

Personalized Normative Feedback and the Moderating Role of Personal Norms: A Field Experiment to Reduce Residential Water Consumption

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Abstract

This article examines the role of social norms messages in promoting water conservation. A field experiment is reported in which residents were provided with personalized feedback about their water consumption, coupled with normative information about similar households in their neighborhood. Normative information was provided either through a web-based interface or through postal mail, and survey data were collected from residents prior to treatment. Results showed that residents who received normative information consumed less water than a randomized control group. Additional analyses showed that web-based distribution was less effective than postal mail. Finally, moderated regression analyses showed that residents with strong personal norms about reduced water consumption were *less* affected by the normative messages than were residents with low personal norms. Implications are discussed for both theory and practice.

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Water is essential for life. While the majority of the earth's surface is covered by water, less than 1% is readily available for human consumption. The rest is salty, or ice. Worldwide, approximately 20% of the human population lacks access to safe drinking water, and for many individuals, the trek to find potable water is a critical daily activity. Unfortunately, water scarcity is likely to become worse in the coming years, due to increasing human population and disruptions linked with climate change (Barlow & Clarke, 2002; Flannery, 2005). By 2025, an estimated two thirds of the world's population will live in water-stressed areas (United Nations, 2008).

Achieving sustainable levels of water consumption is likely to require both an increased supply (e.g., desalinization, transportation, recycling waste water) and a reduction in demand (Dolnicar & Hurlimann, 2010). The United Nations suggests that each person needs 20 to 50 liters of water per day for basic needs such as drinking, cooking, and cleaning. Yet the domestic consumption rates for many countries far exceed this amount—especially countries such as the United States (which has a per capita domestic consumption rate of 370 liters per day), Canada, Australia, and regions of the Middle East (cf. United States Geological Survey, 2009; World Business Council for Sustainable Development, 2006). In the United States, consumption varies widely, with higher per capita domestic consumption in the arid Western regions (e.g., California, Arizona) and southern regions of the country. Interestingly, even in water-stressed regions such as California, only a small percentage of water used in the residential sector is actually consumed; most is used for landscape irrigation, bathing, and washing.

Given the rising demand and decreasing supply of fresh water, many areas have implemented demand management programs. Essentially, these are efforts to promote reductions in water consumption (Brooks, 2006; Fielding, Russell, Spinks, & Mankad, 2012; Russell & Fielding, 2010). Individual-level conservation behaviors have been targeted using a range of intervention strategies, including information campaigns, pricing structures, and prompts. Unfortunately, strategies such

as these have limited impact. Information campaigns are the most common type of intervention chosen for conservation programs, and while they have been shown to effectively increase awareness about an issue, information campaigns are relatively ineffective in producing behavior change (Geller, Erickson, & Buttram, 1983; Schultz, 2002; Staats, Wit, & Midden, 1996). Price incentives (or disincentives) may be more successful, but even the effectiveness of increasing rates to encourage conservation has had limited success (Espey, Espey, & Shaw, 1997; Michelson, McGuckin, & Stumpf, 1999; Slavin, Wodanski, & Blackburn, 1981). Prompts have been shown to be effective for some behaviors, and are especially beneficial for fostering simple and repetitive behaviors (Kurz, Donaghue, & Walker, 2005; Werner, Stoll, Birch, & White, 2002), but they are generally not effective at encouraging new behaviors.

Among other strategies used, social norms approaches have emerged as a promising alternative (Hopper & Nielsen, 1991; Nolan, Schultz, Cialdini, Griskevicius, & Goldstein, 2008; Schultz, 1999; Schultz, Khazian, & Zaleski, 2008). Within the last 10 years, social norms approaches have gained popularity, although they are still relatively underused within the environmental area (Griskevicius, Cialdini, & Goldstein, 2008; Nolan, Kenefick, & Schultz, 2011).

Social norms refer to the beliefs that individuals hold about what the majority of other people do or approve of doing, and research has shown that normative beliefs can strongly influence behavior (Cialdini & Trost, 1998; Prentice & Miller, 1993; Schultz, Tabanico, & Rendón, 2008). This is evident across a number of classic social psychological studies showing that we use the behavior of others as a guide for our own actions (Asch, 1955; Latané & Darley, 1968; Sherif, 1937). Research has shown that individuals are especially susceptible to social normative information in ambiguous situations, but also in very familiar situations such as their home or campus residence hall (Cialdini, Kallgren, & Reno, 1991; Griskevicius et al., 2008; Schultz, 1999). Normative social influence has also been used across a range of applied topics, ranging from littering and theft to alcohol consumption

and sun protection (Cialdini et al., 2006; Cialdini et al., 1991; Keizer, Lindenberg, & Steg, 2008; Mahler, Kulik, Butler, Gerrard, & Gibbons, 2008; Schultz & Tabanico, 2009).

