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An exploratory path analysis of attitudes, behaviors and summer water consumption in the Portland Metropolitan Area

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ABSTRACT

We examined the underlying attitudinal and behavioral factors of summer water consumption among Portland Metropolitan Area households by combining survey responses from households and corresponding empirical water consumption data. Path analysis shows that pro-conservation attitudes regarding water usage (even when controlling for property size and other demographic variables) were strong predictors of actual reductions in summer water consumption. Furthermore, these self-reported attitudes appear to directly impact specific water consumption behaviors identified in the survey, with potentially significant impact in two of three key areas of water conservation strategies: landscaping, adapting conservation technology, but not habitual use. We draw implications for focused educational programs promoting awareness of water conservation issues and monitoring their impacts and efficacy.

1. Introduction

Managing our water resources with sufficient regard for environmental factors, efficient infrastructure, and the costs of continued human development is one of the ongoing key challenges in today's world. Fortunately, water conservation efforts in the U.S. in recent decades have galvanized and mobilized (Lee, Tansel, & Balbin, 2013). Governments at national, state and city levels have implemented water conservation policies, including federal regulatory initiatives from the 1980s and 1990s introducing new standards for the flow technology of toilet, showerheads, and other fixtures consuming water. Furthermore, high-profile information campaigns, such as "turn off the tap" encouraging the more mindful use of water when brushing teeth or gardening, have proliferated across communities. Throughout this period, the country overall has seen substantial water savings from conservation (Coomes, Rockaway, & Rivard, 2010) as directly evident from surpluses monitored by water bureaus, surpassing even the expectations of many optimistic city planners. In fact, in many areas, including the entire states of Arizona, California, Colorado and Oregon, total water consumption has actually decreased, despite continuing growth of the population, the number of utility accounts, and economic activity (APA, 2013). Thus, water consumption appears to have been highly responsive to at least some of the social, technological, and structural changes resulting from these recent initiatives.

While literature on water conservation has traditionally focused on the impacts of top-down structural and institutional factors on water consumption, such as physical infrastructure (property and water-saving technology) and policy (government-based initiatives and laws) (House-Peters & Chang, 2011), fewer attempts have been made to empirically measure decentralized bottom-up 'soft' processes leading to conservation outcomes, such as how individual residents are motivated by policy or awareness of water conservation issues and how their specific behaviors or patterns of water usage change accordingly (Sauri 2013; Chang, 2016). However, the understanding we can glean of the dynamics behind water consumption (a function of many individual users' behaviors at the micro-level) from the vantage point of policies, physical infrastructure (and other solely macro-level variables) is rife with limitations. Given numerous potential intermediary variables by which policies may effect change, most previous studies on such a macro-level is accompanied by the typical problems of spurious correlations; it is not clear, for instance, if areas with strong water-conservation policies incentivize more conservation from its residents, or if the strong water conservation policies themselves are the outgrowth of an already water-conscious community. Furthermore, such 'hard' variables may have, at best, complex correlations with water conservation behavior without direct plausible causal links; even using

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predictors like education and income are problematic, since they may predict better awareness and access to conservation technologies, but also correlate with larger property sizes and more water-consuming amenities (Chang, Parandvash, & Shandas, 2010; Halper, Scott, & Yool, 2012; March & Sauri, 2010; Polebitski & Palmer, 2010).

Moreover, from a practical standpoint, government policy or incentives are not necessarily the most natural leverage point for many conservation efforts. In fact, this tortuous translation from public policy to private behavior often results in the phenomenon of "policy resistance" (Sterman, 2000), where a policy or measure's intended effect is annulled, or even pushed in the opposite direction, through other social-economic feedbacks triggered by the change. A large government project aimed at energy conservation in Australia found that mandating and subsidizing improved thermal insulation in houses, rather than reducing heating energy consumption, and induced residents (presumably motivated by increased comfort and convenience) to wear less clothing indoors (Browne, Jones & Compston, 2011). Examples like these highlight the importance of norms or attitudes about the value of conservation, which are propagated throughout communities and internalized by individuals.

Indeed, many contemporary models of conservation behavior incorporate personal attitudes (and the related norms and motivations) as important causal determinants for conservation outcomes. These models are often informed by the psychology of Planned Behavior (Ajzen & Fishbein, 1975; Lam, 1999; Perren & Yang 2015), which recognize attitudes as important antecedents to adopting conservation behavior, as well as field studies where self-identified voluntary and civic engagement appears to have been a catalyst for conservation behaviors such as household recycling (Oskamp, Edwards, & Okuda, 1997). In other words, individual positive attitudes about conservation (its efficacy, importance, etc.) are needed to overcome barriers to conscious conservation behaviors that reduce household consumption and waste. It may be argued that the dynamics of Water Conservation results (at least in large part) from a similar causal chain of attitudes and behaviors.

