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The Influence of Water Attitudes, Perceptions, and Learning Preferences on Water-Conserving Actions

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ABSTRACT Water conservation is an important natural resource issue, and the focus of a number of educational and extension programs. Inherent in many programs is the causal link between water facts and conservation behaviors that affect water quality and/or quantity. This article interprets the results of a survey on attitudes and perceptions of water resources ($n = 2226$) from nine states (Alabama, Arizona, Florida, Georgia, Hawaii, Mississippi, Oklahoma, Tennessee, and Texas). The goal of the survey was to assess attitudes and perceptions of water supply, water quality, and factors affecting them. We assess the influence of attitudes and perceptions regarding the environment, water resources, governance, information sources, and demographics on water conservation behaviors. Specifically, we assess the role that these factors play in indoor and outdoor water-conserving actions indicated by respondents. We find several statistically significant non-knowledge factors that drive water conservation: perceived importance of water resources and their preferred use; preferred learning modes and information sources; interest in certain types of water issues; views on governance; general environmental attitudes; and demographics. For example, preferring passive learning modes (e.g., reading a newspaper article) negatively influences outdoor conservation, while preferring to learn by taking action (e.g., training) positively influences both indoor and outdoor conservation. These results highlight the importance of a number of non-knowledge factors in water program-related behavior change, and suggest a number of factors that could inform targeted approaches to influence differing audiences.

Impact Statement Understanding the factors that motivate stakeholders to conserve water is important for educators actively engaged in water conservation education. Adoption of outdoor and/or indoor water conservation is explained by the perceived importance of water resources and their preferred use; preferred learning modes and information sources; interest in certain types of water issues; views on governance; general environmental attitudes; and demographics. Findings can be used to improve water education and outreach programs, leading to improved conservation.

Water conservation is an important issue in many parts of the United States. Water supply shortages have become more frequent (Seager et al., 2009; McNulty et al., 2007), and by 2050, more than one-third of all U.S. counties are expected to face a significantly higher risk of water shortage (Spencer and Altman, 2010). Water pollution, population growth, and climate change are expected to increase stresses on water resources (Jorgensen et al., 2009). Water conservation and protection of water quality are of increasing interest to both water suppliers and water users (e.g., Olmstead and Stavins, 2009).

A number of education programs work to change behaviors that impact water quality and supply. For example, Master Gardener and Master Naturalist programs train individuals in best practices for using and engaging with both manmade and natural landscapes; and Stream Team and Water Watch train volunteers in water quality monitoring. Water resource education program success depends on understanding how people think about water and its use (Jorgensen et al., 2009).

The primary focus of water conservation and water quality education programs has been on their effectiveness or cost-effectiveness (Geller et al., 1983; Michelsen et al., 1999; Wang et al., 1999; Syme et al., 2000; Campbell et al., 2004; Howarth and Butler, 2004; Inman and Jeffrey, 2006), with household characteristics and demographics used as covariates (e.g., Cary, 2008; Wang et al., 2005; Inman and Jeffrey, 2006; Renwick and Archibald, 1998; Renwick and Green, 2000; Jorgensen et al., 2009). These studies suggest that education and awareness programs can help reduce water use by up to 25%. However, to support further improvement, it is important to identify the opportunities and challenges for effective educational and extension-based water conservation programs. Clay et al. (2007) suggest that the impact of water resource programs on behavior

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change may depend on whether the recommended practices contravene or obey cultural norms, make the adopter better off, increase or decrease risk for the adopter or require more effort, are perceived as effective, and/or are promoted with mixed messages. Relatively little attention has been focused on factors affecting water users' decisions to change behavior and the role of their attitudes and perceptions (Brown and Davies, 2007; Jorgensen et al., 2009; Campbell et al., 2004; Wang et al., 2005).

