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Mitigating Stigma Associated with Recycled Water: Aquifer Recharge and Trophic Levels

Ellis, S.F.[1], Olesya M. Savchenko[2], and Kent D. Messer[1*]
[1]Department of Applied Economics and Statistics, University of Delaware, [2]University of Florida, Food and Resource Economics Department
*Corresponding author:
messer@udel.edu

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ABSTRACT

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Stigmatization of water and food products can constrain markets and prevent the implementation of scientifically safe solutions to environmental problems, such as water scarcity. Recycled water can be a cost-effective, dependable, and safe solution to water shortages, however, consumers generally either require a large reduction in price to purchase and eat products made with recycled water or reject such products outright. If emerging sustainable agricultural technologies, such as recycled water are to be used to address growing water shortages worldwide, policymakers and industry stakeholders must identify effective strategies for mitigating stigma. Using field experiments involving 1,420 adult participants, we test the effectiveness of two stigma-mitigating techniques. We also successfully demonstrate a novel twist to the collection of representative samples in non-hypothetical experimental settings and compare the results to a more traditional field experiment that recruited participants at a large public gathering. The analysis of these different samples suggests a common finding: passing recycled water through a natural barrier, such as an aquifer, removes the stigma consumers would otherwise attach to it. We also find that the trophic level an organism occupies in the food chain influences stigmatizing behavior. The greater the steps in the food chain between an organism and the use of recycled water, the less it is stigmatized. These results have important implications for efforts to promote large-scale potable and non-potable recycled water projects and the use of recycled water in the agricultural industry.

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For additional information on this research course, contact:

Kent D. Messer

messer@udel.edu

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Abstract

Stigmatization of water and food products can constrain markets and prevent the implementation of scientifically safe solutions to environmental problems, such as water scarcity. Recycled water can be a cost-effective, dependable, and safe solution to water shortages, however, consumers generally either require a large reduction in price to purchase and eat products made with recycled water or reject such products outright. If emerging sustainable agricultural technologies, such as recycled water are to be used to address growing water shortages worldwide, policymakers and industry stakeholders must identify effective strategies for mitigating stigma. Using field experiments involving 1,420 adult participants, we test the effectiveness of two stigma-mitigating techniques. We also successfully demonstrate a novel twist to the collection of representative samples in non-hypothetical experimental settings and compare the results to a more traditional field experiment that recruited participants at a large public gathering. The analysis of these different samples suggests a common finding: passing recycled water through a natural barrier, such as an aquifer, removes the stigma consumers would otherwise attach to it. We also find that the trophic level an organism occupies in the food chain influences stigmatizing behavior. The greater the steps in the food chain between an organism and the use of recycled water, the less it is stigmatized. These results have important implications for efforts to promote large-scale potable and non-potable recycled water projects and the use of recycled water in the agricultural industry.

Keywords: Stigma, recycled water, aquifer recharge, trophic levels

JEL Classification: D12; Q15; Q18

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[1]Ellis and Messer University of Delaware, Department of Applied Economics and Statistics, 531 S. College Avenue, Newark, DE 19716. [2]Savchenko: University of Florida, Food and Resource Economics Department, 1183 McCarty Hall A, Gainesville, FL 32611. For additional information on this research, contact Kent D. Messer (corresponding author): Postal address: 226 Townsend Hall, Newark, DE 19716. Phone: 302-831-1316. Email: messer@udel.edu.

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Stigmatization of water and food products by consumers can limit the tools available to policymakers, agricultural producers, and the food industry to respond to environmental challenges (Edelstein, 2004; Roth, 2007). Stigma arises when consumers perceive food products as risky to use or consume despite the overwhelming scientific evidence that they are safe (Gregory, Flynn and Slovic, 1995; Walker, 2001; Ellen and Bone, 2008; Potts and Nelson, 2008; Kanter, Messer, and Kaiser, 2009). One of the primary barriers to widespread use of sustainable supply side solutions to water scarcity, such as recycled water – wastewater treated to standards that make it safe for drinking and irrigation – is the stigma attached to it (Hartley, 2006; Lazarova et al., 2013; Ormerod and Scott, 2013). Recycled water can be a feasible and cost-effective means to satisfy the growing demand for water (Chen et al., 2013) because it can provide a dependable and safe alternative source. While potable recycled water projects have been successfully implemented in Big Spring and Wichita Falls, Texas and Fountain Valley, California (Martin, 2014), consumer concerns have derailed similar efforts. Projects to provide potable recycled water were indefinitely delayed or cancelled in Tampa, Florida, Brownwood, Texas, and South Queensland, Australia, because of the "yuck factor", a phycological feeling of disgust invoked by consumer perceptions of recycled water going directly from toilet to tap (Sedlak, 2014; Morgan and Grant-Smith, 2015; Rozin et al., 2015; Hummer and Eden, 2016; Wester et al. 2016).

The use of recycled water for irrigation has also struggled to gain acceptance. Recent studies examining consumer preferences for produce irrigated with recycled water have shown that U.S. consumers either require a large reduction in price to purchase these foods relative to produce irrigated with water from conventional or unspecified sources, or rejected these foods outright (Ellis et al., 2018; Savchenko et al., 2018) . These findings have been consistent for a wide variety of produce, both those high in water content, such as strawberries (92%), spinach (92%), broccoli (91%), and baby carrots (87%), as well as those lower in water content, such as grapes (81%), dates (60%), and almonds (6%) (Barreveld, 1993; Bastin and Kenken, 1997; Almond Board of California, 2014). While there currently is no mandatory irrigation water labeling for produce, an increase in marketers labeling food based on the 'freshness' of irrigation could contribute to stigmatization of foods produced with recycled water similar to the negative effects of labeling of other food processes perceived as risky by consumers (Savchenko et al., 2018; Messer, Costanigro, and Kaiser, 2017). Results from Ellis et al. (2018) and Savchenko et al. (2018) indicate a consumer backlash could occur if the use of recycled irrigation water becomes more well-known by consumers. Both studies also found that messaging about the environmental benefits of recycled water did not alleviate consumer concerns. Thus, the strategy outlined by Zilberman, Kaplan, and Gordon (2018) of 'green' retailers voluntarily labeling a product to signal its sustainability to consumers will likely not be successful in the case of recycled irrigation water. Therefore, it is critical from the perspective of policymakers and industry stakeholders to identify strategies that can effectively alleviate consumer concerns about various uses of recycled water so it can be a viable solution to water scarcity.

Alternative sources of drinking and irrigation water are desperately needed. In the United States, 130 million people currently suffer from moderate to severe water scarcity at least one month a year (Mekonnen and Hoekstra, 2016). These water shortages have an outsized effect on the agricultural industry. For example, the western United States, one of the most water stressed regions of the country, accounts for 74% of the total irrigated acres and 81% of total irrigation withdrawals (Person and Morris, 2019). Conditions are expected to worsen due to climate change that will continue to cause shifts in global weather patterns exacerbating the differences between wet and dry regions (Intergovernmental Panel on Climate Change, 2014). Parts of the western United States are expected to be particularly hard hit. Drought conditions in the Southwestern and Central plains of the United States are predicted to exceed those of the driest centuries of the last millennium (Cook, Ault, and Smerdon, 2015).

In this paper, we analyze data from two framed field experiments. The first (Study I) involved 314 adult participants from the mid-Atlantic (Delaware, Maryland, New Jersey, and Pennsylvania). The second (Study II) involved a representative sample of 1,106 adult participants from across the United States that intentionally oversamples participants from the mid-Atlantic so that a direct comparison with Study I could be made. We test the effectiveness of two strategies to mitigate stigma associated with recycled water – passage through a natural barrier (an aquifer) and information about the trophic level of food products. Our experimental design allows us to measure the effectiveness of these stigma-mitigating techniques in a non-hypothetical, demand-revealing setting using a representative sample of U.S. adult consumers and the results suggest that both methods are effective at mitigating stigma. These findings are particularly timely as both federal and state policymakers focus on increasing the use of recycled water in the United States. This is evidenced by the recent release of the National Water Reuse Action Plan by the U.S. Environmental Protection Agency aimed to encourage adoption of recycled water by municipalities across the U.S. and plans to build five water recycling projects in California, Hawaii and Texas with the support of $16.98 million provided by the U.S. Bureau of Reclamation (U.S. Bureau of Reclamation, 2019). Finally, we provide useful insights about recruitment of a representative sample online while running field experiments.

First, we evaluate whether passing recycled water through a natural barrier, such as an aquifer, alleviates the stigma associated with it. Such indirect potable water reuse projects inject recycled water into an underground aquifer, where it is stored for some time before being withdrawn to undergo processing in a traditional water treatment plant. While several indirect potable reuse projects have been implemented in the United States, they have had mixed success. Some, such as the East Valley Water Recycled Project in Los Angeles, California, failed miserably due to public opposition (Lim and Safford, 2019) while others, such as the Groundwater Replenishment system in Orange County, California, are currently operating (Orange County Water District, 2019). Despite some successful indirect potable reuse projects, it is not clear whether passing recycled water through a natural barrier reduces consumer concerns, information that is necessary for the success of future large-scale recycled water projects. We are not aware of any prior study that has explored the stigma-mitigating effects of passing recycled water through a physical environmental barrier in a non-hypothetical demand-revealing experimental setting in which the study participants' decisions have real outcomes.

Second, we examine whether the trophic level of a food product affects consumers' concerns about recycled water. Trophic level refers to an organism's place in the food chain. Plants are categorized as trophic level one because they generally do not consume other living organisms. Cattle, being herbivores, are categorized as trophic level two as they consume organisms from tropic level one. The sequence of plants being irrigated with recycled water and then consumed by cattle represents a type of processing that increases the degree of separation between recycled irrigation water and the beef and dairy products produced from the cattle. There is some evidence that a greater number of processing steps, between the food a consumer purchases and the recycled water used in its production, can have a destigmatizing effect. Savchenko et al. (2019b), for example, showed that simple processing, such as drying and liquefying, could alleviate some consumers' concerns about the use of recycled irrigation water for food products. Lease, MacDonald, and Cox (2014) likewise found that cooking meatballs prepared with recycled water removed the stigma. Thus, a product's trophic level could also act as a stigma-mitigating barrier in consumers' minds against the negative effects they associate with recycled water. This would have far greater implications for the use of recycled water in agricultural production than the postproduction food processing methods of drying, liquifying, and cooking with heat. If produce irrigated with recycled water has less stigma attached to it than potable recycled water, and the products and byproducts of herbivores have even less, then the implementation of recycled water resources should be first focused on animal feed operations first rather than on potable drinking water. To our knowledge, this is the first study to test the effect of a product's trophic level on the stigma attached to it because of the use of recycled water in its production.

Prior studies have identified disgust, safety concerns, and a natural tendency to avoid unfamiliar products (neophobia) as significant factors contributing to the stigmatization of recycled water and consumer responses to its potable and non-potable uses (Savchenko et al., 2019a). Using functional magnetic resonance imaging, Ellis et al. (2019) provided neuroeconomic evidence that disgust is part of consumers' reactions to recycled water and that it is not readily dissipated by behavioral interventions such as videos on the benefits of recycled water. Instead, disgust tends to linger, and mitigation strategies appear to make other aspects of consumers' decision processes, such as how the choice affects society and their self-images, more important. Wester et al. (2016) similarly found that how recycled water was framed and presented to consumers determined how much they were consciously disgusted by it. There is also evidence that the stigma attached to the water and foods produced with it can be partially mitigated through branding and behavioral interventions, like exposure to information and messaging (Marette et al., 2010; McFadden and Huffman, 2017; Savchenko et al., 2018; Ellis, Savchenko, and Messer, 2019).

Several studies found that showing or simply telling people about the number of steps between the water they were drinking and a contaminant, such as municipal waste, lead, or a sterilized cockroach, that was once in contact with the water, reduced consumers' stigmatization (Rozin et al., 2015; Kecinski et al., 2016; Hui and Cain, 2017; Kecinski and Messer, 2018). Processes that have been effective are filtration, boiling, and dilution, and multiple redundant treatments were found to be more effective in reducing stigma than any singular treatment (Kecinski et al., 2016). In a hypothetical, stated-preference study, Rozin et al. (2015) found that allowing the recycled water to filter through a natural system, such as an aquifer, for ten years before treating it and introducing it as drinking water had a similar effect. Likewise, in a survey of California residents, Hui and Cain (2017) showed that informing residents that their local aquifer was recharged with recycled water partially abated their visceral reactions to it. Several unique features of our study design set our paper apart from the previous literature. Unlike prior studies, our analysis relies on data collected in an incentive-compatible experimental setting, where consumers made real decisions that involved spending real money and purchasing products made with different types of recycled water. This enables us to incentivize study participants to reveal their true preferences and avoid hypothetical bias present in stated-preference research (Penn and Hu, 2018). In addition, our analysis uses a representative sample of adult consumers across the United States, strengthening external validity of our results.

The results of our two studies contribute to the growing body of literature on ways to mitigate stigma associated with potable and non-potable uses of recycled water in several important ways. First, using a revealed preference method instead of hypothetical surveys, we find that passing recycled water through an aquifer before using it for drinking and irrigation removes the stigma attached to it. This finding is particularly important for the success of large-scale recycled water projects and is timely because policymakers in the United States are currently considering several large-scale projects that will produce and pass recycled water through aquifers for potable and non-potable uses (WaterWorld, 2018, 2019). Second, our analysis provides evidence that consumers view foods produced from trophic level two organisms that ate feed crops irrigated with recycled water as having significantly fewer negative qualities than recycled water. That is, in the minds of consumers, a food crop possesses the same qualities and contagions as the water with which it is irrigated, but the animals that eat those plants do not, or at least not to the same extent. A valuable finding for agricultural producers and the food industry as it implies that consumers will not stigmatize products such as meat and cheese because the animals' food was irrigated with recycled water. It also assists policymakers who are encouraging agricultural producers to expand their use of recycled water for irrigation by alleviating producers concerns about whether consumers will accept the resulting meat and dairy products. These findings introduce two additional strategies policymakers and industry stakeholders can use in their efforts to mitigate the stigma associated with recycled water.