This paper proposes such an Attitude-Behavior-Consumption framework, in particular to predict summer water consumption in the Portland Metropolitan Area, where we explore the plausibility of a causal chain of environmental action through residents' attitudes, their individual conservation efforts, and empirical water conservation outcomes.

2. Attitudes and water consumption behaviors

As the social sides of environmental problems are increasingly recognized, growing pockets of research have been addressing the effects of pro-conservation attitudes (for example, believing that it is a civil responsibility to conserve water by turning off the faucet when not in use) on associated conservation behaviors (i.e. actually turning off the tap). While our understanding of how such attitudes translate into behavior is largely incomplete, general findings corroborate a positive, albeit complex and nonlinear relationship between the strength of pro-conservation attitudes and their associated behaviors. Bamberg, Moser, and Moeser, (2007) found a statistically significant (but modest) main effect between strength of pro-conservation attitudes and active conservation behavior on the part of individuals in their meta-analysis of general environmental conservation behaviors. This limited effect size seems, in large part, due to the dependence of attitude effect on knowledge and constellation of other factors; Basic understanding of conservation and environmental issues, for instance, was an essential requirement to begin adapting these behaviors (Burgess, 1988). It should be noted, however, that additional training and technical knowledge beyond the basics delivered decreasing returns, with personal attitudes instead becoming the most important cognitive determinant of pro-environmental behavior (Kollmuss & Agyeman, 2002).

Nonetheless, the impact of attitudes is limited and sensitive to the basic material and practical means of individuals institutionally have (Blake, 1999). Costs, such as economic burden of buying conservation equipment were needed to be perceived as affordable (Lee & Paik, 2011). Normative drives were major antecedents to the effects of pro-conservation attitudes, where people identified increased community identification and engagement, neighbors' behavior, and sense of collective moral obligation as their primary motivation for reuse, recycling and other conservation behaviors (Burn, 1991; Gamba & Oskamp, 1994). Along the same vein, most people seem adverse to compromising appearances of social normality for the sake of adapting new environmental practices (Costanzo, Archer, Aronson, & Pettigrew, 1986; Sadalla & Krull, 1995). Finally, cognitive accessibility of conservation's importance (regardless of available information or advanced knowledge of the environment) through personal experiences, such as immersive exposure to pristine natural environments (rivers, forests, etc.) and first-hand experiences of environmental degradation and scarcity also increase the applicability of attitudes to actions (Chawla, 1988). Broadly speaking, these findings suggest the impact of attitudes on pro-environmental behaviors increase with their ease of economic, social, and psychological adaptation (Diekman & Preisendoerfer, 1992), which are in turn reliant on basic technical and community infrastructure satisficing all these dimensions. Thus, when communities can provide these prerequisite conditions, they empower individuals to act and change their daily behaviors according to their ecological values.

A few studies extend these findings to water conservation (most notably, Dolnicar, Hurlimann, & Grun, 2012 Moser, Navarro, Ratiu, & Weiss, 2010, and Willis, Stewart, Panuwatwanich, Williams, & Hollingsworth, 2011). Consistent with the general conservation and attitudes literature, cultural and community-level factors were major determinants of water conservation behavior. In a large international study comparing the cultural attitudes and water consumption patterns of major cities in Europe, Asia, and the Americas, Moser et al. (2010) found cultural attitudes toward water and water conservation predicted differences in magnitude of water conservation among the study cities. Areas that did not culturally emphasize water conservation as a pressing mainstream issue, or trust that others would conserve water, hindered individual and organized conservation efforts, even from those who agreed on its importance. However, individual attitudes appeared highly consequential in other regions (including the UK, Australia, and metropolitan areas of the U.S.) having already above-average awareness and information about water conservation, as well as a generally progressive ethos about the environment. Where scarcity was a salient issue (or water issues were otherwise highly publicized) differences in the strength of positive attitudes played a significant mediating effect on water conservation behaviors and sociodemographic factors within cities (Dolnicar et al., 2012).

Although these cities typically had fairly high average reported pro-conservation attitudes, differences in conservation behavior were still highly discernible by strength of those attitudes. Along the urban areas of Australia's Gold Coast, Willis et al. (2011) found tangible differences in water conservation between households reporting very high perception of importance towards water conservation versus those with only moderately strong agreement. Moreover, modest differences in water consumption by income gaps appeared to be explained by these attitudinal clusters. Gilg and Barr (2006) found a similar pattern among households espousing strong pro-environmental and conservation attitudes in Devon, UK. Their findings suggest an environmentalist commitment engen-