Many studies have connected people's behaviors with their beliefs, perceptions, and attitudes (e.g., Ajzen and Fishbein, 1980; Ajzen, 2005). Recent research suggests that attitudes and perceptions also influence water use behaviors (Clarke and Brown, 2006). For example, attitudes about water pricing and allocation of water for recreation are known to influence water conservation (Syme et al., 2000). Even when conservation program benefits far exceed their costs, negative attitudes toward them can be a major barrier (Ward et al., 2007). For example, a study of water conservation in Mexico found that perceived water waste by neighbors decreased the likelihood of residents conserving water (Corral-Verdugo et al., 2002). Conversely, belief that the water utility and others in the community are actively reducing their water use increases the likelihood of conserving water (Jorgensen et al., 2009). Similarly, beliefs that household water use will not make an appreciable impact on water resources, that water conservation methods are not reliable or effective, and lack of knowledge of water usage are major factors influencing household water conservation (Teodoro, 2009). Trust in government has also been suggested as a possible driver of water conservation, and has been suggested for future research (Jorgensen et al., 2009).

The purpose of this article is to assess the role that attitudes and perceptions play in motivating indoor and/or outdoor water conservation, including perceived importance of water resources and their preferred use; preferred learning modes and information sources; interest in certain types of water issues; views on governance; general environmental attitudes; and demographics. Findings of this study can be used to inform the design and implementation of water outreach programs, leading to improved resource conservation.

MATERIALS AND METHODS

Using survey data from nine states on attitudes and perceptions of water resources, we assess the role that attitudes and perceptions about the environment, water resources, governance, and information sources play in the adoption of indoor and outdoor water-conserving actions. Our data come from surveys conducted by USPS-mail in each of nine states (Alabama, Arizona, Florida, Georgia, Hawaii, Mississippi, Oklahoma, Tennessee, and Texas) from 2005 to 2010. Mahler et al. (2013) provide details of the survey design and data collection methods. Here, we assess the influence of various attitudes and perceptions on water-conserving actions using data from nine states (Table 1). Specifically, we econometrically assess the role that these factors play in the adoption of indoor and outdoor water conservation.

The survey asked "Have you or someone in your household done any of the following in the last 5 years as a part of an individual or community effort to conserve water or preserve water quality? (Check all that apply)." From the response set, we defined outdoor conservation to include changes to yard landscaping; frequency of yard watering; use of pesticides, fertilizers, or other chemicals; how vehicles are washed; method of motor oil and other vehicle fluid disposal; how household chemicals or yard wastes are disposed; and pumping septic system. Indoor conservation was defined to include the adoption of new technologies (low flow faucets, etc.); installation of water-saving appliances (toilet, etc.); how water is used in the house (washing dishes, etc.); and testing drinking water. Other possible responses to the question were omitted from the analysis, including involvement with documenting sources of contamination, smart growth planning, and environmental advisory commission.

The survey also asked a number of questions involving factors that comprise our explanatory variables (Table 1). These included: (1) the perceived importance of water-related issues (e.g., clean drinking water) and allocation of water among competing sources (e.g., water for industry); (2) demographics; (3) water information sources (e.g., extension); (4) preferred learning mode (e.g., passive); (5) preferred topics that respondents would like to learn about (e.g., drinking water issues); (6) perceived role of government institutions in water resource protection; and (7) overall environmental attitude. We identify several important drivers of water conserving actions, and provide a discussion of the model results and their implications for education and conservation programs. Please see Mahler et al. (2013) for a full description of both survey data collection methods and a detailed description of the survey instrument.

We used two econometric specifications to assess the impact of our explanatory variables on water conservation behaviors. A logistic (logit) regression model specification is used to predict the likelihood of indoor conservation adoption and outdoor conservation adoption. The logit regression models (Greene, 2009) for indoor or outdoor water-conserving actions are modeled as:

$$Pr(y_i = 1) = \frac{e^{\beta' x_i}}{(1 + e^{\beta' x_i})} \qquad [1]$$

where *Pr* is probability, y_i = 1 if respondent *i* indicated taking a water-conserving action (defined as indoor for model 1, outdoor for model 2), and 0 otherwise; *x* are the explanatory variables, β are the intercept and parameter weights.

The logit models (Eq. [1]) were parameterized using maximum likelihood estimation with the Logistic Regression procedure in SPSS 20 (SPSS, Inc., 2011; Greene, 2008).

