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Don't rush to flush

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ABSTRACT

Encouraging sustainable water use is a critical endeavor in addressing issues associated with short- and long-term droughts. Toilets account for up to 26.7% of indoor household water use. Therefore substantial opportunity exists to conserve water via reduced flushing after urination at home. Here, we use an online survey ($N = 1008$) to identify barriers to reduced flushing. The majority of participants reported they always flush (63%) and believed that others should always flush. Social norms surrounding cleanliness are the most prevalent reasons for flushing. Results suggest four main barriers to reducing flushing: disgust sensitivity, habitual nature of flushing, norms regarding cleanliness, and lack of pro-environmental motivations. Participants who always flush are less likely to sacrifice for the environment than occasional flushers. Participants tended to underestimate average American water use and their own water use. Targeted interventions to decrease urine-related disgust and increase pro-environmental motivations may help achieve water conservation goals.

1. Introduction

Sustainable water use is an important and critical component in addressing contemporary and interconnected problems of global climate change, drought, and human welfare. Climate change models indicate that water availability may significantly decrease in arid regions already challenged by water shortages (Brusca et al., 2013; Cook, Ault, & Smerdon, 2015). Issues of water inequality can cause significant conflict between upstream users and the water have-nots downstream. These conflicts may be localized tensions between neighbors or much broader conflict between countries (Rozin, Haddad, Nemeroff, & Slovic, 2015). In either case, excessive and unsustainable water use by some at the expense of basic water needs of others is a problem that could be avoided. Therefore, understanding barriers to reducing water use is an important research need.

An individual's bare minimum water requirement is approximately 13.2 gallons per day (Gleick, 1996), yet the average American uses about 98 gallons of water per day (Kenny et al., 2009). Although outdoor water use varies significantly across regions, daily per capita indoor water use averages about 69.3 gallons, and toilets account for 26.7% of this indoor household water use (Mayer et al., 1999). Inskeep and Attari (2013) estimate that decreasing the number of flushes per household per day has the potential to decrease 7% of total indoor water use. Thus, with individuals averaging about 5 flushes per day (by their estimate), substantial opportunity exists to conserve water via reduced flushing after urination at home.

Here we explore self-reported flushing behaviors and identify barriers to water conservation via reduced flushing. To our knowledge, only two studies directly address the question of flushing frequency (Gilg & Barr, 2006; Randolph & Troy, 2008). Both studies found evidence of people's willingness to reduce water consumption through several actions, including using the half flush on a dual flush toilet, but few participants were willing to flush less frequently. To our knowledge, no studies have quantified motivations for such strong opposition to reducing the number of flushes at home.

Potential barriers to changing flushing behavior include the habitual nature of flushing, urine-related disgust sensitivity, and social norms regarding toilet cleanliness (Stern, 2000). Given that Americans average five flushes per day and flushing requires little effort or thought, flushing is most likely a highly habitual behavior. Although dual process models suggest that explicit attitudes would not influence habits, which are automatic as opposed to conscious (Smith & DeCoster, 2000), breaking a habit may require making the behavior effortful or salient to other values and norms. Thus, reversing habitual flushing behaviors may require increasing

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motivation to conserve water through personal or social pro-environmental norms (Dahlstrand & Biel, 1997; Stern, 2000).

Disgust and related fear of contamination also may be a barrier to reducing flushing (Haidt, McCauley, & Rozin, 1994; Tybur, Lieberman, & Griskevicius, 2009). Urine usually does not have a high concentration of pathogens (WHO, 2006), but disgust eliciting factors may include the smell and sight of urine (Ilemobade, Olanrewaju, & Griffioen, 2012; Lundblad & Hellström, 2005; Olatunji, Haidt, McKay, & David, 2008). Feelings of disgust function to protect the individual from disease and, like habit, are most likely unconscious reactions. Given that individuals vary in their disgust sensitivity, measuring how commonly urine elicits disease avoidance behaviors (i.e., disgust-motivated flushing) among participants is important to understanding barriers to reduced flushing. Disassociating urine with disgust among those who are sensitive could include psychological approaches (e.g., changing attitudes about urine) or technical fixes that eliminate disgust-eliciting factors (i.e., sight, smell; Rachman, 2004; Rozin et al., 2015).

