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# Social Preferences and Communication as Stigma Mitigation Devices – Evidence from Recycled Drinking Water Experiments

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**ABSTRACT**

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**Keywords:** Interpretive strategies, sustainable landscape practices, public horticulture institutions, botanical gardens, survey, efficacy, knowledge

Differences between private and public decision-making are quantified using willingness-to-accept (WTA) data collected in artefactual field experiments. Participants first makedecisions in a second-price auction (private rounds) followed by majority-rule voting (public rounds) on the median price collected in the private rounds. Results suggest that other-regarding behavior in the public rounds regarding stigma and disgust can significantly reduce WTA. Chat-box communication can further reduce WTA, and social preferences, education, and unrelated communication are the primary drivers that lead participants to accept significantly lower prices for potentially disgusting tasks. The results have application for sustainable, cost-effective recycled water projects.

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## Introduction

Social preferences are an important component in decision-making that can influence individuals' choices when a decision affects the well-being of others rather than only their own. Numerous studies have addressed these other-regarding behaviors in utility theory and experimental game theory (e.g., Viscusi et al. 1988, Hoffman et al. 1996, Fehr and Schmidt 1999, Fehr et al. 2006, Bolton and Ockenfels 2000, Charness and Rabin 2002, Engelmann and Strobel 2004, 2006, 2007, Andreoni and Miller 2002, Bergstrom 2006, Cox et al. 2007, Cooper and Kagel 2009, Blanco et al. 2011, and Keisner et al. 2013). Far fewer studies have focused on the impacts of other-regarding behavior in public decision-making (e.g., Messer et al. 2010, Deacon and Shapiro 1975, Shabman and Stephenson 1992, 1994, Holmes 1990, Kotchen and Powers 2006, Bergstrom 2006). Many public decisions in both the United States and the European Union are made by majority-rule voting (Barbera and Jackson 2004). Given the importance of such voting and the evidence of other-regarding preferences reported in the literature, it is surprising that the body of literature concerned with social preferences and voting is small. According to Bergstrom (2006), voters are motivated by sympathy gains obtained from the well-being of others impacted by the outcome of the referendum. Charness and Rabin (2002) showed that individuals' decisions are partially motivated by maximizing the welfare of the worst-off individual, which was expressed as a form of quasi-maximin preferences and the overall social efficiency of the outcome of the decisions. Engelmann and Strobel (2006) showed that, overall, models that combined efficiency and maximin preferences were the most successful in experimental games; however, there was much heterogeneity with respect to the subject of the decisions and other factors (see also

Andreoni and Miller 2002).

Moreover, many of the social preference studies have focused on how individuals make choices that involve monetary gains and relative monetary payoffs (Forsythe et al. 1994, Hoffman et al. 1996, Henrich et al. 2001) and ignored social preferences regarding commodities and losses. One exception is Andreoni and Miller (2002), which argued that individuals' preferences extend beyond final allocations of money and that social preferences are idiosyncratic and must be evaluated at the individual level. Keisner et al. (2013) showed experimentally that individuals also have social preferences for commodities and for "bads". The authors showed that extending social preferences beyond predefined income distributions and thus avoiding potential biases toward a particular social preference (see also Engelmann and Strobel 2005, 2007, Bolton and Ockenfels 2006, and Andreoni and Miller 2002) allows different social preferences to coexist in a more general approach to the individual utility function.

Social preferences have not been examined as a way to reduce stigma and disgust. The closest reference to using social preferences in this context is Keisner (2013), which showed that other-regarding behavior exists for commodities and bads. We combine insights about other-regarding preferences from utility theory and experimental economics and design a novel artefactual field experiment that first elicits participants' willingness to accept (WTA) reused tap water relative to filtered reused tap water and bottled water in a second-price auction. The experiment allows us to measure participants' stigma response related to recycled drinking water in an incentive-compatible and demand-revealing setting. We then use the median prices collected in the second-price auction in a majority-rule voting scenario in which decisions made by

participants affect everyone else in the group. Additionally, in two between-subjects treatments, we allow half of the participants to communicate in a five-minute online chat box that records their communications before each vote. Communication has previously been shown to be welfare enhancing by increasing corporation in public goods experiments (e.g., Brosig et al. 2003). Therefore, we can identify not only differences between private and social preferences but also the specific reasons behind participants' altering their behavior in the public round of the experiment.

In the United States, as in many other countries, water quality is a public good. National primary standards for drinking water set by the Environmental Protection Agency (EPA) and apply to public water systems In 1974, the Safe Drinking Water Act was enacted to protect public health by regulating public sources of drinking water, and states are required under the act to report their water treatment measures, the results of tests of concentrations of minerals and contaminates, and standards for regulated and unregulated substances. The costs associated with provision of safe drinking water under the act are large—according to the EPA, $385 billion in infrastructure investments are needed to sustain safe water supplies between 2011 and 2030 (EPA 2013). Moreover, water shortages in developed countries (e.g., shortages caused by the ongoing drought in California) call for alternative means of providing drinking water.

Globally, one of the millennium development goals of the United Nations (2014) is the human right to water and sanitation: All global citizens should have sufficient water (50–100 liters per day) that must be safe, affordable (costing less than 3% of annual income), and accessible (within 30 minutes or 1,000 meters of the home). Population growth

combined with global warming is likely to pose a considerable threat to water availability and provision (Immerzeel et al. 2010, Vörösmarty et al. 2000).

A potential solution to shortages of drinking water worldwide is use of technologies that can cleanse sewer water so it can be reused for drinking. Such water is clean from an objective scientific perspective, but consumers are frequently resistant to water "recycling" because of subjective safety concerns and feelings of disgust at the idea of drinking the water. In essence, consumers attach a stigma to the water and refuse to drink it, rendering its use infeasible. Similarly, some people have strong negative visceral responses to tap water.

