration for the proposed experiment is available at https://aspredicted.org/pv4r3.pdf. The proposed experiment will test whether the email message in the Experimental condition increases the likelihood of people clicking to register for an online research meeting compared to the Control condition. The key dependent variable will be the proportion of people who click to register for the research meeting in the two conditions.

Participants will be randomly assigned to one of two conditions: Experimental vs. Control. The random assignment will be performed at the beginning of the study, and emailed addresses will remain on the same list for the duration of the study. If new email addresses are registered throughout the study, they will be randomly assigned to a condition at that time and will similarly remain on the assigned list for the duration of the study. The email list may vary across experiments but once assigned to a condition the recipient remains in that condition.

The proportion of email recipients who click the link to register for the research seminar will be compared for the two conditions using a z-score test for two population proportions (https://www.socscistatistics.com/tests/ztest/). A *p*-value will be computed for each run of the experiment (i.e., each research seminar). The *p*-value for each run will then be combined into a single p-value using Fisher's method. This *p*-value is used to assess the likelihood that the null hypothesis is true for all experiments (i.e., that there was not a treatment effect in any of the experiments either positive or negative) and will use the standard p<.05 cutoff. Due to potential serial correlation from the same email recipients being part of multiple experiments, the *p*-value may be too liberal (see Alternative Analysis for further discussion of the impacts of serial correlation). The overall effect on the likelihood to click the registration button will be estimated using a simple average of the estimated effect size (relative proportion in each condition) with equal weight given to each experiment. This estimate of the overall treatment effect will not be evaluated statistically.

We will not exclude any outliers; the idea is not applicable because we are examining binary outcomes. Researchers directly involved in this study will be excluded, and researchers presenting at the meeting will be excluded.

The partner agency will incorporate the test into as many email announcements (one for each seminar) as possible from March 2023 through June 2023. We anticipate five email messages over that period using the same list of individuals (approximately 4,917). New users could be added to the list and additional lists could be used. The number of email messages and the lists used will not depend on the results of previous email messages.

We will also collect data on the rate at which emails are opened in the two conditions, on the number of meeting registrations in the two conditions, and an estimate of actual meeting attendance by comparing the emails/names in attendance at the Zoom meeting with the email addresses on the list. These additional comparisons, however, are only exploratory so we will not correct our single primary analysis listed above.

The proportions for email opening rates will be compared for the two conditions using a z-score test for two population proportions (socscistatistics.com/tests/ztest/). A p-value will be computed for each run of the experiment (i.e., each research seminar). The p-value for each run will then be combined into a single p-value using Fisher's method to evaluate the likelihood of accepting the null in every experiment. We will correct these additional analyses for multiple comparisons by setting an alpha level of .05/4 = 0.0125. For the number of meeting registrations and meeting attendees, we will run a logistic regression with registration as the dependent variable and subject, experimental run number (e.g., 1, 2, 3), and condition (control or experimental) as factor variables. The primary statistic will be a Wald test on condition.

Alternative primary analysis for the proposed experiment

A behavioral economist at CARB conducted a simulation demonstrating that registration data may have greater statistical power than email registration clicks in detecting differences between the experimental and control groups by accounting for serial correlation because registration is observable at the individual level whereas clicks are observable at the treatment level. We are including this analysis in Appendix 8. Registrations may have higher power for the reasons shown in this detailed analysis conducted by CARB staff. The UCLA team favors email clicks as the method of measurement because each participant's assigned experimental condition is unambiguous. The clicks occur directly on the email for each condition. In contrast, registrations necessitate matching names and email addresses with the list, which could lead to potential inaccuracies if participants register using an email address that differs from the one on the mailing list. This could result in a biased estimate of the treatment effect (relative likelihood of clicking on the registration button) if the treatment wording causes recipients to change the email address used to register. The UCLA team prioritizes obtaining an unbiased estimate of the effect over an unbiased *p*-value for the test of any treatment effect across experiments and no statistical evaluation of the overall treatment effect. However, the UCLA team also sees the value of the simulations conducted by CARB staff and is including this alternative primary analysis for consideration in Appendix 8.

GENERAL DISCUSSION

Overconsumption significantly contributes to global environmental and social impact, necessitating effective behavioral interventions for reducing consumption in climate change mitigation efforts. These interventions often leverage private benefits to change consumer behavior and lower consumption.

Social behavior change techniques, particularly descriptive norms, are commonly used to convey information about others' behavior. The Green Bundle framework suggests that improved social status is a key private social benefit, and the effectiveness of social norm information depends on the level of observation by others. For instance, Delmas and Lessem (2014) discovered that publicizing dormitory electricity consumption rankings, in addition to privately provided information on consumption, was crucial for reducing usage. Notably, this was for college students who were not financially responsible for consumption.

Public compliance, or conforming to social norms due to perceived observation, is more likely when behavior is publicly visible. However, if people privately accept descriptive norm information as correct behavior, their actions may align with social norms even without observation. This private acceptance could represent a shift in moral beliefs, potentially operating on a different Green Bundle principle, like emotion.

The debate surrounding prosocial behavior questions whether motivations are altruistic or egoistic. Egoistic motivations offer personal benefits aligning with the Green Bundle framework, such as praise, self-image enhancement, improved mood, and avoidance of guilt and shame.

The proposed communication campaign employs the phrase "We need your insights, inputs, and

ideas" in a strategic blend of altruistic and egoistic motivations, as recommended by the Green Bundle framework. This approach is expected to effectively change behavior.

Consumer awareness of private benefits, including quality, social status, health, monetary savings, and emotional returns, is crucial for promoting environmentally friendly behavior and reducing overconsumption. Behavioral interventions can augment technological advancements to minimize pollution and environmental harm caused by overconsumption.

SUMMARY AND CONCLUSIONS

The systematic literature review investigates peer-reviewed academic research on behavioral interventions that successfully promote lower-polluting consumer choices. Our focus is on interventions, field experiments, nudges, and randomized control trials that reveal drivers of eco-friendly consumer choices, informing policy recommendations. Examined consumer choices involve purchasing or using cleaner vehicles, public transportation, energy-efficient appliances, low-carbon footprint food, organic products, and adopting energy and food conservation practices.

We employ the Green Bundle framework by Delmas and Colgan (2018) to categorize articles based on personal benefits—quality, social status, health, monetary savings, and emotional returns. The framework posits that consumers are more inclined to choose green products when they offer private benefits. We considered articles from the psychology, management, and economics fields.

Our findings suggest that successful interventions often utilize information about private benefits, while successful studies that do not use such information tend to rely on hypothetical or self-reported data. Implementing policies that highlight the financial benefits of green behavior can be an effective strategy. Enhancing the visibility of eco-friendly behavior and establishing green options as the default can significantly influence people's actions, leading to more frequent green choices.

The Green Bundle approach emphasizes the use of both altruistic and egoistic motivations to drive behavior change, which is exemplified in the "We need your insights, inputs, and ideas" email wording. Our survey indicated that this wording significantly increased behavioral intentions for attending a hypothetical online research seminar. The Green Bundle framework serves as a valuable tool for changing behavior.

RECOMMENDATIONS

Policy implications for promoting environmentally friendly consumer transportation behavior include increasing gasoline and diesel prices via taxation (Zimmer & Koch, 2017), funding intelligent transportation systems to reduce congestion and fuel waste (Cheng et al., 2020), and making electric vehicles (EVs) readily available for test drives (Brückmann, 2022). Policies encouraging dealerships to maintain a certain number of EVs for test drives may boost sales.

Effective strategies for promoting green behavior include making financial savings visible, requiring that environmental impact be labeled honestly, and monitoring the policy effects of reinforcing green social norms. Before increasing the visibility of environmentally unfriendly behavior, it may be necessary to change attitudes in communities without strong pro-

environmental values.

The Green Bundle approach, which combines information about consumer benefits with eco-friendly choices, is recommended. Successful policies tend to increase (both real and perceived) benefits and decrease the costs of going green, though these factors don't always have to be substantial from a purely financial perspective . Behavioral science research can help policymakers understand psychological costs and benefits, such as setting green options as the default to encourage adoption. The psychological cost of switching can be substantial, even if the monetary cost is low.

Increased psychological benefits may be achieved when consumers observe friends and neighbors adopting green behavior and have opportunities to showcase their own environmentally friendly choices. Often, consumers are unaware of the personal benefits of greener behavior. Providing simple information about quality, social status, health, financial benefits, and emotional returns can promote more sustainable and less polluting consumer behavior.

Leveraging a blend of altruistic and egoistic motivations is a powerful way to drive behavior change. Crafting communication messages that utilize this combination can be an effective means of altering consumer behavior. As an illustration, our proposed message, "We need your insights, inputs, and ideas," demonstrates how these different motivations can be effectively utilized.

REFERENCES

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. Journal of Environmental Psychology, 25(3), 273-291.

Agarwal, S., Sing, T. F., & Sultana, M. (2022). Public media campaign and energy conservation: A natural experiment in Singapore. Energy Economics, 114, 106281.

Akbari, M., Seydavi, M., Palmieri, S., Mansueto, G., Caselli, G., & Spada, M. M. (2021). Fear of missing out (FoMO) and internet use: A comprehensive systematic review and meta-

Allcott, H. (2011). Social norms and energy conservation. Journal of Public Economics, 95(9-10), 1082-1095.

Alt, D. (2015). College students' academic motivation, media engagement and fear of missing out. Computers in Human Behavior, 49, 111-119.

analysis. Journal of Behavioral Addictions, 10(4), 879-900.

Andersen, S. M., & Chen, S. (2002). The relational self: An interpersonal social-cognitive theory. Psychological Review, 109(4), 619.

Andreoni, J. (1990). Impure altruism and donations to public goods: A theory of warm-glow giving. The Economic Journal, 100(401), 464-477.

Angelou, M. [@DrMayaAngelou]. (2018, September 2). I've learned that people will forget what you said, people will forget what you did, but people will never forget [Tweet]. https://twitter.com/DrMayaAngelou/status/1036327789488734208

Apostolidis, C., & McLeay, F. (2016). Should we stop meating like this? Reducing meat consumption through substitution. Food Policy, 65, 74-89.

Aronson, E., Wilson, T. D., Fehr, B., & Akert, R. M. (2013). Social psychology (5th ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Asensio, O. I., & Delmas, M. A. (2015). Nonprice incentives and energy conservation. Proceedings of the National Academy of Sciences, 112(6), E510-E515.

Baca-Motes, K., Brown, A., Gneezy, A., Keenan, E. A., & Nelson, L. D. (2013). Commitment and behavior change: Evidence from the field. Journal of Consumer Research, 39(5), 1070-1084.

Batson, C. D. (2010). Empathy-induced altruistic motivation. In M. Mikulincer & P. R. Shaver (Eds.), Prosocial motives, emotions, and behavior: The better angels of our nature (pp. 15– 34). Washington, DC: American Psychological Association.

Batson, C. D., Ahmad, N., & Stocks, E. L. (2011). Four forms of prosocial motivation: Egoism, altruism, collectivism, and principlism. In D. Dunning (Ed.), Social motivation (pp. 103–126). New York: Psychology Press.

Bauer, J. M., Aarestrup, S. C., Hansen, P. G., & Reisch, L. A. (2022). Nudging more sustainable grocery purchases: Behavioural innovations in a supermarket setting. Technological Forecasting and Social Change, 179, 121605.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. Psychological Bulletin, 117, 497–529.

Bearse, S., Capozucca, P., Favret, L., & Lynch, B. (2009). Finding the green in today's shoppers: Sustainability trends and new shopper insights. GMA/Deloitte Green Shopper Study Research Report, 1-28.

Bernard, J. C., & Liu, Y. (2017). Are beliefs stronger than taste? A field experiment on organic and local apples. Food Quality and Preference, 61, 55-62.

Bodur, H. O., Duval, K. M., & Grohmann, B. (2015). Will you purchase environmentally friendly products? Using prediction requests to increase choice of sustainable products. Journal of Business Ethics, 129(1), 59-75.

Bogard, J., Fox, C., & Goldstein, N. (2021). Reserved for you: Implied selectivity as a new tool of choice architecture. Advances in Consumer Research, 49, 500.

Bolderdijk, J. W., Steg, L., Geller, E. S., Lehman, P. K., & Postmes, T. (2013). Comparing the effectiveness of monetary versus moral motives in environmental campaiging. Nature Climate Change, 3(4), 413-416.

Brooks, J. S., & Wilson, C. (2015). The influence of contextual cues on the perceived status of consumption-reducing behavior. Ecological Economics, 117, 108-117.

Brown, A. L., Imai, T., Vieider, F., & Camerer, C. (2021). Meta-analysis of empirical estimates of loss-aversion (CESifo working paper no. 8848). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3772089

Brückmann, G. (2022). The effects of policies providing information and trialling on the knowledge about and the intention to adopt new energy technologies. Energy Policy, 167, 113047.

Brunner, F., Kurz, V., Bryngelsson, D., & Hedenus, F. (2018). Carbon label at a university restaurant–Label implementation and evaluation. Ecological Economics, 146, 658-667.

Byerly, H., Balmford, A., Ferraro, P. J., Hammond Wagner, C., Palchak, E., Polasky, S., ... & Fisher, B. (2018). Nudging pro-environmental behavior: evidence and opportunities. Frontiers in Ecology and the Environment, 16(3), 159-168.

