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Predicting compliance with an information-based residential outdoor water conservation program

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SUMMARY

Residential water conservation initiatives often involve some form of education or persuasion intended to change the attitudes and behaviors of residential consumers. However, the ability of these instruments to change attitudes toward conservation and their efficacy in affecting water use remains poorly understood. In this investigation the authors examine consumer attitudes toward complying with a persuasive water conservation program, the extent to which those attitudes predict compliance, and the influence of environmental contextual factors on outdoor water use. Results indicate that the persuasive program was successful in developing positive attitudes toward compliance, and that those attitudes predict water use. However, attitudinal variables explain a relatively small proportion of the variance in objectively measured water use behavior. Recommendations for policy are made stressing the importance of understanding both the effects of attitudes and environmental contextual factors in behavior change initiatives in the municipal water sector.

1. Introduction

Residential outdoor water use – primarily for lawn and landscaping irrigation – is a major source of demand in the Southern and Western United States (Mayer et al., 1998; Gleick et al., 2003; Kenny et al., 2009). Therefore, improving the efficiency of outdoor water use, defined as a reduction in wasteful consumption, is an area where potential conservation gains stand to be made (Endter-Wada et al., 2008; Gleick et al., 2003). For instance, the Environmental Protection Agency (2013) estimates that half of all water used for residential irrigation in the U.S. is wasted due to leaks, misdirection, and over-application relative to lawn water needs. Research in irrigation technology and residential water conservation mirrors these findings often reporting high levels of overuse and waste (Haley et al., 2007; Endter-Wada et al., 2008; White et al., 2004).

With these concerns in mind public utility managers have adopted a variety of policy instruments intended to influence residential demands for outdoor water, increase the efficiency of use, and meet new demands through conservation (Gleick et al., 2003; Fielding et al., 2012; Bates et al., 2008; Brooks, 2006). Although substantial water savings are possible through technological solutions including retrofits to irrigation systems (McCready et al., 2009), leak detection (Buchberger and Nadimpalli, 2004), and conversion of irrigated lawns to xeriscape (Sovocool et al., 2006), achieving a broader shift in patterns of consumption, in part, requires a change in consumer behavior (Schultz et al., 2014).

The social and behavioral sciences have much to offer in designing, implementing, and evaluating demand management policy instruments intended to change consumer behaviors, and increase the efficiency of outdoor water use (Russell and Fielding, 2010). Behavioral approaches to managing residential demands for water have historically fallen under two major categories; (a) market-based (Olmstead and Stavins, 2009), and (b) information, education, and persuasion-based (Michelsen et al., 1999; Syme et al., 2000; Geller et al., 1983) policy instruments. The influence of market-based instruments on residents' water use, including conservation pricing schemes and incentives for technological retrofits, have been thoroughly explored in the literature with mixed results (Nieswiadomy, 1992; Arbúes et al., 2003; Olmstead and Stavins, 2009). However, the ability of information, education, and persuasion-based instruments to bring about a change in residents' water use and attitudes toward conservation remains poorly understood, despite the popularity of their use (Michelsen et al., 1999; Syme et al., 2000; Schultz et al., 2014; Geller et al., 1983).

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The efficacy of persuasive instruments in achieving a change in behavior varies as a function of constituent attitudes toward the behaviors that they promote, and the social and environmental contexts in which they occur (Seyranian et al., 2015; Treizenberg et al., 2014; Dillard and Shen, 2013; Fishbein and Ajzen, 2010). Therefore, it is necessary to understand residents' attitudes toward water conservation behaviors encouraged through persuasive communications and the environmental factors that facilitate and constrain their adoption in order to evaluate the efficacy of associated demand management initiatives (Monroe, 2003).

In the current study we assess the relative efficacy of one such persuasive information-based policy instrument designed to improve the efficiency of residential outdoor water use among a subset of the most prolific water users in College Station, Texas. Specifically, we assess attitudinal and environmental contextual factors that influence residents' compliance with a recommended volume of lawn irrigation referred to as a "water budget". The water budget is a persuasive communication provided to residents containing feedback on their water use along with a comparison of their water use to an "efficient" standard determined from estimated minimum plant water requirements (i.e., the water budget), the water use of their neighbors, and tips on how to conserve. A better understanding of the factors that influence residents' ability to comply with the water budget (e.g., using less water than it calls for) will provide managers with the information needed to determine alternative courses of intervention, improve the sustainability of the municipal water system, and reduce impacts on source ecosystems and groundwater basins.