Despite domestic drinking water shortages, there is strong opposition in many communities to introducing treated sewer water into community water supplies (Dingfelder 2004). In the 1990s, for example, the City of San Diego's plan to use recycled water as part of its drinking supply was abandoned due to negative perceptions of the project and despite a large, already-spent sunk cost (Ross et al. 2014). Similar cases have been reported in Australia; in multiple cities in Queensland, public opposition led to rejection of projects aimed at using recycled drinking water (Ross et al. 2014, Uhlmann and Head 2011, Po et al. 2003). Johnstone and Serret (2012) analyzed data from a survey of 10,000 households from ten Organization for Economic Cooperation and Development countries and found that the determinants of household decisions to purchase bottled water and filtration systems for tap water were influenced by negative perceptions of tap water.

Much of the stigma related to recycled water stems from a psychological concept of "disgust" (see Goffman1963, Fallon et al. 1984, Rozin 2001, Hejmadi et al. 2004). People are offended by the idea of drinking water that has been in contact with raw sewage—"once in contact, always in contact," which is referred to as the law of contagion (see Rozin et al. 1986). Once an item has come into contact with a contagion, the item is forever contaminated even when the item poses no actual health risk. Moreover, the definition of a contagion is heavily influenced by social and cultural norms (Gerard and Rabbie 1961, Goffman 1963, Kahan 1998, Meigs 1978). In western societies, for example, feces, most body parts, and insects (in American culture) are widely considered disgusting (Rozin et al. 1985).

Our revealed preference experiments look at differences between private decision-making in second-price auctions and public decision-making in majority-rules voting. We show that other-regarding behavior can be a successful stigma mitigation device. Results provide insight into the psychology of economic decision-making related to disgust and stigma, which are typically associated with consumption of recycled water. We identify three complementary approaches for increasing the acceptability of recycled drinking water and reducing disgust and stigmatization. First, we find that mitigation in the form of additional filtering of the water significantly reduces disgust. Second, after measuring differences between private and public decision-making, we find that participants are more willing to consume recycled water (as evidenced by reduced WTA values) when making a public decision represented by a majority-rule vote. Finally, we find that communication related to other-regarding behavior and education can further reduce stigma among participants.

The results, therefore, make two important contributions to the literature. We introduce a novel design that allows us to measure the difference between private reservation prices (in second-price auctions) and public decision-making (in majority-rule voting). This design shows how other-regarding behavior in public decision-making and communication can be successful stigma mitigation devices, leading to socially preferred outcomes. With that knowledge, policymakers can more effectively employ private and public decision-making processes and improve public perceptions of recycled water. Many participants' disproportionately negative reactions to recycled water improved when they knew that their decisions influenced the plight of others. Additional mitigation through filtration and increased public communication can further reduce their negative reactions.

**Experimental Design**

The experiment consisted of two parts that each involved three tasks. In the first part of the experiment, we used a second-price auction design to elicit data on participants' private willingness to accept (WTA). In the second part, participants made decisions in a majority-rule voting mechanism. In the majority-rule vote, they had do decide whether they wanted the entire group to drink a three-ounce glass of water in exchange for the amount of the median price elicited in the auction. If a majority of the group's participants voted in favor of drinking the water, all members of the group would drink the water and receive the median price. If a majority of the group's participants voted against drinking the water at the median price, no one would drink the water and no one would be paid.

**Types of Water**

Participants were asked to place a private and a public offer on drinking three ounces of each of three types of water:

(1) Penta® ultra-purified bottled water

(2) Reused tap water

(3) Filtered reused tap water

The waters were displayed to participants in identical dispensers at the front of the room, and the only distinguishable feature for each water was a sign on the top of the dispenser identifying the type of water it contained. At a specific point during the experiment, participants were given a handout that provided short descriptions of the source of the water, included whether and how it had been treated (see Appendix A). Each water also was tested during the experiment for total dissolved solids (TDSs) measured in parts per million (ppm), and participants were given a handout containing information about TDSs provided by the EPA (see Appendix B). The testing was done at the front of the room, and a participant confirmed and read aloud each measurement, which was then written on a white board for everyone to see. The reused tap water came from treated surface water that had received effluent from wastewater treatment plants and storm drains upstream from where it was withdrawn to be treated. Hence, our reused tap water had previously come into contact with potentially disgusting substances such as human and animal feces. The Penta ultra-purified bottled water, henceforth referred to simply as Penta water, was selected because it is advertised as having no dissolved solids and may be perceived as

safer than tap water. Filtered reused tap water was reused water that had been filtered by a Zero water filter, which is advertised to reduce dissolved solids in water to zero and would therefore be comparable to Penta water in terms of total dissolved solids. In the experiment, both the Penta water and the filtered reused tap water contained zero ppm of TDSs; the reused tap water contained between 193 and 303 ppm of TDSs.

**Second-price Auction**

Despite some evidence to the contrary (Kagel et al. 1987, Kagel and Levin 1993), a number of studies have shown that second-price auctions are demand-revealing (Coppinger et al. 1980, Noussair et al. 2004, Shogren et al. 2001, Parkhurst et al. 2004, Lusk and Shogren 2007). The second-price auction in our experiment asked participants to make WTA offers for each type of water. First, the participants were trained to use the bidding mechanism in two practice rounds to ensure that they understood it. Irwin et al. (1998) and Kagel and Roth (1995) showed that practice using the bidding mechanism is an important step in producing incentive-compatible results.