Camilleri, A. R., & Larrick, R. P. (2014). Metric and scale design as choice architecture tools. Journal of Public Policy & Marketing, 33(1), 108-125.

Carrico, A. R., Raimi, K. T., Truelove, H. B., & Eby, B. (2018). Putting your money where your mouth is: An experimental test of pro-environmental spillover from reducing meat consumption to monetary donations. Environment and Behavior, 50(7), 723-748.

Chaouloff, F. (1989). Physical exercise and brain monoamines: A review. Acta Physiologica Scandinavica, 137(1), 1-13.

Chen, V. L., Delmas, M. A., Kaiser, W. J., & Locke, S. L. (2015). What can we learn from high-frequency appliance-level energy metering? Results from a field experiment. Energy Policy, 77, 164-175.

Chen, V. L., Delmas, M. A., Locke, S. L., & Singh, A. (2017). Information strategies for energy conservation: A field experiment in India. Energy Economics, 68, 215-227.

Cheng, Z., Pang, M. S., & Pavlou, P. A. (2020). Mitigating traffic congestion: The role of intelligent transportation systems. Information Systems Research, 31(3), 653-674.

Cialdini, R.B., & Trost, M.R. (1998). Social influence: Social norms, conformity, and compliance. In D.T. Gilbert, S.T. Fiske, & G. Lindzey (Eds.), The handbook of social psychology (4th ed., pp.151–92). Boston: McGraw-Hill.

Constantino, S. M., Sparkman, G., Kraft-Todd, G. T., Bicchieri, C., Centola, D., Shell-Duncan, B., ... & Weber, E. U. (2022). Scaling up change: A critical review and practical guide to harnessing social norms for climate action. Psychological Science in the Public Interest, 23(2), 50-97.

Costa, D. L., & Kahn, M. E. (2013). Energy conservation "nudges" and environmentalist ideology: Evidence from a randomized residential electricity field experiment. Journal of the European Economic Association, 11(3), 680-702.

Cozzio, C., Volgger, M., Taplin, R., & Woodside, A. G. (2020). Nurturing tourists' ethical food consumption: Testing the persuasive strengths of alternative messages in a natural hotel setting. Journal of Business Research, 117, 268-279.

d'Adda, G., Gao, Y., & Tavoni, M. (2022). A randomized trial of energy cost information provision alongside energy-efficiency classes for refrigerator purchases. Nature Energy, 7(4), 360-368.

Davis, D. F., Bagchi, R., & Block, L. G. (2016). Alliteration alters: Phonetic overlap in promotional messages influences evaluations and choice. Journal of Retailing, 92(1), 1-12.

de Freitas Netto, S. V., Sobral, M. F. F., Ribeiro, A. R. B., & Soares, G. R. D. L. (2020). Concepts and forms of greenwashing: A systematic review. Environmental Sciences Europe, 32(1), 1-12.

Degirmenci, K., & Breitner, M. H. (2023). Gamification and sensory stimuli in eco-driving research: A field experiment to reduce energy consumption in electric vehicles. Transportation Research Part F: Traffic Psychology and Behaviour, 92, 266-282.

del Mar Solà, M., Escapa, M., & Galarraga, I. (2023). Effectiveness of monetary information in promoting the purchase of energy-efficient appliances: Evidence from a field experiment in Spain. Energy Research & Social Science, 95, 102887.

Delmas, M. A., & Burbano, V. C. (2011). The drivers of greenwashing. California Management Review, 54(1), 64-87.

Delmas, M. A., & Colgan, D. (2018). *The green bundle: Pairing the market with the planet*. Stanford University Press.

Delmas, M. A., & Grant, L. E. (2014). Eco-labeling strategies and price-premium: The wine industry puzzle. Business & Society, 53(1), 6-44.

Delmas, M. A., & Lessem, N. (2014). Saving power to conserve your reputation? The effectiveness of private versus public information. Journal of Environmental Economics and Management, 67(3), 353-370.

Delmas, M. A., & Lessem, N. (2017). Eco-premium or eco-penalty? Eco-labels and quality in the organic wine market. Business & Society, 56(2), 318-356.

Delmas, M. A., Gergaud, O., & Lim, J. (2016). Does organic wine taste better? An analysis of experts' ratings. Journal of Wine Economics, 11(3), 329-354.

D'Souza, C., Taghian, M., & Khosla, R. (2007). Examination of environmental beliefs and its impact on the influence of price, quality and demographic characteristics with respect to green purchase intention. Journal of Targeting, Measurement and Analysis for Marketing, 15, 69-78.

Ebeling, F., & Lotz, S. (2015). Domestic uptake of green energy promoted by opt-out tariffs. Nature Climate Change, 5(9), 868-871.

Edenhofer, O. (Ed.). (2015). Climate change 2014: Mitigation of climate change (vol. 3). Cambridge University Press.

Festinger, L. (1953). An analysis of compliant behavior. In M. Sherif & M. O. Wilson (Eds.), Group relations at the crossroads (pp. 232-256). New York: Harper.

Galarraga Gallastegui, I. (2002). The use of eco-labels: a review of the literature. European Environment, 12(6), 316-331.

Garnett, E. E., Balmford, A., Sandbrook, C., Pilling, M. A., & Marteau, T. M. (2019). Impact of increasing vegetarian availability on meal selection and sales in cafeterias. Proceedings of the National Academy of Sciences, 116(42), 20923-20929.

Garvin, D. (1987). Competing on the eight dimensions of quality. Harvard Business Review, 65, 101-109.

Geiger, S. M., Fischer, D., Schrader, U., & Grossman, P. (2020). Meditating for the planet: Effects of a mindfulness-based intervention on sustainable consumption behaviors. Environment and Behavior, 52(9), 1012-1042.

Goldstein, D. G., Johnson, E. J., Herrmann, A., & Heitmann, M. (2008). Nudge your customers toward better choices. Harvard Business Review, 86(12), 99-105.

Gorton, M., Tocco, B., Yeh, C. H., & Hartmann, M. (2021). What determines consumers' use of eco-labels? Taking a close look at label trust. Ecological Economics, 189, 107173.

Haberl, H., Wiedenhofer, D., Virág, D., Kalt, G., Plank, B., Brockway, P., ... & Creutzig, F. (2020). A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part II: Synthesizing the insights. Environmental Research Letters, 15(6), 065003.

Hanss, D., & Böhm, G. (2013). Promoting purchases of sustainable groceries: An intervention study. Journal of Environmental Psychology, 33, 53-67.

Hato, Beata. (2013). (Compulsive) mobile phone checking behavior out of a fear of missing out: Development, psychometric properties and test-retest reliability of a C-FoMO-scale (ANR: 610304) [Master's thesis, Tilburg Umiversity]. https://www.semanticscholar.org/paper/(Compulsive)-Mobile-Phone-Checking-Behavior-Out-of-Hato-Hoetjes/2f96f25b371f03e1a1a092f0cfe2c3aa5c1ca132

Havas, L., Ballweg, J., Penna, C., & Race, D. (2015). Power to change: Analysis of household participation in a renewable energy and energy efficiency programme in Central Australia. Energy Policy, 87, 325-333.

Heydarian, A., Pantazis, E., Carneiro, J. P., Gerber, D., & Becerik-Gerber, B. (2016). Lights, building, action: Impact of default lighting settings on occupant behaviour. Journal of

Environmental Psychology, 48, 212-223.

Hodkinson, C. (2019). 'Fear of Missing Out'(FOMO) marketing appeals: A conceptual model. Journal of Marketing Communications, 25(1), 65-88.

Idahosa, L. O., & Akotey, J. O. (2021). A social constructionist approach to managing HVAC energy consumption using social norms–A randomised field experiment. Energy Policy, 154, 112293.

Intergovernmental Panel on Climate Change. (2022). Climate change 2022: Mitigation of climate change. Working group III contribution to the IPCC sixth assessment report. https://www.ipcc.ch/report/ar6/wg3/about/how-to-cite-this-report

Jalil, A. J., Tasoff, J., & Bustamante, A. V. (2020). Eating to save the planet: Evidence from a randomized controlled trial using individual-level food purchase data. Food Policy, 95, 101950.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. Econometrica, 47(2), 263-292.

Katare, B., Yim, H., Byrne, A., Wang, H. H., & Wetzstein, M. (2022). Consumer willingness to pay for environmentally sustainable meat and a plant-based meat substitute. Applied Economic Perspectives and Policy, 45(1), 145-163.

Knezevic Cvelbar, L., Grün, B., & Dolnicar, S. (2022). Do employees hold the key to environmental sustainability in tourism businesses? Empirical evidence from a field study. Journal of Sustainable Tourism, 1-14.

Kristensson, P., Wästlund, E., & Söderlund, M. (2017). Influencing consumers to choose environment friendly offerings: Evidence from field experiments. Journal of Business Research, 76, 89-97.

Kuncel, N. R., & Tellegen, A. (2009). A conceptual and empirical reexamination of the measurement of the social desirability of items: Implications for detecting desirable response style and scale development. Personnel Psychology, 62(2), 201-228.

Kutzner, F., Kacperski, C., Schramm, D., & Waenke, M. (2021). How far can we get with eco driving tech? Journal of Environmental Psychology, 76, 101626.

Lanzini, P., & Thøgersen, J. (2014). Behavioural spillover in the environmental domain: An intervention study. Journal of Environmental Psychology, 40, 381-390.

Leary, M. R., Tambor, E. S., Terdal, S. K., & Downs, D. L. (1995). Self-esteem as an interpersonal monitor: The sociometer hypothesis. Journal of Personality and Social Psychology, 68, 518–530.

Lee, E. J., Choi, H., Han, J., Kim, D. H., Ko, E., & Kim, K. H. (2020). How to "Nudge" your consumers toward sustainable fashion consumption: An fMRI investigation. Journal of Business Research, 117, 642-651.

Liang, J., Qiu, Y., & Xing, B. (2021). Social versus private benefits of energy efficiency under time-of-use and increasing block pricing. Environmental and Resource Economics, 78, 43-75.

Limnios, E. M., Schilizzi, S. G., Burton, M., Ong, A., & Hynes, N. (2016). Willingness to pay for product ecological footprint: Organic vs non-organic consumers. Technological Forecasting and Social Change, 111, 338-348.

Loock, C. M., Staake, T., & Thiesse, F. (2013). Motivating energy-efficient behavior with green IS: an investigation of goal setting and the role of defaults. MIS Quarterly, 1313-1332.

Lorenz-Walther, B. A., Langen, N., Göbel, C., Engelmann, T., Bienge, K., Speck, M., & Teitscheid, P. (2019). What makes people leave LESS food? Testing effects of smaller portions and information in a behavioral model. Appetite, 139, 127-144.

Lyon, T. P., & Montgomery, A. W. (2015). The means and end of greenwash. Organization & Environment, 28(2), 223-249.

MacKinnon, J. B. (2021). The day the world stops shopping: How ending consumerism saves the environment and ourselves. Harper Collins.

Magnusson, M. K., Arvola, A., Hursti, U. K. K., Åberg, L., & Sjödén, P. O. (2001). Attitudes towards organic foods among Swedish consumers. British Food Journal, 103(3), 209-227.

Mahmoodi, J., Prasanna, A., Hille, S., Patel, M. K., & Brosch, T. (2018). Combining "carrot and stick" to incentivize sustainability in households. Energy Policy, 123, 31-40.

Manca, S., Altoè, G., Schultz, P. W., & Fornara, F. (2020). The persuasive route to sustainable mobility: Elaboration likelihood model and emotions predict implicit attitudes. Environment and Behavior, 52(8), 830-860.

Markus, H., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. Psychological Review, 98, 224– 253.

Mediaweek (2015). MTV and Flight Centre create travel FOMO. https://www.mediaweek.com.au/mtv-and-flight-centre-create-travel-fomo/

Milkman, K. L., Patel, M. S., Gandhi, L., Graci, H. N., Gromet, D. M., Ho, H., ... & Duckworth, A. L. (2021). A megastudy of text-based nudges encouraging patients to get vaccinated at an upcoming doctor's appointment. Proceedings of the National Academy of Sciences, 118(20), e2101165118.

Min, J., Azevedo, I. L., Michalek, J., & de Bruin, W. B. (2014). Labeling energy cost on light bulbs lowers implicit discount rates. Ecological Economics, 97, 42-50.

Momsen, K., & Stoerk, T. (2014). From intention to action: Can nudges help consumers to choose renewable energy? Energy Policy, 74, 376-382.

Newell, R. G., & Siikamäki, J. (2014). Nudging energy efficiency behavior: The role of information labels. Journal of the Association of Environmental and Resource Economists, 1(4), 555-598.

Newman, G. E., Gorlin, M., & Dhar, R. (2014). When going green backfires: How firm intentions shape the evaluation of socially beneficial product enhancements. Journal of Consumer Research, 41(3), 823-839.

O'Garra, T., & Fouquet, R. (2022). Willingness to reduce travel consumption to support a low-carbon transition beyond COVID-19. Ecological Economics, 193, 107297.

Osman, M., & Thornton, K. (2019). Traffic light labelling of meals to promote sustainable consumption and healthy eating. Appetite, 138, 60-71.