RESULTS

Summary statistics and descriptions of variables and related survey questions are reported in Table 1. On average, survey respondents were unlikely to have intentionally adopted additional indoor conservation (mean 0.40) and likely to have adopted outdoor conservation (mean 0.77) (Table 1).

Respondents generally viewed the importance of clean water very high—near 5 on a 1 to 5 scale for clean rivers, lakes, and streams (4.68); clean groundwater (4.71); and

Table 1. Summary statistics of variables included in econometric models (*n* = 2226).

Variables	Description	Survey question†	Mean	SD
Dependent	Adopt indoor conservation (1– yes, 0– otherwise)	Q68	0.40	0.49
	Adopt outdoor conservation (1– yes, 0– otherwise)	Q68	0.77	0.42
Independent				
Importance of…	Clean river, lakes & streams (1– not important, … 5– extremely important)	Q1	4.68	0.59
	Clean groundwater (1– not important, … 5– extremely important)	Q2	4.71	0.57
	Clean drinking water (1– not important, … 5– extremely important)	Q3	4.94	0.27
Importance of water for…	Aquatic habitat and fishing (1– not important, … 5– extremely important)	Q10	4.36	0.84
	Power generation, commerce, and/or industry (1– not important, … 5– extremely important)	Q5, Q6, Q7	4.12	0.89
	Agriculture, irrigation, and/or livestock (1– not important, … 5– extremely important)	Q8, Q18, Q19	4.39	0.79
	Household and private sector (1– not important, … 5– extremely important) landscapes	Q15, Q16	3.40	1.27
	Recreation (1– not important, … 5– extremely important)	Q4	3.89	1.12
Importance of actions…	Residential water conservation (1– not important, … 5– extremely important)	Q41	4.22	0.94
Information sources	Extension (1– yes, 0– no)	Q70	0.16	0.37
	Environmental groups (1– yes, 0– no)	Q70	0.29	0.45
Preferred learning methods ‡	Active (1– checked, 0– not checked)	Q72	0.80	0.40
	Passive (1– checked, 0– not checked)	Q72	0.66	0.47
	Action (1– checked, 0– not checked)	Q72	0.27	0.44
Like to learn about…§	Community water quality issues (1– checked, 0– not checked)	Q71	0.55	0.50
	Drinking water quality issues (1– checked, 0– not checked)	Q71	0.42	0.49
	Well/septic water quality issues (1– checked, 0– not checked)	Q71	0.29	0.46
	Personal water quality issues (1– checked, 0– not checked)	Q71	0.56	0.50
How well do these protect water quality	Federal government (1– very poorly, …, 5– very well)	Q62	2.94	1.01
	State government (1– very poorly, …, 5– very well)	Q62	3.06	1.05
	County, city, or town (1– very poorly, …, 5– very well)	Q62	3.20	1.12
	Individual citizens (1– very poorly, …, 5– very well)	Q62	2.79	1.03
General environmental attitude	View of nature (1– for total natural resource use, …, 9– for total environmental protection)	Q66	5.31	1.97
Demographics	Reside in city limits (1– yes, 0– otherwise)	Q74	0.56	0.50
	Time in state (1– <5 yr, …, 4– “All my life”)	Q77	3.25	0.81
	Gender (1– female, 0– otherwise)	Q78	0.33	0.47
	Education (1– less than high school, …, 5– advanced college)	Q80	3.48	1.12

† When >1 question indicated, used average of responses calculated across the listed questions.
‡ “Active learning methods” are defined based on respondents’ choices of such methods as read printed materials (e.g., fact sheets), visit a website, watch a video (or DVD) of information, and attend a fair or festival; “Passive learning methods” include respondents’ choices of such methods as look at a demonstration or display, read a newspaper article or series, or watch TV coverage; “Action learning methods” include options to attend a short course or workshop, take part in a onetime volunteer activity, take a course for certification or credit, get trained for a regular volunteer position, and learn how to conduct home, farm, or workplace water practices assessment.
§ “Community issues” include watershed management, watershed restoration, forest management and water issues, and community actions concerning water issues; “Drinking water issues” include drinking water and health and protecting (public) drinking water supplies; “well/septic issues” include private well and septic system management, private well protection, and septic system management; and “Personal issues” include irrigation management, animal (manure) waste management, nutrient and pesticide management, home and garden landscaping, and landscape buffers.

clean drinking water (4.94). Views on how water should be allocated, as measured by importance of water for various uses, varied considerably. On a scale of 1 to 5 measuring importance, we found that respondents generally viewed water for agriculture, irrigation, and/or livestock as most important (4.39), followed closely by water for aquatic habitat and fishing (4.36); water for power generation, commerce, and/or industry (4.12); water for recreation (3.89); and water for household and private sector use (3.40). Respondents also tended to view residential water conservation as extremely important (4.22).