This paper also contributes to the methodological literature on how to recruit a reasonably representative sample of adult consumers in experimental studies (Coppock, 2018; Brink, Lee, and Pyzoha, 2019; Boas, Christenson, and Glick, 2020). Study II replicated the incentive-compatible design of Study I but converted the in-person field experiments into an online experiment. A novel twist to data collection that we show to be an effective way to collect representative samples in non-hypothetical experimental settings. In doing this we were able to evaluate the robustness of convenience sampling. Consumers from the mid-Atlantic (Delaware, Maryland, New Jersey, and Pennsylvania), the four states where most participants from Study I were drawn, were oversampled in Study II so that a direct comparison could be made between the two studies. These findings are particularly relevant for studies that involve non-hypothetical purchase decisions involving actual products as they have traditionally only been conducted in-person.

Experiment Design

Method

We conducted two framed field experiments to assess the impact of stigma mitigation strategies on consumer preferences for potable recycled water and foods produced with recycled water. Study I was conducted with participants from the mid-Atlantic region of the US, while Study II collected a sample of consumers representative of the entire United States. Both experiments relied on a revealed-preference, single-bounded, dichotomous-choice design. Dichotomous-choice designs use a posted-price mechanism, which mimics consumers' usual purchasing decisions – when presented with a product, they choose either to purchase it at the listed price or not. Formally, each participant i was offered a purchase opportunity j at listed price P and chose either to make a purchase (D = 1) or pass on the opportunity (D = 0):

$$D_{ij} = \begin{cases} 1 \ if \ P_{ij} \leq EU_{ij} \\ 0 \ if \ P_{ij} > EU_{ij} \end{cases}. \qquad (1)$$

When the price, P_{ij}, was less than or equal to participants' expected utility, EU_{ij}, they purchased the product. When P_{ij} was greater than participants' expected utility, they chose not to purchase the product. In line with Fehr and Rangel (2011), the decision value (expected utility), EU_{ij} for participant i's purchase opportunity j was generated by integrating attributes, such as product and water type, over all purchase opportunity dimensions K, such as taste, healthfulness, sense of disgust, and self-image. The model assumes that

$$EU_{ij} = \sum_{k \in K} W_{ij} C_{jk}(k), \qquad (2)$$

where C_j is a vector of attributes for dimension k of purchase opportunity j, and W_ij is a vector of weights participant i applies to each dimension of purchase opportunity j. Each stigma mitigation strategy, s, aimed to affect how a participant generated a value for a product's attribute (water type) and how the attribute was weighted. When computing expected utility, each stigma mitigation strategy either minimized some dimension of the attribute, such as disgust, or emphasized a dimension, such as the product's separation from the perceived contagion. Taking this into account, Equation 2 becomes:

$$EU_{ij} = \sum_{k \in K} W_{ij}(s) C_{jk}(k, s). \qquad (3)$$

Study I

Study I was conducted at three locations in New Castle County, Delaware - a motor vehicle office, a large shopping mall, visited by close to 20 million people a year, and a farmer's market (an indoor facility open year-round that sells discount foods and hosts a flea market). We employed convenience sampling in multiple field locations to collect a sample of adult consumers that was more representative of the general population than would be possible using the standard approach of recruiting undergraduate students for experiments conducted in a university laboratory. The selected experiment locations are all frequented by a diverse array of consumers (see table 1). In addition, the shopping mall and the farmer's market are heavily patronized by consumers from surrounding states, particularly Maryland, New Jersey, and

Pennsylvania (see figure 1). The experiment was successfully completed by 314 adult participants, producing 4,710 observations.

Over the course of the experiment, participants were offered fifteen purchase opportunities consisting of five products produced with three different types of water (see experiment instructions in Appendix A). Participants were presented with these products and entered their responses using tablet computers running Python based software. All products, with their branding labels removed, were displayed in a central location during the experiment so participants could view and compare them. In the instructions, participants were told they would earn $10 for their time and that they should think of this money as a bank from which they could withdraw money to purchase products. To make the decisions incentive-compatible and to encourage participants to carefully consider each purchase opportunity independently, administrators informed participants that one of their purchase decisions would be randomly selected for implementation at the end of the experiment and that each decision was equally likely to be binding. The purchase opportunities were presented on a single page to prevent bias related to the discovered preference hypothesis (Plott, 1996) and the order of their presentation was randomized across participants to avoid ordering effects . This enabled participants to change any decision after contemplating all purchase opportunities.

The three types of water used in the experiment to explore the stigma-mitigating effect of passing recycled water through a physical barrier were (1) —groundwater (a conventional source for potable and irrigation water), (2) recycled water (a stigmatized solution to water scarcity), and (3) groundwater drawn from an aquifer recharged with recycled water (a stigmatized water source that has passed through a physical barrier). Below are the definitions presented to participants at the beginning of the experiment and at the top of the purchasing opportunities page:

Recycled water is highly treated wastewater from various sources such as domestic sewage, industrial wastewater, and storm water runoff.

Groundwater is a source of fresh water that lies in aquifers beneath the land surface.

An **aquifer** is an underground body of rock that contains or can transmit groundwater.

Aquifer recharge is a process that replenishes groundwater stored in aquifers.

The five products presented to participants – bottled water, fresh spinach, lamb chops, cheddar cheese, and hot chocolate mix – tested the effect a product's trophic level (see figure 2), and therefore, the degree of separation from recycled water, had on consumers' stigmatization of the product. Trophic levels technically do not apply to bottled water since water is a chemical substance rather than an organism. Therefore, we refer to water here as belonging to trophic level zero. Spinach, as a primary producer in the food chain, or in other words, an organism that converts energy (e.g. light) into organic matter, belongs to trophic level one. Lamb chops, cheddar cheese (made with milk from cows), and hot chocolate mix (made with dehydrated milk from cows) belong to trophic level two as byproducts of herbivores.

Bottled water was included as one of the products so that a direct comparison could be made between consumers' stigmatization of a type of water and of a product produced with it. Spinach was included as the trophic level one product and lamb chops, cheddar cheese, and hot chocolate mix were included as the trophic level two products because these were the products whose water source we could verify. Best practices in experimental economic research do not allow deception (Rousu et al., 2015). Thus, each product had to be produced with the type of water it was labeled with in the experiment. This requirement constrained our choice of products at trophic levels one and two.

The purchase opportunities in the experiment were phrased to emphasize a product's trophic level and described the water used as either "recycled water," "groundwater," or "groundwater from an aquifer recharged with recycled water" in the following questions.

1. Do you want to purchase 16 ounces of bottled [**recycled water**] for $_____?
2. Do you want to purchase approximately 8 ounces of spinach irrigated with [**recycled water**] for $_____?
3. Do you want to purchase approximately half a pound of lamb chops from lamb that grazed on grass irrigated with [**recycled water**] for $_____?
4. Do you want to purchase an approximately one-pound block of cheddar cheese made with milk from a cow that grazed on grass irrigated with [**recycled water**] for $_____?
5. Do you want to purchase approximately 16 ounces of hot chocolate mix made with powdered milk from a cow that grazed on grass irrigated with [**recycled water**] for $_____?

The price in each purchase decision was randomly drawn from a normal distribution ranging from $0.01 to $10.00 , with a standard deviation of one-half of the mean price . Mean prices were obtained from the most recently available national mean prices and were adjusted to 2017 levels using the U.S. Bureau of Labor Statistics' Consumer Price Index for All Urban Consumers: Food and Beverages.

Once the purchase decisions were made, the software presented participants with a survey (see Appendix B) that collected their demographic information. After completing the survey, participants rolled a digital die displayed on the screen to randomly determine which of their purchase decisions would be implemented. If during the experiment a participant chose yes to purchasing the product in the randomly selected binding option, they were given the product and the remainder of the $10 participation fee after deducting the product's cost. Thus, if the listed price was $4, the participant received the product and the remaining $6. However, if during the experiment a participant chose not to buy the product in the randomly selected binding option, then they received the $10 participation fee and no product because they chose not to purchase the product.

Study II

To strengthen the external validity and check the robustness of Study I's results, we conducted a second non-hypothetical, demand-revealing experiment. Study II replicated the design of Study I but collected a representative sample of adult consumers from the entire United States. We were able to do this by employing a novel twist to data collection that demonstrates an effective way to collect representative samples in non-hypothetical experimental settings. Delaware, Maryland, New Jersey, and Pennsylvania, the four states where most participants from Study I were drawn, were oversampled so that a direct comparison could be made between Study I and II.

Prior to data collection, a power analysis using parameter estimates from Study I and involving 1,000 simulations of the experiment was conducted to ensure Study II was fully powered. The results indicated that at the 80% power level, a sample of 543 participants was needed to detect changes that are statistically significant at the 1% level or less for the key trophic level and water type treatments. Study II was successfully completed by 546 adult participants in Delaware, Maryland, New Jersey, and Pennsylvania and 560 adult participants across the remainder of the United States (see figure 1) for a total of 1,106 participants, producing 19,908 observations.

To obtain a nationally representative sample, the in-person field experiment was converted into an online experiment administered through Qualtrics. As in Study I, participants were told at the beginning of the experiment that their purchasing decisions were real and one of them would be randomly selected for binding implementation. We maintained incentive-compatibility by also informing participants that they would receive their cash and/or products through the mail at the conclusion of the experiment. Participants were then asked to provide a valid mailing address. Those who provided invalid mailing addresses were removed from the sample as they were not making real purchasing decisions with real money if they could not receive the cash and/or products.

The design of the Qualtrics version of the experiment largely replicated the original Study I design. However, to further test the robustness of the findings in Study I, we added an additional product option. In Study I, lamb chops were used as a trophic level two product because at that time no other type of meat was known to be produced with all three types of water. However, lamb is one of the least commercially popular meats in the United States (U.S. Department of Agriculture, Economic Research Service, 2020), and participants' preferences for lamb could potentially affect their purchasing decisions. To address this concern, after Study I was conducted, cattle ranches using each of the three water sources were identified, enabling us to include sirloin steak as an additional trophic level two product. This expanded the number of purchase opportunities from fifteen to eighteen. Like the original fifteen, the three additional options were phrased to emphasize the product’s trophic level and described the water used as either “recycled water,” “groundwater,” or “groundwater drawn from an aquifer recharged with recycled water” in the following question.

Do you want to purchase approximately 6 ounces of sirloin steak from cattle that grazed on grass irrigated with [**recycled water**] for $_____?

We also updated the mean prices and standard deviations of the products to reflect the most recently available national mean prices . The demographic questions concerning age, sex, employment, political affiliation, ethnicity, household income, and educational attainment were moved to a pre-experiment survey so that participants could be screened to obtain a representative sample. The post-experiment survey was also streamlined to reduce cognitive load (see Appendix B).

Each participant in Study I and II was randomly assigned to either a control group or one of three social marketing treatment groups. The results of these between subject treatments were null in both Study I and II. Including the dummy variables for the social-marketing treatments in the analysis described below does not change the coefficients of interest and the Akaike’s Information Criterion (AIC) and Bayesian Information Criterion (BIC) both indicate that not including them in the models is the better fit. Further discussion of the between subject social marketing treatments can be found in Appendix C of this paper.

Results

Study I

Summary statistics for the demographic characteristics of the Study I sample are presented in table 1. While the sample is representative regionally and nationally based on sex, it is skewed towards 18 to 34-year-old, non-white consumers earning $49,999 of less annually. It also over sampled those with some college education while under sampling those with a high school diploma or less and those with a bachelor's degree. Figure 3 displays the percent of participants who, when given the opportunity, purchased (vertical axis) products produced with each type of water within a given price range (horizontal axis). The top pane of figure 3 suggests that participants did not distinguish between groundwater and groundwater drawn from an aquifer recharged with recycled water. However, the percent of consumers willing to purchase products produced with recycled water was consistently lower across all price ranges.

Since the data collected in the experiment is binary (yes/no purchase decisions), we used a logit model to analyze the effects of the stigma-mitigation strategies. To account for the within-subject design (fifteen observations per participant), a logit model was estimated with a random effects' specification (Charness, Gneezy, and Kuhn 2012; Duffy et al., 2019) and clustered standard errors:

$$\log\left(\frac{D_{ij}}{1-D_{ij}}\right) = \alpha + \beta_1{}'P_{ij} + \beta_2{}'W_{ij} + \beta_3{}'T_{ij} + \beta_4{}'X_i + \mu_i + \varepsilon_{ij} \qquad (4)$$

where $\mu_i \sim N(0, \sigma^2_\mu)$ and $\varepsilon_{ij} \sim N(0, \sigma^2)$, W_{ij} is a vector of dummy variables for irrigation water type, T_{ij} is a vector of dummy variables for trophic levels, and X_i is a matrix of control variables that can include how frequently participants generally consume each product and their demographic characteristics.

The estimates and Wald test results from Equation 4 are reported in tables 2 and 3, respectively. Our analysis involves multiple simultaneous comparisons, which increases the likelihood of a Type I error. To account for the family-wise error rate and guard against the rejection of a true null hypothesis, we used a Bonferroni correction of the Wald test probability values . We find that participants prefer ($p \leq 0.001$) groundwater and groundwater drawn from an aquifer recharged with recycled water over recycled water for potable and irrigation purposes.