The Focus Theory of Normative Conduct differentiates between descriptive and injunctive norms, and predicts that when a norm becomes activated, it exerts a greater influence on behavior (Cialdini et al., 1991; Cialdini, Reno, & Kallgren, 1990). The type of norm that is made salient can dictate the direction of influence. *Descriptive norms* refer to an individual's beliefs about the prevalence of a behavior within a group. *Injunctive norms* refer to an individual's beliefs about the extent to which others within the group would socially approve of us if we engaged in a particular behavior. Research has established that these two types of norms can operate differently and that they can produce unique behavioral reactions (McDonald, Fielding, & Louis, 2014; Smith & Louis, 2008). This was illustrated in a study by Reno, Cialdini, and Kallgren (1993) in which they manipulated the cleanliness or litter in an environment (descriptive norm) and whether the behavior was made salient to participants as socially undesirable (injunctive norm). A descriptive normative message only prevented littering in already clean environments, whereas an injunctive message could prevent littering independent of whether the message was delivered in a clean or littered environment (see also Keizer, Lindenberg, & Steg, 2011). These findings emphasize that in instances where a behavior is common but socially undesirable, it would be unwise to provide individuals with a descriptive normative message that highlights the prevalence of the undesirable behavior. This phenomenon has been overlooked by various public service announcements that inadvertently increased an undesirable behavior by making its widespread prevalence the most salient aspect of their message (Cialdini, 2003). These findings also have clear implications for conservation campaigns that seek to emphasize perception of conservation behaviors and de-emphasize perceptions of wasteful behavior.

In instances where a behavior is common and desirable, however, descriptive norms can be very effective in motivating

similar behavior, and this type of feedback has successfully encouraged conservation behavior in several behavioral domains, including recycling behavior and energy consumption (Nolan et al., 2008; Schultz, 1999; Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). Schultz (1999) showed that a message providing descriptive normative information about the recycling behavior of an individual's neighborhood significantly increased recycling behavior. Similar results were found in a later study that provided individuals with descriptive normative feedback about their own energy consumption in comparison with the average consumption of their neighborhood (Schultz et al., 2007).

Moderating Variables

The power of normative social influence is clear in both conservation- and non-conservation-related contexts. But factors that moderate the process of normative social influence remain largely unexplored (Rimal & Real, 2005). As shown in a series of studies on littering behavior by Cialdini and colleagues (Cialdini et al., 1991; Cialdini et al., 1990), there is evidence that injunctive normative messages can moderate a descriptive normative message. Not surprisingly, normative messages are found to be effective when their descriptive and injunctive elements are aligned. Under these conditions, motivation to engage in a behavior becomes strongest when it is perceived as both common and socially desirable (Cialdini et al., 2006). For example, in a study of college drinking habits, Lee, Geisner, Lewis, Neighbors, and Larimer (2007) showed that students' perceptions of their peers' approval of alcohol consumption increased the influence of a positive descriptive norm about student drinking. Similarly, studies in the environmental behavior domain have shown that perceptions of both high group involvement in (descriptive norm) and high group approval of (injunctive norm) engagement in conservation behaviors produces the highest rates of actual participant conservation behavior (Göckeritz et al., 2010; Schultz et al., 2008; Schultz et al., 2007).

Providing individuals with an aligned normative message

proves to be especially important in promoting persistent socially desirable behaviors. Schultz and colleagues (2007) provided a clear example of this effect in results from a field experiment aimed at encouraging energy conservation. Participants were first identified as either lower- or higher-than-average consumers. Participants who received only a descriptive norm gravitated toward that norm, even if their usage was below average—a phenomenon referred to as a “boomerang effect.” However, high-energy-using participants who also received an injunctive norm showed a sustained low level of consumption, thereby eliminating the boomerang effect. The authors suggest that reminding participants that conservation behavior is socially desirable affirmed their feelings that prior deviation from the social norm through above-average conservation habits was socially desirable and therefore justified.

In addition to perceptions of social approval, *personal involvement* has been shown to moderate the relationship between descriptive normative beliefs and behavior. Whereas injunctive norms exert a positive moderating effect (higher injunctive norms strengthen the relationship between descriptive norms and behavior), personal involvement has been found to exert a negative moderating effect. In a correlational study, Göckeritz et al. (2010) showed that individuals who were more personally involved in energy conservation showed a weaker correlation between descriptive norms and conservation behavior than did individuals who were less involved in the behavioral domain. Although this finding seems counterintuitive, the authors hypothesized that individuals with low personal involvement process information about the behavior differently than those with high personal involvement. The Elaboration Likelihood Model provides a useful theoretical framework for understanding this effect, and suggests that when people do not have strong pre-existing attitudes about a topic, they are more likely to be persuaded by easily accessible and “peripheral” messages than more reasoned ones (Petty & Cacioppo, 1986). The finding that low personal involvement may result in greater susceptibility to

normative messages is consistent with evidence that normative influence operates largely through peripheral processes (Cialdini, 2003). Individuals who are influenced by normative messages are unlikely to later attribute changes in their behavior to their changed perceptions of others' behavior, and instead will cite personal reasons for their actions (Griskevicius et al., 2008; Nolan et al., 2008).