Water resource information sources, preferred learning methods, and respondent interest in water resource issues varied significantly. Information sources for water include extension (1 if extension is a source of water information, 0 otherwise; mean value 0.16) and environmental groups (1 if environmental group was a source, 0 otherwise; 0.29). Other information sources were considered, but were excluded from the model due to poor performance. Preferred learning methods were defined as Active (1 if indicated, 0 if otherwise), Passive (1 if indicated, 0 otherwise), and Action (1 if indicated, 0 otherwise). Active learning methods are defined based on respondents' choices of such methods as read printed materials (e.g., fact sheets), visit a web site, watch a video (or DVD) of information, and attend a fair or festival; Passive learning methods include respondents' choices of such methods as look at a demonstration or display, read a newspaper article or series, or watch TV coverage; and Action learning methods include options to attend a short course or workshop, take part in a onetime volunteer activity, take a course for certification or credit, get trained for a regular volunteer position, and learn how to conduct home, farm, or workplace water practices assessment. Generally speaking, respondents strongly preferred Active (mean value 0.80) compared with Passive (0.66) and Action (0.27). Interest in learning about water issues was higher for personal water issues (1 if indicated, 0 otherwise; mean value 0.56) and community water issues (mean value 0.55) than for drinking water issues (mean value 0.42) or well/septic water quality issues (mean value 0.29). Community issues were defined to include watershed management, watershed restoration, forest management and water issues, and community actions concerning water issues; drinking water issues include drinking water and health, and protecting (public) drinking water supplies; well/septic issues to include private well and septic system management, private well protection, and septic system management; and personal issues to include irrigation management, animal (manure) waste management, nutrient and pesticide management, home and garden landscaping, and landscape buffers.

Views on performance of government and individuals in fulfilling their responsibilities to protect water quality were measured by a 5-point scale [ranging from 1 (very poorly), to 5 (very well)]. On average, respondents ranked the performance of government (2.90–3.20) higher than individuals (mean 2.79) to protect water quality, but ranked local-level government (3.20) higher than state (3.06) or federal government (2.94). We also included a scale that measured general environmental attitudes [with the scale from 1 (total natural resource use) to 9 (total environmental protection)], and found that respondents generally favor environmental protection (mean 5.31).

Table 2. Overall model statistics.

Model statistics	Indoor actions logit	Outdoor actions logit
LR χ^2 (27 df)	122.86	211.46
p value	<0.001	<0.001
Percent correctly predicted	63.2%	77.8%

We also included a number of demographic variables in our analysis, including whether the respondent resided in city limits (1 if yes, 0 if no), how much time they had spent in the state (1 if less than 5 years, 2 if 5 to 9 years, 3 if more than 10 years but not all my life, and 4 if all my life), their gender (1 if female, 0 otherwise), and their highest education level attained (1 if less than high school, 2 if high school, 3 if some college or vocational training, 4 if college degree, 5 if advanced college). On average, respondents lived within city limits (mean 0.56), spent more than 10 yr in the state (mean 3.25), were male (mean 0.33), and had some college or vocational training (mean 3.48).

Recall that we specified two econometric models: (1) logit model of indoor conservation adoption; and (2) logit model of outdoor conservation adoption. Both econometric models performed well and were statistically significant at the 99.9% confidence level (Table 2), and produced parameter estimates with theoretically expected signs. The outdoor actions logit model had better predictive power, correctly predicting 77.8% of observed outdoor conservation actions, whereas the indoor actions logit model correctly predicted 63.2%.