Peattie, K., & Crane, A. (2005). Green marketing: Legend, myth, farce or prophesy? Qualitative

Market Research: An International Journal, 8(4), 357-370.

Peñasco, C., & Anadón, L. D. (2023). Assessing the effectiveness of energy efficiency measures in the residential sector gas consumption through dynamic treatment effects: Evidence from England and Wales. Energy Economics, 117, 106435.

Pluta-Olearnik, M., & Szulga, P. (2022). The Importance of Emotions in Consumer Purchase Decisions—A Neuromarketing Approach. Marketing of Scientific and Research Organizations, 44(2), 87-104.

Przybylski, A. K., Murayama, K., DeHaan, C. R., & Gladwell, V. (2013). Motivational, emotional, and behavioral correlates of fear of missing out. Computers in Human Behavior, 29(4), 1841-1848.

Rai, V., & Sigrin, B. (2013). Diffusion of environmentally-friendly energy technologies: buy versus lease differences in residential PV markets. Environmental Research Letters, 8(1), 014022.

Rau, H., Nicolai, S., & Stoll-Kleemann, S. (2022). A systematic review to assess the evidence-based effectiveness, content, and success factors of behavior change interventions for enhancing pro-environmental behavior in individuals. Frontiers in Psychology, 13.

Ricci, E. C., Banterle, A., & Stranieri, S. (2018). Trust to go green: An exploration of consumer intentions for eco-friendly convenience food. Ecological Economics, 148, 54-65.

Ro, M., Brauer, M., Kuntz, K., Shukla, R., & Bensch, I. (2017). Making cool choices for sustainability: Testing the effectiveness of a game-based approach to promoting pro-environmental behaviors. Journal of Environmental Psychology, 53, 20-30.

Rose, J. P., & Vogel, E. (2020). Self-esteem and social status. Encyclopedia of Personality and Individual Differences, 4754-4758

S&P Global Mobility (2022). New EV entries nibbling away at Tesla EV share. https://www.spglobal.com/mobility/en/research-analysis/new-ev-entries-nibbling-away-at-tesla-ev-share.html

Sarkar, J. G., Sarkar, A., Dwivedi, Y. K., & Balaji, M. S. (2022). Sweat it for sustainability: Impact of physical activity/exercise on sustainable consumption. Psychology & Marketing, 39(11), 2184-2199.

Schultz, P. W., Gouveia, V. V., Cameron, L. D., Tankha, G., Schmuck, P., & Franěk, M. (2005). Values and their relationship to environmental concern and conservation behavior. Journal of cross-cultural psychology, 36(4), 457-475.

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2007). The constructive, destructive, and reconstructive power of social norms. Psychological Science, 18(5), 429-434.

Shackel, B. (2009). Usability–Context, framework, definition, design and evaluation. Interacting with Computers, 21(5-6), 339-346.

Sherif, M. (1936). The psychology of social norms. New York: Harper.

Smith, E. R., Murphy, J., & Coats, S. (1999). Attachment to groups: Theory and management. Journal of Personality and Social Psychology, 77, 94–110.

Spies, K., Hesse, F., & Loesch, K. (1997). Store atmosphere, mood and purchasing behavior. International Journal of Research in Marketing, 14(1), 1-17.Schmitt, B. (1999). Experiential marketing. Journal of Marketing Management, 15(1-3), 53-67.

Stanszus, L. S., Frank, P., & Geiger, S. M. (2019). Healthy eating and sustainable nutrition through mindfulness? Mixed method results of a controlled intervention study. Appetite, 141, 104325.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. Journal of Environmental Psychology, 29(3), 309-317.

Sun, J. J., Bellezza, S., & Paharia, N. (2021). Buy less, buy luxury: Understanding and overcoming product durability neglect for sustainable consumption. Journal of Marketing, 85(3), 28-43.

Tandon, A., Dhir, A., Almugren, I., AlNemer, G. N., & Mäntymäki, M. (2021). Fear of missing out (FoMO) among social media users: A systematic literature review, synthesis and framework for future research. Internet Research, 31(3), 782–821.

Tesla. (January 2, 2023). Number of Tesla vehicles delivered worldwide from 1st quarter 2016 to 4th quarter 2022 (in 1,000 units) [Graph]. In Statista. Retrieved March 22, 2023, from https://www.statista.com/statistics/502208/tesla-quarterly-vehicle-deliveries/

Tiefenbeck, V., Staake, T., Roth, K., & Sachs, O. (2013). For better or for worse? Empirical evidence of moral licensing in a behavioral energy conservation campaign. Energy Policy, 57, 160-171.

Tom, S. M., Fox, C. R., Trepel, C., & Poldrack, R. A. (2007). The neural basis of loss aversion in decision-making under risk. Science, 315(5811), 515-518.

Västfjäll, D. (2002). Emotion induction through music: A review of the musical mood induction procedure. Musicae Scientiae, 6, 173–211.

Verplanken, B., & Roy, D. (2016). Empowering interventions to promote sustainable lifestyles: Testing the habit discontinuity hypothesis in a field experiment. Journal of Environmental Psychology, 45, 127-134.

Walsh, S. (2015). Winning with FOMO. Marketing Magazine. http://marketingmag.ca/consumer/winning-with-fomo-column-155875/

Waters, J. (2021, May 30). Overconsumption and the environment: Should we all stop shopping?The Guardian. https://www.theguardian.com/lifeandstyle/2021/may/30/should-we-all-stop-shopping-how-to-end-overconsumption

Waytz, A., Epley, N., Cacioppo, J. T., & Akalis, S. A. (2013). Social connection and seeing human. The Oxford handbook of social exclusion (pp. 251-256).

Weber, S., Puddu, S., & Pacheco, D. (2017). Move it! How an electric contest motivates households to shift their load profile. Energy Economics, 68, 255-270.

Whitmarsh, L., & O'Neill, S. (2010). Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. Journal of Environmental Psychology, 30(3), 305-314.

Wiedmann, T., Lenzen, M., Keyßer, L. T., & Steinberger, J. K. (2020). Scientists' warning on

affluence. Nature Communications, 11(1), 1-10.

Wilson, B. M., Harris, C. R., & Wixted, J. T. (2020). Science is not a signal detection problem. *Proceedings of the National Academy of Sciences*, *117*(11), 5559-5567.

Yang, C., Shang, J., & Yang, J. (2019, August). Economic benefit analysis of household distributed photovoltaic under different financing modes. In Proceedings of the 2nd International Conference on Information Management and Management Sciences (pp. 150-154).

Zimmer, A., & Koch, N. (2017). Fuel consumption dynamics in Europe: Tax reform implications for air pollution and carbon emissions. Transportation Research Part A: Policy and Practice, 106, 22-50.

Zwicker, M. V., Nohlen, H. U., Dalege, J., Gruter, G. J. M., & van Harreveld, F. (2020). Applying an attitude network approach to consumer behaviour towards plastic. Journal of Environmental Psychology, 69, 101433

APPENDIX

Appendix 1. Word search and inclusion/exclusion criteria

AB=("consumer behav*" OR purchas* OR "consumption")

AND AB=(intervention OR "field experiment" OR "randomized control trial" OR nudg* OR "behav* change" OR "choice architecture")

AND AB=("environmentally friendly" OR green OR "low* pollut*" OR "energy efficien*" OR sustainab* OR "electric vehicle*" OR "car" OR "active mobility" OR "renewable energy" OR "solar" OR "transport*" OR "organic")

Publication years: 2012-2023

Search engine: Web of Science

Date of last search: 02/11/2023

Requirements for Inclusion
• Experimental/Quasi-experimental design
> • The study must have either participants/households/communities being randomly assigned to conditions OR an intervention is implemented and the dependent variable is measured both pre and post intervention.
> • Studies without random assignment and only measures post intervention should not be included.
> • Studies that include only correlations (e.g., correlation between green purchasing behavior and water usage) should not be included.

• Experimental manipulation is designed to affect household environmental behavior (e.g., green purchases; electricity, water, gasoline usage; food wasted, trash generated; recycling contamination)
• The dependent variable is a behavioral measure (as opposed to attitude); can include purchase intentions/willingness to pay
> • Examples of what to include: kilowatt-hours of electricity used, gallons of water used, pounds of trash used, miles driven, rates of recycling contamination, number of green products purchased, willingness to pay for a green product
> • Examples of what not to include: attitudes toward recycling, how much someone likes a product, how much someone thinks they will recycle

• If an article reports multiple interventions, only significant differences will be included, and the effect will be coded as significant. If an article reports only non-significant findings, the effect will be coded as non-significant.

Appendix 2. List of journals included in the analysis

American Journal of Agricultural Economics Appetite

Applied Economic Perspectives and Policy Business Strategy and the Environment Ecological Economics

Energy Economics Energy Policy

Energy Research & Social Science Environment and Behavior Environmental & Resource Economics

European Review of Agricultural Economics Food Policy

Information Systems Research International Journal of Consumer Studies

International Journal of Contemporary Hospitality Management Journal of Business Ethics

Journal of Business Research Journal of Consumer Research

Journal of Environmental Economics And Management Journal of Environmental Psychology

Journal of Marketing

Journal of Retailing and Consumer Services Journal of Sustainable Tourism

Journal of the Association of Environmental and Resource Economists Journal of the European Economic Association

Journal of Transport Geography Mis Quarterly

Nature Climate Change Nature Energy

Nature Sustainability

Proceedings of The National Academy of Sciences of The United States Of America Psychology & Marketing

Technological Forecasting and Social Change Transportation Research Part A-Policy and Practice

Transportation Research Part F-Traffic Psychology and Behaviour

Appendix 3. Behaviors

The dependent variables for most articles measure actual behavior rather than relying on self-reported behavior or behavioral intentions. This is illustrated in Table A1, with 68% of articles reporting measured behavior.

Table A1. Type of Behavior

Type of Behavior	Number of Articles	% of Articles
Measured behavior	48	68%
Behavioral Intention	16	23%
Self-reported behavior	7	10%
Total	71	100%

Appendix 4. Length of Intervention

Table A2 shows the length of each intervention. Approximately half (48%) were completed in a day or less with relatively few (14%) taking longer than a year.

Table A2. Length of Intervention

Length of Intervention	Number of Articles	% of Articles
Day or less	34	48%
Day–Week	4	6%
Week–Month	3	4%
Month–Year	20	28%
Longer than a year	10	14%
Total	71	100%

Appendix 5. Location of the study

As shown in Table A3, most of the studies are field studies conducted in the *real-world* (56%), and in most of these field studies participants were *unaware* (58%) that they were being observed as part of a research study.

Table A3. Geographical Location of Study

Location of Study	Number of Articles	% of Articles
Real-world (unaware)	23	32%
Real-world (aware)	17	24%
Online	14	20%
In-lab	11	15%
Real-world data	6	8%
Total	71	100%

Appendix 6. Study Randomization Design

Most studies (73%) had random assignment to condition and are therefore considered to be "true" experiments rather than quasi-experiments (See Table A4).

Table A4. Study Randomization Design

Random Assignment	Number of Articles	% of Articles
Experiment	52	73%
Quasi-experiment	19	27%
Total	71	100%

Appendix 7. Articles included in the systematic review

Agarwal, S., Sing, T. F., & Sultana, M. (2022). Public media campaign and energy conservation: A natural experiment in Singapore. *Energy Economics*, *114*, 106281.

Allcott, H., & Rogers, T. (2014). The short-run and long-run effects of behavioral interventions: Experimental evidence from energy conservation. *American Economic Review*, *104*(10), 3003-3037.

Apostolidis, C., & McLeay, F. (2016). Should we stop meating like this? Reducing meat consumption through substitution. *Food Policy*, *65*, 74-89.

Asensio, O. I., & Delmas, M. A. (2015). Nonprice incentives and energy conservation.

Proceedings of the National Academy of Sciences, *112*(6), E510-E515.

Baca-Motes, K., Brown, A., Gneezy, A., Keenan, E. A., & Nelson, L. D. (2013). Commitment and behavior change: Evidence from the field. *Journal of Consumer Research*, *39*(5), 1070-1084.

Bauer, J. M., Aarestrup, S. C., Hansen, P. G., & Reisch, L. A. (2022). Nudging more sustainable grocery purchases: Behavioural innovations in a supermarket setting. *Technological Forecasting and Social Change*, *179*, 121605.

Bernedo, M., Ferraro, P. J., & Price, M. (2014). The persistent impacts of norm-based messaging and their implications for water conservation. *Journal of Consumer Policy*, *37*, 437-452.

Bhanot, S. P. (2017). Rank and response: A field experiment on peer information and water use behavior. *Journal of Economic Psychology*, *62*, 155-172.

Bodur, H. O., Duval, K. M., & Grohmann, B. (2015). Will you purchase environmentally friendly products? Using prediction requests to increase choice of sustainable products. *Journal of Business Ethics*, *129*(1), 59-75.

Brückmann, G. (2022). The effects of policies providing information and trialling on the knowledge about and the intention to adopt new energy technologies. *Energy Policy*, *167*, 113047.

Brunner, F., Kurz, V., Bryngelsson, D., & Hedenus, F. (2018). Carbon label at a university restaurant–label implementation and evaluation. *Ecological Economics*, *146*, 658-667.