All offers were submitted using tablet computers running Willow software for economic experiments (Weel and McCabe 2010). In the practice rounds and in subsequent rounds that elicited WTA, the participants were asked to offer the least amount of money they would accept as compensation and still be willing to perform a task. In the practice rounds, the tasks were to eat a piece of chocolate and to draw a picture. Participants were informed that the person who submitted the lowest bid would win the auction and would receive the amount of the second lowest offer as compensation. In the case of multiple

lowest offers, the winner would be chosen by random drawing and would receive the amount of the offers.

Participants also were told that the offers could be any value between $0 and $5,000 and that they could opt to decline the task. An offer of $5,000 ensured that a participant would not have to perform the task but also meant that no compensation would be given. Participants were further informed that their offers had to be equal to or less than a reserve price that would be randomly drawn from a normal distribution (unknown to participants) with a mean and standard deviation of $40 (and truncated at $0 and $5,000). Inclusion of the reserve price was designed to discourage overbidding and thus avoid disproportionately large payoffs, which are a concern in auctions involving a small number of participants. None of the winning bids in our auction exceeded the reserve price.

After the practice rounds were completed, administrators passed out the printed instructions that included information about the three types of water and TDSs. Participants were given time to read the material and then viewed a short video presentation that once again explained the bidding mechanism and payoffs. These materials explained that, at the end of the experiment, one of the six tasks would be randomly selected for implementation

**Majority-rule Voting**

The public-decision portion of the experiment asked participants to take majority-rule votes using the private WTA information collected in the auction to determine whether the group would consume a sample of one of the waters. They were shown a graph of the

distribution of the WTA offers from the auction, and the price for each water in the votes was the median price of this distribution. If a majority of the participants voted in favor of drinking the three ounces of water, everyone in the group drank the water and received the median price as compensation. If a majority of the participants voted against drinking the water, the group members did not drink the water and received no compensation.

If participants' private (auction) and public (majority rule) preferences are identical, we would expect half of the participants to vote yes and half to vote no when presented with the median price. If that is not the case, we can measure the difference between their private and public decisions. In this sense, we have an accurate and precise way to measure WTA between private decision-making that affects only oneself and public decision-making that takes into account the welfare of the others. In order to classify the preferences, we split this public-decision portion of the experiment into two between-subjects treatments. Treatment 1 involved simple majority-rule voting with no modifications or additional information aside from the median price and the distribution of the reservation prices. Treatment 2 added a timed five-minute chat-box communication prior to each round of voting in which participants could post messages that were visible to everyone in the group. After five minutes, the software unlocked the option to vote and the participants made their decisions. Records of the chat communication provide insight into differences between the participants' private and public decision-making.

**Results for Private Decisions**

Of the 109 individuals who participated in the auction, 57 received the communication treatment and 52 received the no-communication treatment. These artefactual field

experiments were conducted at two locations, and the participants were members of the university staff and of the Osher Lifelong Learning Institute. The mean age of the participants was 48 years, the mean annual income was between $40,000–$60,000, 60% were female and 40% were male, 91% had concerns about whether it was safe to consume water outside the United States, and 59% had concerns about consuming water in the United States. On average, the participants consumed 23 twelve-ounce glasses of water each week.

Walker (2001) argued that "the normal use of the word 'stigma' entails . . . an unwarranted level of avoidance behavior. Stigma represents a misconception, a misperception of risk, an overreaction to something." The results of our second-price auction experiment suggest that reused tap water is stigmatized as the mean WTA for reused tap water is $1,377. However, the median and mode for reused tap water is $30 and $0, respectively. Thus, the mean response appears to be inflated by a few participants who had a disproportionately strong response to this negligible risk. In fact, the health risk associated with drinking reused tap water is no different than the risk associated with drinking Penta water or filtered reused tap water. A strong stigma response was reported in prior experiments regarding disgust, such as willingness to drink water that had been in contact with a sterilized dead cockroach (Rozin et al. 1986, Rozin 2001, Kecinski 2015a, 2015b).

Interestingly, we find that the simple mitigation step of filtering the reused tap water with a ZeroWater® filter, which reduces the TDSs to zero, reduces the stigma response nearly to the level for ultra-purified bottled water. The mean WTA for filtered reused tap water (hereafter referred to as filtered water) is $250.70, which indicates that, although most

participants responded with a low WTA, for others (four participants offered $5,000, signaling their unwillingness to drink the water at any amount possible in the payoff vector) the stigma associated with the water was not reduced by filtration even though the water contained no TDSs (see Figure 1). The median responses to Penta water and filtered water are $0.50 and $2.00.

Figure 2 shows percentile responses to each type of water in four 25-percentile groups. The WTA value for reused tap water separates from Penta and filtered water around the 20th percentile and steadily increases until the 53rd percentile, at which point participants readily offer more than $100. Participants offer $1,000.00 to $4,999.99 between the 70th and 82nd percentiles; thereafter, they refuse to consume the water for any amount lower than $5,000. The offers for Penta and reused tap water move close together and remain under $100 until the 88th percentile for reused tap water and the 94th percentile for Penta water.

We include the percentile graphic because it visually demonstrates the spectrum of stigma responses to reused tap water, and, more importantly, the degree of stigma that remains after mitigation. Among health experts, recycled water is typically thought of as a safe, cost-effective, and ecologically sound solution to water shortages (Gleick 2000). Yet most recycled water projects have failed because of negative public perceptions of them. Our results show that people's perceptions of recycled water may not be as negative as the results of studies that used monetary incentives have suggested.

Results from a two-limit random-effects Tobit regression model (Table 1) indicate that there are significant differences in individuals' WTA Penta and reused tap water at the

1% level. In fact, participants, on average, required an additional $2,025 to drink reused tap water relative to Penta water. There are significant differences in WTA for Penta and filtered water, and those differences are significant at the 5% level. On average, participants required an additional $360 to drink the filtered water relative to Penta water.