1.1. Literature review

To conceptualize the process by which the water budget communications ultimately influence compliance, we draw on the integrated model (IM) of behavioral prediction (Fishbein and Ajzen, 2010; Fishbein, 2000; Fishbein and Yzer, 2003). The IM, along with its predecessors, the theory of reasoned action (TRA) and theory of planned behavior (TPB), is one of the most widely used psychological theories for predicting individual behavior (Armitage and Conner, 2001). The theory has had wide appeal in applied contexts like residential water use given its relative parsimony (Fishbein and Ajzen, 2010; Russell and Fielding, 2010). Broadly speaking, the IM hypothesizes that an intention to perform a behavior is the most proximal antecedent to its performance. Behavioral intentions are in turn a function of attitudes toward the outcome of carrying out the behavior, beliefs concerning the expectations of one's peers related to the behavior, and the extent to which the behavior is under the volitional control of the individual in question (Ajzen, 1991; Eagly and Chaiken, 1993). Perceived behavioral control (PBC) – or perceived self-efficacy – can have a direct effect on behavior when the measure of PBC is a close approximation of actual control (Hardeman et al., 2002; Kaiser and Gutscher, 2003). Behavior change in the IM is hypothesized to occur indirectly through changes in attitudes, normative beliefs, and beliefs concerning one's self-efficacy in carrying out the behavior. Positive evaluations of behaviors advocated by persuasion can lead to the formation of an intention that ultimately translates into compliance (Eagly and Chaiken, 1993; Petty and Cacioppo, 1986). To that end, the water budget program is a persuasive effort intended to foster positive attitudes toward water conservation, positive beliefs concerning water conservation behaviors in the broader community, the skills and knowledge needed for one to comply, and ultimately an intention to do so.

A number of factors, however, may influence the extent to which a given behavior is under actual volitional control (Eagly and Chaiken, 1993). Although a persuasive communication like the water budget might be successful in developing a positive intention to perform a given behavior, an individual may not be able to translate that intention into action (Kollmus and Agyeman, 2002). Consumer choice is constrained by a variety of social, cultural, political, and physical characteristics of the systems in which individuals are embedded (Lutzenhiser, 1993). The "ABC" model suggests that behavior (B) is a function of both attitude (A) and the context (C) in which it occurs (Guagnano et al., 1995). When contextual factors exert a significant influence on behavior, the attitude–behavior relationship can be quite small (Stern et al., 1999; Stern, 2000). Therefore, the performance of water conservation behaviors that are often complex, costly in terms of time, and limited in terms of financial incentive, are a function not only of cognitive processes like those modeled through the intention–behavior relationship but are shaped by the broader social, institutional, and environmental context (Black et al., 1985). In addition to attitudes, each of these variables represents a potential lever for managers to manipulate in order to achieve a change in water use behavior among their constituents. Therefore, behavioral change requires both a positive evaluation of the attitude object (complying with the water budget) and an absence of barriers that can potentially impede its performance (Kollmus and Agyeman, 2002; Stern et al., 1999; Stern, 2000; Guagnano et al., 1995). The question remains, however, which variables are the most salient for managers to target for intervention; attitudes or environmental contextual factors?

1.2. The integrated model and water conservation behaviors

The IM – and TPB/TRA – has been a guiding framework in many investigations of water conservation intentions and behaviors. Trumbo and O'keefe (2001, 2005), for example, drew on the TPB in their investigation of water conservation intentions among residential water users, finding support for the applicability of the theory in explaining intentions to reduce water use. Lam (2006) also used the TPB to predict intentions to engage in water conservation behaviors among Taiwanese utility workers. Clark and Finley (2007) drew on the TPB as well as general environmental attitudes and concern, and socio-demographic characteristics to explain water conservation intentions in their study of Bulgarian residential water customers. In their work they found that in addition to the relationships hypothesized by the TPB, general environmental attitudes, environmental concern, and socio-demographic characteristics were also significantly correlated with intentions to conserve water. Yazdanpanah et al. (2014), examined water conservation behaviors adopted by famers in Iran. In their analysis they found that an intention to engage in water conservation actions was significantly correlated with self-reported conservation behaviors. While these studies, and others, have advanced our understanding of the social psychological factors that drive the public's intent, they have fallen short in demonstrating the theory's ability to account for actual behavior; that is, where behavior is objectively measured.

In fact, the few studies that have examined the relationship between metered water use and conservation intentions have reported relatively weak associations between intention and behavior. For example, Fielding et al. (2012) found that curtailment intentions were not a significant predictor of metered water use among residents in Australia. Similarly, Jorgensen et al. (2014), in addition to expressing concerns over the applicability of individual theories of behavior in accounting for household water use, reported a weak relationship between an intention to conserve and future water use. Armitage and Conner (2001) in a review of the TPB across all fields of application found that studies using observed behavior measures reported a weaker intention–behavior relationship compared to those relying on self-reports.