Related to the idea of disgust, social norms regarding toilet cleanliness may also influence flushing behaviors. Common expectations of encountering urine-free toilets may exert strong social pressure. Embarrassment about leaving urine in a toilet may create a significant barrier for individuals who might otherwise be motivated to conserve water via reduced flushing. Measuring the role of such norms will be integral to overcoming barriers to flushing less.

Increased understanding of how to encourage adoption of the "if it's yellow, let it mellow" approach will help increase water conservation. Research suggests potential for environmental concern and related motivations to influence water use behaviors (Gilg & Barr, 2006; Willis, Stewart, Panuwatwanich, Williams, & Hollingsworth, 2011). Social norms that pressure people to conserve water for the greater good may be more influential than cleanliness concerns (Shove, 2003). If pro-environmental norms are stronger than cleanliness norms, people may be willing to reduce flushes, or may already be doing so. Furthermore, experience with drought may increase risk perceptions that in turn influence environmental concern and encourage water conservation (Weber, Blais, & Betz, 2002; Zaval, Keenan, Johnson, & Weber, 2014). Household-level behavior strongly influences the entire water management system, and thus understanding and changing motivations for water use behaviors can provide more effective solutions compared to extensive infrastructure overhaul (Grant et al., 2012). Exploring these relationships and how they compete with social norms about cleanliness can provide a robust model that predicts flushing behavior.

In this study we quantify flushing frequency and identify barriers to decreased flushing by measuring the extent to which disgust, drought experience, risk perception, habit, environmental concern, social norms, and other factors might influence flushing behavior. Our objective is to increase knowledge of how to encourage water conservation through one of the most water intensive indoor household activities.

2. Methods

2.1. Participants

In December 2014, we recruited 1008 participants via Amazon's Mechanical Turk (MTurk) Internet panel who completed the survey online. MTurk is a somewhat new and commonly used platform for psychological studies, and has been shown to produce reliable data that is significantly more diverse than traditional college samples (Buhrmester, Kwang, & Gosling, 2011; Paolacci, Chandler, & Stern, 2010). Each participant received a $1 gift certificate to Amazon.com on completion. Participants were screened by location (U.S.) and age (18 years or older). Median age was 33 years (compared with 37.2 years in the U.S.; Census 2010), median level of education was some college or a college degree (35.4% have an associate's degree or more in the U.S.), and median family income was $40,000 ($50,054 in the U.S.; Census 2010). Fifty-seven percent of participants were male (49.2% in the U.S.; Census 2010), and 53% self-identified as liberals, 25% as moderates, and 22% as conservatives. These trends may indicate some selection or response bias; like many online surveys, participants tended to be younger and male compared to U.S. Census data (Ansolabehere & Schaffner, 2014; Bell, Huber, & Viscusi, 2011).

2.1.1. Survey materials

All questions in the survey focused on flushing after urination at home. The survey began with a closed-ended item measuring flushing frequency at home: "How often do you flush after you urinate at home?" with five response options (never, sometimes, half of the time, most of the time, always). The survey then branched to an open-ended item asking about reasons for flushing behaviors, worded specifically for either participants who indicated they (a) always flush (response "Always") or (b) do not always flush (responses "Never", "Sometimes", "Half of the time", and "Most of the time") after urinating at home. We chose separate branching with unique wording because we expected participants who always flushed to be different from occasional flushers. All participants then completed the same items for the rest of the survey. Closed-ended, multiple-choice questions using 5-point Likert scales were used to measure attitudes, beliefs, and behaviors discussed in greater detail in the sections below. This research was approved by Indiana University's Internal Review Board at the Office of Research Administration, and informed consent was received from all participants. The complete survey can be found in Appendix A.