Camilleri, A. R., & Larrick, R. P. (2014). Metric and scale design as choice architecture tools. *Journal of Public Policy & Marketing*, *33*(1), 108-125.

Carrico, A. R., Raimi, K. T., Truelove, H. B., & Eby, B. (2018). Putting your money where your is: An experimental test of pro-environmental spillover from reducing meat consumption to monetary donations. *Environment and Behavior*, *50*(7), 723-748.

Chen, V. L., Delmas, M. A., Kaiser, W. J., & Locke, S. L. (2015). What can we learn from high-frequency appliance-level energy metering? Results from a field experiment. *Energy Policy*, *77*, 164-175.

Cheng, Z., Pang, M. S., & Pavlou, P. A. (2020). Mitigating traffic congestion: The role of intelligent transportation systems. *Information Systems Research*, *31*(3), 653-674.

Chwialkowska, A., & Flicinska-Turkiewicz, J. (2021). Overcoming perceived sacrifice as a barrier to the adoption of green non-purchase behaviours. *International Journal of Consumer Studies*, *45*(2), 205-220.

Costa, D. L., & Kahn, M. E. (2013). Energy conservation "nudges" and environmentalist ideology: Evidence from a randomized residential electricity field experiment. *Journal of the European Economic Association*,

11(3), 680-702.

Cozzio, C., Volgger, M., Taplin, R., & Woodside, A. G. (2020). Nurturing tourists' ethical food consumption: Testing the persuasive strengths of alternative messages in a natural hotel setting. *Journal of Business Research*, *117*, 268-279.

d'Adda, G., Gao, Y., & Tavoni, M. (2022). A randomized trial of energy cost information provision alongside energy-efficiency classes for refrigerator purchases. *Nature Energy*, *7*(4), 360-368.

Degirmenci, K., & Breitner, M. H. (2023). Gamification and sensory stimuli in eco-driving research: A field experiment to reduce energy consumption in electric

vehicles. *Transportation Research Part F: Traffic Psychology and Behaviour*, *92*, 266-282.

del Mar Solà, M., Escapa, M., & Galarraga, I. (2023). Effectiveness of monetary information in promoting the purchase of energy-efficient appliances: Evidence from a field experiment in Spain. *Energy Research & Social Science*, *95*, 102887.

Delmas, M. A., & Lessem, N. (2014). Saving power to conserve your reputation? The effectiveness of private versus public information. *Journal of Environmental Economics and Management*, *67*(3), 353-370.

Dowd, A., Ashworth, P., Carr-Cornish, S., & Stenner, K. (2012). Energymark: Empowering individual Australians to reduce their energy consumption. *Energy Policy*, *51*, 264-276.

Ebeling, F., & Lotz, S. (2015). Domestic uptake of green energy promoted by opt-out tariffs.

Nature Climate Change, *5*(9), 868-871.

Ellis, S. F., Savchenko, O. M., & Messer, K. D. (2022). Mitigating stigma associated with recycled water. *American Journal of Agricultural Economics*, *104*(3), 1077-1099.

Frank, P., & Brock, C. (2018). Bridging the intention–behavior gap among organic grocery customers: The crucial role of point-of-sale information. *Psychology & Marketing*, *35*(8), 586-602.

Garnett, E. E., Balmford, A., Sandbrook, C., Pilling, M. A., & Marteau, T. M. (2019). Impact of increasing vegetarian availability on meal selection and sales in cafeterias. *Proceedings of the National Academy of Sciences*, *116*(42), 20923-20929.

Geiger, S. M., Fischer, D., Schrader, U., & Grossman, P. (2020). Meditating for the planet: Effects of a mindfulness-based intervention on sustainable consumption behaviors.

Environment and Behavior, *52*(9), 1012-1042.

Ghesla, C., Grieder, M., & Schubert, R. (2020). Nudging the poor and the rich–A field study on the distributional effects of green electricity defaults. *Energy Economics*, *86*, 104616.

Hanss, D., & Böhm, G. (2013). Promoting purchases of sustainable groceries: An intervention study. *Journal of Environmental Psychology*, *33*, 53-67.

Hartmann, C., Lazzarini, G., Funk, A., & Siegrist, M. (2021). Measuring consumers' knowledge of the environmental impact of foods. *Appetite*, *167*, 105622.

Havas, L., Ballweg, J., Penna, C., & Race, D. (2015). Power to change: Analysis of household participation in a renewable energy and energy efficiency programme in Central Australia. *Energy Policy*, *87*, 325-333.

He, H. Z., & Kua, H. W. (2013). Lessons for integrated household energy conservation policy from Singapore's southwest Eco-living Program. *Energy Policy*, *55*, 105-116.

Heydarian, A., Pantazis, E., Carneiro, J. P., Gerber, D., & Becerik-Gerber, B. (2016). Lights, building, action: Impact of default lighting settings on occupant behaviour. *Journal of Environmental Psychology*, *48*, 212-223.

Houde, S., Todd, A., Sudarshan, A., Flora, J. A., & Armel, K. C. (2013). Real-time feedback and electricity consumption: A field experiment assessing the potential for savings and persistence. *The Energy Journal*, *34*(1).

Idahosa, L. O., & Akotey, J. O. (2021). A social constructionist approach to managing HVAC energy consumption using social norms–A randomised field experiment. *Energy Policy*, *154*, 112293.

Jalil, A. J., Tasoff, J., & Bustamante, A. V. (2020). Eating to save the planet: Evidence from a controlled trial using individual-level food purchase data. *Food Policy*, *95*, 101950.

Katare, B., Yim, H., Byrne, A., Wang, H. H., & Wetzstein, M. (2022). Consumer willingness to pay for environmentally sustainable meat and a plant-based meat substitute. *Applied Economic Perspectives and Policy*, 1-19, doi:10.1002/aepp.13285

Knezevic Cvelbar, L., Grün, B., & Dolnicar, S. (2022). Do employees hold the key to environmental sustainability in tourism businesses? Empirical evidence from a field study. *Journal of Sustainable Tourism*, 1-14.

Kramer, J., & Petzoldt, T. (2022). A matter of behavioral cost: Contextual factors and behavioral interventions interactively influence pro-environmental charging decisions. *Journal of Environmental Psychology*, *84*, 101878.

Kristensson, P., Wästlund, E., & Söderlund, M. (2017). Influencing consumers to choose environment friendly offerings: Evidence from field experiments. *Journal of Business Research*, *76*, 89-97.

Kutzner, F., Kacperski, C., Schramm, D., & Waenke, M. (2021). How far can we get with eco driving tech? *Journal of Environmental Psychology*, *76*, 101626.

Lanzini, P., & Thøgersen, J. (2014). Behavioural spillover in the environmental domain: An intervention study. *Journal of Environmental Psychology*, *40*, 381-390.

Lee, E. J., Choi, H., Han, J., Kim, D. H., Ko, E., & Kim, K. H. (2020). How to "nudge" your consumers toward sustainable fashion consumption: An fMRI investigation. *Journal of Business Research*, *117*, 642-651.

Liang, J., Qiu, Y., & Xing, B. (2021). Social versus private benefits of energy efficiency under time-of-use and increasing block pricing. *Environmental and Resource Economics*, *78*(1), 43-75.

Limnios, E. M., Schilizzi, S. G., Burton, M., Ong, A., & Hynes, N. (2016). Willingness to pay for product ecological footprint: Organic vs non-organic consumers. *Technological Forecasting and Social Change*, *111*, 338-348.

Loi, T. S. A., & Loo, S. L. (2016). The impact of Singapore's residential electricity conservation efforts and the way forward. Insights from the bounds testing approach. *Energy Policy*, *98*, 735-743.

Loock, C. M., Staake, T., & Thiesse, F. (2013). Motivating energy-efficient behavior with green IS: an investigation of goal setting and the role of defaults. *MIS Quarterly*, *37*(4), 1313-1332.

Lorenz-Walther, B. A., Langen, N., Göbel, C., Engelmann, T., Bienge, K., Speck, M., & Teitscheid, P. (2019). What makes people leave less food? Testing effects of smaller portions and information in a behavioral model. *Appetite*, *139*, 127-144.

Mahmoodi, J., Prasanna, A., Hille, S., Patel, M. K., & Brosch, T. (2018). Combining "carrot and stick" to incentivize sustainability in households. *Energy Policy*, *123*, 31-40.

Manca, S., Altoè, G., Schultz, P. W., & Fornara, F. (2020). The persuasive route to sustainable mobility: Elaboration likelihood model and emotions predict implicit attitudes. *Environment and Behavior*, *52*(8), 830-860.

Menapace, L., & Raffaelli, R. (2017). Preferences for locally grown products: Evidence from a

natural field experiment. *European Review of Agricultural Economics*, *44*(2), 255-284.

Min, J., Azevedo, I. L., Michalek, J., & de Bruin, W. B. (2014). Labeling energy cost on light bulbs lowers implicit discount rates. *Ecological Economics*, *97*, 42-50.

Momsen, K., & Stoerk, T. (2014). From intention to action: Can nudges help consumers to choose renewable energy? *Energy Policy*, *74*, 376-382.

Newell, R. G., & Siikamäki, J. (2014). Nudging energy efficiency behavior: The role of information labels. *Journal of the Association of Environmental and Resource Economists*, *1*(4), 555-598.

O'Garra, T., & Fouquet, R. (2022). Willingness to reduce travel consumption to support a low-carbon transition beyond COVID-19. *Ecological Economics*, *193*, 107297.

Osman, M., & Thornton, K. (2019). Traffic light labelling of meals to promote sustainable consumption and healthy eating. *Appetite*, *138*, 60-71.

Peñasco, C., & Anadón, L. D. (2023). Assessing the effectiveness of energy efficiency measures in the residential sector gas consumption through dynamic treatment effects: Evidence from England and Wales. *Energy Economics*, *117*, 106435.

Ro, M., Brauer, M., Kuntz, K., Shukla, R., & Bensch, I. (2017). Making cool choices for sustainability: Testing the effectiveness of a game-based approach to promoting pro-environmental behaviors. *Journal of Environmental Psychology*, *53*, 20-30.

Rosenfeld, D. L., Bartolotto, C., & Tomiyama, A. J. (2022). Promoting plant-based food choices: Findings from a field experiment with over 150,000 consumer decisions. *Journal of Environmental Psychology*, *81*, 101825.

Sarkar, J. G., Sarkar, A., Dwivedi, Y. K., & Balaji, M. S. (2022). Sweat it for sustainability: Impact of physical activity/exercise on sustainable consumption. *Psychology & Marketing*, *39*(11), 2184-2199.

Schall, D. L., Wolf, M., & Mohnen, A. (2016). Do effects of theoretical training and rewards for energy-efficient behavior persist over time and interact? A natural field experiment on eco-driving in a company fleet. *Energy Policy*, *97*, 291-300.

Stanszus, L. S., Frank, P., & Geiger, S. M. (2019). Healthy eating and sustainable nutrition through mindfulness? Mixed method results of a controlled intervention study. *Appetite*, *141*, 104325.

Sun, J. J., Bellezza, S., & Paharia, N. (2021). Buy less, buy luxury: Understanding and overcoming product durability neglect for sustainable consumption. *Journal of Marketing*, *85*(3), 28-43.

Suter, J. F., & Shammin, M. R. (2013). Returns to residential energy efficiency and conservation measures: A field experiment. *Energy Policy*, *59*, 551-561.

Tiefenbeck, V., Staake, T., Roth, K., & Sachs, O. (2013). For better or for worse? Empirical evidence of moral licensing in a behavioral energy conservation campaign. *Energy Policy*, *57*, 160-171.

Ungemach, C., Camilleri, A. R., Johnson, E. J., Larrick, R. P., & Weber, E. U. (2018).

Translated attributes as choice architecture: Aligning objectives and choices through decision signposts. *Management Science*, *64*(5), 2445-2459.

Verplanken, B., & Roy, D. (2016). Empowering interventions to promote sustainable lifestyles: Testing the habit discontinuity hypothesis in a field experiment. *Journal of Environmental Psychology*, *45*, 127-134.

Weber, S., Puddu, S., & Pacheco, D. (2017). Move it! How an electric contest motivates households to shift their load profile. *Energy Economics*, *68*, 255-270.

Zimmer, A., & Koch, N. (2017). Fuel consumption dynamics in Europe: Tax reform implications

for air pollution and carbon emissions. *Transportation Research Part A: Policy and Practice*, *106*, 22-50.

Zwicker, M. V., Nohlen, H. U., Dalege, J., Gruter, G. J. M., & van Harreveld, F. (2020).

Applying an attitude network approach to consumer behaviour towards plastic. *Journal of Environmental Psychology*, *69*, 101433.

Appendix 8. Alternative primary analysis for the proposed experiment

There are four outcome variables: the number of opened emails, the number of clicks on the registration button in the email, registrations, and attendance.

Opens: An open is when an email recipient opens the email, counted once per individual. This is observed at the treatment level.

Clicks: The email has a button to register for the seminar. The number of clicks is the number of unique individuals that click on the registration button, regardless of whether they register. This is observed at the treatment level.

Registrations: Individuals must register to participate in the seminar. They may register with any email address, which means that the address may not match an address from the mailing list.

Registrations are observed at the individual level.