The research findings on personal involvement and the potential processing differences between highly and less involved individuals suggests that *personal norms* might similarly moderate normative social influence. Personal norms are a person's internal standards for conduct that flow from internalized values (Cialdini et al., 1991; Schwartz, 1977). In essence, personal norms provide a moral obligation for engaging in a target behavior. While a number of studies have identified personal norms as a strong predictor of behavior (Eriksson, Garvill, & Nordlund, 2006; Hartland, Staats, & Wilke, 1999; Nordlund & Garvill, 2003; Steg & de Groot, 2010; Stern, 2000), no studies that we know about have experimentally examined its role as a moderator of other social influence strategies. Based on the Elaboration Likelihood Model referenced above, and the findings reported by Göckeritz et al. (2010), personal norms should exert a negative moderating effect. That is, when an individual has strong moral convictions about a topic, the level of social support for a behavior should exert little influence. Indeed, in these situations, we might observe an indignation effect whereby strong personal norms result in *more* behavior when others are not engaged in the behavior (cf. Hornsey, Majkut, Terry, & McKimmie, 2003; Hornsey, Smith, & Begg, 2007). Yet, for individuals with low personal norms, we would hypothesize a strong influence of normative information, especially when descriptive and injunctive normative messages are aligned.

A fourth potential moderator for normative influence is the medium used to convey the information. As noted above, normative social influence has been used to promote behavior change across a range of applied topics. However, to our knowledge, no study has tested the relative effectiveness of

various media. While classic studies of conformity used staged confederates to manipulate normative information, most contemporary applied studies have used media such as print, radio, or television. The most common medium for normative feedback has been through paper-based communications, in the form of leaflets, door hangers, or postal mail (Allcott, 2011; Allcott & Rogers, 2012; Collins, Carey, & Sliwinski, 2002; Ferraro & Price, 2011; Hill & Abraham, 2008; Schultz, 1999). Online normative feedback has also been used, although it has not been tested in large-scale experimental settings. However, the use of computer-based feedback offers some clear advantages over these paper-based feedback mediums in terms of cost, real-time feedback options, and scalability. In addition, the use of web-based, personalized normative feedback has proven to be successful in preventing event-specific behaviors (Lewis & Neighbors, 2006; Neighbors, Lee, Lewis, Fossos, & Waltern, 2009; Neighbors, Lewis, & Larimer, 2004).

Hypotheses

The aim of the current research was to examine the ability of norms-based messages to reduce residential water consumption. In a field experiment, we provided residents with feedback about their water consumption, compared with the neighborhood norm, and overlaid with an injunctive message of social approval (or disapproval). Based on the theoretical framework provided in the introduction, we formulated four hypotheses. First, we hypothesized that personalized normative feedback that aligned an injunctive and descriptive norm would cause a reduction in water consumption relative to the information-only and no-treatment control conditions. This is a conceptual replication of previous research using normative messages to reduce household electricity consumption, but as Fielding et al. (2012) note, very few experimental studies have tested strategies for water demand management. We hypothesized that this effect would occur for feedback delivered online and for feedback delivered via postal mail.

Second, we hypothesized that personal norms would moderate the effect, such that respondents with lower personal

norms would show larger reductions in consumption, relative to the information-only and no-treatment controls. This hypothesis was derived from Göckeritz et al. (2010) and from research by Hornsey et al., (2003, 2007), but has not yet been tested experimentally in a field context.

Third, we hypothesized that the moderating effect of personal norms would operate differently for the postal-mail versus web-based delivery, with postal mail producing a stronger moderation effect than web-based communications. For households in the postal-mail condition, we hypothesized a moderation effect in line with Hypothesis 2, whereby households with low personal norms would respond more favorably to an aligned norm message. However, in the web condition, we expected that the moderating role of personal norms would be attenuated due to selective exposure—that is, households with high personal norms would be more likely to look at the information on the web (because of the extra effort required). This hypothesis was intended to elaborate on the dual-process model that provided the foundation for Hypothesis 2. We reasoned that the extra effort required to access information via the web would result in participants who were more likely to process the message in an elaborated manner, thereby attenuating the hypothesized moderating effect associated with personal norms.

Finally, our fourth hypothesis was about the moderating role of prior water usage, and we predicted that descriptive normative feedback alone (without an injunctive element) would generate an especially strong moderating effect, consistent with previous research (Ferraro & Price, 2011; Schultz et al., 2007).

Method

Participants

A sample of 1,600 households received a postal-mail invitation to participate in the study and one-page survey about water use. These households were selected from three different socioeconomic regions of a San Diego suburb. Of the 1,600

households solicited, 505 responded to the survey. Of these, 360 households agreed to participate in the experimental portion of the study and provided signed consent for our team to access their water meters and for historical water usage data to be released from the local water company. Of the 360 households that opted to participate in the study, 35 were excluded from the experiment because their prior water usage was unavailable. An additional 24 households were excluded because they had inaccessible water meters. This resulted in 301 usable cases for analysis. Of the survey respondents, 53% were women and 47% were men. The mean age of the respondents was 50 years old ($SD = 14.25$). Ninety-one percent of the participants owned their home, the average household size was 3.60 people, 26% had children under the age of 18 living in the home, and 94% had home Internet access.

Materials

A survey was used to obtain demographic information, reported personal norms, and a signed release to access water data from the local utility. The survey also contained several measures that are not reported, including six items from the New Ecological Paradigm scale, questions measuring attitudes about landscaping with native plants, self-reported conservation behaviors, and personal values. Participants provided household information including the age and gender of the survey respondent and other information:

(a) number of children under the age of 10 in the home, (b) availability of Internet access, (c) owned or rented house, and (d) the total number of people living in the home.