Prediction of Outdoor Conservation

Our logit model of outdoor water conservation predicts the likelihood of respondents adopting any outdoor water conservation tools or behaviors. The model includes a number of statistically significant parameter estimates. See Table 3 for parameter estimates, *p* values, and odds ratios; and see Table 4 for a summary of the signs and statistical significance for only significant variables. Odds ratios are more intuitive to interpret than logit model parameters. They indicate the influence of a single variable on water conservation adoption when holding all other variables constant, and can be used to assess the relative impact of the explanatory variables. Our discussion of the results below includes parenthetical reference to the sign of the variable's impact, its odds ratio, and statistical significance.[1] For example, +10.0** indicates a variable that has a positive sign, is statistically significant at $p < 0.01$, and has an odds ratio of 10.0.

Perceptions of importance of water quality, water for various uses, and water conservation were important drivers of outdoor conservation. Perceived importance of clean lakes and rivers (+31.9**), and clean groundwater (+24.3*) increased the likelihood of respondents adopting outdoor conservation. Their odds ratios are interpreted to mean that each one-unit increase in these variables make respondents more than 31 times more likely and 24 times more likely, respectively, to adopt outdoor conservation. Perceived importance of water for power, commerce, and industry (−17.2*) reduced the likelihood of adoption,

[1] Asterisks designate significance as follows: *0.05 level, **0.01 level, ***0.001 level, † 0.1 level.

Table 3. Parameter estimates of the logit models.

Categories	Independent variables	Indoor logit			Outdoor logit		
		Coeff.	*P* value	Odds ratio	Coeff.	*P* value	Odds ratio
Importance of…	CleanLR	0.073	0.463	7.6	0.277**	0.009	31.9
	CleanGW	0.092	0.351	9.6	0.218*	0.039	24.3
	CleanDW	0.173	0.403	18.8	0.028	0.888	2.8
Importance of water for…	Aquatic	0.014	0.836	1.4	−0.055	0.499	5.6
	PwrCommInd	−0.090	0.149	8.6	−0.189*	0.014	17.2
	AgIrrigLvstk	0.072	0.310	7.5	−0.071	0.397	6.8
	Household	−0.028	0.518	2.8	0.117*	0.022	12.5
	Recreation	−0.073	0.136	7.0	−0.043	0.470	4.2
Importance of action	ResdtWatCnsrv	0.023	0.672	2.3	0.223***	0.000	25.0
Information sources	Extension	0.350**	0.004	41.9	0.115	0.469	12.2
	EnvtGps	0.436***	0.000	54.6	0.480***	0.000	61.5
Preferred learning	Active	0.142	0.225	15.3	0.066	0.616	6.8
	Passive	−0.123	0.214	11.5	−0.225†	0.057	20.2
	Action	0.292**	0.007	33.9	0.076	0.586	7.9
Like to learn about…	Community	0.134	0.365	14.4	0.358*	0.049	43.1
	Drinking	−0.096	0.492	9.1	0.175	0.339	19.2
	WellSeptic	0.186	0.139	20.4	−0.062	0.713	94.0
	Personal	0.006	0.961	0.6	0.630***	0.000	87.7
How well do these protect water quality	Federal	0.009	0.884	0.9	−0.167*	0.034	15.4
	State	−0.136†	0.060	12.7	−0.126	0.160	11.8
	CountyTown	0.147**	0.009	15.8	0.164*	0.017	17.8
	Individuals	−0.038	0.449	3.7	−0.014	0.819	1.4
Environmental attitude	EnvProtScale	0.072**	0.004	7.4	0.020	0.481	2.0
Demographics	CityLimits	−0.023	0.809	2.3	−0.089	0.435	8.5
	Time	−0.174**	0.002	16.0	−0.023	0.734	2.3
	Gender (female)	−0.025	0.802	2.4	−0.352**	0.002	297.0
	Education	−0.015	0.731	1.4	0.024	0.638	2.4
	Constant	−1.889†	0.054	84.9	−1.182	0.213	69.3

* Significant at the 0.05 level.
** Significant at the 0.01 level.
*** Significant at the 0.001 level.
† Significant at the 0.1 level.

whereas perceived importance of water for household use (+12.5*) increased the likelihood. Viewing residential water conservation as important for protecting water resources (+25.0***) increased the probability that a respondent adopted outdoor conservation.