2.1.2. Reasons for flushing behavior

Through literature review and pre-testing, we identified 17 potential reasons that might influence people's flushing behavior at home that were asked to participants on a Likert scale (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Disagree and 5 = Strongly disagree). We first asked about internal, psychological influences such as: habit, upbringing, convenience, social norms, and other perceptions about toilet cleanliness and disgust related to sight and smell of urine. We also asked about external or physical influences including saving money on a water bill, clogging the toilet, urination frequency, waking a partner or roommate, and how often one wants to clean the toilet.

2.1.3. Encountering urine in the toilet

We posed a scenario of encountering urine in a home toilet to gauge whether reduced flushing on the part of one individual might increase flushing for others. We asked participants what they would do if they encountered (a) their own urine, (b) a significant other's urine, and (c) a guest's urine in their toilet at home, with response options (1 = Flush then use toilet, 2 = Use toilet then flush, 3 = Use toilet but not flush, 4 = Other, please specify).

2.1.4. Perceptions of household water use

Using open-ended responses, we asked participants to estimate how much water the average American uses, how much they use, how much a single flush uses, and how much water is used in total by flushing in a typical day. Questions were adapted from Attari (2014) and were intended to gauge whether misperceptions of water use related to toilet flushing were prevalent among our sample.

2.1.5. Willingness to conserve water in the bathroom

We included seven items to measure participants' willingness to engage in various water conservation behaviors in the bathroom, including reduced flushing, checking for leaks, installing a toilet tank insert (to displace water and reduce water/flush), and replacing their current toilet with more efficient options (1 = Not willing at all, 2 = Moderately willing, 3 = Extremely willing, 4 = I already do this).

2.1.6. Willingness to sacrifice via reduced flushing

We measured participants' willingness to make sacrifices for the environment via reduced flushing, adapting similar measures from Davis, Le, and Coy (2011), Etcheverry and Le (2005) (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Disagree and 5 = Strongly disagree). We created a composite variable by averaging responses to the 6 items ($\overline{X} = 3.53$, standard deviation [SD] = 0.90, $\alpha = 0.92$). We also assessed the perception that reduced flushing would not be worthwhile because other people would not be willing to do so (further referred to as the drop in the bucket concept; Attari, Krantz, & Weber, 2014).

2.1.7. Experience with and risk perception about drought

Risk experience was measured by participants' self-reports regarding whether they lived in a drought prone area, were currently experiencing drought, or had experienced drought in the past month or year (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Disagree and 5 = Strongly disagree). Risk perception was assessed by asking participants whether they thought drought to be a serious problem and if they conserved water to address this risk. We created a composite variable by averaging responses to the six items ($\overline{X} = 2.34$, SD = 0.99, $\alpha = 0.90$).

2.1.8. Disgust sensitivity

In additional to the urine-specific disgust questions described above, contamination-based disgust sensitivity was assessed using an abbreviated scale adapted from Haidt et al. (1994) and Olatunji et al. (2009).[1] We created a composite variable for contamination-based disgust by averaging responses to the six items ($\overline{X} = 2.73$, SD = 0.83, $\alpha = 0.75$).

3. Results

3.1. Current and future flushing behaviors

Of the total sample of 1008 participants, 63% reported they always flush after urinating at home, 22% flush most of the time, 9% flush half of the time, 5% flush sometimes, and 0.3% never flush. Sixty-five percent of participants indicated they believed that people should always flush after urinating at home. Sixty-seven percent of women and 61% of men reported always flushing ($t = 2.04$; $p < 0.05$).