In Table 1, we report the marginal effects and truncate the model at the $0 lower bound and $5,000 upper bound. The dependent variable (*V*) represents each participant's offer. The *P*, *R* and *F* variables represent Penta water, reused tap water and filtered water, respectively. We initially controlled for gender effects. However, none of the results of that analysis were significant, and the following regression models do not include the gender dummy variable.

The model can be summarized for person *i* as

$$V_{ij} = \alpha + \beta_1 * P_i + \beta_2 * R_i + \beta_3 * F_i + \mu_i + \varepsilon_{ij} \text{ where } \mu_i \sim N(0, \sigma_\mu^2) \text{ and } \varepsilon_{ij} \sim N(0, \sigma^2). \quad (1)$$

To gain insight into the types of water that participants were most likely to reject entirely, we use a random-effects logistic regression (see Table 2):

$$log \frac{P_{ij}}{1-P_{ij}} = \alpha + \beta_1 * P_i + \beta_2 * R_i + \beta_2 * F_i + \mu_i + \varepsilon_{ij}, \text{ where } \mu_i \sim N(0, \sigma_\mu^2) \text{ and } \varepsilon_{ij} \sim N(0, \sigma^2). \quad (2)$$

We find that, relative to Penta water, participants are significantly more likely to offer $5,000 and refuse consumption of reused tap water at the 1% level. However, that was not true for filtered water, indicating that participants do not associate significantly more stigma with filtered water. This is an important finding. It shows that there could be simple, relatively inexpensive ways to overcome principal refusal of water recycling

projects. However, people may still request significantly higher compensation to drink filtered water.

An argument can be made for excluding participants who respond with principal refusal from the regression model. We know from previous studies that efforts to mitigate stigma related to disgust may fail for a small minority of participants (Rozin 2001, Kecinski et al. 2015a, 2015b). However, given the relatively small number of people who have such an extreme visceral response, it seems reasonable to explore options that would benefit the vast majority of people while not endangering the rest. Hence, we use another Tobit model (see Table 3) that excludes the $5,000 offers (right-censored) to analyze the behavior of people who are willing to drink the water for some price. We find that those participants request a significantly greater amount of monetary compensation for reused tap water but we find no significant differences between Penta water and filtered water.

**Results for Public Decisions**

In the majority-rule voting portion of the experiment, participants were assigned to one of two communication treatments: (1) no communication between participants, and (2) a with-communication treatment in which participants took part in five minutes of group chat discussion before each vote on a type of water (Penta, reused tap, and filtered reused tap water). Participants were shown the median price for the water generated by their own group's offers in the second-price auction. If we assumed that people had the same preferences in second-price auction and majority-rules voting, we would expect a 50/50 split between yes and no voting. However, in this part of the experiment, the decision environment has changed since participants' decisions now affect the other members of

the group, and we find large discrepancies between the WTA values from the private second-price auction and the public majority-rule votes. The advantage of our design is that we can quantify and categorize these discrepancies.

The results of the public decisions are presented in Figure 3. Overall, yes votes were dominant. Many participants were willing to accept the median price and, thus, less than their private WTA to drink the water. This was particularly true for Penta and filtered water. In the no-communication treatment, 85% of participants voted in favor of the entire group drinking Penta water and 87% voted in favor of drinking reused tap water at median prices. Voting in the communication treatment was similar—82% were in favor of the entire group drinking Penta water and 88% were in favor of the group drinking filtered water. These results reveal two important points: (1) communication might not have a substantial impact on majority-rule voting if the task involved appears to be safe and is not disgusting; and (2) majority-rule voting dramatically reduces WTA, suggesting that the participants are displaying social preferences since the decisions now affect the welfare of others.

The results for reused tap water are different. In the no-communication treatment, participants do not move toward voting yes. In fact, we observe a slight drop in acceptability of the reused water—only 48% of participants voted in favor of the whole group drinking it. However, 67% of participants in the communication treatment voted in favor of drinking the water. This suggests that (1) when a task is sufficiently disgusting and stigmatized and participants make decisions without prior communication, the induced disgust may not be offset by social preferences alone; (2) when participants are allowed to communicate and share their feelings and thoughts about reused tap water and

to learn about other participants' feelings and thoughts, their decisions are influenced by social considerations that reduce their WTA. These are important, policy-relevant findings that may provide additional leverage in efforts to make recycled water projects acceptable to a majority of a population.

We define "yes-switching" as participants' moves to accept a median price in the majority-rule vote that is less than their offers in the second-price auction. "No-switching" on the other hand involves participants' who do not accept a price in the majority-rules voting at or above their second-auction offer. Table 4 summarizes the results for yes- and no-switching behaviors.

Overall, for Penta water, 29% of the participants in both treatments accepted a price that was less than their offers in the second-price auction while 5% of the participants did not accept the median price even though it was equal to or greater than their offers in the auction. Using a sign test, we can reject the null hypothesis that these switches were random at a 1% significance level.

For reused tap water, we could not reject the null hypothesis of random yes-no switching in the no-communication treatment. The communication treatment, on the other hand, appears to have had an impact on switching behavior: 21.05% of the participants became yes-switchers while only 5.26% became no-switchers. Using a sign test, we can reject the null hypothesis of random switching at the 1% level.

For filtered water, we find for both treatments that participants' switching decisions are not random. These results are statistically significant at the 1% level. Furthermore, we find that 32.43% in the no-communication treatment and 35.09% in the communication

treatment become yes-switchers; by comparison, none in the no-communication treatment and only 3.5% in the communication treatment become no-switchers.