Personal water conservation norms were measured with seven items, each rated on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The items were “I feel a personal obligation to save as much water as possible,” “I feel morally obliged to save water, regardless of what others do,” “I feel guilty when I waste water,” “People like me should do everything they can to reduce water use,” “It’s important to me that I conserve water every day,” “I am mindful of how much water I use in my daily behaviors,” and “I would be a better

person if I saved water.” Responses were averaged to create a personal norms scale score (Cronbach’s $\alpha = .91$; $M = 3.96$, $SD = 0.69$). These items were adapted from Steg, Dreijerink, and Abrahamse (2005).

Monthly water usage data for each household was obtained from the local water district, from July 2009 to August 2010. As part of the survey, respondents were asked to sign a release form allowing one-time access to their data, which we used as baseline and to populate the normative feedback treatment conditions. These data were provided in units of 100 cubic feet. Student researchers also collected water usage data for each household’s individual water meter before and after the experimental intervention. Water meters were read in cubic feet and then converted to gallons (each cubic foot corresponds to 7.48 gallons). For the current analyses, the water meter reads were converted into average units per day, by dividing the water usage by the number of days between meter reads.

Procedure

An initial survey of 1,600 residential addresses was conducted using Dillman’s Tailored Design Method (Dillman, 2007). Households first received a notification postcard in the mail explaining the study. Approximately 3 days later, households received a letter addressed to “current resident” encouraging them to complete an attached survey. The survey indicated that respondents must be at least 18 years of age. The survey included the demographic and psychological measures described above, and also requested signed consent to access their household water usage from the local water company.

Participants who met the criteria for inclusion in the experiment (i.e., returned the survey, signed the data release, had 12 months of historical water usage, and had an accessible water meter for our team to read) were notified about the experiment and informed that researchers from the university would be collecting water usage data by reading their individual water meters. Similar postcards were sent to all selected households, regardless of condition, and the study was described generically as “Water Use in North County.” This

postcard also indicated that households could opt out of the experiment by calling or sending an e-mail; none of the households opted out.

Baseline water usage data were obtained from the water company in monthly units. These data were used for the treatment conditions and for statistical analyses. For our dependent measure, trained research assistants conducted a water meter read of each household to obtain a post-treatment water usage data. In teams of two, researchers located each household's water meter and recorded each digit on the display. Water meters were easily located and read from the sidewalk in front of each house. Each member of the field team read the water meter and recorded the digits independently of each other. A reliability check was conducted for a subset of the homes, in which two researchers would read the meter and then cross-check the data to assess the reliability of the reads ($r = .88$). One week later, following the experimental intervention, researchers conducted another water meter read of each household following the same procedure. The difference between the two reads served as the outcome variable for the current study.

Design

The 301 eligible households were randomly assigned to one of seven experimental conditions using a simple random assignment procedure, which included three conditions that received all information through postal-mailed letters, three conditions that received information through an online website, and a no-treatment randomized control group. Households in the web conditions received a postal-mail letter containing a secure university URL, along with a unique login and password to access their personalized information. Households in the postal-mail conditions received a one-page home water report showing their personalized information in a printed format. The materials for all of the treatment conditions were delivered to the post office on the same date in early August.

Participants in the mailed and web-based conditions were randomly assigned to one of the three conditions. *Information-*

only ($n = 46$ web; $n = 38$ mail): Households received tips on how to reduce water consumption (no normative feedback). The tips were focused on specific behaviors, and adapted from brochure and website information distributed by the water company. *Descriptive norms* ($n = 44$ web; $n = 44$ postal): Households received the same tips about ways to reduce water consumption described above. In addition, households received personalized information about their own water usage compared with the water usage of similar households in their neighborhood (descriptive message). *Aligned norms* ($n = 42$ web; $n = 43$ mail): Households received tips about ways to reduce water consumption described above. In addition, they received personalized information about their water usage in comparison with similar households in their neighborhood accompanied by a happy or sad face conveying social approval or disapproval (descriptive and injunctive message). Participants who consumed less water than the average household in their neighborhood received a happy face, and those households who had consumed more than their neighborhood's average received a sad face. None of the households consumed an amount exactly equal to the average. The feedback was provided in gallons and based on the data obtained from the water utility.

Finally, a seventh condition served as a no-treatment randomized control ($n = 44$). These households received no information about the experiment. Thus, the overall design was a 2 (medium: web vs. mail) \times 3 (message: descriptive norm, descriptive + injunctive, information only) factorial design with a randomized control. In this design, the information-only condition serves as a primary control group, but we included a no-treatment control as a test of the effectiveness of information by itself.

Results

The primary dependent variable was the water usage in the week following the distribution of experimental materials, quantified as the average daily cubic feet (units). Because the water district provided only monthly data—and because our

intervention lasted only 1 week—we obtained a separate measure of household water usage for the week following our intervention. Examination of the distribution revealed three extreme outliers, which were Winsorized to be in line with the other usage readings. For the week-long post-intervention period, the average water consumption for the 301 households was 0.60 units per day ($SD = 0.39$; units represent 100 cubic feet, with each unit equal to 748 gallons). Using monthly data obtained from the water utility, the average daily water usage in the month preceding the intervention was 0.58 ($SD = 0.36$). This translates into 433.84 gallons per day (0.58×748). For international comparisons with other countries, this corresponds to a daily usage of 1,642 liters per household (433.84 gallons per day \times 3.785 liters per gallon). With an average of 3.60 individuals per household, this results in a daily per capita consumption rate of 456 liters, well above the national average of 370 reported in the introduction to this article.