Our results also show that there is no significant difference ($p=1.000$) in participants' preferences for groundwater and groundwater drawn from an aquifer recharged with recycled water. These findings indicate that passing recycled water through an aquifer before using it for drinking and irrigation can remove the stigma associated with recycled water.

We find that the frequency of a participant's consumption of trophic level one (spinach) and two (lamb chops, cheddar cheese, hot chocolate mix) products has a statistically significant ($p \leq 0.006$) and positive effect on participants' likelihood of purchasing a product. However, the frequency of participants' consumption of trophic level zero products (bottled water) has no statistically significant effect ($p=0.071$). This is likely because healthy adults regularly drink water on a daily basis and 'daily' was the most frequent category of consumption participants could choose.

Other control variables that were tested, such as sex, age, ethnicity, household income, educational attainment, political affiliation, having a child under 18 in the household, previous knowledge about the different types of water, whether a participants grows their own food, the type of water participants most often drink, and experimental site had no statistically significant effect on participants' purchasing decisions.

To determine whether a product's trophic level can have a mitigating effect on the stigma associated with recycled water, we estimated an iteration of Equation 4 that included a matrix of interaction terms between trophic level and water type (W_{ij} T_{ij}).

$$log\left(\frac{D_{ij}}{1-D_{ij}}\right) = \alpha + \beta_1{}'P_{ij} + \beta_2{}'W_{ij} + \beta_3{}'T_{ij} + \beta_4{}'W_{ij}T_{ij} + \beta_5{}'X_i + \mu_i + \varepsilon_{ij} \qquad (5)$$

The regression results for Equation 5 are reported in table 2. Wald tests for Equation 5 are presented in table 4 . We find no significant difference in consumers' preferences for the trophic level zero (bottled water) and trophic level one (spinach) products regardless of water type (p=0.073 for groundwater, p=0.223 for groundwater drawn from an aquifer recharged with recycled water, and p=0.097 for recycled water). This suggests participants did not view plant crops as a barrier between them and the water they were irrigated with. For all water types, we find that participants prefer ($p \leq 0.003$) the products from trophic level two (lamb chops, cheddar cheese, and hot chocolate mix) over the product from trophic level zero (bottled water). This indicates that the herbivores in trophic level two provide enough separation from the recycled irrigation water to mitigate consumers' stigma. While the plant crop possesses the same level of stigma as the water with which it was irrigated, the animal that eats that crop inherits significantly less stigma.

Study II

The data from Study II was divided into two fully powered subsamples—the four oversampled states of Delaware, Maryland, New Jersey, and Pennsylvania, and the rest of the United States. Descriptive statistics for the demographic characteristics of both subsamples are presented in table 1. Both subsamples are representative of their respective regions based on educational attainment, ethnicity, household income, and age. The rest of the United States subsample is also representative based on sex, while the Delaware, Maryland, New Jersey, and Pennsylvania subsample has a slight overrepresentation of females.

The second and third panes of figure 3 show the percent of consumers willing to purchase products produced with different types of water in the two subsamples collected during Study II. Similar to what we found in Study I, figure 3 suggests that although consumers may not differentiate between groundwater and groundwater from an aquifer recharged with recycled water, the percent of participants willing to purchase products produced with recycled water tends to be lower across all price ranges. To test this, we estimated Equation 4 for each subsample. Regression results are presented in table 2 and the corresponding Wald test results are reported in table 3. Study I's findings were largely replicated using a nation-wide sample. In both subsamples, participants prefer groundwater and groundwater drawn from an aquifer recharged with recycled water over recycled water for potable and irrigation purposes ($p \leq 0.004$ for Delaware, Maryland, New Jersey, and Pennsylvania subsample, $p \leq 0.015$ for the rest of United States subsample). Results also show that there is no statistically significant difference in participants' preferences for groundwater and groundwater drawn from an aquifer recharged with recycled water ($p=0.097$ for Delaware, Maryland, New Jersey, and Pennsylvania subsample, $p=1.000$ for the rest of United States subsample).

The results from both subsamples also indicate that passing recycled water through an aquifer before using it for drinking and irrigation can remove the stigma associated with recycled water, consistent with Study I findings.

Consistent with Study I's results, consumption frequency of trophic level one (spinach) and two (lamb chops, cheddar cheese, hot chocolate mix) products have a statistically significant and positive effect on participants' likelihood of purchasing a product ($p \leq 0.015$ for Delaware, Maryland, New Jersey, and Pennsylvania subsample, $p=0.000$ for the United States subsample). Participants' consumption frequency of trophic level zero (bottled water) remains insignificant ($p=0.058$ for Delaware, Maryland, New Jersey, and Pennsylvania subsample, $p=0.220$ for the rest of United States subsample) similar to Study I findings.

To check the robustness of Study I's trophic level findings, we estimated Equation 5 for both subsamples (see table 2 for regression results). Wald test results for Equation 5 are displayed in table 4 and indicate that a product's trophic level has a stronger mitigating effect on the stigma associated with recycled water than Study I suggested. For all water types, we find that participants prefer ($p \leq 0.027$ for Delaware, Maryland, New Jersey, and Pennsylvania subsample, $p \leq 0.013$ for the United States subsample) products from trophic level one (spinach) over those from trophic level zero (bottled water) and trophic level two (lamb chops, cheddar cheese, hot chocolate mix, and sirloin steak). These results imply that plant crops irrigated with recycled water do not inherit all the stigma attached to recycled water itself and the animal that eats the plant crop inherits even less. Each trophic level above recycled water is a barrier that significantly reduces participants concerns about the negative effects of recycled water.

Effects of Drought and Environmental Views on Purchasing Decisions

The post-experiment survey in Study II included questions regarding the frequency of drought experienced by participants and whether they perceive the types of water used in our analysis as environmentally friendly. To examine whether these factors impact consumers' purchasing decisions, we estimated an expanded version of Equation 4 that included a variable for drought frequency ranging from one (never experience drought) to five (year-round drought), dummy variables indicating participants' perceptions of a specific water type and interactions of these variables with water types (see table 5). Regression results reported in column 1 of table 5 suggest that participants from the Delaware, Maryland, New Jersey, and Pennsylvania subsample who live in a community with a higher frequency of drought are more likely to make a purchasing decision ($p=0.021$). However, the frequency of drought in their community has no impact on their likelihood to purchase products produced with recycled water or groundwater drawn from an aquifer recharged with recycled water ($p\geq0.436$). This result is not surprising considering these four states are in a region of the United States that is historically water rich. Interestingly, participants from the rest of the United States subsample with a higher frequency of drought in their community were more likely to purchase products produced with groundwater drawn from an aquifer recharged with recycled water (Recharged*Drought Frequency, 0.163, $p=0.057$). This suggests that as droughts become more common in consumers' communities, their willingness to purchase products made with this type of water may increase.

Wald test results reported in table 6, (generated from the regression estimates presented in columns 2 and 4 of table 5) show that participants in both subsamples who view recycled water as environmentally friendly were more likely to purchase ($p=0.000$) products produced with it than participants who did not share this view. Participants who held this view were also more likely to purchase ($p\leq0.014$) products made with groundwater drawn from an aquifer recharged with recycled water than their counterparts. However, viewing groundwater drawn from an aquifer recharged with recycled water as environmentally friendly had no significant effect ($p\geq0.303$) on the purchasing decisions of participants from either subsample.

Finally, we also explored the role of a set of demographic characteristics on consumers' purchasing decisions. As noted above, the demographic characteristics tested in Study I did not have significant effects on participants' purchasing behavior. This is true for Study II as well. The control variables sex, age, ethnicity household income, political affiliation and presence of a child under 18 in the household had no statistically significant effects on participants' purchasing decisions.

Discussion

Policy Implications

The analysis presented in this paper shows evidence of the effectiveness of two strategies to mitigate stigma associated with recycled water. As the number of states and water utilities actively exploring the feasibility of water recycling projects (U.S. Environmental Protection

Agency, 2018) grows rapidly, so does the need to understand how to gain public acceptance of recycled water and to evaluate cost-benefit tradeoffs of water recycling projects for potable and non-potable purposes. Our finding that consumers are much more likely to accept recycled water for potable and irrigation purposes if it first passes through a natural barrier, such as an aquifer, provides valuable, and most importantly, actionable information for decision makers. Given that public acceptance of recycled water is critical for successful implementation of water recycling projects, our analysis suggests that decision makers should focus on indirect potable and non-potable water recycling projects that alleviate the stigma attached to recycled water.

Indirect potable and non-potable reuse projects can play an important role in integrated water management increasingly employed by municipalities and water utilities in the U.S. to manage rising water demand through diversification of water supply and simultaneous implementation of measures to reduce demand. Such projects also have the potential to be implemented at scale and provide substantial volumes of high-quality water in a cost-effective manner. For example, Groundwater Replenishment System (GWRS) facility in Orange County Water District in California supplies enough potable water for 600,000 residents in the northern and central parts of Orange County. The annual cost of groundwater recharge with recycled water at GWRS was \$0.39/m3 (\$478/AF) in 2010 compared to the cost of treated imported water that was \$0.65/m3 (\$800/AF) (Lazarova, 2013). While cost-effectiveness of indirect potable reuse (IPR) projects is largely site-specific, recycled water produced through IPR is generally less expensive than other alternative sources of water supply such as desalination (Cooley and Phurisamban, 2016) or importing water (Lazarova, 2013). It is however, more expensive that direct potable reuse (DPR) that conveys recycled water directly into an existing water supply system avoiding the additional costs associated with passing the water through a physical environmental barrier both in large coastal communities (Cooley and Phurisamban, 2016) and in small-to-medium sized arid inland communities (Herman et al., 2017). However, the cost of public opposition to such projects is likely to be high.

Although estimates of capital and operational costs associated with recycled water projects are available, lack of economic valuation related to social costs and benefits of these projects precludes comprehensive economic analyses (Declercq et al., 2020). This implies that the benefits associated with implementation of water recycling projects such as decreases in pollution discharge, improvements in groundwater quality or mitigation of stigma related to recycled water are not taken into account when policymakers weigh the cost-benefit trade-off of different water recycling schemes.

To help inform cost-benefit analyses of water recycling projects, we use a representative sample of the entire United Sates to quantify the value of stigma-mitigating practice of passing recycled water through a physical barrier. Specifically, we estimate U.S. consumers' mean willingness-to-pay (WTP) for products produced with three types of water under our analysis (table 7). U.S. consumers' mean WTP for recycled water is significantly smaller (\$0.2, $p<0.001$) than both the mean WTP for groundwater drawn from an aquifer recharged with recycled water and for groundwater (\$0.9, $p<0.001$). Though WTP for groundwater (\$1.3) is higher than that for groundwater drawn from an aquifer recharged with recycled water, this difference is not statistically significant ($p<0.06$). These mean WTP values confirm our earlier analysis that consumers stigmatize recycled water and products produced with it, but also provide an economic value consumers place on stigma-mitigation technique of passing recycled water through a physical barrier. These estimates can be used in cost-benefit analyses of indirect potable and non-potable water reuse projects.

The second stigma mitigation strategy that we tested revealed that herbivores (trophic level two) eating plant crops irrigated with recycled water adequately reduce consumers' negative associations with recycled water . This finding aligns with conclusions by Whiting et al. (2019) that little or no stigma attaches to inedible crops such as cotton while significant stigma attaches to fresh produce such as strawberries. Future research should explore if 'green' retailers could charge a premium for these products by voluntarily labeling them and signaling their sustainability. Our results show that plant crops irrigated with recycled water inherit all the stigma attached to recycled water itself, while the animal that eats the plant crop does not inherits the stigma. Therefore, it acts as a barrier that significantly reduces participants concerns about the negative effects of recycled water. These results also have important policy implications suggesting that agricultural producers should focus on using recycled water for feed and non-edible crops. In 2018, only 1.9% of 55,938,795 irrigated acres in the United States were irrigated with recycled water (U.S. Department of Agriculture, 2018). Given that in California, for example, the cost of non-potable recycled water, including the construction of a separate distribution system to deliver it to customers, is cheaper than construction of direct and indirect potable water recycling schemes (Cooley and Phurisamban, 2016), our result suggests an opportunity to substantially expand the use of recycled water without cause consumer backlash.

Finally, our analysis showed that as consumers experience more frequent droughts in their communities, their willingness to purchase produce made with groundwater drawn from an aquifer recharged with recycled increases. This result is intuitive and may explain in part why indirect and direct potable recycling projects are primarily located in semi-arid areas.

Recruitment of Representative Samples in Experimental Settings

Findings from field experiments that rely on convenience sampling are often subject to criticism as they may produce results that are not representative of the general population and lack external validity (Coppock, 2018). In Study II we employed a novel twist in data collection to recruit a sample representative of the general population of the United States based on gender, educational attainment, household income, political affiliation, ethnicity, and age. The experiment in Study II was converted from an in-person field experiment to an online experiment administered through Qualtrics. We maintained incentive-compatibility of the experiment by soliciting mailing addresses from participants and informing them that they would receive their cash and/or products through the mail at the conclusion of the experiment. We successfully replicated the results of Study I, using a nationally representative sample collected in Study II. This result supports previous studies that obtained consistent estimates from convenience and national samples (Coppock, 2018). It also contributes to the growing number of studies on replicability of experiments across different platforms such MTurk, Qualtrics and YouGov.