We measured willingness to flush less in the future, along with other conservation behaviors that occur in the bathroom (see Appendix B). Overall, participants were most willing to conserve water only if drought occurred or water prices increased, to install a toilet tank insert, and to check for leaks. Occasional flushers showed higher average willingness to engage in all water conserving behaviors than those who always flush. Occasional flushers were significantly more willing to flush less ($t = 27.89$; $p < 0.0001$), install a toilet tank insert ($t = 2.29$; $p < 0.05$), conserve if prices increase ($t = 9.41$; $p < 0.0001$), and conserve if drought occurred ($t = 6.38$; $p < 0.0001$). Of our sample, 33% reported having a low-flow toilet, 7% reported having a toilet tank insert installed, 5% reported having a dual-flush toilet installed, and only 2% reported having a composting toilet.

3.2. Open-ended reasons

To analyze reasons for always or occasionally flushing separately, two raters coded participants' first three reasons from the open-ended responses. The interrater reliability was high for the first reason ($\kappa = 0.68–0.70$) corresponding to substantial agreement for each set of codes (Landis & Koch, 1977). Table 1 shows the frequency of the first three reasons mentioned in the open-ended responses. The most common open-ended response for always flushing was contamination-based (e.g., using words like disgusting, unhygienic, unsanitary) followed by avoiding smell. Before any prompting about environmental concerns, always flushers mentioned that water conservation did not seem like a sufficient reasons to encounter urine in the home toilet. The most common open-ended response for not always flushing was to save water, either for environmental or financial reasons. Even among occasional flushers, participants mentioned that the presence of others (e.g., partners, roommates, guests) influenced when they decided to flush.

3.3. Influences on current and future flushing behaviors

Descriptive statistics revealed that social norms surrounding cleanliness (i.e., embarrassment and expectations that guests do not want to encounter urine left in a toilet at home) were the most agreed upon reasons for flushing among the entire sample (all show >84% agreement). Being taught to always flush (87% agreement) and the habitual nature of flushing (80% agreement) were also predominant behavioral motivations. The smell of urine (81% agreement) was a stronger elicitor of disgust compared to the sight of urine (60% agreement).

As expected, flushing frequency and willingness to flush less were negatively correlated ($r = -0.69$, $p < 0.0001$). Flushing frequency was positively related to all 17 flushing reasons (see Appendix B) including the belief that reduced flushing is a sacrifice, disgust sensitivity, and the drop in bucket concept. Flushing frequency was negatively related to drought risk perception/experience and willingness to sacrifice via reduced flushing. Age and male gender were negatively correlated with flushing frequency (both $r = -0.08$; $p < 0.01$). Political ideology (higher numbers denote conservative ideology) was positively correlated with flushing frequency ($r = 0.07$; $p < 0.05$). Willingness to flush less was related to all the same independent variables (except age) as flushing frequency but in the opposite direction (i.e., positive relationships were negative and vice versa).

Multiple regressions revealed explanatory factors for a model explaining flushing frequency (sum of squares = 576.86, df = 5, $R^2 = 0.73$; Table 2) that consisted of habit, sight-related urine disgust, and willingness to sacrifice via reduced flushing. Similarly, the model explaining willingness to flush less (sum of squares = 723.44, df = 5, $R^2 = 0.63$; Table 2) consisted of the same three variables (habit, sight-related urine disgust, and willingness to sacrifice) plus drought risk perceptions and belief that reduced flushing requires a personal sacrifice.

3.4. Always flushers versus occasional flushers

Participants who always flushed versus occasional flushers differed in their self-reported toilet behaviors and their motivations for flushing (see Fig. 1). Always and occasional flushers significantly

[1] For more details and the complete DS-R scale, see http://people.stern.nyu.edu/jhaidt/disgustscale.html.

Table 1
Top five open-ended reasons for always or occasionally flushing (percentages calculated within each group).