Treatment Effects

To test for differences across treatments, we conducted an analysis of variance (ANOVA) with seven experimental conditions: web-based information, web-based descriptive norm, web-based aligned norm, postal-mail information, postal-mail descriptive norm, postal-mail aligned norm, and no-treatment control. Because of the potential for treatment effects to work differently among homeowners versus renters, we included home ownership as a between-subjects variable. In our initial analysis, two variables were used as statistical covariates: the average daily water usage during the month preceding our intervention (obtained from the water company) and the presence of children in the home (obtained from the survey data). Due to five cases of missing data, the working sample was reduced to 296.

The results from the analysis of covariance revealed several significant effects. First, the water usage in the prior month was a statistically significant covariate, $F(1, 281) = 355.05, p < .001$. Second, the analysis revealed a marginally significant

condition effect, $F(6, 281) = 2.00, p = .07$. Mean scores revealed that households in the control condition ($M_{\text{adjusted}} = 0.72, SE = 0.07, n = 43$) did not differ from households in the information-only conditions (web $M_{\text{adjusted}} = 0.63, SE = 0.04, n = 46$; mail $M_{\text{adjusted}} = 0.63, SE = 0.08, n = 38$). Because these conditions did not differ, they were combined into a single control condition. In addition, the medium of the distribution (web or mail) did not affect the dependent variable and were subsequently combined. With the conditions grouped, a new analysis of covariance comparing descriptive, norm-aligned, and combined control revealed a significant main effect for condition, $F(2, 288) = 3.66, p = .027$. The combined comparison group ($M_{\text{adjusted}} = 0.68, SE = 0.05, n = 127$) used significantly more water than households in the descriptive feedback condition ($M_{\text{adjusted}} = 0.50, SE = 0.047, n = 86$), $t(288) = 4.91, p < .001$, and those in the aligned norm condition ($M_{\text{adjusted}} = 0.57, SE = 0.045, n = 83$), $t(288) = 2.97, p = .01$.¹ The descriptive and aligned norm conditions did not differ significantly from each other.

Moderation

Having demonstrated a significant main effect for the experimental treatments (Hypothesis 1), our analyses proceeded to directly test our hypotheses about moderators. Our first moderated hypothesis was that residents with higher personal norms would be less influenced by normative messages than residents with low personal norms (Hypothesis 2) and that this effect would be in opposite directions for households who received web-based versus postal-mail messages (Hypothesis 3). In matching the survey measures of personal norms to the water usage data from our meter reads, we found a differential pattern of web hits across the conditions. Across the three web-based conditions, only 26 of the 141 households hit the website at least once (4 = *information only*; 12 = *descriptive norm*; 10 = *aligned norm*). Given the small sample size for hitters, we did not perform moderation analyses with the web conditions. Examination of the mean scores

revealed a pattern in line with our hypotheses: households that hit the website had lower levels of baseline water usage, higher personal norms, and a range of more favorable proenvironmental attitudes including awareness of consequences and ascription of responsibility, but these effects were not statistically significant. The treatment effects did not differ across the two groups (hitters and non-hitters), and regardless of whether the household hit the website or not, the two feedback conditions used less water than the controls during the post-intervention period. Unfortunately, the small number of residents who hit the website pre-vented further analyses of the hypothesized moderation effect for personal norms in the web condition, and subsequent analyses of moderation effects reported below are based only on households in the postal-mail treatment conditions.

Baseline water usage as a moderator.

Our second set of moderation analyses focused on the postal-mail condition and the differential response for high and low water-using households. Our first analysis here examined the role of baseline water usage in both the descriptive and the norm-aligned messages. We began by testing the main effect for the treatment, separately for those households in the postal-mail condition. A 4 (condition: control, information only, aligned norm, descriptive norm) \times 2 (ownership: owned, rented) analysis of covariance (ANCOVA) was performed using the observed water consumption one week after the treatment as the dependent variable. Household water usage in the month prior to the intervention was used as a covariate, along with the presence of children in the home. The results showed a significant effect for condition, $F(3, 155) = 3.06, p = .03$, and for baseline water usage, $F(1, 155) = 131.75, p < .001$. Mean scores showed that the control condition ($M_{\text{adjusted}} = 0.69; SE = 0.07$) used significantly more water than the descriptive norm condition ($M_{\text{adjusted}} = 0.39; SE = 0.07$). The information-only condition ($M_{\text{adjusted}} = 0.62; SE = 0.08$) and aligned norm condition ($M_{\text{adjusted}} = 0.56; SE = 0.07$) did not differ significantly, although the pattern of means was in the