While this method proved effective and demonstrates a means to collect representative samples in non-hypothetical settings, it came with additional financial costs. Collecting the Study II sample cost approximately 14% more per participant than the Study I sample. These additional costs were due to Qualtrics' fee for recruiting participants and the postage and materials to send participants their cash and/or products through the mail. This method of data collection also took considerably longer. In Study I, it took three days to collect data from 314 participants—a rate of nearly 105 participants per day. For Study II, it took 63 days to collect data from 1,106 participants, a rate of less than 18 participants per day. Part of this deceleration in the rate of data collection is because Study I used convenience sampling and Study II was targeting nationally representative demographic quotas. Another aspect, however, was that we were asking participants in an online experiment for their mailing addresses. This resulted in a large portion of individuals contacted about participating providing invalid addresses and an even greater number declining to participate. One of the strengths of in-person field experiments is the legitimacy that an administrator's presence lends the experiment. Future studies that employ this novel twist to data collection could try asking participants for their email addresses instead of their mailing addresses. Participants may be more willing to provide an email address over the internet and are able to receive payment through it using services such as PayPal or Venmo. Mailing addresses for those that actually purchase products could then be solicited through email.

Conclusion

Stigmatization of water and food products can constrain markets, preventing implementation of scientifically safe solutions to environmental problems such as water scarcity. Though recycled wastewater can be a cost-effective, dependable, and safe solution to water shortages, consumers, on average, either require a large reduction in price to purchase foods produced with recycled water or reject them outright. This negative response arises from a psychological reaction of disgust induced by the perception that the water goes directly from toilets to taps. Previous studies have provided evidence that such stigmatization can be partially reduced by behavioral interventions such as labels that provide positive information about recycled water and messaging that explains the environmental benefits of using this water. However, those mitigation strategies do not typically eliminate consumers' feelings of disgust. Instead, how recycled water is framed and presented to consumers determines how much they are consciously disgusted. Therefore, we explore mitigation strategies that stress the barriers between a consumer and the contagions associated with recycled water.

In a field experiment and an online experiment involving 1,420 adult participants, we tested several stigma-mitigation strategies using a revealed-preference, incentive-compatible mechanism. We find that consumers prefer products produced with groundwater and groundwater drawn from an aquifer recharged with recycled water over ones produced with recycled water and that there is no statistical difference in consumers' preferences for the two water sources. This indicates that passing recycled water through a natural barrier, such as an aquifer, before using it for drinking and irrigation significantly mitigates the stigma consumers attach to the resulting food products.

We also find that the trophic level of an organism affects the degree of stigma consumers attach to products derived from it. Our results indicate that consumers do not view the consumption of recycled water by plants (trophic level one) as an adequate barrier against their negative associations with the water. Food crops appear to be associated with the same level of stigma as the water with which they are irrigated. Consumption of those plants by herbivores, on the other hand, appears to provide adequate separation and significantly reduces their concerns about the effects of recycled water. These findings introduce two additional strategies policymakers and industry stakeholders can use in their efforts to mitigate the stigma associated with recycled water. We also employed a novel twist to data collection in our online experiment that demonstrates an effective way to collect representative samples in non-hypothetical experimental settings.

Our findings provide valuable and, more importantly, actionable information for policymakers, water utilities, and the agricultural and food industries. Our analysis shows that consumers are much more likely to accept recycled water for potable and irrigation purposes if it first passes through a natural barrier, such as an aquifer. Recharging aquifers with recycled wastewater would not only remove the stigma attached to recycled water, but also contribute to solving the growing environmental problem of saltwater intrusions into aquifers. Such artificial groundwater recharging is used by some water districts in California (CASA, 2019; Orange County Water District, 2019), but the success of the projects has been mixed because of some public opposition to recycled water. Our findings provide valuable information for policymakers and planners who are promoting these types of large-scale water recycling projects. However, additional research is needed to see if consumers' responses to potable drinking water from an aquifer recharged with recycled water depends on whether they obtain their water from a municipal system, that further treats the water before it reaches taps, or from individual wells, that only provide further treatment when an in-home filtration system is installed.

Our finding that the use of recycled water in agriculture is most accepted by consumers as irrigation for crops fed to herbivores, such as cattle, rather than applied directly to plants intended for human consumption, is crucial for agricultural producers and the food industry in determining how to incorporate recycled water into their operations. This finding aligns with conclusions by Whiting et al. (2019) that little or no stigma attaches to inedible crops such as cotton while significant stigma attaches to fresh produce such as strawberries. Statistically, fresh produce irrigated with recycled water is as stigmatized as the water. If widespread adoption of recycled irrigation water is to succeed, producers should use it primarily for feed and for non-edible crops rather than for produce when possible.

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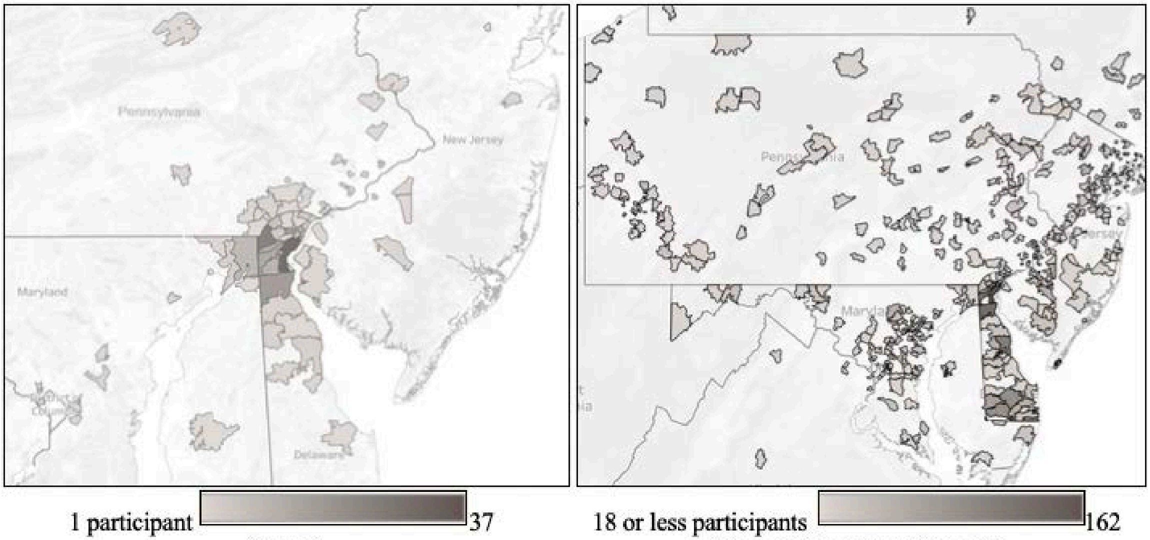
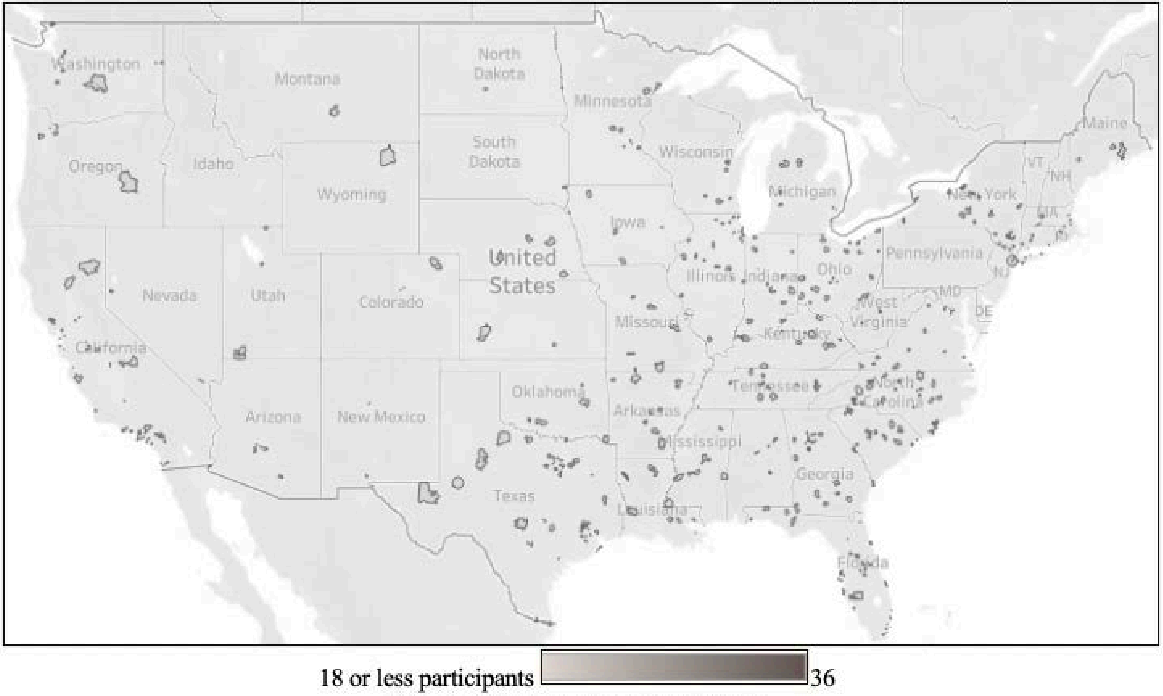


Study I

Study II (DE, MD, NJ & PA)



Study II (the rest of the United States)

Figure 1. Participants' zip codes.

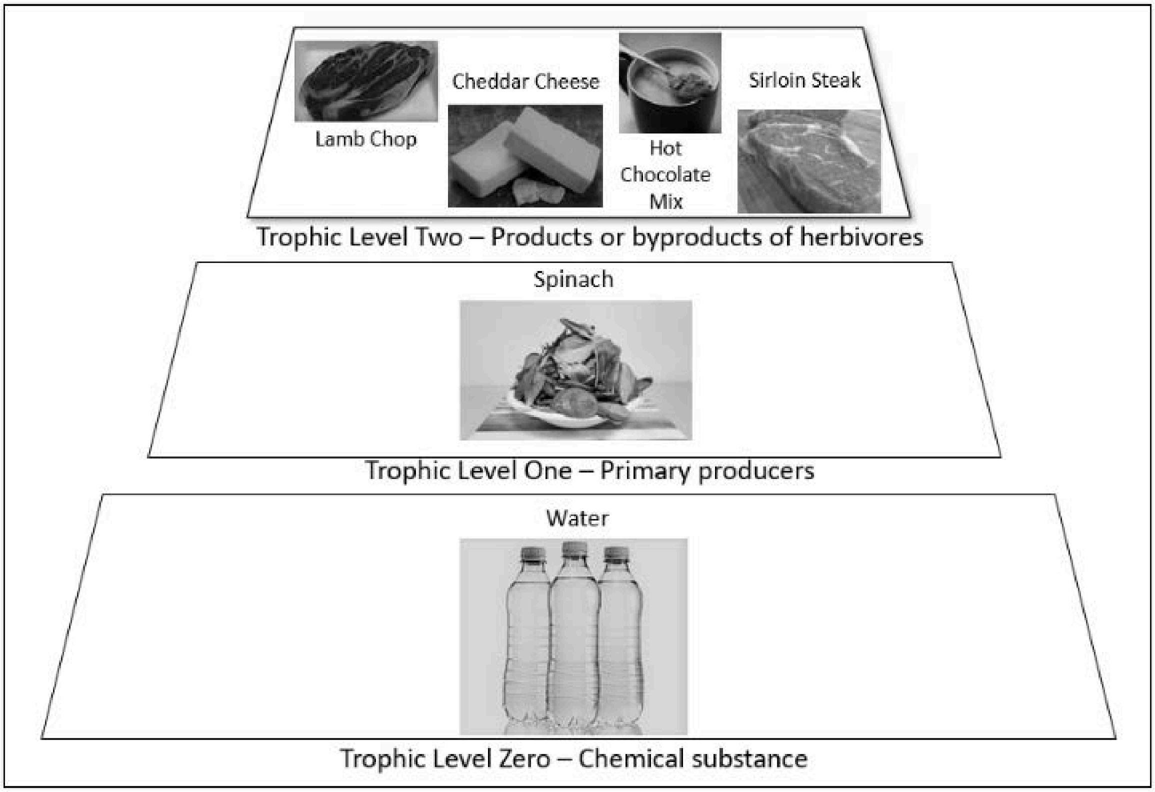
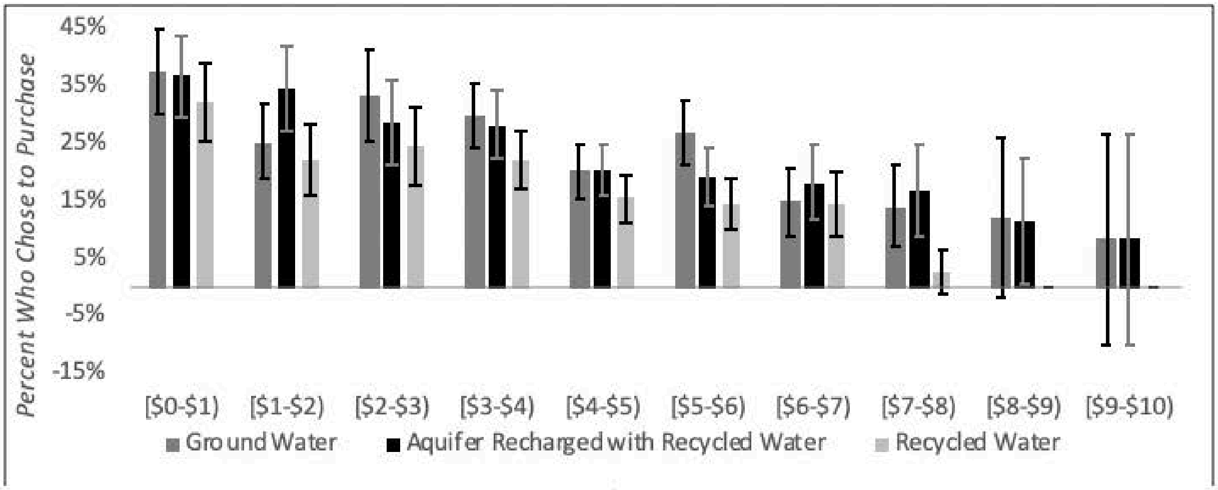
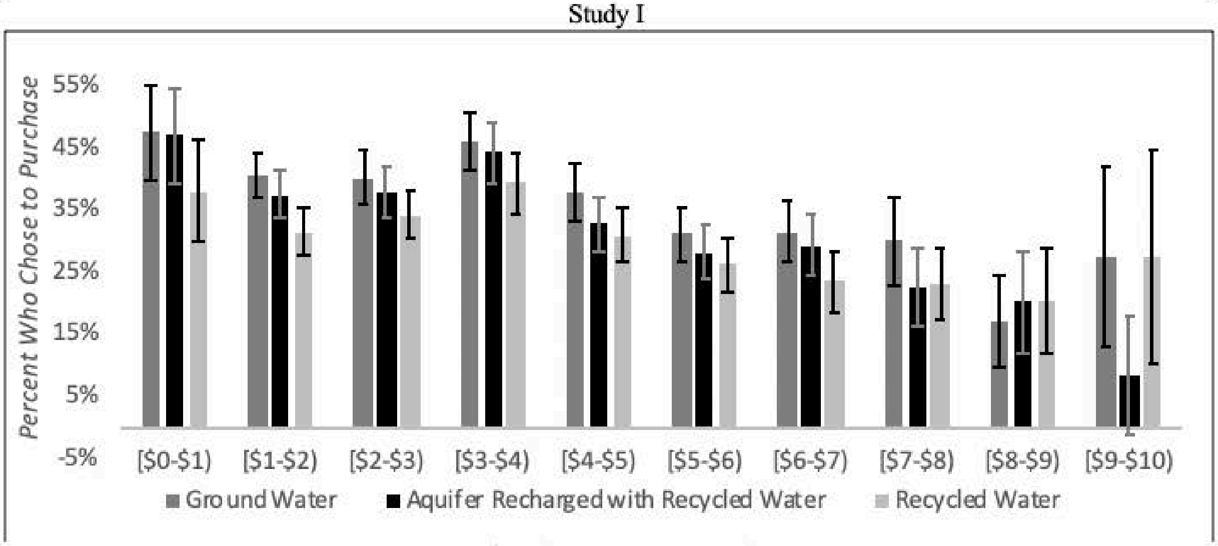