Reason for always flushing (n = 638)	%	Reason for occasionally flushing (n = 370)	%
Fear of contamination	57	Save water	43
Smell	42	Flushing in presence of others	31
Social norms/manners	25	Clear urine/hydrated, thus not necessary	23
Maintain clean toilet	18	Save money	12
Taught/habit	10	Forget to flush	10

Table 2
Regressions predicting flushing frequency and willingness to flush less in the future.

Parameter	Flushing frequency		Willingness to flush less	
	B	SE	B	SE
Intercept	2.09**	0.11	3.30**	0.15
Habit	0.57**	0.01	−0.42**	0.02
Drought risk perceptions	−0.006	0.01	0.07*	0.02
Reduced flushing is sacrifice	0.008	0.01	−0.12**	0.02
Sight-related disgust	0.05**	0.01	−0.09**	0.02
Willingness to sacrifice	−0.08**	0.02	0.37**	0.03

*p = 0.001 **p < 0.0001.

differed by every measure of willingness to sacrifice (composite willingness to sacrifice: t = 13.37; p < 0.0001); occasional flushers showed greater willingness to sacrifice for the environment ($\overline{X} = 4.00$) than always flushers ($\overline{X} = 3.27$). Always flushers showed significantly greater belief that flushing less would not be worthwhile because of others' lack of compliance (i.e., drop in bucket concept; $\overline{X} = 2.79$) compared to occasional flushers ($\overline{X} = 2.24$; t = −7.85; p < 0.0001). Always and occasional flushers significantly differed by overall drought-related risk perception (composite risk perception: t = 2.65; p < 0.01) and specifically by two items from the overall risk perception index: believing drought to be a serious problem (t = 4.17; p < 0.0001) and living in a drought prone area (t = 2.36; p < 0.02). Occasional flushers showed greater drought-related risk perception ($\overline{X} = 2.45$) than always flushers ($\overline{X} = 2.28$).

We asked participants to imagine they had walked into their bathroom at home and what they would typically do if they encountered urine in their toilet. Overall, 68% of participants reported that they would flush first when encountering a guest's urine. About 50% of participants reported that they would flush first when encountering a significant other's urine. Twenty-eight percent reported that they would flush first when encountering their own urine. Always and occasional flushers significantly differed in their responses to each scenario (own urine: t = 17.00; significant other's urine: t = 13.35; guest's urine: t = 9.09; all p < 0.0001; see Fig. 2).

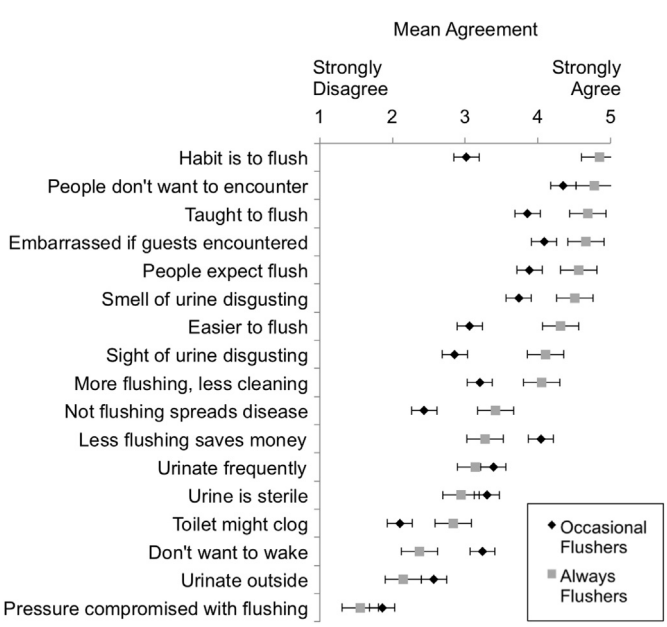

Fig. 1. Mean agreement for flushing reasons differ between always and occasional flushers. Error bars indicate standard errors.