expected direction. The moderating role of baseline water usage (high or low) was tested through a series of planned interactions. For each of the postal-mail conditions (descriptive norm, aligned norm, information only), a dichotomous contrast was computed (0 = *control*, 1 = *treatment*). A multiplicative term was then computed as the product of baseline water usage (continuous) and the dichotomous treatment. This multiplicative term was then tested using regression, with post-treatment water usage as the dependent variable. Baseline water usage was entered on the first step, followed by the dichotomous treatment variable and the multiplicative term (see Aiken & West, 1991, for more details on this procedure). The analyses were conducted using centered predictor variables (descriptive norm condition centered $M = 0$, $SD = 0.50$; baseline usage centered $M = 0$, $SD = 0.36$). For the descriptive norm condition, the results showed a significant effect for baseline usage (constant = 0.575, $b = 0.536$; $SE = 0.096$, $t = 5.61$, $p < .001$), a significant main effect for the descriptive norm treatment ($b = -0.142$, $SE = 0.063$, $t = -2.25$, $p = .027$), and a significant multiplicative term ($b = -0.53$, $SE = 0.19$, $t = -2.77$, $p = .007$). This analysis was followed with simple slopes equations in which post-treatment water usage was regressed onto baseline usage separately for the control and treatment conditions. The results are shown in Figure 1. As shown in Figure 1, households with high baseline usage showed markedly lower consumption compared with the control group after receiving a descriptive norm message, whereas households with low baseline usage showed a slightly elevated rate of consumption compared with the control condition.

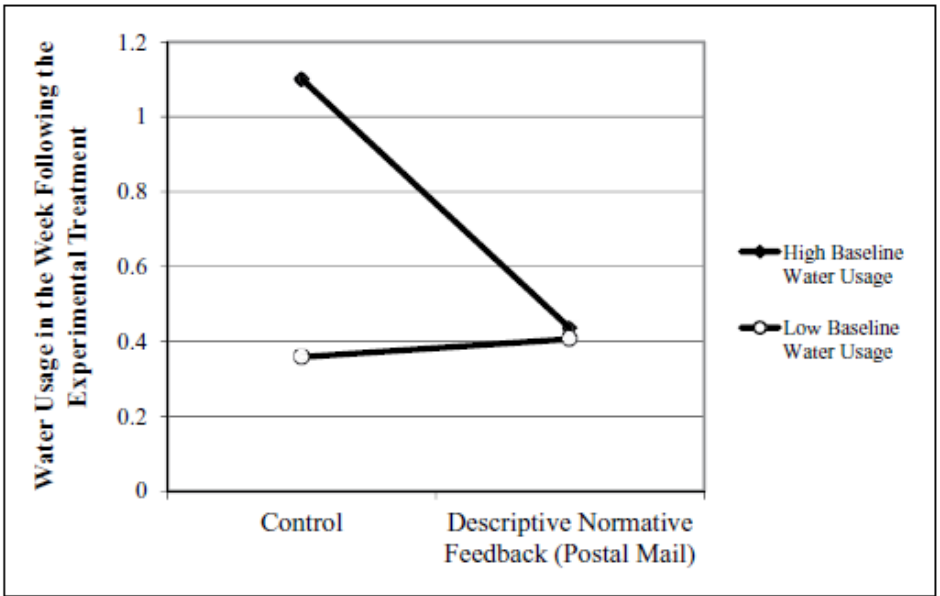


Figure 1. Post-treatment water usage regressed onto control versus descriptive normative feedback for low and high water baseline consumption.

Note. Water usage was measured in units of 100 cubic feet per day. For conversion, each unit equals 748 gallons.

A similar contrast was performed for the aligned norm condition. The results showed a significant effect for baseline water usage (constant = 0.628, $b = 0.864$, $SE = 0.085$, $t = 10.16$, $p < .001$), but neither the treatment ($b = -0.043$, $SE = 0.059$) nor the multiplicative term were significant ($b = 0.096$,

$SE = 0.171$). Finally, the same analysis was conducted for the information- only condition versus the no-treatment control. Results showed a significant effect for baseline water usage (constant = 0.647, $b = 0.915$, $SE = 0.106$, $t = 8.62$, $p < .001$), but neither the treatment effect ($b = -0.011$, $SE = 0.067$) nor the multiplicative term ($b = 0.212$, $SE = 0.213$) were statistically significant.

Personal norms as a moderator.

Finally, we tested the moderating role of personal norms on the treatment effect (Hypothesis 3). These analyses focused on households in the three postal-mail treatment conditions, contrasted with the randomized control. The analyses were complicated by the fact that personal norms were predictive of baseline water usage ($r = -.23$, $p = .002$ across the full sample). Thus, for these analyses, we controlled for the baseline usage before exploring the multiplicative interaction of personal norms. As with the previous analysis, the moderating role of personal norms was tested through a series of planned interactions. Baseline water usage was entered on the first step, followed by the dichotomous treatment variable, personal norms (continuous), and the multiplicative term (see Aiken & West, 1991, for more details on this procedure). As with the previous analyses, computations were performed using centered predictors (Centered Personal Norms $M = 0$, $SD = 0.69$).