Overall, we observe a large amount of yes-switching, which indicates that many participants have social preferences that influence their decisions. The monetary impacts of these social preferences are substantial (see Figure 4). On average for Penta water, yes-switchers are willing to go $16.47 below their private reservation prices in the no-communication treatment and $12.38 below in the communication treatment. For reused tap water and filtered water, the reductions are pronounced. On average, yes-switchers in the no-communication treatment went $122.25 below their private reservation prices for reused tap water and $62.41 below for filtered water. In the communication treatment, yes-switchers reduced their WTA by $483.91 for reused tap water and $531.05 for filtered water.

**Chat Communication**

We find that chat box communication is an effective tool in reducing participants' WTA reused tap water and filtered water. Overall, communication has a significant impact on yes-switching behavior.[1] But what exactly leads participants in the communication treatment to accept prices that are dramatically lower than their private reservation prices? To find out, we analyze the language used in the chat communications. We begin our analysis by listing likely reasons for changes in behavior between the private and public rounds. *A priori*, we expect that behavioral changes will fall into one of two broad categories: (a) responses to educational messages about health concerns and water quality

[1] A logit regression showed participants were significantly more likely to become yes-switchers ($p = 0.02$) when they were able to communicate.

(self-regarding behavior), and (b) responses to the needs of others (other-regarding behavior).

After taking a first look at the 425 lines of chat-box communication, we were able to assign switching behaviors to one of three categories: (1) other-regarding behavior when communication in the group revealed a line count of other-regarding messages; (2) education when communication in the group revealed a line count of education-related messages; and (3) unrelated when communication in the group revealed a line count of messages not related to the experiment. After we assigned these categories, two undergraduate students independently coded the communications line by line. The experimenters then did their own line-by-line coding of the messages and compared the results. A similar approach was taken by Bradfield and Kagel (2015) and Baranski and Kagel (2013). Whenever there was majority agreement (two out of three), the category was finalized. When both undergraduate students and the experimenters disagreed on the category to be assigned to a message, the category was discussed, and the undergraduates and experimenters presented arguments supporting their choice, after which a majority-rule vote was taken. Majority-rule voting was required only 2% of the time. A complete list of all of the chat messages and the codings can be found in the Appendix C.

For example, other-regarding behavior contained messages such as, "let's do it" or simply "yes," as we counted those as relating to getting others to join. Chat communication related to education included references to the water and to the experiment in general if it actually informed participants in a meaningful way. For example, participant 1 posted that *"*This water is also theoretically identical to the bottled one." We found that participant 14 used that information when making the decision: *"*Oh

yeah, it's filtered, 0 ppm; it's probably fine and 3 oz is like nothing." An example of unrelated communication is chat involving humor and random communication, such "Can't they pay us to drink beer?"

Of the 425 lines of communication, other-regarding messages were the most frequent with a line count of 212, followed by unrelated communication at 155 lines and education messages at 58 lines.

For the decision about Penta water, 45.22% of the lines were coded as relating to other-regarding behavior, 13.38% were education-related, and 41.4% were unrelated. For reused tap water, 57.52% of the lines related to other-regarding behavior, 11.76% to education, and 30.72% to unrelated communication. For filtered water, 46.09% related to other-regarding preferences, 16.52% to education, and 37.39% to unrelated communication (see figure 5).

As previously noted, participants were significantly more likely to become yes-switchers when they received the communication treatment. To find out whether specific types of communication (other-regarding, education, and unrelated) have a significant impact on yes-switching behavior, we use a logit model to estimate the effects in the communication treatment by water type (Table 5). We find that other-regarding behavior had a large impact on yes-switching when participants considered filtered water ($p$=0.003).We were surprised to find that unrelated communication had a significant impact on yes-switching for reused tap water ($p$= 0.025). Perhaps, as the unrelated communications tended to include humorous comments, humor successfully alleviated participants' concerns or distracted them from their disgust sufficiently. Moreover, we

found a strong effect of other-regarding preferences on yes-switching regarding filtered re-used tap water ($p=0.003$). Given the overall significant effect of communication on yes-switching behavior, many influences have an impact on participants' decisions. Those influences occur simultaneously and are often difficult to categorize so our results from the chat communication should be interpreted cautiously.

**Conclusions**

We present results from revealed preferences field experiments that measure participants' WTA Penta ultra purified water, reused tap water and filtered reused tap water. We distinguished private decision-making in a second-price auction from public decision-making in majority-rule votes. After receiving information about the three types of water, participants first submitted offers in the second-price auction. We then used the median offers generated from the second-price auction in two between-subject majority-rule voting treatments. The first treatment provided participants with an opportunity to discuss their thoughts in a five-minute chat session prior to the vote. There was no such option in the second treatment, which simply asked participants for a yes or no vote on whether the entire group should drink the sample of water at the median price. Our design highlights differences between private decision-making, which affects only the decision-maker, and public decision-making, which affects all members of the group. This design allows us not only identify differences in these decision environments but also to quantify them.

We find that participants reacted strongly to reused tap water, evidenced by their requesting, on average, more than $1,300 to drink three ounces of it. This high average is driven by a few individuals who were particularly opposed to consuming the water and

by some who reacted with principal refusal by offering $5,000. The extreme differences between mean and median ($30) shows stark idiosyncratic behaviors among participants. We also show that the simple mitigation of filtering the reused tap water with a ZeroWater filter successfully reduced the mean and median responses to $250 and $2 respectively.

We further find that social preferences can be a successful stigma mitigation device. Participants substantially reduce their WTA in the public decision rounds compared to the private rounds. Additionally, we find that communication has a significant impact on participants to further reduce their WTA. On average, for reused tap water and filtered reused tap water, participants reduce their WTA between private and public decision-making by $122 and $62 in the no-communication treatment. With communication participants reduce their WTA for reused tap water and filtered tap water by $483 and $531 respectively.