3.5. Actual versus perceived water use

Participants estimated that an average flush uses 3.6 gallons (std. dev. = 22.69; median = 2), which accurately reflects common toilet models found throughout the U.S. Overall, participants perceived that the average American uses 39.5 gallons of water per day indoors (std. dev. = 58.77; median = 20) when in reality Americans average about 69.3 gallons per day indoors (Mayer et al., 1999). Overall, participants underestimated their own water use to a larger degree, indicating they use on average 29.2 gallons per person per day indoors (std. dev. = 41.03; median = 15).

4. Discussion

Results highlight four main barriers to reduced flushing among our sample of participants: disgust, habit, social norms, and insufficient pro-environmental motivation, all related to increased flushing. Below we address each of these barriers to water conservation via reduced flushing and highlight literature that suggests how these barriers might be overcome. Identifying specific barriers to decreased flushing after urination at home will inform efforts to increase household water conservation.

Results suggest that disgust sensitivity leads to increased flushing. Urine left in the toilet, especially the smell of urine, may trigger contamination fears among those who are disgust sensitive. Anecdotally, open-ended responses suggest urine may have magical contagion properties (Haidt et al., 1994) for some participants. For example, some participants stated “Not flushing the toilet can cause breathing issues and the spread of unwanted germs, bacteria, and other potentially hazardous chemicals, odors, and microorganisms,” and “flushing urine every time decreases the risk of disease in the air.” In other words, some always flushers perceived that unsanitary elements of urine can transfer beyond the toilet bowl and contaminate the rest of the bathroom, other areas, and even air in the home. Additionally, urine of unrelated others may be considered more disgusting (see Fig. 2), a finding supported by the broader disgust literature (Olatunji et al., 2009, 2012). Disassociating urine with disgust among those sensitive could include technical fixes that eliminate disgust-eliciting factors, such as deodorizing pouches that mask the smell of urine in the bathroom. Psychological approaches (e.g., changing attitudes about urine) may also successfully dissociate urine with disgust. Research on disgust in general and in relation to recycled water provides evidence for the intuitive nature of contamination-based disgust

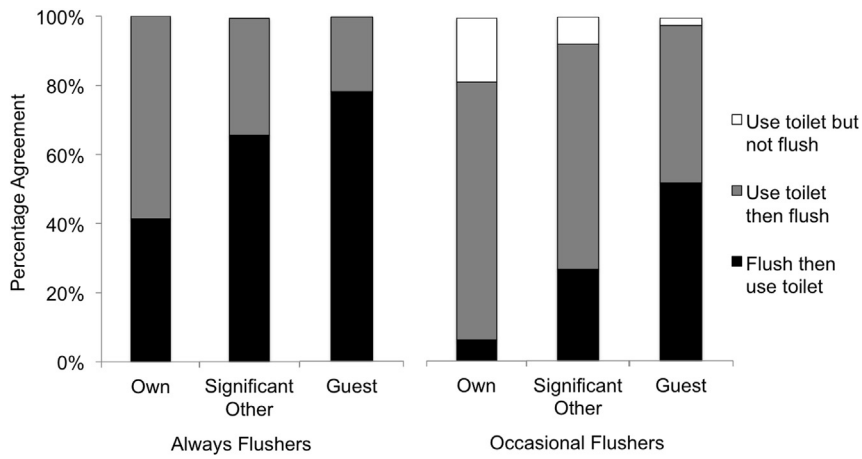

Fig. 2. When presented with the scenario of encountering urine left in a home toilet, always and occasional flushers showed similar patterns but differed in the degree to which they would flush before using the toilet. Percentage agreement on flushing first increases with less familiar sources of urine (from own urine to guest's urine).

and avoidance behaviors (Rozin et al., 2015; Tsao & McKay, 2004). Cognitive processing may help some individuals overcome intuitive processing and heuristics that lead one to react to urine with disgust. Communication interventions that address urine-related risk perceptions and frame urine as sterile and rarely infectious may decrease disgust sensitivity (Rozin et al., 2015). Repeated exposure to urine in the toilet of friends and family may function as a sort of phobia treatment through desensitization for disgust sensitive individuals (Olatunji, Forsyth, & Cherian, 2007; Rachman, 2004).