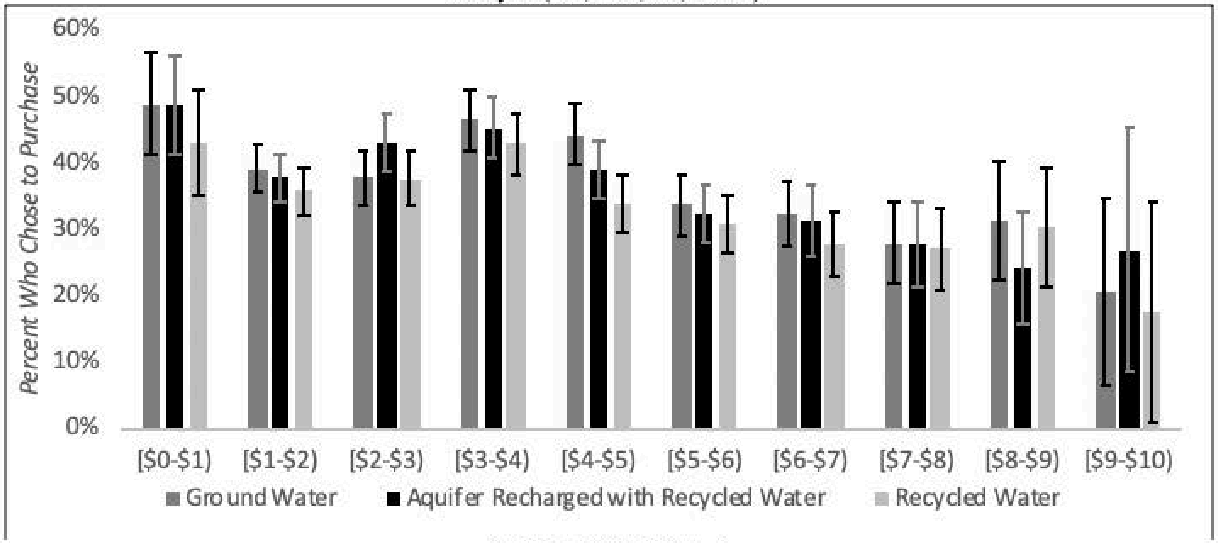
Figure 2. Products and their trophic levels.



Study I



Study II (DE, MD, NJ, & PA)



Study II (United States)

Figure 3. Percent of participants willing to purchase products by water type and price.

Table 1. Summary Statistics

		2018 American Community Survey		Sample		
		DE, MD, NJ, & PA	United States	Study I	Study II (DE, MD, NJ, & PA)	Study II (the rest of United States)
	Total Participants			314	546	560
Sex	*Female*	52%	51%	51%	57%	53%
Educational Attainment	*High School or less*	41%	40%	30%	34%	42%
	Some College	17%	21%	33%	21%	21%
	Associates Degree	7%	8%	9%	8%	9%
	Bachelor's Degree	21%	19%	13%	22%	18%
	Graduate Degree	14%	12%	14%	16%	10%
Ethnicity	*Non-Hispanic White*	64%	61%	54%	70%	66%
	Black	16%	12%	29%	17%	17%
	Hispanic	12%	18%	8%	6%	11%
	Asian	6%	5%	7%	4%	4%
	Other	2%	3%	10%	3%	2%
Income	*$49,999 or less*	35%	42%	51%	39%	45%
	$50,000 to $99,999	29%	30%	28%	32%	34%
	$100,000 to $149,999	17%	15%	11%	16%	13%
	$150,000 and above	19%	13%	10%	12%	8%
Age	*18 – 34*	28%	30%	46%	31%	32%
	35 – 54	33%	33%	37%	37%	35%
	55 and above	38%	36%	17%	32%	33%

Table 2. Results of Stigma Mitigation Strategies

	Study I				Study II (DE, MD, NJ, & PA)				Study II (United States)			
	Equation 4		Equation 5		Equation 4		Equation 5		Equation 4		Equation 5	
	Coef.	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*
Price	-0.398***	(0.041)	-0.400***	(0.041)	-0.359***	(0.026)	-0.359***	(0.026)	-0.326***	(0.026)	-0.326***	(0.026)
Trophic Level												
One	0.448**	(0.175)	0.484*	(0.232)	0.540***	(0.082)	0.713***	(0.132)	0.554***	(0.089)	0.706***	(0.153)
Two	0.856***	(0.179)	1.092***	(0.212)	1.318***	(0.103)	1.366***	(0.141)	1.269***	(0.111)	1.373***	(0.140)
Water Type												
Recharged Aquifer	-0.059	(0.175)	0.174	(0.228)	-0.208*	(0.106)	0.018	(0.177)	-0.066	(0.100)	0.100	(0.173)
Recycled	-0.612***	(0.178)	-0.426	(0.260)	-0.480***	(0.116)	-0.530**	(0.186)	-0.295**	(0.111)	-0.176	(0.190)
Interactions												
*Recharged*Trophic Level One*			-0.115	(0.265)			-0.371	(0.193)			-0.300	(0.210)
*Recharged*Trophic Level Two*			-0.362	(0.206)			-0.247	(0.168)			-0.173	(0.170)
*Recycled*Trophic Level One*			0.036	(0.307)			-0.143	(0.190)			-0.156	(0.223)
*Recycled*Trophic Level Two*			-0.334	(0.235)			0.111	(0.162)			-0.139	(0.171)
Frequency of Consumption												
Trophic Level Zero	0.187	(0.103)	0.187	(0.103)	0.143	(0.075)	0.143	(0.075)	0.105	(0.085)	0.105	(0.085)
Trophic Level One	0.291**	(0.106)	0.292**	(0.106)	0.206*	(0.085)	0.206*	(0.085)	0.369***	(0.093)	0.369***	(0.093)
Trophic Level Two	1.040***	(0.183)	1.042***	(0.183)	1.316***	(0.158)	1.317***	(0.158)	1.086***	(0.169)	1.087***	(0.169)
Constant	-4.873***	(0.638)	-5.017***	(0.642)	-5.168***	(0.475)	-5.235***	(0.479)	-5.109***	(0.548)	-5.206***	(0.553)
Total N	4,710		4,710		9,828		9,828		10,080		10,080	
Individuals	314		314		546		546		560		560	
AIC	3905		3910		9521		9523		9631		9637	
BIC	3970		4000		9593		9624		9704		9738	

$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Sex, age, ethnicity, household income, educational attainment, political affiliation, having a child under 18 in the household, previous knowledge about the different types of water, whether a participants grows their own food, the type of water participants most often drink, and experimental site had no statistically significant effect on participants' purchasing decisions and excluding them does not affect the coefficients of interest. These results are available upon request.

Table 3. Wald Tests from Equation 4

Study I			
Wald Test	χ^2	Prob.	BCP
Ground = Recharged Aquifer	0.11	0.738	1.000
Ground = Recycled	11.78	0.001	0.001
Recharged Aquifer = Recycled	14.41	0.000	0.000
Study II (DE, MD, NJ, & PA)			
Wald Test	χ^2	Prob.	BCP
Ground = Recharged Aquifer	3.90	0.048	0.097
Ground = Recycled	17.03	0.000	0.000
Recharged Aquifer = Recycled	9.82	0.002	0.004
Study II (the rest of United States)			
Wald Test	χ^2	Prob.	BCP
Ground = Recharged Aquifer	0.44	0.507	1.000
Ground = Recycled	7.12	0.008	0.015
Recharged Aquifer = Recycled	8.96	0.003	0.006
BCP: Bonferroni Corrected Probability Value			

Table 4. Wald Tests from Equation 5

	Study I								
	Ground			Recharged Aquifer			Recycled		
Wald Test	χ^2	Prob.	BCP	χ^2	Prob.	BCP	χ^2	Prob.	BCP
Level Zero = Level One	4.37	0.037	0.073	2.53	0.112	0.223	3.89	0.049	0.097
Level Zero = Level Two	26.39	0.000	0.000	11.41	0.001	0.002	9.87	0.002	0.003
Level One = Level Two	12.01	0.001	0.001	5.55	0.019	0.037	1.63	0.202	0.404
	Study II (DE, MD, NJ, & PA Sample)								
	Ground			Recharged Aquifer			Recycled		
Wald Test	χ^2	Prob.	BCP	χ^2	Prob.	BCP	χ^2	Prob.	BCP
Level Zero = Level One	29.33	0.000	0.000	6.13	0.013	0.027	15.84	0.000	0.000
Level Zero = Level Two	93.27	0.000	0.000	68.14	0.000	0.000	115.54	0.000	0.000
Level One = Level Two	27.02	0.000	0.000	37.57	0.000	0.000	51.68	0.000	0.000
	Study II (the rest of United States)								
	Ground			Recharged Aquifer			Recycled		
Wald Test	χ^2	Prob.	BCP	χ^2	Prob.	BCP	χ^2	Prob.	BCP
Level Zero = Level One	21.37	0.000	0.000	7.42	0.007	0.013	12.05	0.001	0.001
Level Zero = Level Two	96.64	0.000	0.000	68.77	0.000	0.000	61.67	0.000	0.000
Level One = Level Two	24.00	0.000	0.000	32.42	0.000	0.000	27.49	0.000	0.000
BCP: Bonferroni Corrected Probability Value									

Table 5. Effects of Drought and Environmental Views on Purchasing Decisions

	Study II (DE, MD, NJ, & PA)				Study II (the rest of United States)			
	(1)		(2)		(3)		(4)	
	Coef.	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*
Price	-0.359***	(0.026)	-0.363***	(0.026)	-0.327***	(0.026)	-0.332***	(0.027)
Trophic Level								
One	0.541***	(0.082)	0.551***	(0.083)	0.554***	(0.089)	0.561***	(0.091)
Two	1.318***	(0.103)	1.335***	(0.105)	1.272***	(0.111)	1.293***	(0.112)
Water Type								
Recharged Aquifer	-0.208*	(0.106)	-1.080***	(0.257)	-0.066	(0.100)	-1.058***	(0.253)
Recycled	-0.480***	(0.116)	-1.472***	(0.292)	-0.295**	(0.111)	-1.136***	(0.298)
Experience & Perceptions								
Drought Frequency	0.212*	(0.092)	0.186	(0.109)	0.133	(0.086)	0.051	(0.105)
Env Friendly Recharged	-0.019	(0.204)	-0.009	(0.254)	-0.049	(0.236)	-0.200	(0.273)
Env Friendly Recycled	0.571**	(0.217)	-0.240	(0.266)	0.594**	(0.227)	0.084	(0.271)
Interactions								
*Recharged*Drought Frequency*			0.012	(0.098)			0.163	(0.086)
*Recycled*Drought Frequency*			0.083	(0.106)			0.090	(0.094)
*Recharged*Env Friendly Recharged*			0.243	(0.256)			0.427	(0.238)
*Recycled*Env Friendly Recharged*			-0.267	(0.295)			0.041	(0.256)
*Recharged*Env Friendly Recycled*			1.088***	(0.268)			0.615*	(0.255)
*Recycled*Env Friendly Recycled*			1.518***	(0.311)			0.979***	(0.271)
Frequency of Consumption								
Trophic Level Zero	0.077	(0.079)	0.078	(0.080)	0.101	(0.087)	0.102	(0.088)
Trophic Level One	0.191*	(0.087)	0.195*	(0.088)	0.311**	(0.096)	0.314**	(0.097)
Trophic Level Two	1.262***	(0.165)	1.285***	(0.169)	0.978***	(0.177)	0.989***	(0.179)
Demographic Controls	Y		Y		Y		Y	
Constant	-5.655***	(0.590)	-5.170***	(0.609)	-5.256***	(0.725)	-4.724***	(0.745)
Total N	9,828		9,828		10,080		10,080	
Individuals	546		546		560		560	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Demographic control variables include sex, age, ethnicity, household income, political affiliation, and having a child under 18 in the household. These variables have no statistically significant effect on participants' purchasing decisions.