Attendance: Attendance includes a name and email. The email should match the registration email but may not match the email in the mailing list.

These outcomes are sequential—anyone who attends must register (the people presenting are excluded from the experiment), anyone who registers must click the registration button, and anyone who clicks the registration button must open the email. The point at which the treatment is applied is either immediately before the open or immediately before the click, depending on the preview settings of the individual's email. In our model the likelihood of an individual clicking is dependent on the treatment, but the likelihood of progressing from the click step to the register step (and the email they use to register) is independent of the treatment. We also assume anyone who registers or attends does so with the same email address each time, though this email may not match their email on the email list.

Clicks are observed at the treatment level, which invalidates the standard errors if multiple experiments are run with a shared population due to potential serial correlation because appropriate clustering is not possible. We bound the potential effect of clustering by creating two counterfactuals based on the observed individual-level *registrations*. For *clicks* that cannot be accounted for with *registrations* (unaccounted *clicks*) the counterfactuals assign *clicks* to be either disperse or clustered. This is explained in the example below.

Suppose there are two experiments with six total invitees (1, 2, 3, 4, 5, 6). Four are invited to Experiment one (1, 2, 5, 6) and four are invited to Experiment 2 (3, 4, 5, 6). Individual level clicks are known for those who register. Suppose we observe that for Experiment 1, subjects 1 and 5 register but there are three clicks. For Experiment 2, subject 4 registers but there are two clicks. Table 1 shows that some subjects could not have registered or clicked because they were not invited (indicated by X), and others are known to have registered and therefore clicked (indicated by O for observed) because we can match their email to the email list. There is one unaccounted click in each experiment. In the disperse counterfactual, we assign clicks to individuals who were not observed to register, spreading the clicks across different subjects when possible: subjects 2 and 3 are assigned a hypothetical click (D). For the clustered hypothetical, the unaccounted clicks are assigned within-subject when possible. Here we assign both unaccounted clicks to subject 6, indicated by C. Both hypotheticals have the same total number of clicks but represent the extremes with respect to serial correlation.

Subject	Exp 1 Click	Exp 1 Reg	Exp 2 Click	Exp 2 Reg
1	O	O	X	X
2	D		X	X
3	X	X	D	
4	X	X	O	O
5	O	O		
6	C		C	

Table A8.1: Example disperse counterfactual clicks.

Serial correlation, or the likelihood of individuals taking correlated actions across multiple experiments, affects standard errors because the observations are not independent. Individuals could have idiosyncratic preferences for attending seminars which have a substantial impact on their likelihood of attending any seminar. Later we show the extent to which serial correlation affects results, but first we discuss the simulation and regression model.

Simulation

We test power using simulations with the following data generating process for *clicks* and *registrations*.

Parameters (typical values): Number of experiments for each listserv, number of listservs (2), number of individuals on a listserv (4000), overlap of individuals across listservs (2000), likelihood of clicking for portions of the population (60% of population [low click likelihood] – 0.001%, 30% of population [medium click likelihood] – 1%, 10% of population [high click likelihood] – 10%), likelihood of registering conditional on clicking (65%), and treatment effect (0 to 1 percentage point increase in the likelihood of clicking, independent of original click likelihood). We run 500 simulations for each parameter set presented.

The treatment effect is modeled as a percentage point increase in the likelihood of *clicking*, and therefore a corresponding likelihood of *registering* as a function of the likelihood of registering which did not vary by treatment. Using the observed *registration* and the known number of *clicks* for each treatment for each experiment, we generate the hypothetical disperse and clustered distributions of *clicks* discussed above.

Model Specification

Each outcome variable is binary for individuals. Clicks and opens are not observed at the individual level but they are modeled as binary actions for the individual. Two models we consider are the Linear Probability Model (LPM) and Logistic regression (logit). We use the LPM as the primary specification due to ease of interpretation and because the domain of covariates is limited

such that the primary issue with the LPM (that it could produce results outside of the unit interval) is not a concern. We have no covariates for individual attributes aside from treatment assignment and experiment session. We will provide logit results for robustness. The LPM and logit provide practically identical power in our simulations (Figures A8.1 and A8.2). Further, our simulation shows that the LPM applied to registrations and clicks is unbiased. The literature supports selecting the LPM over logit for binary outcomes under some conditions, finding that the LPM is preferred when events are rare (fewer than 25% of one outcome).[7]
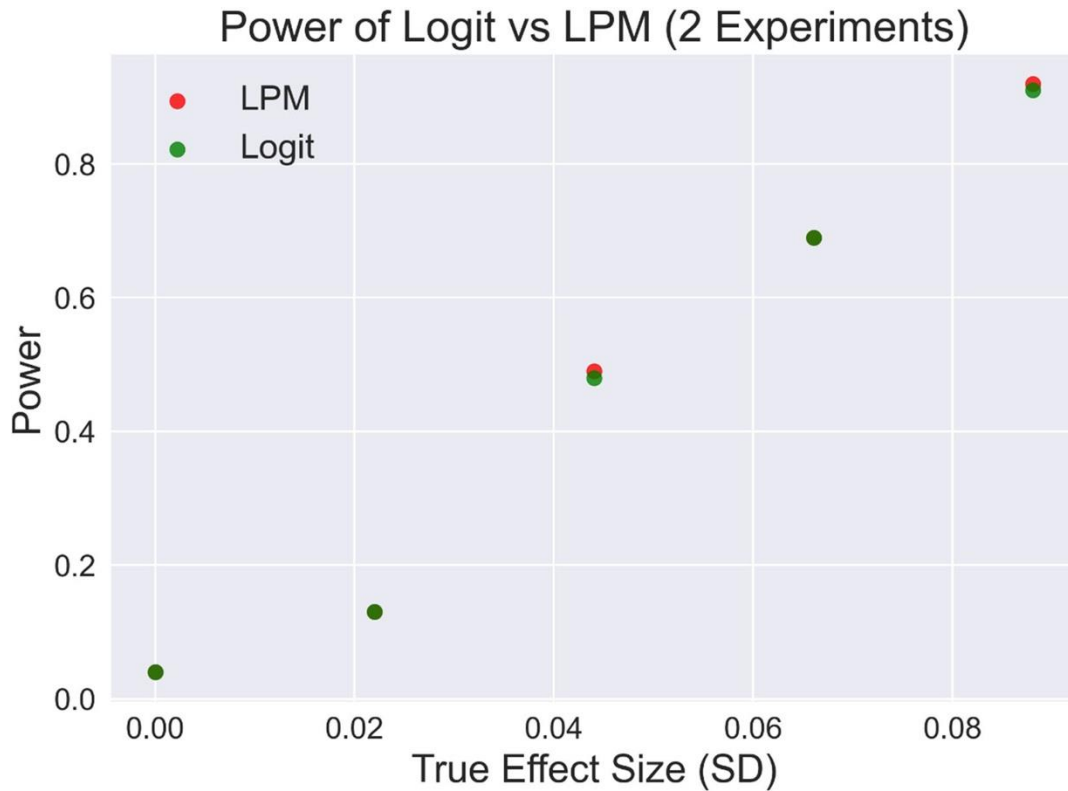
Figure A8.1: LPM and logit power for two experiments.

---

[7] Timoneda JC. Estimating group fixed effects in panel data with a binary dependent variable: How the LPM outperforms logistic regression in rare events data. Soc Sci Res. 2021 Jan;93:102486. doi: 10.1016/j.ssresearch.2020.102486. Epub 2020 Oct 29. PMID: 33308684
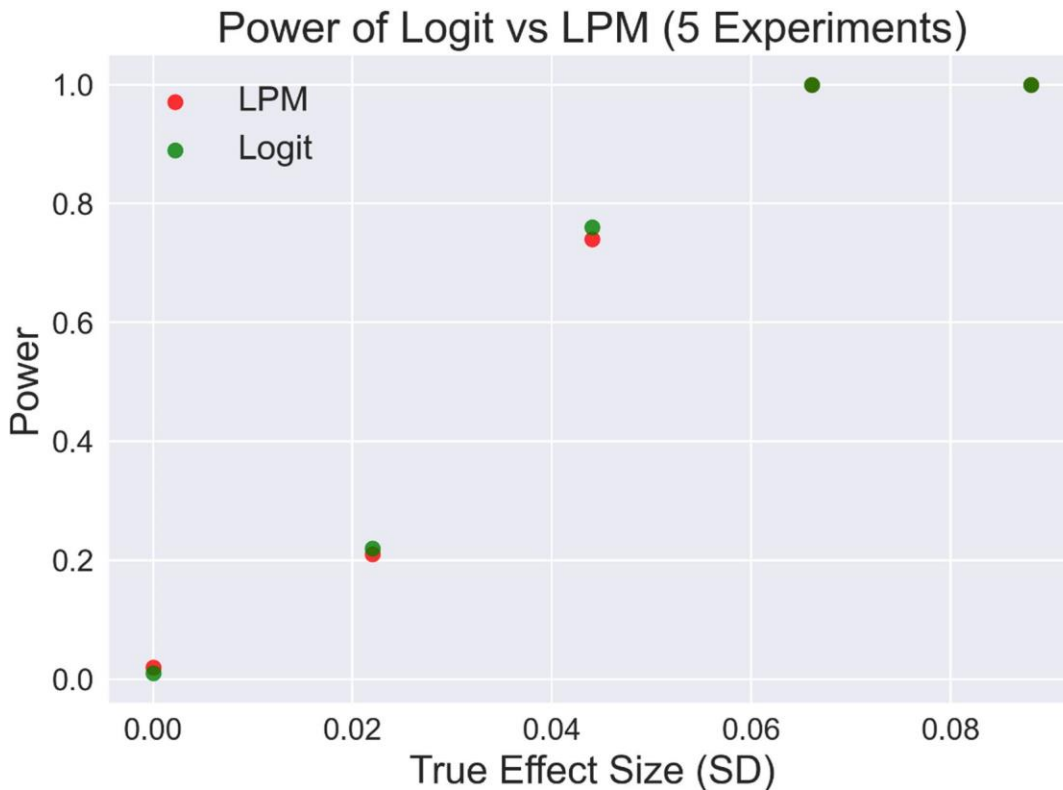
Figure A8.2: LPM and logit power for five experiments. The regression is:

$$C_{ie} = \beta_0 + \beta_1 Treatment_i + \beta_3 Experiment_e + \epsilon_{ie}$$

Where C_{ie} is the hypothetical *click* outcome for subject i in experiment e, $Treatment_i$ is the treatment assigned to subject i, and $Experiment_e$ is the vector of indicators for each experiment. This model is fit with a random effects LPM. The random effects model provides a more powerful estimate of the treatment effect than would a fixed effects model and is justified because the treatment variable is randomly assigned by design.