Coding the chat communication allows us to draw conclusions about what motivated participants in the public rounds to undercut the WTA expressed in the private rounds. We find that the communications fall into three broad categories: other-regarding preferences, education, and unrelated communication. Unrelated communication had a significant impact on yes-switching for reused tap water and other-regarding preferences have a significant effect for filtered reused tap water.

The results of this study provide powerful insight into the psychology of economic decision-making. Disgust and stigma related to recycled water are critical components of recycled water projects and may determine the success of this cost-effective and

sustainable solution to many water shortages around the globe. We provide three complementary ways to reduce disgust and stigma related to reused tap water: (1) through simple mitigation by filtration, (2) by using public instead of private decision-making outlets – levying the power of social preferences as a stigma mitigation device, and (3) by considering the impacts of communication on WTA.

The study's contribution to the literature is twofold. First, we introduce a novel design that allows one to measure the difference between private reservation prices (second-price auctions) and public decision-making (majority-rule votes). Second, we identify arenas in which policymakers can improve public perceptions of recycled water projects. Many participants' reactions to recycled water were less severe when their decisions influenced the plight of others. Combining additional filtration of treated water with communication to and between individuals affected by a project is an important step toward ensuring the success of those welfare enhancing those projects.

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**Table 1.** Random-effects Tobit Regression with Marginal Effects

| Value | dy/dx | St. Error | p-Value |
|---|---|---|---|
| *Reused Tap Water* | 2025.6150 | 312.5084 | 0.000 |
| *Filtered Reused Tap Water* | 361.3569 | 178.6483 | 0.043 |
| *Penta Ultra Purified Water* | (Baseline) | | |
| *Constant* | -733.4389 | 173.4972 | 0.000 |

**Table 2.** Random-effects Logit Regression with Marginal Effects

| Offers at $5,000 | dy/dx | St. Error | p-Value |
|---|---|---|---|
| *Reused Tap Water* | 13.9706 | 2.6749 | 0.000 |
| *Filtered Reused Tap Water* | 2.3839 | 1.6945 | 0.160 |
| *Penta Ultra Purified Water* | (Baseline) | | |
| *Constant* | -27.8028 | 2.7233 | 0.000 |

**Table 3.** Random-effects Tobit Regression with Marginal Effects, excl. Right Censored

| Value | dy/dx | St. Error | p-Value |
|---|---|---|---|
| *Reused Tap Water* | 922.7773 | 190.8438 | 0.000 |
| *Filtered Reused Tap Water* | 154.6236 | 91.8270 | 0.092 |
| *Penta Ultra Purified Water* | (Baseline) | | |
| *Constant* | -446.2846 | 100.2713 | 0.000 |

**Table 4.** Yes-Switching Percentages and Sign Test

| | Penta Ultra Purified Water | Reused Tap Water | Filtered Reused Tap Water |
|---|---|---|---|
| ***Yes-Switching*** | | | |
| No Communication | 29.73% | 13.51% | 32.43% |
| Communication | 29.82% | 21.05% | 35.09% |
| ***No-Switching*** | | | |
| No Communication | 5.41% | 8.11% | 0.00% |
| Communication | 5.26% | 5.26% | 3.51% |
| No Communication | p = 0.011 | p = 0.363 | p = 0.000 |
| Communication | p = 0.001 | p = 0.017 | p = 0.000 |

**Table 5.** Logit Regression on Communication Effects by Water Type

| | Value | Coefficient | St. Error | p-Value |
|---|---|---|---|---|
| ***A*** | *Other-Regarding Preferences* | 0.0429 | 0.0451 | 0.342 |
| | *Education Preferences* | 0.2048 | 0.1368 | 0.135 |
| | *Unrelated Communication* | -0.0058 | 0.0582 | 0.920 |
| | *Constant* | -2.7687 | 0.5320 | 0.000 |
| ***B*** | *Other-Regarding Preferences* | 0.0293 | 0.0732 | 0.688 |
| | *Education Preferences* | -0.2368 | 0.1645 | 0.150 |
| | *Unrelated Communication* | 0.1916 | 0.0891 | 0.032 |
| | *Constant* | -3.6128 | 0.8024 | 0.000 |
| ***C*** | *Other-Regarding Preferences* | 0.2577 | 0.0918 | 0.005 |
| | *Education Preferences* | -0.2446 | 0.1751 | 0.163 |
| | *Unrelated Communication* | 0.0510 | 0.0577 | 0.376 |
| | *Constant* | -3.1737 | 0.6149 | 0.000 |