Table 6. Wald Tests for the Effects of Drought and Environmental Views on Purchasing Decisions

Study II (DE, MD, NJ, & PA)		
Wald Test	χ^2	Prob.
View Groundwater from an Aquifer Recharged with Recycled Water as Environmentally Friendly		
Yes = No (Ground)	0.00	0.972
Yes = No (Recharged Aquifer)	0.84	0.361
Yes = No (Recycled)	1.06	0.303
View Recycled Water as Environmentally Friendly		
Yes = No (Ground)	0.81	0.368
Yes = No (Recharged Aquifer)	13.77	0.000
Yes = No (Recycled)	19.84	0.000
Study II (United States)		
Wald Test	χ^2	Prob.
View Groundwater from an Aquifer Recharged with Recycled Water as Environmentally Friendly		
Yes = No (Ground)	0.54	0.463
Yes = No (Recharged Aquifer)	0.70	0.401
Yes = No (Recycled)	0.32	0.570
View Recycled Water as Environmentally Friendly		
Yes = No (Ground)	0.10	0.757
Yes = No (Recharged Aquifer)	6.06	0.014
Yes = No (Recycled)	14.95	0.000

Table 7: U.S. Consumers' Mean Willingness-to-Pay.

	Mean WTP	Confidence Interval
Recycled water	$0.2	
	(0.291)	[-0.374, 0.766]
Groundwater drawn from aquifer recharged with recycled water	$0.9	
	(0.258)	[0.419, 1.430]
Groundwater	1.3	
	(0.260)	[0.819, 1.840]

Note: Standard errors are in parentheses. 95% confidence intervals are in square brackets obtained using delta method.

Appendix A. Experiment Instructions

Printed Instructions

Please read these instructions carefully and do not communicate with anyone while you are making your decisions.

- **You will earn $10 by participating in this research that you may keep and/or use to purchase food or drink products.** You may think of this money as a bank account from which you can withdraw money.
- Depending on the decisions you make, you may receive a combination of cash and food or drink products.
- Your decisions are just like the ones you make in a store: you either buy the product at the listed price or you do not.
- There are no greater physical risks from participating in this study than those you would face in a store. **Please remember that all decisions are real purchasing decisions, but only one of your purchasing decisions will be randomly selected and implemented.**

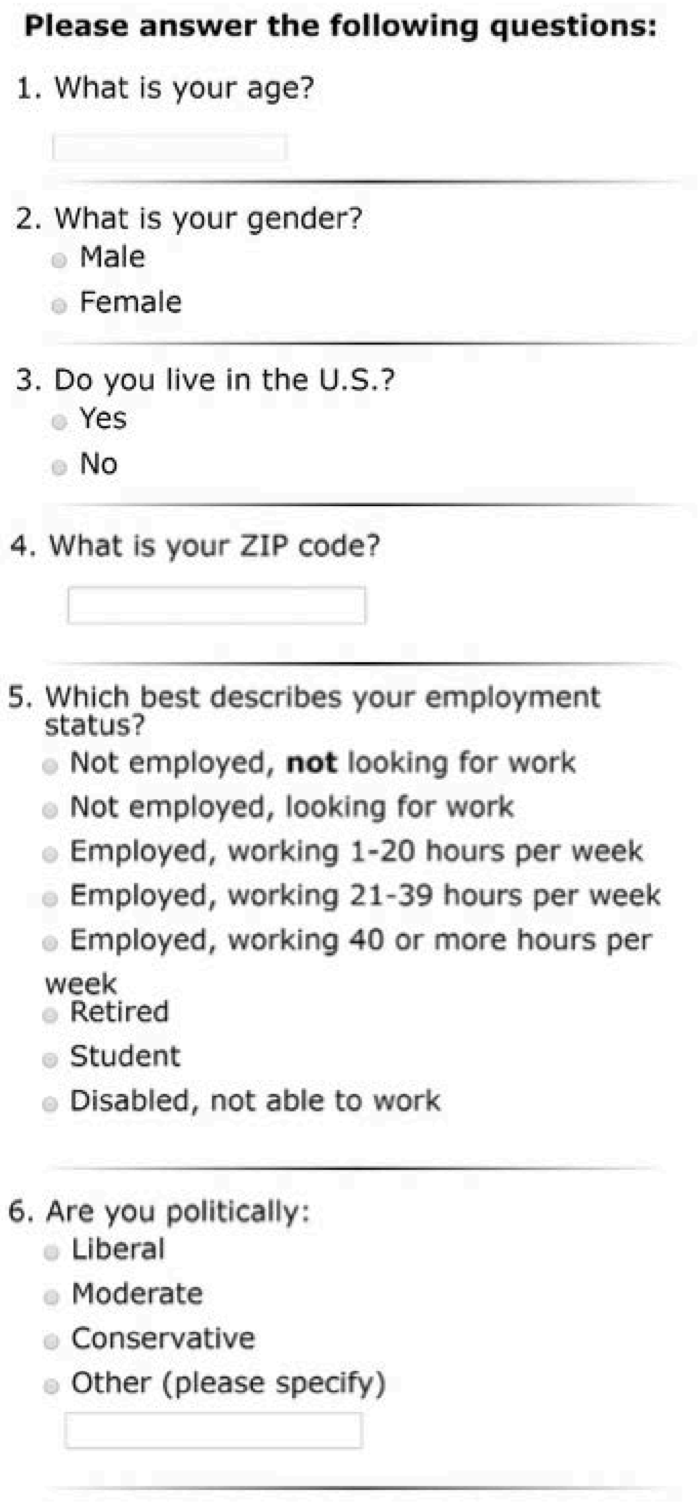
Steps:

1. You will face a series of "options" to purchase a product. For each option, decide if you want to buy the product at the listed price by selecting "Yes" or "No."
2. Complete a short survey.
3. Roll a digital die to determine which purchasing option will be implemented (only one will be implemented).
4. Receive cash and/or product.

- **Example 1:** If you selected Yes for an option that cost $3 and this option is randomly implemented, you will receive the product and $7 cash ($10 – $3 = $7).
- **Example 2:** If you selected No for an option and this option is randomly implemented, you will receive $10 cash and will not receive any product.

Appendix B. Surveys

B.1 Study I Post-Experiment Survey



Please answer the following questions:

1. What is your age?

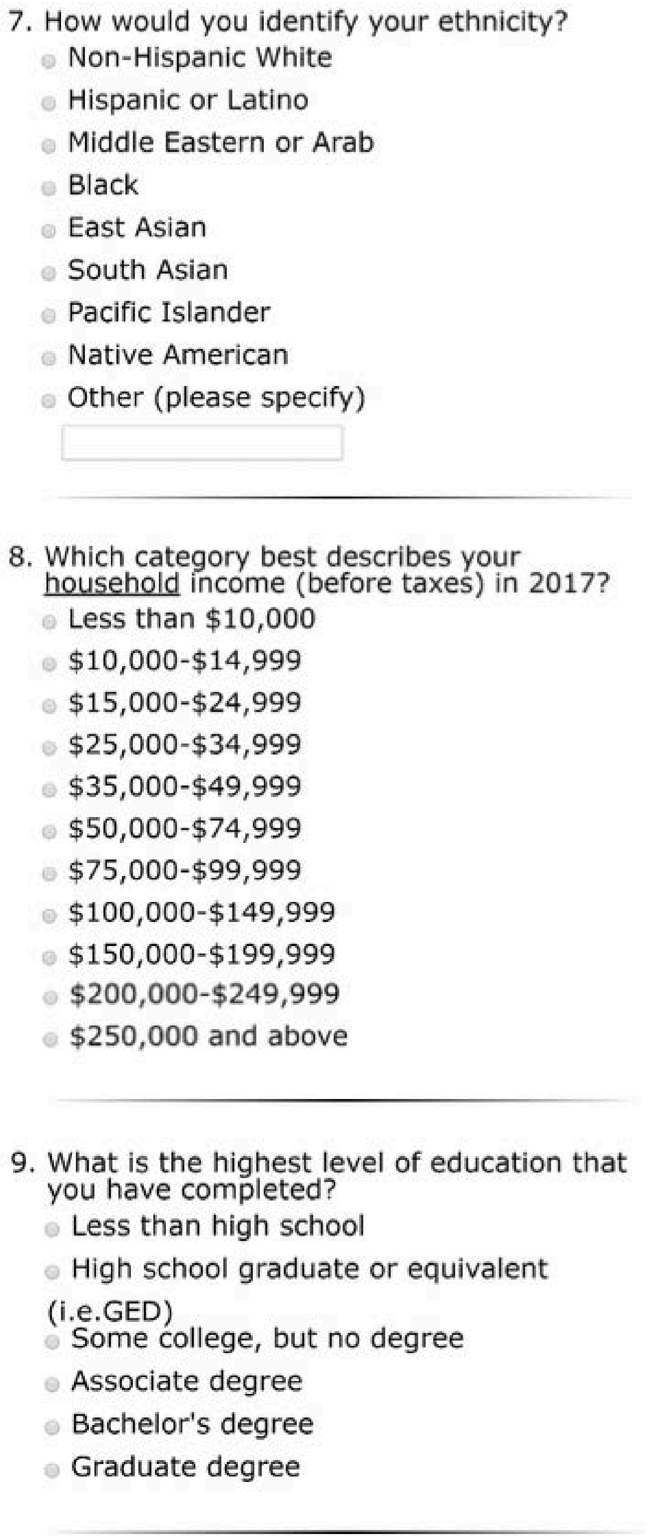
2. What is your gender?
   - ○ Male
   - ○ Female

3. Do you live in the U.S.?
   - ○ Yes
   - ○ No

4. What is your ZIP code?

5. Which best describes your employment status?
   - ○ Not employed, **not** looking for work
   - ○ Not employed, looking for work
   - ○ Employed, working 1-20 hours per week
   - ○ Employed, working 21-39 hours per week
   - ○ Employed, working 40 or more hours per week
   - ○ Retired
   - ○ Student
   - ○ Disabled, not able to work

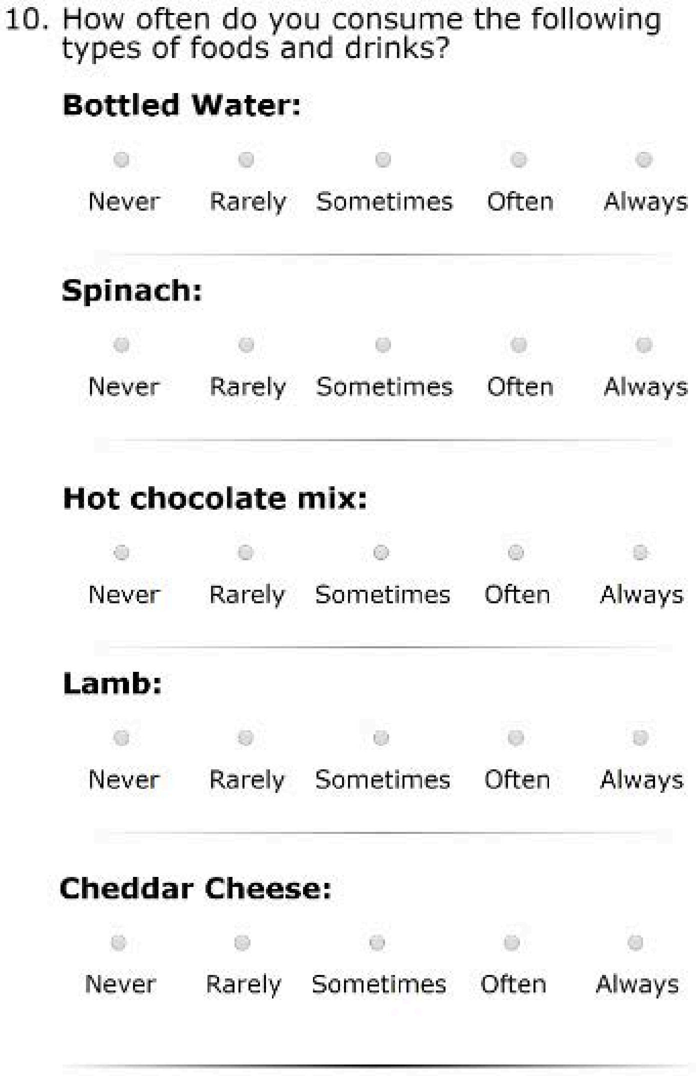
6. Are you politically:
   - ○ Liberal
   - ○ Moderate
   - ○ Conservative
   - ○ Other (please specify)