Information sources, preferred learning mode, and interest in types of water issues also appear to drive the conservation decision. Having received water resource information from environmental groups (+61.5***) increased the likelihood of outdoor conservation; preferring a passive learning mode (−20.2†) decreased outdoor conservation, and higher interest in both community issues (+43.1*) and personal water resource issues (+87.7***) appeared to positively influence outdoor conservation.

Perceptions about how well different levels of government protect water quality also influence adoption of outdoor conservation. On average, a more favorable view of the federal government's performance (−15.4*) in protecting water quality was negatively associated with outdoor conservation, whereas more favorable views of county, town, or city government (+17.8*) increased outdoor conservation. Finally, women (−297.0**) were much less likely to adopt outdoor water conservation.

Prediction of Indoor Conservation

Largely different factors appear to drive the decision to adopt indoor conservation compared with outdoor conservation. Unlike outdoor conservation, perceived importance of water quality, water for alternative uses (e.g., household use), and water conservation were not statistically significant drivers of indoor water conservation. Sources of information, however, were important drivers of indoor conservation. Similar to outdoor conservation, indoor conservation was positively influenced by

Table 4. Estimated effects of independent variables on conservation.

Category	Independent variable	Indoor logit effect	Outdoor logit effect
Importance of…	CleanLR	ns‡	+**
	CleanGW	ns	+*
Importance of water for…	Aquatic	ns	ns
	PwrCommInd	ns	−*
	Household	ns	+*
Importance of action	ResdtWatCnsrv	ns	+***
Information sources	Extension	+**	ns
	EnvtGps	+***	+***
Preferred learning	Passive	ns	−†
	Action	+**	ns
Like to learn about…	Community	ns	+*
	Personal	ns	+***
How well do these protect water quality	Federal	ns	−*
	State	−†	ns
	CountyTown	+**	+*
Environmental attitude	EnvProtScale	+**	ns
Demographics	Time	−**	ns
	Gender (female)	ns	−**
	Constant	−†	ns

* Significant at the 0.05 level.
** Significant at the 0.01 level.
*** Significant at the 0.001 level.
† Significant at the 0.1 level.
‡ns, not significant.

respondents receiving water resource information from environmental groups (+54.6***). Unlike outdoor conservation, having received water resource information from extension (+41.9**) was positively influenced with the adoption of indoor conservation.

The role of preferred learning mode also differed between indoor and outdoor conservation, with indoor conservation positively influenced by action-type learning (+33.9**). Other statistically significant factors include views on government, general environmental attitude, and time in state. Similar to outdoor conservation, indoor conservation is positively influenced by higher levels of evaluation of county, town, and city government's performance (+15.8**) in protecting water quality. Unlike outdoor conservation, views on the federal government were not significant, but views on state government were. On average, positive views on state government's role (−12.7†) in protecting water resources reduce the likelihood of respondents reporting indoor conservation. Also unlike outdoor conservation, general environmental attitude (+7.4**) is a statistically significant factor in the adoption of indoor conservation. Finally, time in state (−16.0**) is a negative influence on the likelihood of indoor conservation adoption.

DISCUSSION

Knowledge about environmental problems and the ways to address them is thought to lead to action that improves environmental quality (e.g., Hines et al., 1987; Hungerford and Volk, 1990); that is, knowledge is a prerequisite to action. Yet, given significantly limited resources supporting environmental programs, it may be important to think strategically when implementing these programs—in terms of targeting specific audiences, creating programs that are more likely to reach audiences how and when they prefer (Diem, 2003). Our results suggest a number of other important factors that, perhaps in conjunction with increasing knowledge, influence water conservation actions. We present two statistically significant models that rely on non-knowledge factors to predict adoption of water conservation by residential water users, particularly for outdoor water conservation. Our outdoor conservation logit and indoor conservation logit models performed well, correctly predicting adoption or non-adoption of conservation 77.8 and 63.2%, respectively. The weaker performance of our indoor model may be explained by the fairly narrow definition of indoor conservation, including adoption of new technologies but not common behavior changes like turning off faucets while brushing teeth, doing full loads of laundry and dishes, and so forth. The survey did not include observations on these additional indoor conservation actions, and these remain a source for future research.