Serial Correlation

Above we discussed how we provide bounds for serial correlation of the *clicks* variable by generating hypothetical distributions of *clicks* by assuming either highly disperse or highly clustered distributions of unaccounted *clicks*. The difference between the two distributions depends largely on the proportion of unaccounted *clicks*: when there are more unaccounted clicks, assuming a highly clustered distribution reduces power. This is shown in Figures A8.3, A8.4, and A8.5, which show how power varies as the registration likelihood varies while high *click* likelihood individuals have a 10% chance of clicking, without treatment. In Figures A8.6, A8.7, and A8.8 we show analogous results when high *click* likelihood individuals have a 20% chance of clicking, without treatment. Figure A8.9 emphasizes that for the same effect size, as measured by standard deviation (SD), there is greater power when the likelihood of *clicking* is lower.
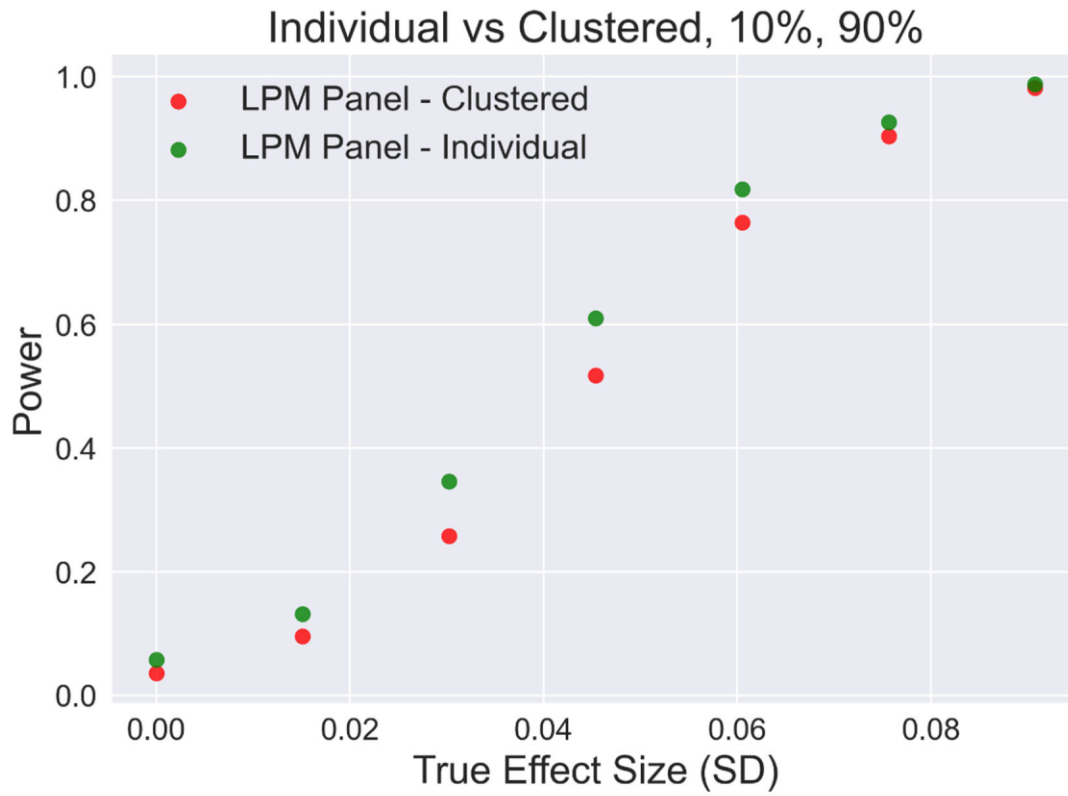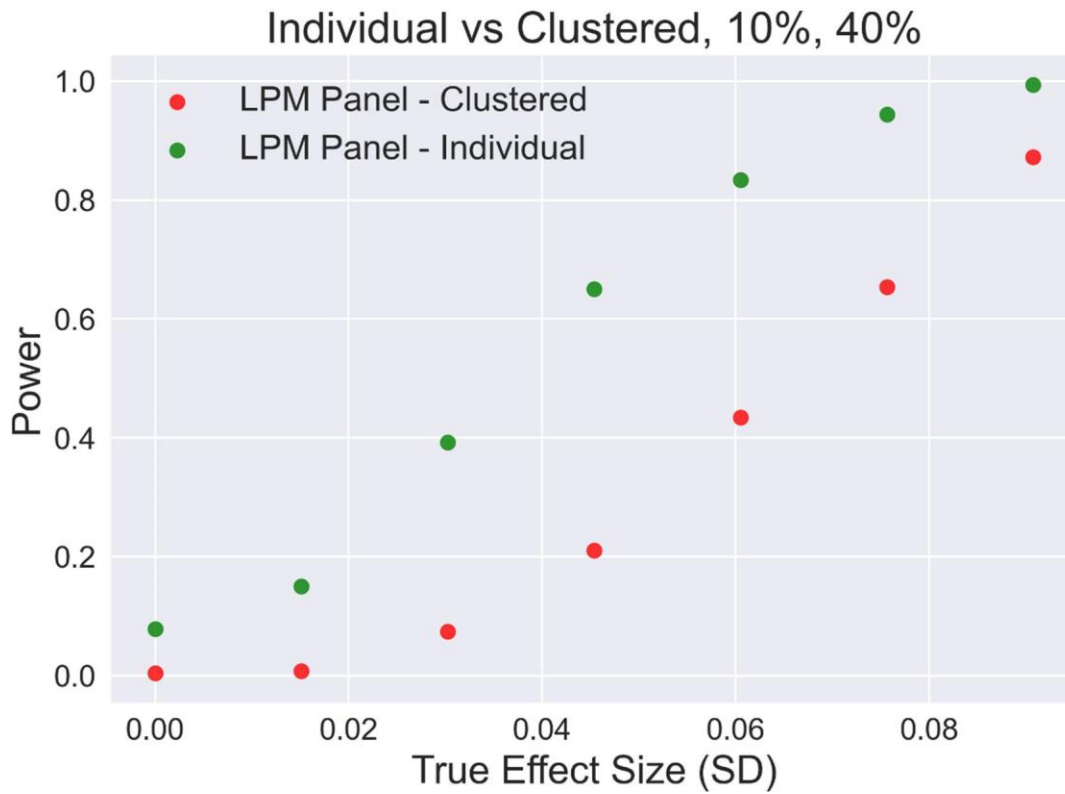
Figure A8.3: Comparison of the effects of the disperse (individual) and clustered distribution assumptions on power for a 10% chance of *clicking* for high *click* likelihood individuals and a 90% chance of *registering* conditional on *clicking*.
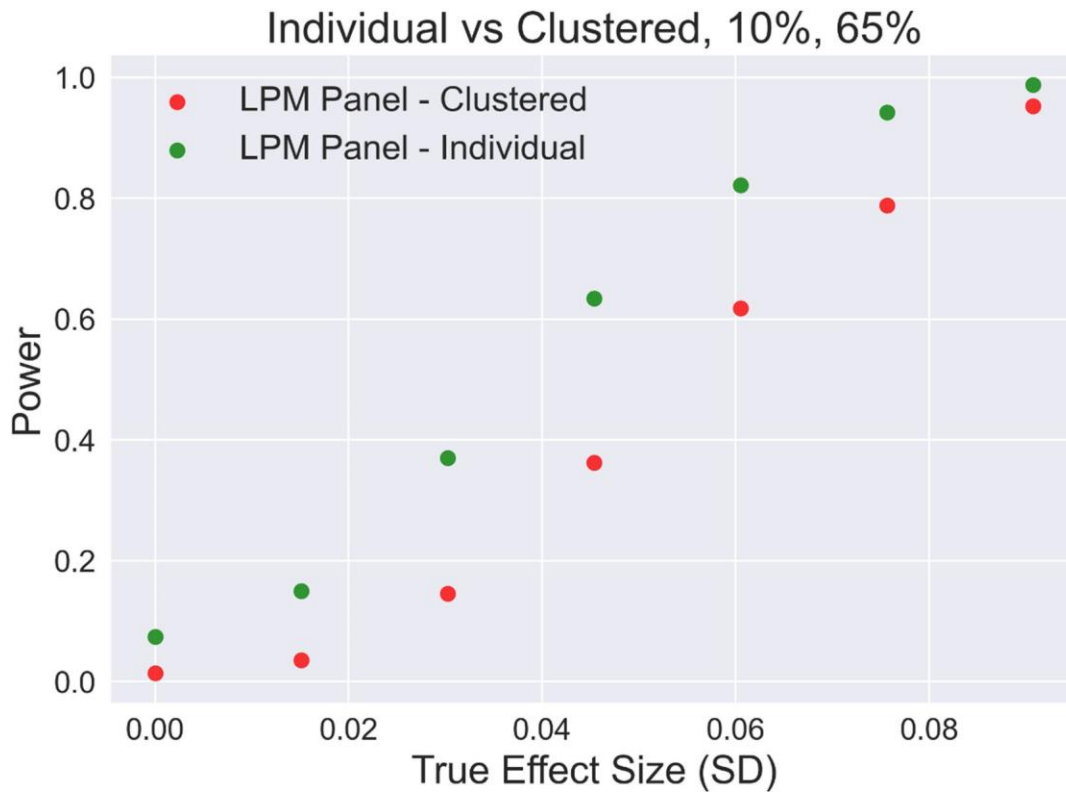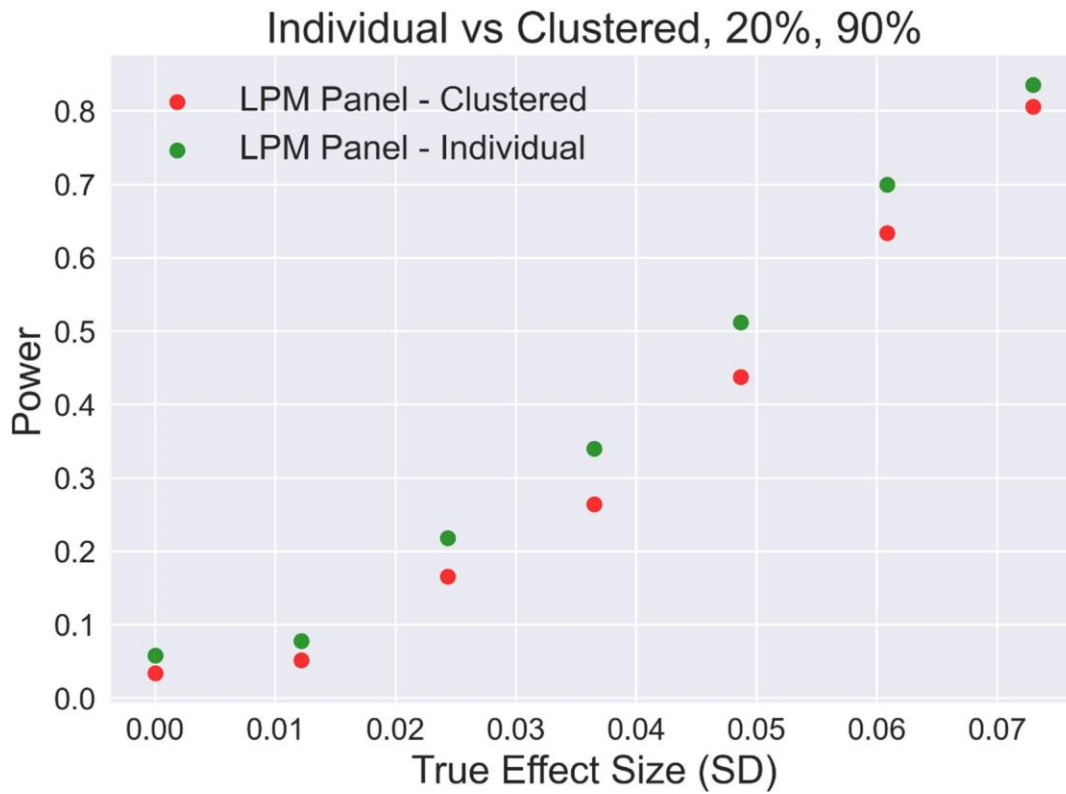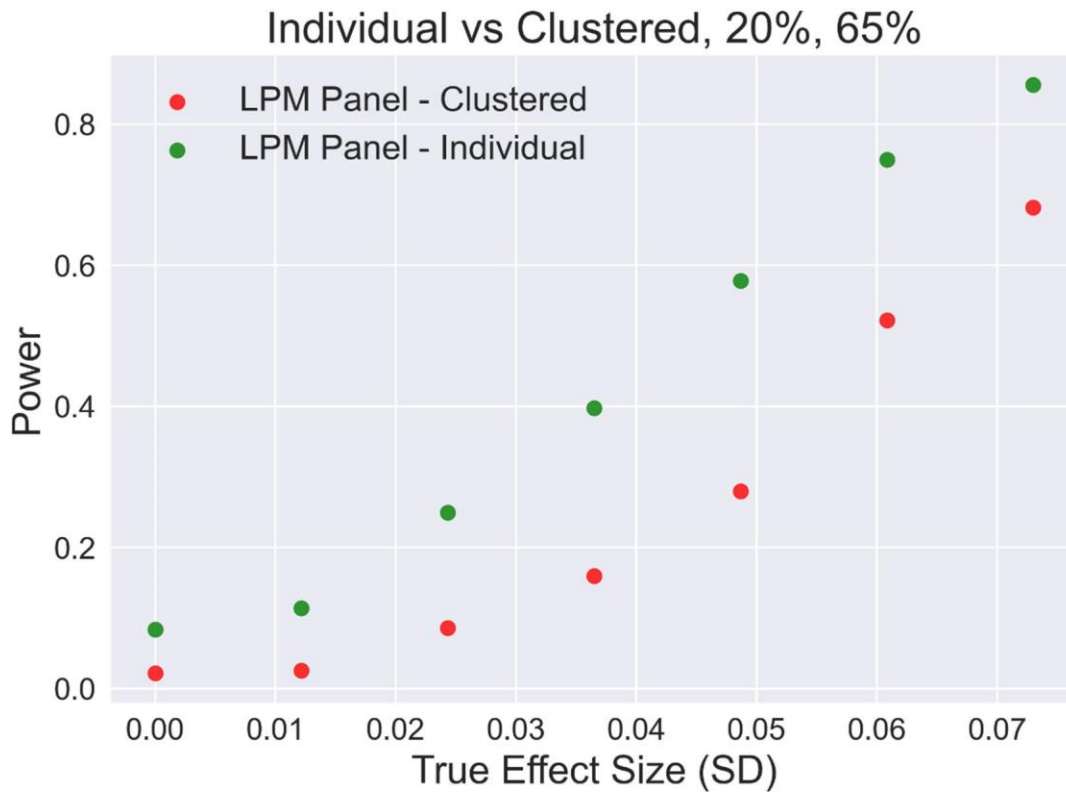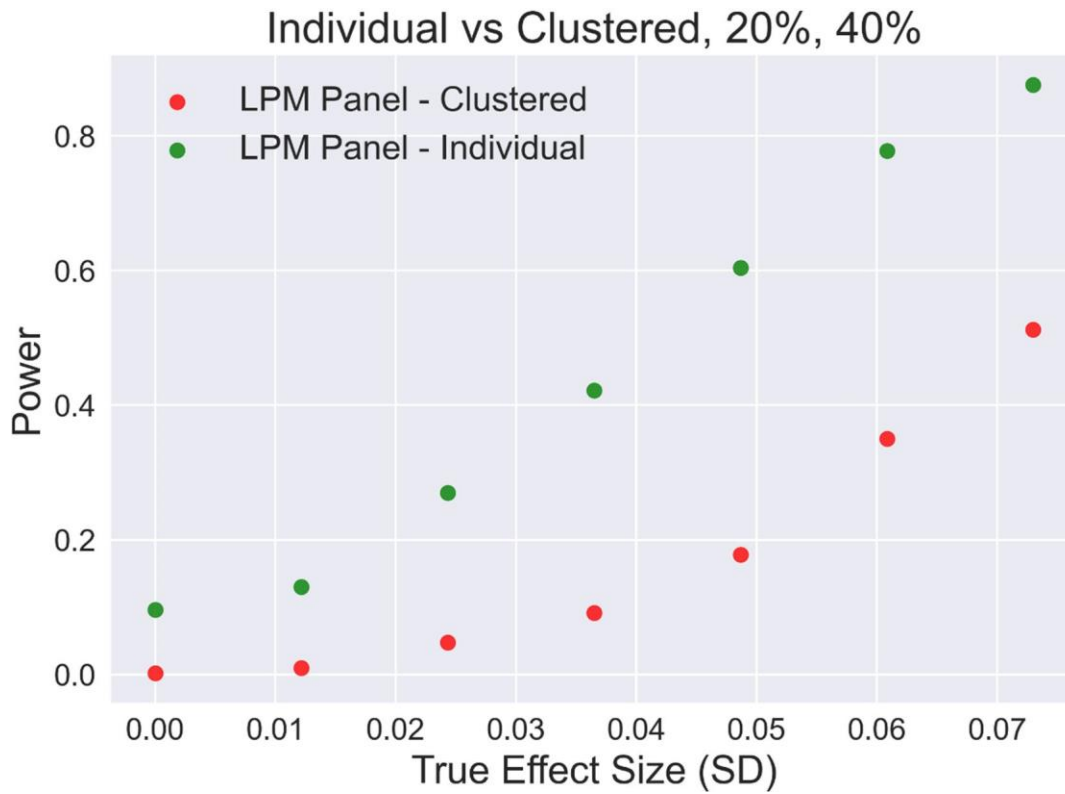
Figure A8.4: Comparison of the effects of the disperse (individual) and clustered distribution assumptions on power for a 10% chance of *clicking* for high *click* likelihood individuals and a 65% chance of *registering* conditional on *clicking*.