7. How would you identify your ethnicity?
   - ○ Non-Hispanic White
   - ○ Hispanic or Latino
   - ○ Middle Eastern or Arab
   - ○ Black
   - ○ East Asian
   - ○ South Asian
   - ○ Pacific Islander
   - ○ Native American
   - ○ Other (please specify)

8. Which category best describes your <u>household</u> income (before taxes) in 2017?
   - ○ Less than $10,000
   - ○ $10,000-$14,999
   - ○ $15,000-$24,999
   - ○ $25,000-$34,999
   - ○ $35,000-$49,999
   - ○ $50,000-$74,999
   - ○ $75,000-$99,999
   - ○ $100,000-$149,999
   - ○ $150,000-$199,999
   - ○ $200,000-$249,999
   - ○ $250,000 and above

9. What is the highest level of education that you have completed?
   - ○ Less than high school
   - ○ High school graduate or equivalent (i.e.GED)
   - ○ Some college, but no degree
   - ○ Associate degree
   - ○ Bachelor's degree
   - ○ Graduate degree



10. How often do you consume the following types of foods and drinks?

Bottled Water:

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

Spinach:

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

Hot chocolate mix:

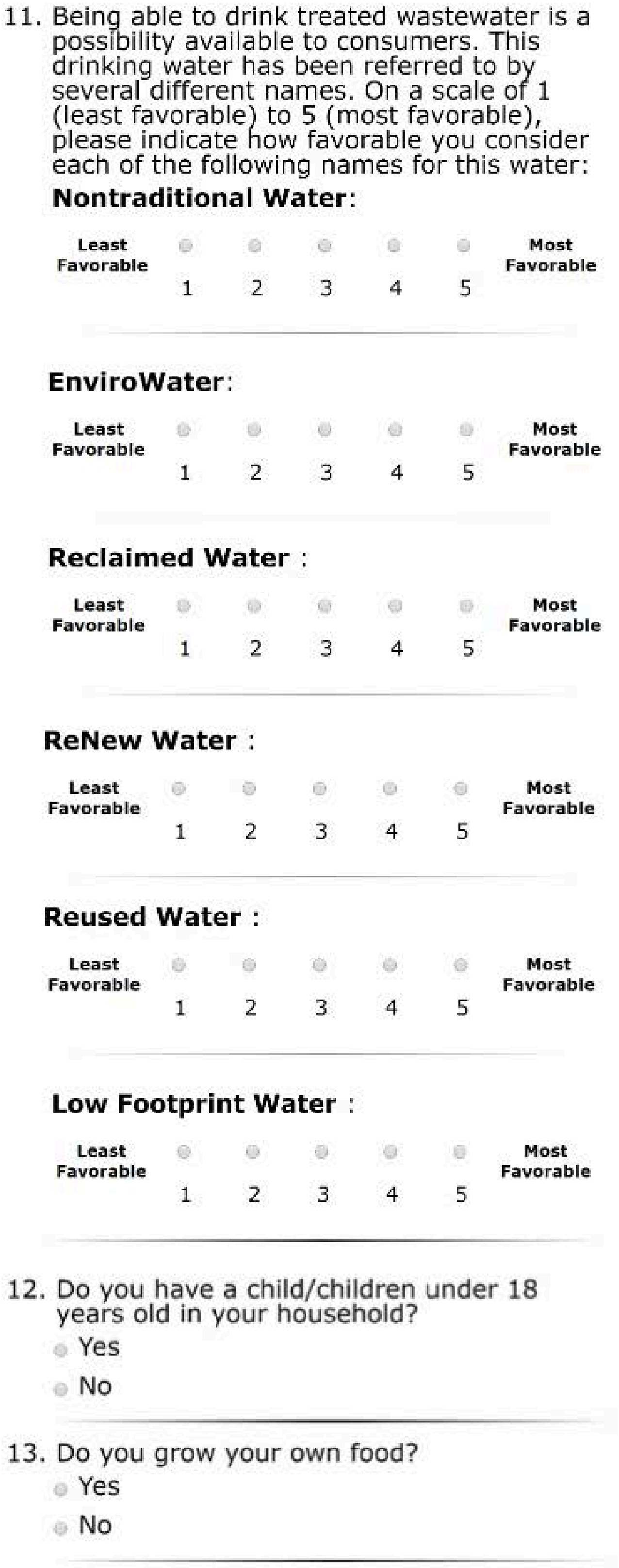
○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

Lamb:

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

Cheddar Cheese:

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always



11. Being able to drink treated wastewater is a possibility available to consumers. This drinking water has been referred to by several different names. On a scale of 1 (least favorable) to 5 (most favorable), please indicate how favorable you consider each of the following names for this water:

Nontraditional Water:

Least Favorable	○	○	○	○	○	**Most Favorable**
	1	2	3	4	5	

EnviroWater:

Least Favorable	○	○	○	○	○	**Most Favorable**
	1	2	3	4	5	

Reclaimed Water :

Least Favorable	○	○	○	○	○	**Most Favorable**
	1	2	3	4	5	

ReNew Water :

Least Favorable	○	○	○	○	○	**Most Favorable**
	1	2	3	4	5	

Reused Water :

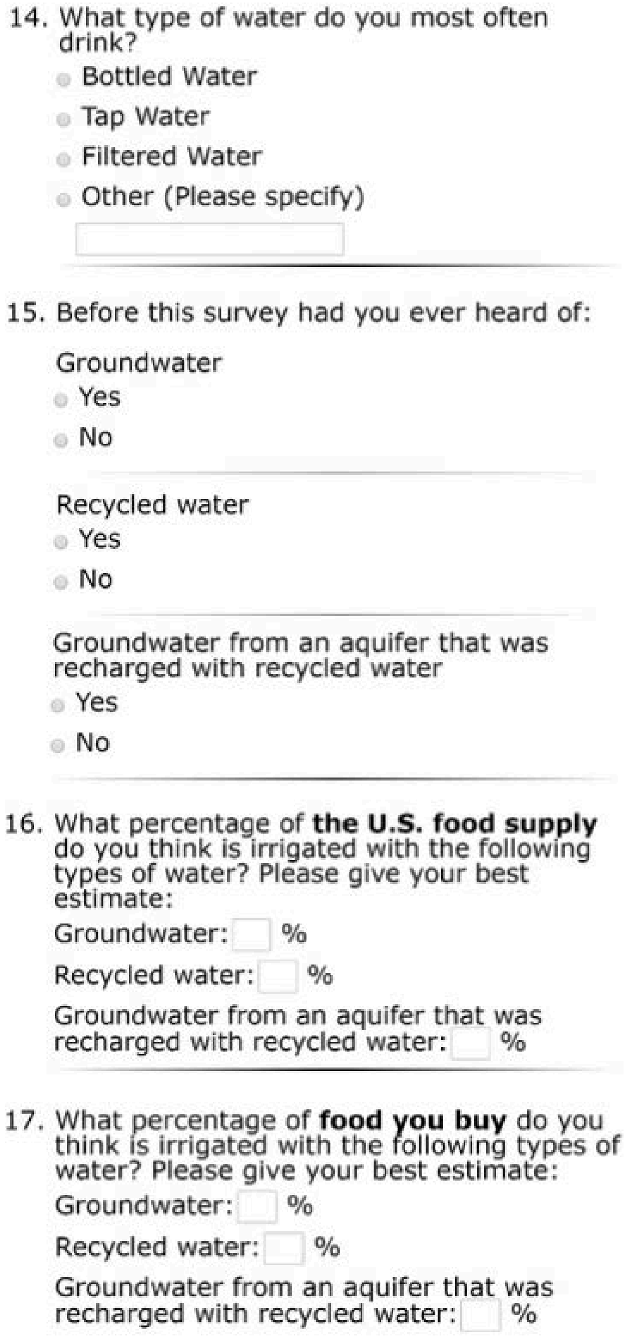
Least Favorable	○	○	○	○	○	**Most Favorable**
	1	2	3	4	5	

Low Footprint Water :

Least Favorable	○	○	○	○	○	**Most Favorable**
	1	2	3	4	5	

12. Do you have a child/children under 18 years old in your household?
   - ○ Yes
   - ○ No

13. Do you grow your own food?
   - ○ Yes
   - ○ No



14. What type of water do you most often drink?
   - ○ Bottled Water
   - ○ Tap Water
   - ○ Filtered Water
   - ○ Other (Please specify)

15. Before this survey had you ever heard of:

   Groundwater
   - ○ Yes
   - ○ No

   Recycled water
   - ○ Yes
   - ○ No

   Groundwater from an aquifer that was recharged with recycled water
   - ○ Yes
   - ○ No

16. What percentage of **the U.S. food supply** do you think is irrigated with the following types of water? Please give your best estimate:

   Groundwater: ☐ %

   Recycled water: ☐ %

   Groundwater from an aquifer that was recharged with recycled water: ☐ %

17. What percentage of **food you buy** do you think is irrigated with the following types of water? Please give your best estimate:

   Groundwater: ☐ %

   Recycled water: ☐ %

   Groundwater from an aquifer that was recharged with recycled water: ☐ %

B.2 Study II Pre-Experiment Survey

1. What is your age?
2. What is your sex?
    a. Male
    b. Female
3. What best describes your employment status?
    a. Not employed, not looking for work
    b. Not employed, looking for work
    c. Employed, part time
    d. Employed, full time
    e. Retired
    f. Student
    g. Disabled, not able to work
4. What are you politically?
    a. Liberal
    b. Moderate
    c. Conservative
    d. Other (please specify)
5. How would you identify your ethnicity?
    a. Non-Hispanic White
    b. Hispanic or Latino
    c. Middle Eastern or Arab
    d. Black
    e. South or East Asian
    f. Pacific Islander
    g. Other (please specify)
6. Which category best describes your household income (before tax) in 2019?
    a. Less than $10,000
    b. 10,000 - $14,999
    c. $15,000 - $24,999
    d. $25,000 - 34,999
    e. $35,000 - $49,999
    f. $50,000 - $74,999
    g. $75,000 - $99,999
    h. $100,000 - $149,999
    i. $150,000 - $199,999
    j. $200,000 - $249,999
    k. $250,000 and above
7. What is the highest level of education you have completed?
    a. Less than High school
    b. High school graduate or equivalent (i.e. GED)
    c. Some college but no degree
    d. Associate degree
    e. Bachelor’s degree
    f. Graduate degree

B.3 Study II Post Experiment Survey

1. How often do you consume the following types of foods and drinks?
    a. Bottled water
        i. Never
        ii. Rarely
        iii. Sometimes
        iv. Weekly
        v. Daily
    b. Spinach
        i. Never
        ii. Rarely
        iii. Sometimes
        iv. Weekly
        v. Daily
    c. Hot Chocolate
        i. Never
        ii. Rarely
        iii. Sometimes
        iv. Weekly
        v. Daily
    d. Lamb
        i. Never
        ii. Rarely
        iii. Sometimes
        iv. Weekly
        v. Daily
    e. Cheddar Cheese
        i. Never
        ii. Rarely
        iii. Sometimes
        iv. Weekly
        v. Daily
    f. Sirloin Steak
        i. Never
        ii. Rarely
        iii. Sometimes
        iv. Weekly
        v. Daily
2. Do you have a dependent child under 18 years old in your household?
    a. Yes
    b. No
3. What type of water do you most often drink?
    a. Bottled water
    b. Tap water
    c. Filtered water
    d. Other (please specify)
4. How often do you experience drought in your community?
    a. Never
    b. It has occurred, but not often
    c. Every few years
    d. Seasonally
    e. Year-round
    f. I do not know

5. Before this survey have you ever heard of this type of water?
    a. Groundwater
        i. Yes
        ii. No
        iii. I do not know
    b. Groundwater from an aquifer that was recharged with recycled water
        i. Yes
        ii. No
        iii. I do not know
    c. Recycled water
        i. Yes
        ii. No
        iii. I do not know
6. Is this type of water harmful to people's health?
    a. Groundwater
        i. Yes
        ii. No
        iii. I do not know
    b. Groundwater from an aquifer that was recharged with recycled water
        i. Yes
        ii. No
        iii. I do not know
    c. Recycled water
        i. Yes
        ii. No
        iii. I do not know
7. Is this type of water environmentally friendly?
    a. Groundwater
        i. Yes
        ii. No
        iii. I do not know
    b. Groundwater from an aquifer that was recharged with recycled water
        i. Yes
        ii. No
        iii. I do not know
    c. Recycled water
        i. Yes
        ii. No
        iii. I do not know

Appendix C. Discussion of Between-Subject Social Marketing Treatments

Motivation and Experiment Design

Exposure to information and messaging has been shown to increase consumers acceptance of recycled water (Ellis et al., 2018; Savchenko et al., 2018), however, the effectiveness of the messaging is dependent on who delivers it (Whiting et al., 2019). Celebrity endorsements have been used in the branding of products since the late eighteenth century and have been shown to greatly influence the purchasing decisions and attitudes of consumers (Vemuri and Madhav, 2004; McCormick, 2016). The idea behind this strategy is that the public reputation and achievements of a celebrity are used to certify a product's claims, while simultaneously having the celebrities positive and desirable qualities shape the product's image (White, Goddard, and Wilbur, 2009; Mukherjee, 2012). Recently, the car brand Lincoln used actor Matthew McConaughey to shed its stigmatizing reputation as an outdated, "old man" car for an image of "quiet luxury" (DeBord, 2016).