Our findings indicate a number of factors that may affect water conservation decisions (which should be seriously considered when designing water conservation education programs) and highlight the complex role that these factors play in residential water conservation. Perceived importance of clean lakes and rivers, and groundwater positively impact outdoor conservation, but importance of drinking water does not. Our finding about perceived importance of water quality on outdoor conservation is largely consistent with the literature. We know, for example, that farmers' perception of water quality is a significant driver of both water conservation and soil conservation efforts (Bruening and Martin, 1992). However, the finding on drinking water was unexpected.

Attitudes about the importance of water for competing uses also drive conservation in our models. Higher perceived importance of water for power generation, commercial use, and industrial use negatively influences outdoor conservation; and water for households positively affects outdoor conservation. The negative effect of power generation, commercial use, and industrial use on respondents' likelihood of using water conservation could indicate that industry and commerce use of water is of no environmental concern. The negative impact of perceived importance of water for recreation is consistent with the literature. For example, Bruening and Martin (1992) show that views on water for recreation negatively affect willingness to participate in both indoor and outdoor conservation. As expected, perceived importance of residential water conservation for addressing water resource issues was statistically significant for outdoor conservation (e.g., Jeffrey and Seaton, 2004).

Receiving water resource information from established and respected sources is also an important driver of water conservation behaviors. As expected, getting information from extension or environmental groups increases the likelihood of adopting indoor conservation tools or behaviors. However, we did not expect to find that extension is not a statistically significant factor in decisions to adopt outdoor conservation. We note that 16% of respondents included in this analysis indicated having received water resource information from extension, which is somewhat lower than broader studies examining the use of any extension information (e.g., Warner et al., 1996; Verma and Burns, 1995). Previous research has noted that stakeholders are more likely to be aware of individual extension programs but fail to make the connection to the Cooperative Extension Service or the "brand name" extension (Abrams et al., 2010).

It is likely that respondents to our survey had engaged with extension programs, given that 27% of our respondents indicated participating in action-type programs (Table 1), which are highly likely to have been connected to an extension program. We also note that Borisova et al. (2012) has shown that participation in extension's Master Gardener program is a significant driver of homeowners' landscaping practices. Hence, we urge caution when interpreting our finding about extension, particularly since we know that extension and education programs have been shown to affect water conservation, suggesting that they are themselves important tools for managing water resources (Rasmussen, 2002).

Preferred learning modes—the ways in which our respondents prefer to receive water resource information—provide an interesting dimension to our analysis. Preferences for active learning opportunities (e.g., watching an informational DVD) was not statistically significant, whereas preferring passive learning (e.g., reading a newspaper article) negatively influenced outdoor conservation. Preferring to learn by taking action (e.g., training) positively influences indoor conservation. These results have important implications for educational program design and implementation. For example, outreach that involves mainly passive-type modes of learning, which reduces the likelihood of outdoor conservation, might not be as successful as programs that involve action-type learning activities, particularly for indoor water conservation. However, it may also be possible that those who are more likely to engage in passive learning are physically unable to implement outdoor conservation practices. Also, we note that other research has found that passive-type information delivery has been rated as very or somewhat effective by more than 87% of respondents in Kansas (Market Research Institute, Inc., 2000), although that research did not involve water resource information. This is an area for future research.

Interest in certain types of water issues also influences water-conserving actions, with interest in community issues positively impacting the adoption of outdoor conservation; and interest in ways to take action around the home or farm to improve water resources is positively related to outdoor conservation (see Boellstorff et al., 2013 for a broader discussion).

Perceptions about how well different levels of government protect water quality also influence water conservation, with more positive views about lower-level government (e.g., municipal) and/or less positive views about higher-level government (e.g., federal) increasing the likelihood of water conservation. This is an interesting finding, but one that is consistent with the literature finding that lack of trust in state institutions and water suppliers reduces likelihood of people making water conservation efforts (Heiman, 2002; Jorgensen et al., 2009. Interestingly, views about how well individuals protect water quality were not significant, despite the expected role that moral suasion is expected to play in water use behaviors (e.g., Hurd, 2006).