Figure A8.5: Comparison of the effects of the disperse (individual) and clustered distribution assumptions on power for a 10% chance of *clicking* for high *click* likelihood individuals and a 40% chance of *registering* conditional on *clicking*.

Figure A8.6: Comparison of the effects of the disperse (individual) and clustered distribution assumptions on power for a 20% chance of *clicking* for high *click* likelihood individuals and a 90% chance of *registering* conditional on *clicking*.

Figure A8.7: Comparison of the effects of the disperse (individual) and clustered distribution assumptions on power for a 20% chance of *clicking* for high *click* likelihood individuals and a 65% chance of *registering* conditional on *clicking*.

Figure A8.8: Comparison of the effects of the disperse (individual) and clustered distribution assumptions on power for a 20% chance of *clicking* for high *click* likelihood individuals and a 40% chance of *registering* conditional on *clicking*.

Figure A8.9: Comparison of a 10% vs 20% chance of *clicking* for the high *click* group.

We choose to use panel data methods with hypothetical distributions of clicks, as shown above, rather than the alternative of a "combined methods" which combines the p-value from individual experiments using Fisher's method and then divides by the number of experiments to adjust for potential serial correlation, which although we do not have an analytical justification for this adjustment, numerically it appears to be sufficiently conservative. Panel methods provide substantially greater power, however, the combined methods approach modeled here is not the final approach used in this report. The approach used in this report does not adjust divide the p-value by the number of experiments, and therefore has higher power but is also more than 5% likely to commit a Type 2 error of falsely rejecting the null. Further, note that the null tested under the combined methods approach (Fisher's method) is not a test of the overall effect and does not have an accompanying estimate of the overall effect size. Figure A8.10 compares the panel methods approach using the clustered assumption and Fisher's combined method when there is a 65% chance of registration conditional on clicking. Figure A8.11 shows same comparison under the disperse (individual) assumption, which increases the power of the panel method but is invalid with serial correlation. The relative advantage of panel methods increases as the likelihood of registration increases. This is expected because, as above, we can bound serial correlation at a lower level. This effect is shown in Figure A8.12, which replicates the conditions of Figure A8.10 with a higher chance of registration. Figure A8.13 shows that at a registration likelihood of 40%, panel methods are roughly as powerful as Fisher's combined method. As the likelihood of registration approaches 100%, the disperse distribution approaches the individual distribution until all clicks are accounted for.
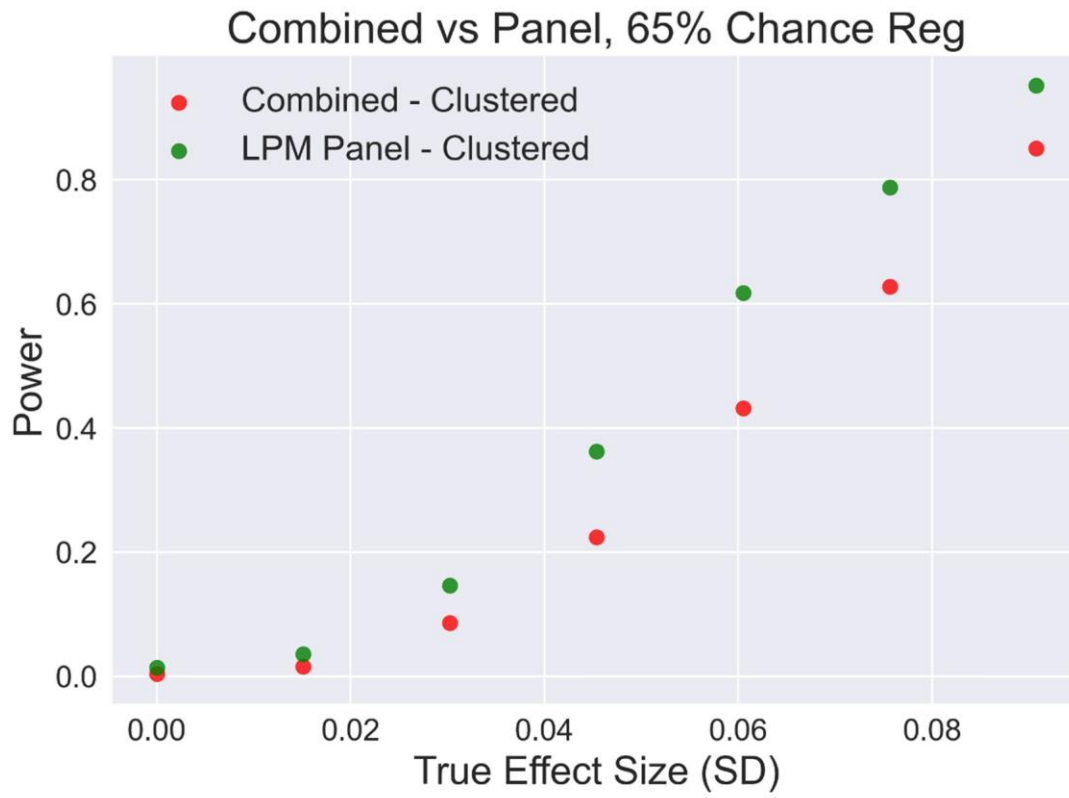
Figure A8.10: Combined and panel methods compared for a combined methods approach that adjusts for serial correlation, which is not the final method recommended in the report.
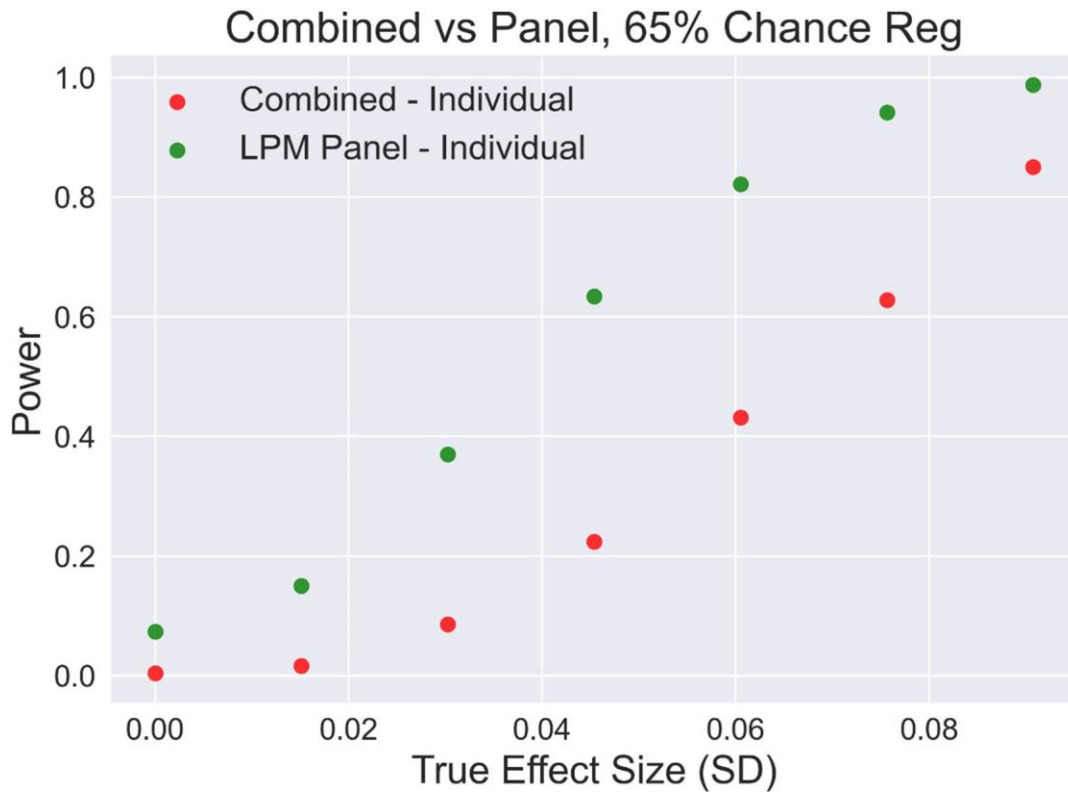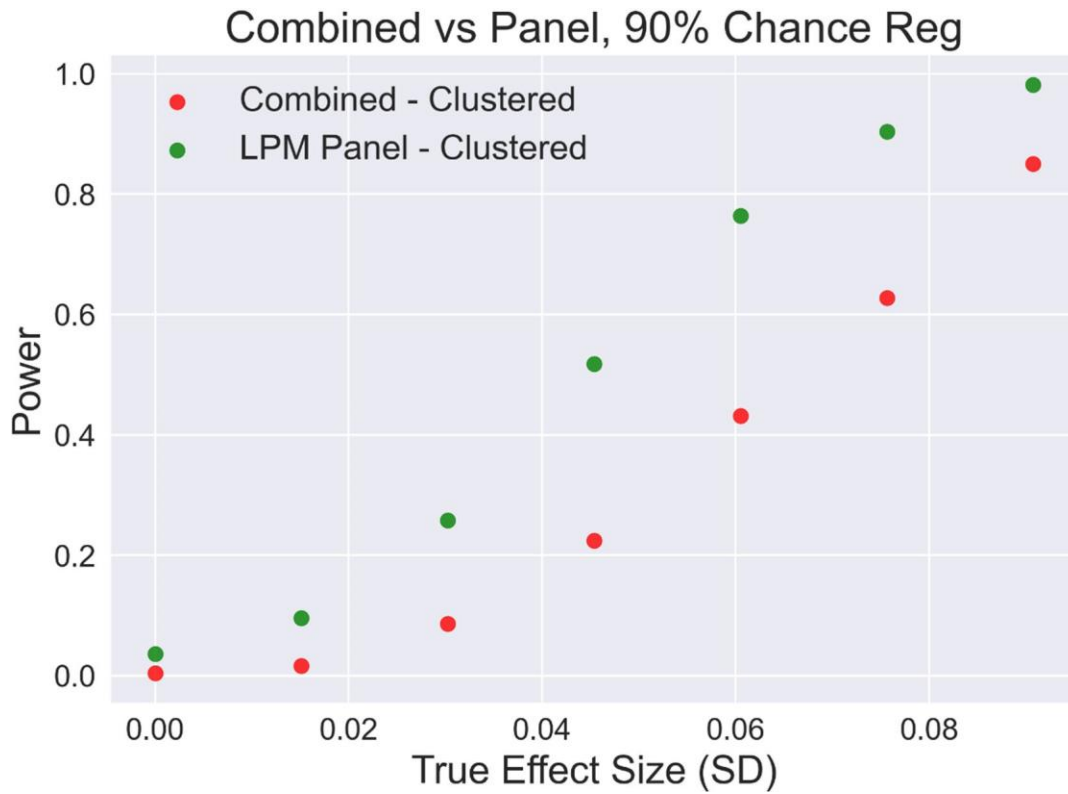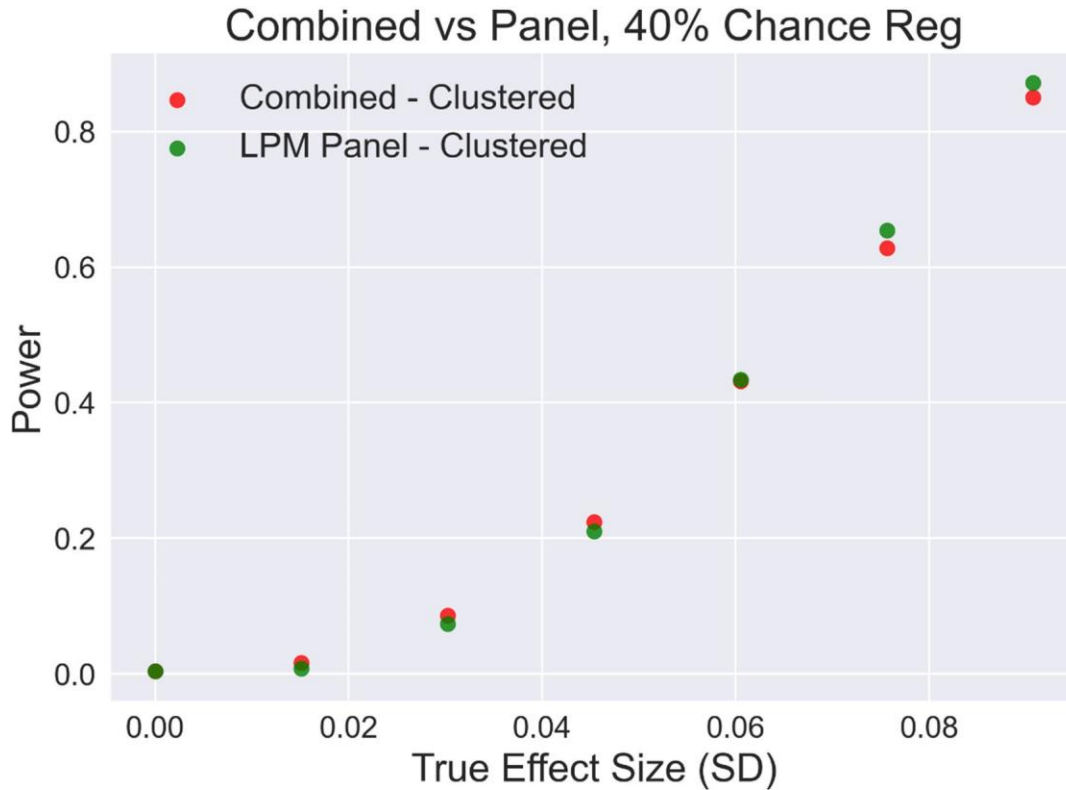
Figure A8.11: Combined and panel methods compared for a combined methods approach that adjusts for serial correlation, which is not the final method recommended in the report.