Another type of messenger that has proven effective is one's own peers, specifically the use of their descriptive norms to make social comparisons (Allcott, 2011; Brent, Cook, and Olsen, 2015). This social marketing tool has increased energy and water conservation by both prompting consumers to correct internalities and leveraging the psychic or moral cost they incur when violating a social norm (Taylor, Rollins, and Lott, 2018). For example, consumers are provided information about their peers' typical energy and water usage, which leads them to update their beliefs on what is an appropriate amount to use. If a consumer's typical usage is above their new understanding of the social norm, they may realize the long-term costs of their current habits and lower their energy and water usage to maximize their utility. Alternatively, they may face a psychic or moral cost for violating a social norm and reduce their energy and water use to relieve it.

Using a 2x2 between subject design, we tested the effect of social marketing on participants' preferences for products made with recycled water. There was a control group and three treatment groups—a celebrity endorsement video, a social comparisons statement, and both a celebrity endorsement video and a social comparison statement. Since some participants in Study I needed headphones and not others, we designed our treatment and control groups such that everyone needed headphones to prevent potential bias associated with the John Henry effect. Thus, the control group watched a ten second video that displayed the following statement:

> *Recycled water purified to drinking water standards is a safe and sustainable water source.*

The celebrity endorsement video was two minutes and one second and featured Bill Gates, local and state politicians, journalists, Jack Black, Astronauts on the International Space Station, and Jimmy Fallon drinking potable recycled water. Due to the general prohibition on deception in experimental economics, the celebrities we could feature in our video was constrained by those who have drank potable recycled water in publicly available footage. The statement from the control group video was displayed during the last ten seconds of the celebrity endorsement video and a slightly modified version of the statement appeared during the first nine seconds:

> *Recycled water purified to drinking water standards is a safe and sustainable water source. These people drink it.*

Those in the social comparison treatment watched the control group video and then saw the following statement, which came from the study conducted by Li, McCluskey, and Messer (2018):

> *In previous studies, 95% of people were willing to pay for food produced with recycled irrigation water.*

Participants in the combined treatment watched the celebrity endorsement video before reading the above social comparison statement.

Results and Discussion

To see if the social marketing treatments had any effect on participants perceptions of the various water types, two iterations of Equation 4 were estimated. The first incorporated dummy variables for the social marketing treatments (see table C.1 for estimates). The second also included interaction terms between the social marketing treatments and water types (see table C.2 for estimates).

Wald test[11] results, generated using the regression estimates from table C.2, are displayed in tables C.3. Findings show that the social marketing treatments did not have any statistically significant effect ($p \geq 0.102$) on participants preferences for the different water types in Study I or either of the two Study II subsamples. Neither relative to the control group, nor between any of the treatment groups.

While celebrity endorsements have been shown to have a powerful effect on consumers' purchasing decisions, it has also been shown that the effectiveness of an endorsement is dependent on how well a celebrity fits with a product and how the target audience views the celebrity (McCormick, 2016). The key to a successful celebrity endorsement is quick salience and quick connect (Mukherjee, 2012), and the celebrities in our video may not have possessed these qualities to a sufficient level in relation to recycled. Future research should explore the effects of more targeted celebrity endorsements of stigmatized water and food.

As for using social comparisons to influence consumer decision-making, previous studies have compared participants to their neighbors, a social group they felt a part of (Allcott, 2011; Brent, Cook, and Olsen, 2015). It is possible that comparing people to other participants in previous studies did not have the same social leverage as comparing consumers to their neighbors. Conversely, social comparisons may only be a powerful nudge when there are potent private, built-in incentives (i.e. conserving water and energy saves people money). Purchasing products produced with recycled water has large public benefits, but no private ones aside from positive feelings from doing something environmentally beneficial, which may be outweighed by the feeling of disgust that recycled water induces. The possible limitations of social comparisons, as well as the restrictions to widespread adoption imposed by the highly diffuse private consumer benefits from recycled water should be explored further in future research.

Table C.1 Equation 4 including Social Marketing Treatments

	Study I		Study II (DE, MD, NJ, & PA)		Study II (United States)	
	Coef.	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*
Price	-0.398***	(0.041)	-0.359***	(0.026)	-0.326***	(0.026)
Trophic Level						
One	0.448**	(0.175)	0.541***	(0.082)	0.554***	(0.089)
Two	0.856***	(0.179)	1.318***	(0.103)	1.269***	(0.111)
Water Type						
Recharged Aquifer	-0.059	(0.175)	-0.208*	(0.106)	-0.066	(0.100)
Recycled	-0.612***	(0.178)	-0.480***	(0.116)	-0.295**	(0.111)
Social Marketing						
Celebrity Endorsements & Social Comparison	0.001	(0.342)	0.021	(0.230)	0.067	(0.263)
Celebrity Endorsement	0.040	(0.346)	0.238	(0.249)	-0.141	(0.291)
Social Comparison	0.023	(0.330)	0.137	(0.220)	0.290	(0.268)
Frequency of Consumption						
Trophic Level Zero	0.187	(0.105)	0.146	(0.075)	0.112	(0.086)
Trophic Level One	0.293**	(0.106)	0.195*	(0.087)	0.374***	(0.094)
Trophic Level Two	1.037***	(0.188)	1.313***	(0.159)	1.075***	(0.172)
Constant	-4.886***	(0.672)	-5.237***	(0.496)	-5.177***	(0.595)
Total N	4,710		9,828		10,080	
Individuals	314		546		560	
AIC	3911		9526		9635	
BIC	3995		9619		9729	
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$						

Table C.2 Effect of Social Marketing Treatments on Consumers' Perceptions of Recycled Water

	Study I		Study II (DE, MD, NJ, & PA)		Study II (the rest of United States)	
	Coef.	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*
Price	-0.401***	0.042	-0.362***	0.026	-0.329***	0.026
Trophic Level						
One	0.450**	0.177	0.545***	0.083	0.557***	0.090
Two	0.861***	0.182	1.331***	0.103	1.280***	0.111
Water Type						
Recharged Aquifer	-0.280	0.327	-0.583**	0.224	-0.425*	0.194
Recycled	-1.057**	0.369	-1.047***	0.222	-0.729**	0.231
Social Marketing						
Celebrity Endorsements & Social Comparison	-0.751	0.464	-0.578*	0.286	-0.454	0.313
Celebrity Endorsement	0.083	0.450	-0.318	0.301	-0.503	0.345
Social Comparison	-0.218	0.436	0.027	0.283	0.114	0.317
Interactions						
*Recharged*Celebrity Endorsements & Social Comparison*	0.989*	0.467	0.829**	0.295	0.745**	0.279
*Recharged*Celebrity Endorsement*	-0.374	0.508	0.770**	0.295	0.415	0.298
*Recharged*Social Comparison*	0.398	0.471	0.020	0.312	0.307	0.265
*Recycled*Celebrity Endorsements & Social Comparison*	1.329**	0.519	1.044***	0.320	0.845**	0.305
*Recycled*Celebrity Endorsement*	0.300	0.535	0.971**	0.311	0.705*	0.332
*Recycled*Social Comparison*	0.368	0.481	0.353	0.330	0.246	0.310
Frequency of Consumption						
Trophic Level Zero	0.188	0.106	0.147	0.076	0.113	0.086
Trophic Level One	0.296**	0.107	0.196**	0.088	0.376***	0.094
Trophic Level Two	1.048***	0.190	1.322***	0.160	1.080***	0.173
Constant	-4.724***	0.703	-4.973***	0.507	-4.943***	0.604
Total N	4,710		9,828		10,080	
Individuals	314		546		560	
AIC	3892		9483		9615	
BIC	4015		9620		9752	
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$						

Table C.3 Wald Tests from Equation 6

	Study I								
	Ground			Recharged Aquifer			Recycled		
Wald Test	χ^2	Prob.	BCP	χ^2	Prob.	BCP	χ^2	Prob.	BCP
Control = Celebrity Endorsements & Social Comparison	2.63	0.105	0.315	1.39	0.238	0.714	0.16	0.688	1.000
Control = Celebrity Endorsements	0.03	0.853	1.000	0.02	0.896	1.000	0.98	0.323	0.970
Control = Social Comparison	0.25	0.617	1.000	0.33	0.568	1.000	1.80	0.180	0.541
Celebrity Endorsements & Social Comparison = Celebrity Endorsements	3.00	0.083	0.250	1.09	0.297	0.890	0.25	0.618	1.000
Celebrity Endorsements & Social Comparison = Social Comparison	1.29	0.256	0.769	0.46	0.497	1.000	0.67	0.414	1.000
Celebrity Endorsements = Social Comparison	0.44	0.509	1.000	0.19	0.666	1.000	0.13	0.717	1.000
	Study II (DE, MD, NJ, & PA)								
	Ground			Recharged Aquifer			Recycled		
Wald Test	χ^2	Prob.	BCP	χ^2	Prob.	BCP	χ^2	Prob.	BCP
Control = Celebrity Endorsements & Social Comparison	4.09	0.043	0.129	0.43	0.512	1.000	0.36	0.551	1.000
Control = Celebrity Endorsements	1.12	0.290	0.870	0.53	0.469	1.000	0.08	0.776	1.000
Control = Social Comparison	0.01	0.923	1.000	0.82	0.366	1.000	2.46	0.117	0.350
Celebrity Endorsements & Social Comparison = Celebrity Endorsements	0.74	0.389	1.000	1.83	0.176	0.528	0.79	0.37	1.000
Celebrity Endorsements & Social Comparison = Social Comparison	4.50	0.034	0.102	2.28	0.131	0.393	4.53	0.033	0.100
Celebrity Endorsements = Social Comparison	1.34	0.246	0.739	0.03	0.861	1.000	1.72	0.189	0.568
	Study II (the rest of United States)								
	Ground			Recharged Aquifer			Recycled		
Wald Test	χ^2	Prob.	BCP	χ^2	Prob.	BCP	χ^2	Prob.	BCP
Control = Celebrity Endorsements & Social Comparison	2.10	0.148	0.443	1.36	0.244	0.732	0.33	0.563	1.000
Control = Celebrity Endorsements	2.12	0.145	0.436	0.19	0.661	1.000	0.01	0.917	1.000
Control = Social Comparison	0.13	0.720	1.000	0.95	0.329	0.987	1.61	0.204	0.612
Celebrity Endorsements & Social Comparison = Celebrity Endorsements	0.02	0.889	1.000	2.53	0.112	0.336	0.22	0.636	1.000
Celebrity Endorsements & Social Comparison = Social Comparison	3.09	0.079	0.237	0.07	0.787	1.000	0.36	0.548	1.000
Celebrity Endorsements = Social Comparison	3.05	0.081	0.242	2.02	0.156	0.467	1.27	0.259	0.778

Appendix D. Purchase Decisions by Sample and Product Type

	Percent of Each Product that was Purchased		
	Study I	*Study II (DE, MD, NJ, & PA)*	*Study II (United States)*
Bottled Water	30%	33%	35%
Spinach	20%	38%	41%
Cheddar Cheese	25%	37%	40%
Lamb Chops	20%	31%	34%
Hot Chocolate Mix	20%	32%	34%
Sirloin Steak		36%	40%
	Percent of Participants Who Chose not to Purchase a Product Regardless of Water Type		
	Study I	*Study II (DE, MD, NJ, & PA)*	*Study II (United States)*
Bottled Water	32%	34%	33%
Spinach	46%	29%	28%
Cheddar Cheese	40%	29%	26%
Lamb Chops	49%	40%	38%
Hot Chocolate Mix	47%	36%	35%
Sirloin Steak		27%	27%

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[1] As part of the CONSERVE project, this study builds on the ideas and findings past research on recycled water. However, all data presented in this article is original and has not been used in any other published article or unpublished manuscript.

[2] Results indicate that presentation order had no effect on purchase decisions in Study I or II.

[3] Bottled recycled water that was safe for potable use was sourced from Pima County Regional Wastewater Reclamation Department in Tucson, Arizona, through collaborators with the CONSERVE project.

[4] Participants were not made aware of the price distributions or of the mean prices for the products.

[5] For Study I, the mean price of bottled water (16 ounces) was $0.96 (SD $0.48), the mean price of spinach (8 ounces) was $2.04 (SD $1.02), the mean price of lamb chops (half pound) was $5.93 (SD $2.97), the mean price of cheddar cheese (1 pound) was $4.26 (SD $2.13), and the mean price of hot chocolate mix (16 ounces) was $4.66 (SD $2.33).

[6] For Study II, the mean price of bottled water (16 ounces) was $1.45 (SD $0.73), the mean price of spinach (8 ounces) was $1.92 (SD $0.96), the mean price of lamb chops (half pound) was $5.50 (SD $2.75), the mean price of cheddar cheese (1 pound) was $4.34 (SD $2.17), the mean price of hot chocolate mix (16 ounces) was $4.36 (SD $2.18), and the mean price of sirloin steak (6 ounces) was $5.76 (SD $2.88).

[7] The Bonferroni correction for this family of hypotheses is $\frac{p}{2}$.

[8] The Bonferroni correction for this family of hypotheses is $\frac{p}{2}$.

[9] A breakdown of purchase decisions by product type can be found in Appendix D.

[10] Using trophic levels as a stigma mitigation technique for recycled water has direct benefits to the general population. However, for vegetarians and vegans the benefits are more indirect. Our finding suggest that recycled water resources should be focused on animal feed operations first and potable drinking water projects last. If vegetarians and vegans are stigmatized by recycled water this prioritization minimizes their interaction with stigmatized products. For vegetarians that consume animal byproducts, such as cheese, our trophic level findings are directly relevant to them, albeit in a more limited manner. When consuming produce irrigated with recycled water vegetarians and vegans, like the wider population, can still use other proven mitigation strategies, such as drying, liquifying, and cooking with heat.

[11] The Bonferroni correction for this family of hypotheses is $\frac{p}{3}$.

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