We found evidence that most individuals in our sample were taught to flush every time they urinated, which resulted in a habitual and automatic behavior. Yet we also found evidence that the occasional flushers in our sample overcame the habit through motivations to save water and money. Drought experience and risk perceptions also related to water saving motivations. Interventions that successfully motivate always flushers to consider drought conditions, financial benefits, and pro-environmental norms may lead to increased water conservation in American households. Like disgust, habit is intuitive; making flushing a more cognitive behavior through increased salience could help change flushing habits. Individuals who have recently read information about saving water through reduced flushing could think twice the next time they urinate and behave in accordance pro-environmental motivations such as altruistic or biospheric values (Dahlstrand & Biel, 1997; Stern, 2000).

Both always and occasional flushers were influenced by social norms to flush after urinating as evidenced by high agreement with statements about embarrassment if a guest encountered urine, others' expectations of not encountering urine, and that one should flush. The pressure of social norms was also evident in open-ended responses such as “With splash back being a threat to anyone, I'd rather not be the cause” and “if you don't flush, there will be some unhappy people waiting for you!” Always flushers were more influenced by such social norms, while occasional flushers displayed greater willingness to sacrifice for the environment by flushing less. Shifting social norms from emphasizing cleanliness to the environment such that people accept and expect urine in toilets would reduce flushing in both groups. Norm shifts can occur via intuitive pathways; simply observing that others do not always flush may result in behavior change toward new habits that favor water conservation over consumption (Gregory & Di Leo, 2003). Research on moral reasoning suggests additional ways in which social norms might be changed over time (Paxton & Greene, 2010; Sacchi, Riva, Brambilla, & Grasso, 2014). A discussion with a respected friend can cause an individual to reason through the moral implications of their actions and encourage pro-social and pro-environmental behaviors (Joireman, Lasane, Bennett, Richards, & Solaimani, 2001; Stern, 2000; Stern, Dietz, Abel, Guagnano, & Kalof, 1999).

Results suggest a lack of pro-environmental motivations among this sample, particularly among always flushers. Supporting the quantitative results, some examples of open-ended responses from always flushers include: “I understand it's a waste of water, but I can't stand the idea of pee just sitting in a toilet all day” and “there are endless methods of conserving water that don't sacrifice cleanliness and sanitation.” Motivations for water conservation behaviors included drought risk and water price increases. Increasing perceptions that environmental quality (e.g., water quantity and quality) is a public good may increase willingness to sacrifice for the environment (Stern, 2000). Similarly, raising awareness of adverse consequences in relation to drought and climate change may encourage pro-environmental motivations and concomitant behaviors like water conservation (Schwartz, 2011; Stern et al., 1999). Importantly, messages aimed at raising awareness should also aim to increase self-efficacy that an individual's flushing behavior is not simply a “drop in the bucket” and thus worth the personal sacrifice in order to conserve water on a broader and meaningful scale (Sarabia-Sánchez, Rodríguez-Sánchez, & Hyder, 2014).

Findings indicate that self-enhancement biases may influence perceptions of water use (Brown, 1986). Although participants on average accurately estimated the amount of water used in a single flush, both always and occasional flushers underestimated their overall daily water use. Note that, although we do not have actual measures of participants' water use, the mean estimate of own use among our sample was 29 gallons per person per day for indoor water use, which is far less than what the average Americans uses based on available data of 69.3 gallons per person per day (Mayer et al., 1999), and thus this perception is likely to indicate that many individuals in our sample are underestimating their own use. Underestimating water use may inhibit conservation of water to the extent that individuals already consider themselves water conservative. Addressing misconceptions through improved feedback of water use (e.g., more illustrative and easy to interpret information on water bills) or other interventions may address self-enhancement bias.