Figure A8.12: Combined and panel methods compared for a combined methods approach that adjusts for serial correlation, which is not the final method recommended in the report.

Figure A8.13: Combined and panel methods compared for a combined methods approach that adjusts for serial correlation, which is not the final method recommended in the report.

Based on these simulations we choose to use panel methods since they provide more power than Fisher's combined method. Further, panel methods provide a preferable interpretation , including an estimate of the overall effect size with a confidence interval.

Outcome Variables

Under most conditions, registrations is the most powerful outcome variable, even under the assumption that the treatment effect has no effect on registrations conditional on clicks. As noted above, we also assume that the treatment has no effect on the email address used to register. Figure A8.14 shows that registrations is more powerful than the clustered LPM for clicks unless the treatment effect is so large that both specifications have high power.
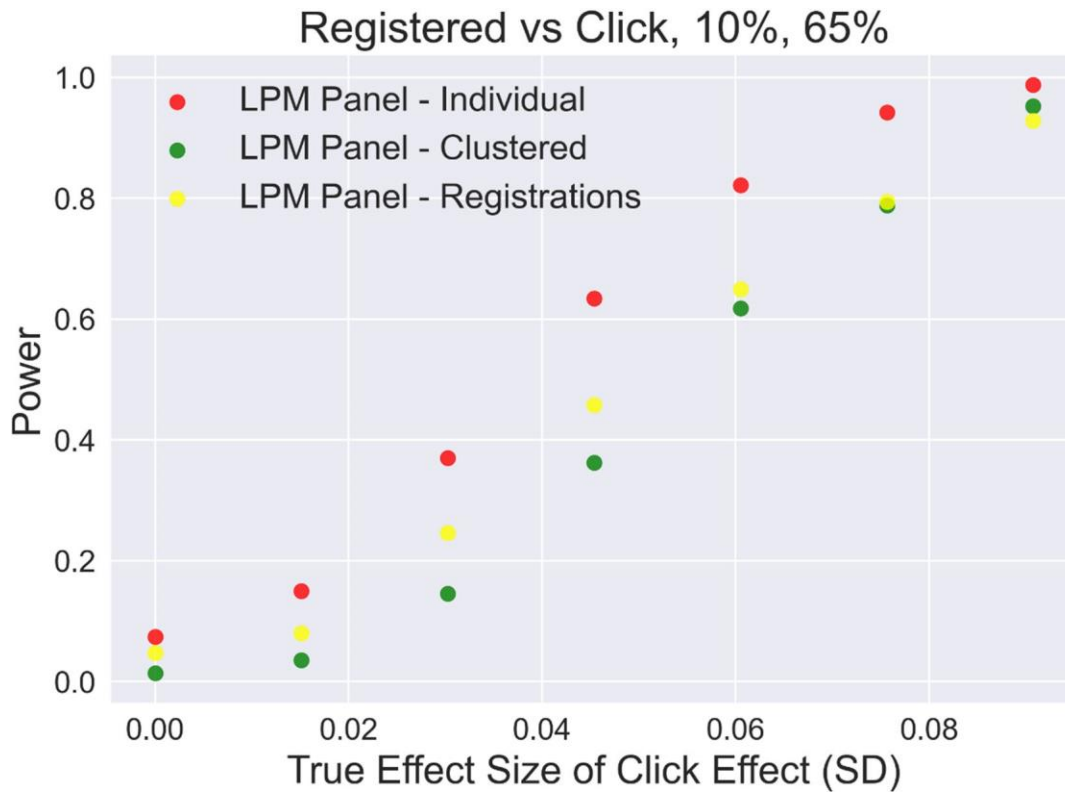
Figure A8.14: *Registrations* compared to *clicks* with the horizontal axis measured as the effect size on *clicking*.

When the horizontal axis is measured as the effect size with respect to the measured variable (effect on clicking and effect on registering), the power of registrations approaches the power of clicks under the disperse assumption, as shown if Figure A8.15. The power advantage for registrations comes from being able to directly account for serial correlation and therefore not needing the additional caution applied to unaccounted clicks.
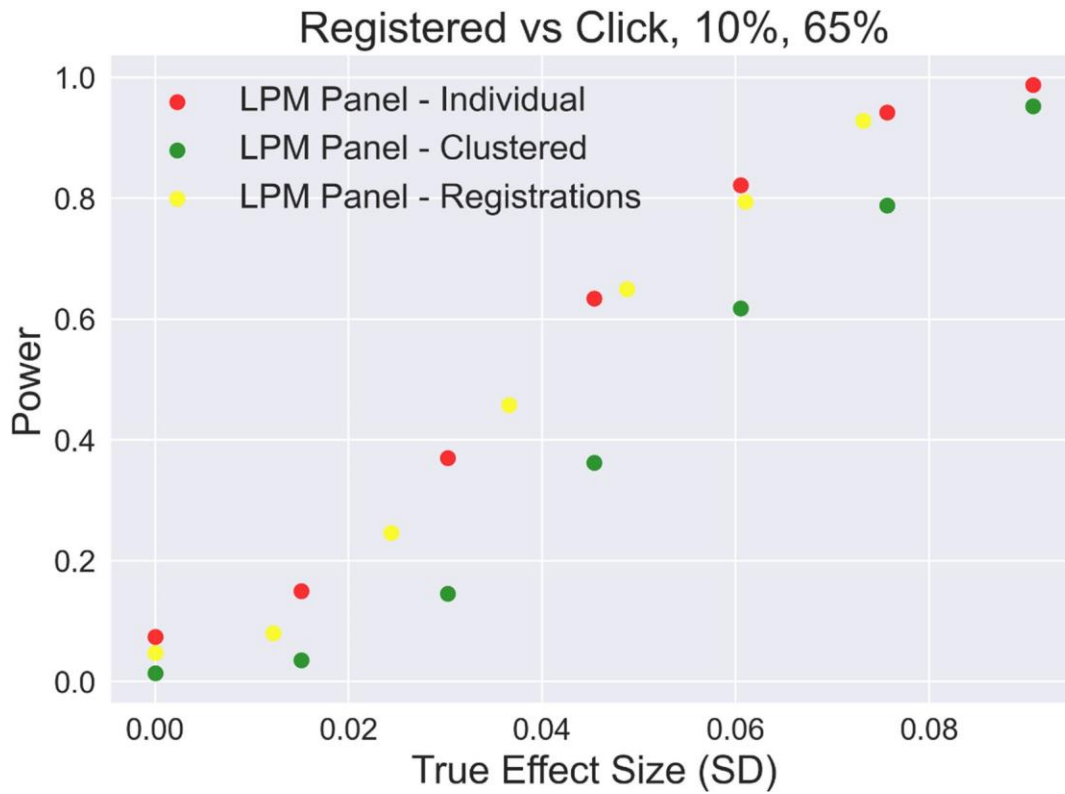
Figure A8.15: *Registrations* compared to *clicks* with the horizontal axis measured in the respective effect size.

The advantage of *registrations* as an outcome variable holds when compared to *clicks* using Fisher's combined method, as shown in Figure A8.16.
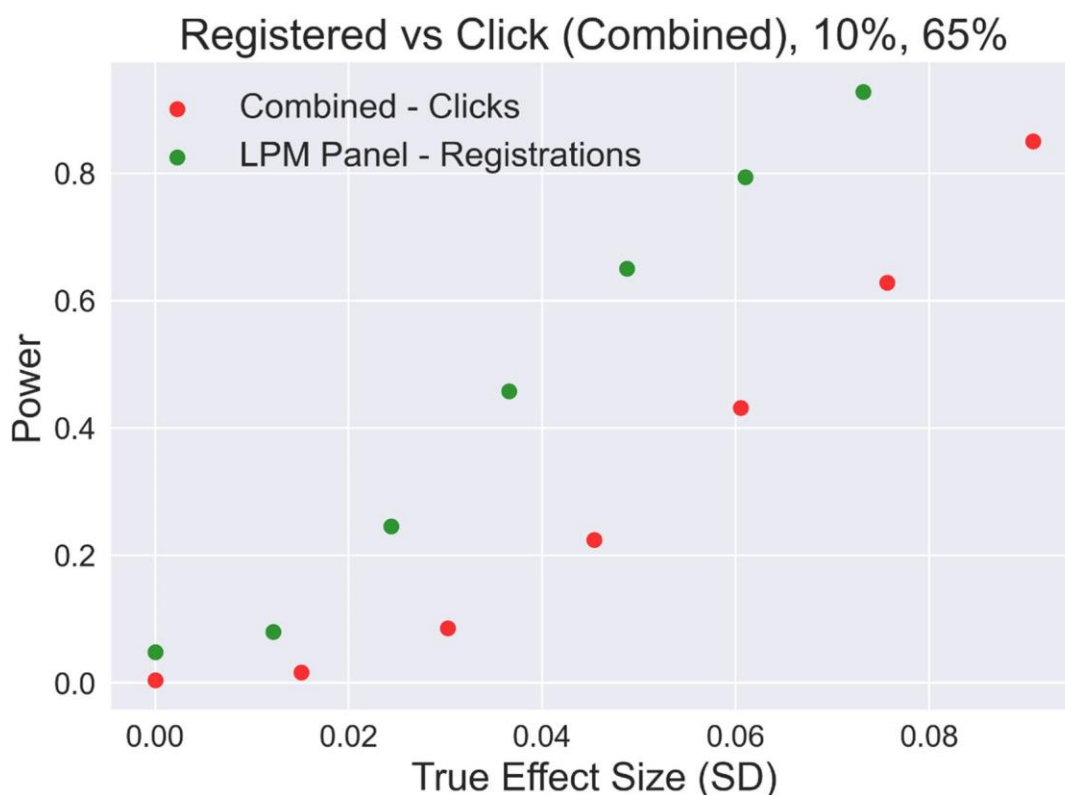
Figure A8.16: *Registrations* using panel methods compared to *clicks* using Fisher's combined method for a combined methods approach that adjusts for serial correlation, which is not the final method recommended in the report.

For datasets with low serial correlation and low likelihood of registering conditional on clicking, the LPM with the disperse assumption may be a reasonable, if slightly optimistic, estimate. If we suspect unobserved serial correlation, the disperse assumption is not appropriate and instead we must use the more conservative clustered assumption. Relative to registrations, the LPM with the clustered assumption for clicks has lower power for the regions of the treatment effect where there is considerable variability in power across methods. Further, if there is a treatment effect on the likelihood of registering beyond the effect on clicking, which would be important for policy purposes since it may result in greater attendance which is the policy goal, registrations would be an even more powerful metric.

Attendance is the most important policy metric and, like registrations, can be directly estimated with the LPM. If we examine this and another metric we can adjust for multiple hypotheses testing with the Benjamini-Hochberg procedure.