**Notes:** A – Penta Ultra Purified water, B – reused tap water, C – filtered reused tap water.

**Figure 1.** Mean and Median Willingness-to-Accept Compensation to Drink 3 oz.

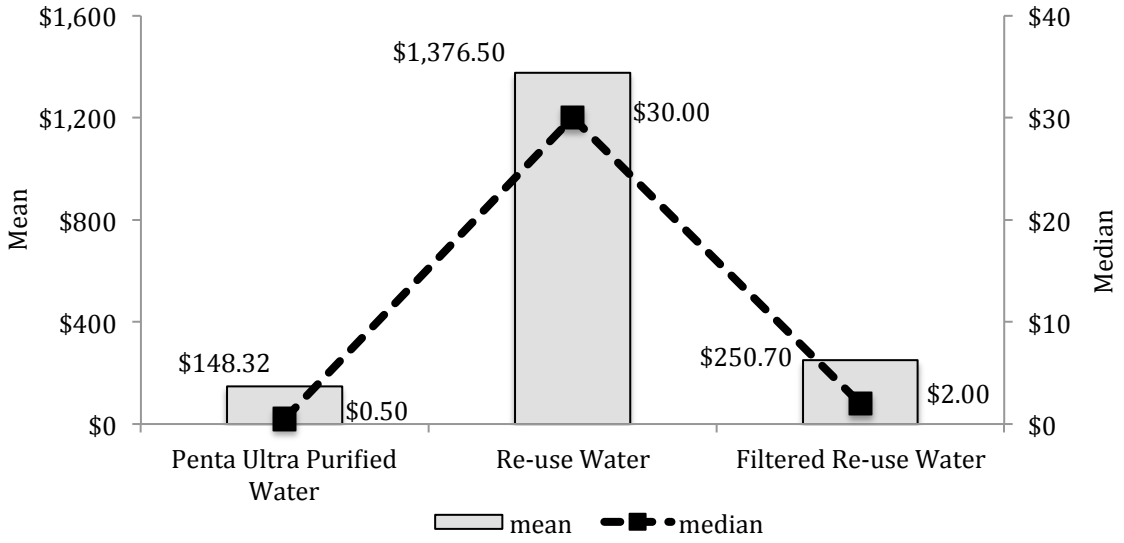



**Figure 2:** 25th Percentile Offer Distribution by Water Type

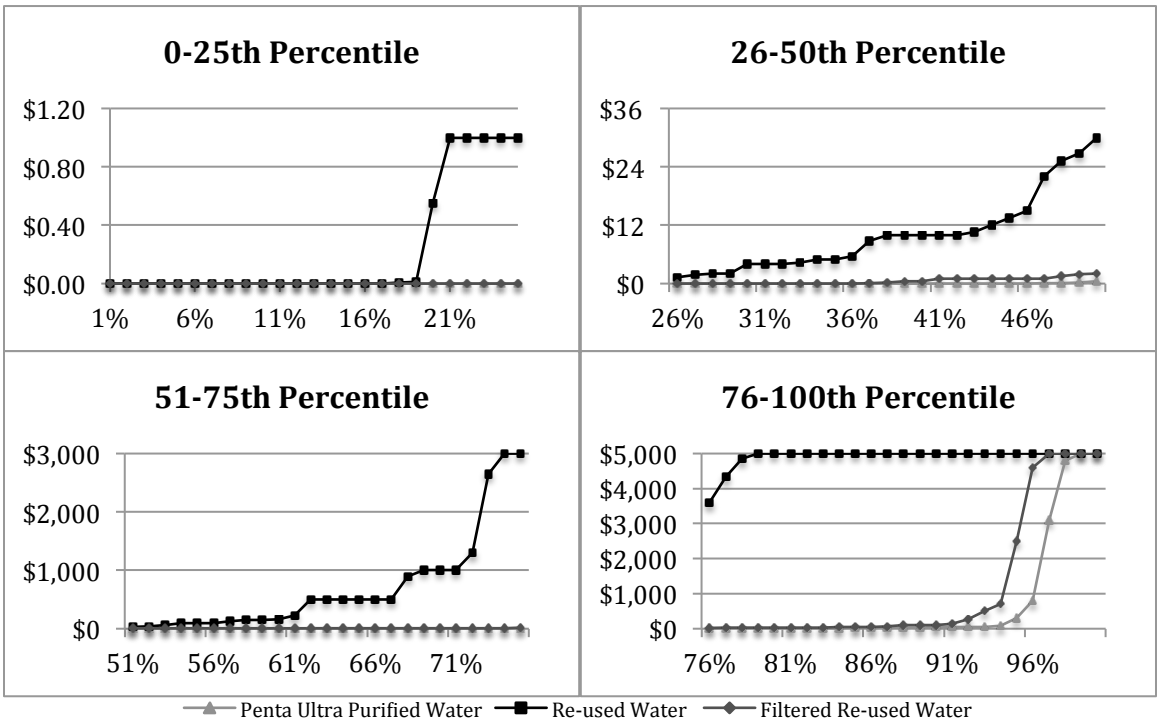