Overall, willingness to flush less was low in our sample; only replacing current toilet with a composting or dual flush toilet were less supported activities. Interestingly, participants were open to

toilet inserts more than checking for leaks, perhaps because the former requires little effort or mechanical knowledge; once a toilet insert is simply placed in the tank, no further effort is required. Based on previous work showing that people think of curtailment rather than efficiency improvements as effective actions to decrease water use (Attari, 2014), we expected low willingness to replace current toilets with more efficient fixtures. Although flushing less requires no expertise, costs nothing, and actually saves money, such curtailment behaviors may be unpopular due to disgust and norms about cleanliness. Participants may be more willing to make efficiency improvements even if they require some cost or effort (e.g., checking for leaking, toilet inserts) rather than encounter urine in home toilets. Given high willingness and low current rates of toilet inserts, campaigns such as Drop-A-Brick (http://www.projectdropabrick.org/) may have potential to increase water conservation and meet water rationing goals in time of extreme short-term drought.

Given the low willingness to flush less, a majority of participants will require intrinsic and/or extrinsic motivations to reduce flushing. Theories in psychological and economic sciences offer several ways to inform behavior change around toilet use. For example, rational choice theory would suggest that economic incentives in the form of increased water prices (i.e., extrinsic motivation) might best encourage reduced flushing. On the other hand, the norm activation model points to the role of personal and moral norms (i.e., intrinsic motivation) as a potential major driver in pro-environmental behaviors, such as reduced flushing to conserve water (Chan & Bishop, 2013; Stern et al., 1999). Shifting personal norms toward water conservation may require making salient the causes and consequences of water scarcity and the role of individual choices (Joireman et al., 2001; Stern, 2000). If the average American is similar to our average participant, a major shift in norms regarding flushing behavior is in order. Encouraging such a shift, especially over short time frames, will be a major challenge to those aiming to address regional droughts, such as the current drought in California. High-profile media coverage of drought and the associated images that evoke empathy for those suffering (not only people, but perhaps also entities in nature, such as wildlife or ecosystems) may serve to increase awareness of consequences, which could be a first step toward motivating water conservation. Lastly, even after major shifts, behavioral maintenance is required to solidify new habits, in our case “letting it mellow” (Prochaska, Redding, & Evers, 2008).

Increasing willingness to flush less at home will also require long-term efforts to shift social norms from emphasizing perceived cleanliness to pro-environmental motivations. Until such a paradigm shift in American bathroom norms occurs, encouraging decreased flushing may be a challenge for many Americans who were not brought up to do so without external motivations such as drought or price hikes. Technical fixes such as toilet tank inserts and deodorizing pouches may circumvent issues of habit, disgust, and social norms. Future research could measure interventions aimed at behavior change and explore flushing behaviors outside the home.

Our study fits into the broader literature that explores a variety of well-established, habitual, pro-environmental behaviors and suggests techniques for overcoming barriers (Gifford, 2011). For example, recycling has dramatically increased over the past decades due to a variety of interventions, such as changing judgments of the importance of recycling (Sherman, Ahlm, Berman, & Lynn, 1978). With regard to littering, Cialdini, Reno, and Kallgren (1990) showed the importance of norm activation in changing littering decisions. In the domain of energy use, Pallak, Cook, and Sullivan (1980) showed that public commitment significantly decreased residential energy use. Finally, in relation to disgust, techniques that emphasize information and behavioral modeling have been successful in getting people to pick up after their dogs (Jason, Zolik, & Matese, 1979). Although interventions such as these could have an impact on flushing, this behavior presents an additional, important challenge. While the other behaviors are mainly in the public domain, flushing is very much a private activity that is self-regulated. Thus, any successful interventions must achieve internalized changes in the norms and attitudes that drive such behaviors.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jenvp.2015.06.003.

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