For the descriptive norm condition (Centered $M = 0$, $SD = 0.50$), the results revealed a significant effect for baseline water usage (Centered $M = 0$, $SD = 0.36$; constant = 0.615; $b = 0.554$, $SE = 0.11$, $t = -5.06$, $p < .001$) and a significant effect for treatment ($b = -0.198$, $SE = 0.08$, $t = -2.47$, $p = .016$). The personal norms effect was not statistically significant ($b = -0.093$, $SE = 0.058$, $t = -1.60$, $p = .12$), nor was the multiplicative interaction term ($b = 0.172$, $SE = 0.118$, $t = 1.45$, $p = .15$). For the aligned norm condition, the results showed a significant effect for baseline water usage (constant = 0.656, $b = 0.899$, $SE = 0.077$, $t = 11.71$, $p < .001$), a significant effect

for the aligned norm condition ($b = -0.134$, $SE = 0.062$, $t = -2.16$, $p = .035$), a non-significant effect for personal norms ($b = -0.073$, $SE = 0.047$, $t = -1.57$, $p = .12$), and a significant treatment by personal norm interaction ($b = 0.189$, $SE = 0.093$, $t = 2.02$, $p = .047$). Simple slopes analyses were conducted, and the results are shown in Figure 2. As shown in the figure, households with low personal norms had a marked reduction in water consumption after receiving normative feedback compared with the control condition, whereas households that were high in personal norms showed relatively little effect associated with the aligned normative feedback. Interestingly, households with low personal norms used less water than households with high personal norms after receiving aligned normative feedback.

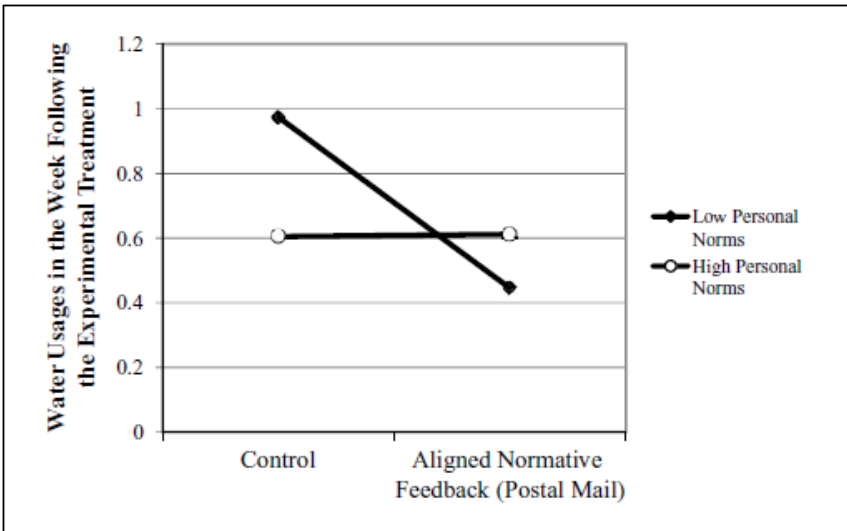


Figure 2. Post-treatment water usage regressed onto control versus aligned normative feedback for participants with low and high personal norms.

Note. Water usage was measured in units of 100 cubic feet per day. For conversion, each unit equals 748 gallons. The aligned normative feedback condition received both descriptive normative feedback combined with an injunctive emoticon.

Finally, a similar analysis was performed for the information-only condition, testing for the moderating effect of personal norms. Results showed that baseline water usage was significant (constant = 0.685, $b = 0.925$, $SE = 0.120$, $t = 7.70$, $p < .001$). The other predictors—personal norms, treatment, and the multiplicative term—were not significant.

Discussion

The reported field experiment contributes to the small but growing body of work examining strategies to manage demand for water. The reported experiment focused on the role of normative messages in reducing residential water consumption, along with several moderators suggested in prior research. First, the results replicate previous findings showing that normative messages can produce a reduction in residential water consumption. Interestingly, tests of the information-only condition showed that providing tips about ways to save water did not produce a significant reduction in water consumption relative to a no-treatment control. Second, the results showed that base-line water usage moderated the influence of a descriptive norm message, but not an aligned norm message containing both a descriptive and an injunctive normative element. And finally, we showed that personal norms moderated the influence of an aligned norm message.

First, the results showed an overall reduction in residential water consumption for households that received either a descriptive or an aligned norm message. This effect was observed in the week following the intervention, with the descriptive norm condition using 26% less than the control condition (0.50 compared with 0.68, in units of 100 cubic feet) and the aligned norm condition used 16% less (0.57 compared with 0.68). This basic effect replicates previous studies (Allcott, 2011; Ferraro & Price, 2011; Schultz et al., 2007) and demonstrates that the approach can be effectively applied to water (see also Fielding et al., 2013). Interestingly, the effects observed in this study are larger than those obtained in prior studies of residential electricity (Schultz et al., 2007 reported an aggregated difference of 6% for an aligned norm mes- sage vs.

control; Nolan et al., 2008 reported a difference of 10% for a descriptive norm message vs. control).

While the research findings from this study show a clear effect for normative messages, notable is the lack of an effect for information only. The information-only condition provided residents with helpful tips about ways to reduce water consumption in and around their homes, but did not provide any reason for reducing consumption. This approach is commonplace in many applied domains and yet has consistently been found in behavioral research not to induce change (Mckenzie-Mohr, 2011; Mckenzie-Mohr, Lee, Schultz, & Kotler, 2012; Schultz, 2002). Our results replicate previous findings in showing that information-only communications are generally not sufficient to induce changes in behavior. Interestingly, the information-only condition did not interact with personal norms, suggesting that even for individuals who have a strong moral obligation to reduce their consumption, information is not sufficient to induce change (likely because these individuals already engage in efforts to reduce consumption).