**Figure 3.** Voting Behavior with and without Communication

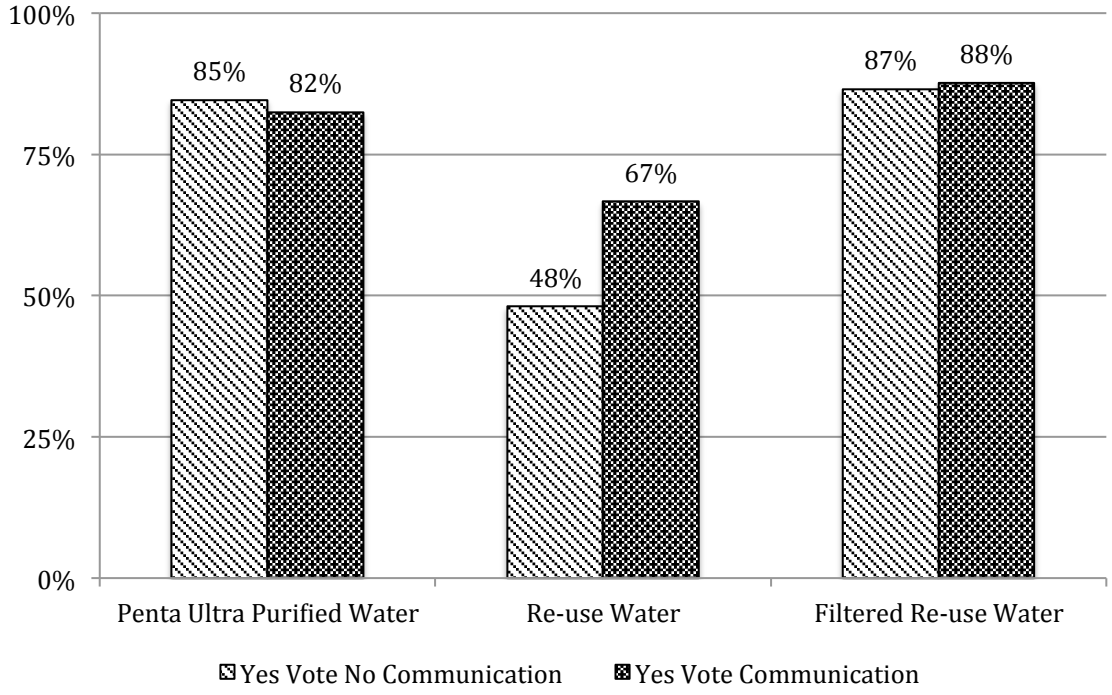



**Figure 4.** Voting Effect on Mean Willingness-to-Accept (Reduction)

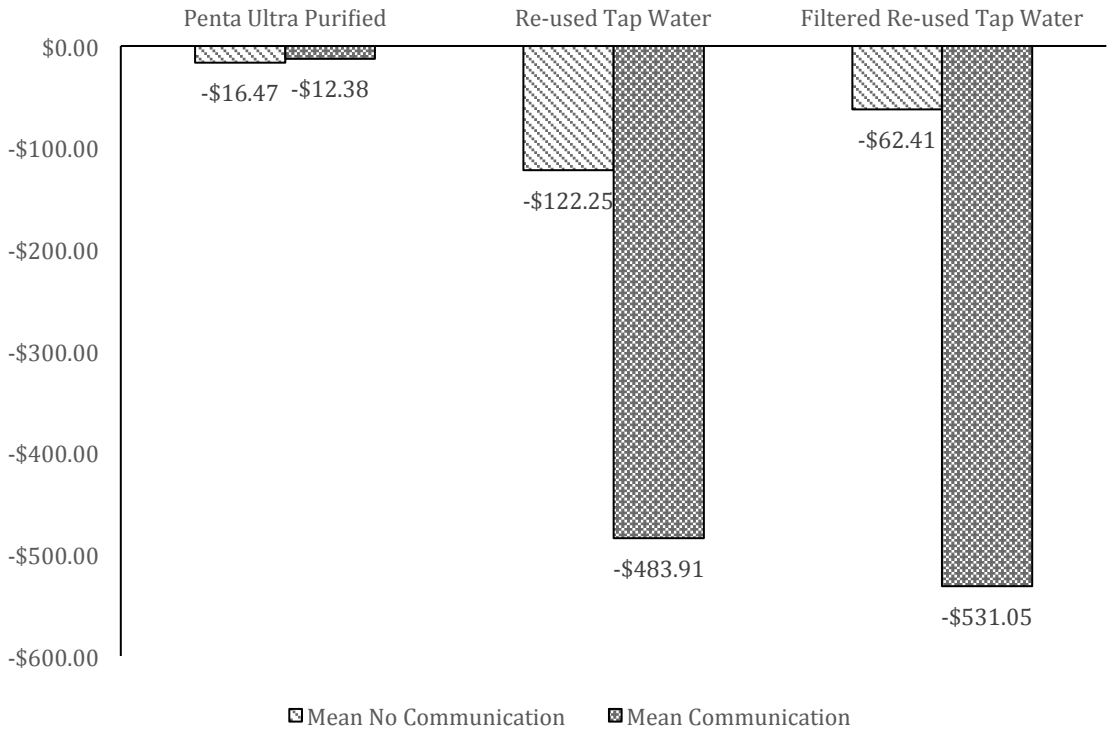
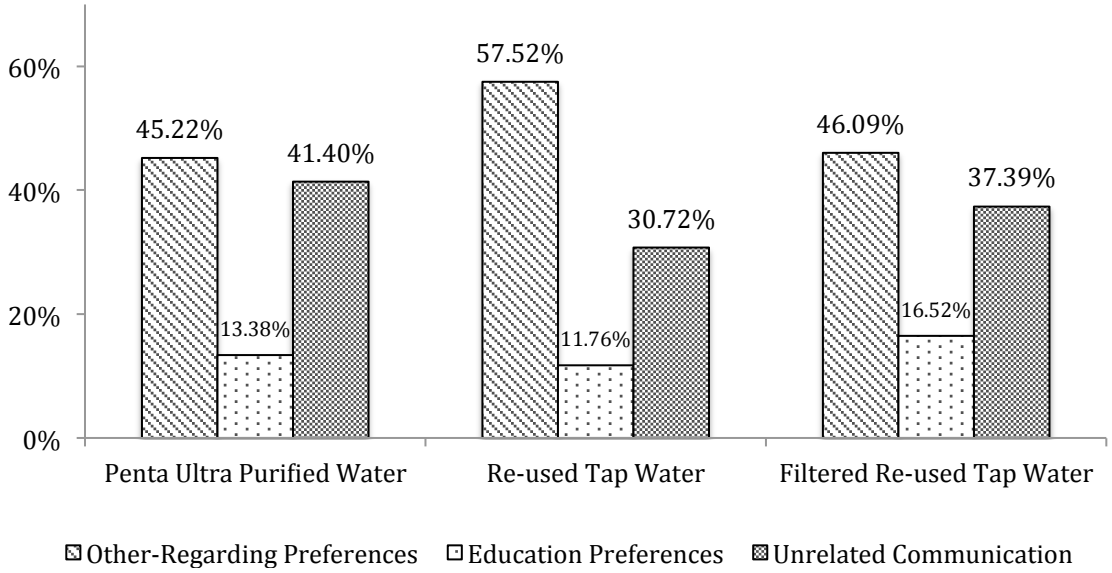


**Figure 5.** Chat-Box Communication Breakdown by Category



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