Another finding from the current experiment is the low number of participants who accessed the web-based materials. Of the 141 households assigned to receive web-based materials, only 26 (18%) hit the website. This was especially surprising, given the level of interaction and involvement that our research team had with the participants. All 141 of these households completed our survey about water consumption; they all had Internet in their homes; they all agreed to have their water data released to us from the utility; and they all received a postcard alerting them to our project. In addition, there were a number of verbal exchanges (all positive) between the residents and our research team. In several cases, the resident assisted our research team in locating the underground water meter in their yard. While these results call into question the viability of web-based intervention strategies, it is important to note that the approach used in this article required considerable effort on the part of the resident. The recent growth of “push” technologies in which information is sent to a device (often a smartphone)

without the need for the person to request it may lower the difficulty threshold and make this a more viable channel for reaching large numbers of people.

Finally, our results showed two meaningful moderator effects. First, we found that baseline water usage moderated the descriptive norm message but not the aligned norm message. For households that were high in baseline water use, the descriptive normative feedback produced a reduction in consumption. But for low water usage, the descriptive norm feedback condition created a trend toward increased consumption. This effect has been termed the “magnetic middle” by Goldstein, Martin, and Cialdini (2008) and documented in a study by Schultz et al. (2007) in which a descriptive norm-only message produced reductions in electricity consumption for high-using households, but an increase for low-using households. Similarly, Ferraro and Price (2011) showed that descriptive normative information about the amount of water consumed by neighbors resulted in nearly twice as much reduction in water consumption for high users (5.28%) compared with low users (2.72% relative reduction; see also Lewis & Neighbors, 2006; Mansur & Olmstead, 2007). The lack of moderation for the aligned norm message in the current study is also consistent with Schultz et al. who showed that adding an injunctive element eliminated the boomerang effect but that high-using households continued to reduce their consumption. Thus, with an aligned norm message in which both groups showed reduced consumption, there is no interaction for baseline usage.

The final moderator effect showed that personal norms moderated the influence of the aligned norm message, but not the descriptive norm. While we had hypothesized that personal norms would moderate both the descriptive norm and the aligned norm message, the results do show that normative information is evaluated differently for people who feel a strong obligation to reduce their consumption. Our results suggest that it is the person who has a low level of moral obligation who is most influenced by the aligned normative message. This effect has been suggested in prior correlational research (Göckeritz et

al., 2010), but it has not been previously demonstrated experimentally. As suggested by dual-process models to persuasive communications, individuals who do not care about a topic are more likely to utilize peripheral processing for these messages, and are therefore more influenced by subtle cues about the behavior of others. In contrast, individuals who care a great deal about a topic are more likely to use a central route to process the message, and are less likely to be persuaded by subtle normative cues.

While the findings from the study show that normative messaging offers a promising tool for managing residential demand for water, it is important to note the opt-in design of the study. The sample was selected from diverse regions of a single city in California and therefore may not generalize to other regions. In addition, the participants in our study were identified through a selection process and all of them completed a survey and agreed to participate. It is likely that such participants may hold stronger personal norms about water conservation than non-responders, and therefore may have been more receptive to our treatment conditions. However, the experimental nature of the study design means that this is not a confound, but instead a problem of generalizability and external validity. In addition, it is important to note that there was considerable variability in household water consumption, even within the treatment conditions. Given our limited interactions with participants, we could not account for individual household fluctuations in water consumption due to temporary events such as residents away on vacation or visiting guests. Fortunately, the experimental nature of the study design means that this is not a confound, but it does increase the variability in our measure of household water consumption.

The results from the reported experiment show the potential influence of normative messages on water consumption. From an applied perspective, the consumption of fresh water represents a critical social issue and environmental issue around the world. Especially in arid regions such as the West Coast of the United States, Northern Mexico, much of Australia, the Middle East, various parts of Africa, and many

other regions of the world, efficient use of fresh water is a critical issue. While water desalinization offers a potential technical solution, the cost and resources required to process fresh water are prohibitive. As a result, behavioral solutions designed to reduce demand are critical, and environmental psychologists can play an important role in proposing and testing effective strategies (as well as recommend what to avoid).

Authors' Note

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Note

1. For comparison, the data were also analyzed using a 7 (condition) \times 2 (home ownership: rented or owned) \times 2 (time: baseline and post-intervention) mixed model ANOVA, with time as a repeated factor. The results showed the hypothesized Time \times Condition interaction, $F(6, 285) = 2.33, p = .03$. Follow-up analyses showed that the control condition increased over time ($M = .50, SE = .10$ prior to intervention, and $M = .64, SE = .10$ post-intervention). The web-based information-only condition showed a similar increase (from $M = .66, SE = .05$ to $M = .69, SE = .06$) as did the postal-mail information-only condition ($M = .54, SE = .11$ to $M = .60, SE = .12$). The descriptive norm feedback condition decreased for the postal-mail condition ($M = .70, SE = .10$ to $M = .50, SE = .10$) and for the web condition it remained flat ($M = .58, SE = .10$ to $M = .58, SE = .10$). The aligned norm condition remained flat for the postal-mail condition ($M = .54, SE = .10$ to $M = .54, SE = .10$) and the web condition decreased ($M = .52, SE = .09$ to $M = .50, SE = .10$). The average correlation in usage across time (from pre-intervention to post-intervention) was $r = .76$.

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