General environmental attitudes also somewhat positively influence indoor conservation, but not outdoor conservation. A large number of studies have demonstrated a link between environmental attitudes and actions (e.g., O'Connor et al., 2002), but we did not find one here.

Demographics also play a role in water conservation behaviors. It is interesting to note that the time spent in state and gender (female) reduces the likelihood and amount of conservation. Research has shown that gender and a number of other demographic variables are helpful predictors of environmental perceptions and opinions (e.g., Leiserowitz, 2005; Jorgensen et al., 2009). Unexpectedly, we did not find that residing inside city limits vs. outside, or having higher levels of education vs. lower levels influenced water conservation behaviors. It has been shown that level of awareness of water issues is influenced by education (Udayakumara et al., 2010), and one might assume that education level would be a good proxy for knowledge of water resource issues; yet we found that education level was not a statistically significant factor in any of the models.

Finally, it is interesting to note that indoor and outdoor conservation efforts by residential water users are largely driven by different factors. Perceptions of the importance of (1) water quality (e.g., clean groundwater); (2) water for various uses (e.g., for household use); and (3) residential water conservation were statistically significant factors for outdoor conservation, but not for indoor conservation. Other important departures between the two models include: (1) the role of receiving water resource information from extension—important driver of indoor, but not outdoor conservation efforts; (2) preferred mode of learning—preferring "passive" learning was statistically significant for outdoor but not for indoor conservation, and preferring "action" based learning was important for indoor but not for outdoor; (3) level of interest in types of water issues (e.g., community) were influential for outdoor but not for indoor conservation; (4) views about government and individual roles in protecting water quality were important for both indoor and outdoor, but views on federal government were statistically significant for outdoor conservation and not for indoor, whereas views on state government were important for indoor but not for outdoor; (5) general environmental attitudes were an important variable for indoor conservation but not for outdoor; and (6) different demographic factors affected indoor and outdoor conservation, with time spent in state being important to indoor but not outdoor conservation, and gender being important for outdoor but not indoor conservation. In fact, the outdoor and indoor logit models shared only two common statistically significant variables: having received water resource information from environmental groups, and views on how well county, town, and city government protects water quality. These findings serve to emphasize the importance of considering these factors when designing and implementing educational programs that center on water conservation.

CONCLUSIONS

Using survey data (n = 2226) from nine states (Alabama, Arizona, Florida, Georgia, Hawaii, Mississippi, Oklahoma, Tennessee, and Texas), we assessed the influence of attitudes and perceptions regarding the environment, water resources, governance, information sources, and demographics on water conservation use. Specifically, we modeled indoor water-conserving actions and outdoor actions indicated by respondents. Our data come from surveys conducted by USPS-mail in each of the states 2005–2010 (Mahler et al., 2013).

Our models suggest that non-knowledge factors are important drivers of water conservation, particularly outdoor water conservation. These included perceived importance of water resources, water uses, and residential water conservation; preferred information sources; preferred learning methods and topics; views about how well different levels of government protect water quality; environmental attitudes; and demographics. For example, we found that respondents were more likely to have adopted outdoor water-conserving actions with higher perceived importance of clean lakes and rivers and clean groundwater; lower perceived importance of water for power generation, commerce, and industry and/or higher perceived importance of water for households; higher ratings of the importance of residential water conservation (to make a difference); lower desire to learn about water resources through passive methods; having received water resource information from environmental groups; preferring to learn about community water resource issues and personal steps for protecting water resources; having more trust in county, town, or city government and/or less trust in federal government to protect water quality; and being male. Furthermore, outdoor and indoor water conservation actions appear to be driven by largely different factors. Perceived importance of water quality, importance of water for use by various groups, importance of residential water conservation, and interest in various types of water resource issues (e.g., community water issues) were not significant factors for indoor conservation. However, having received water resource information from extension and having more positive general environmental attitudes increased the likelihood of indoor but not outdoor conservation. These results highlight the importance of viewing outdoor and indoor water conservation motivations differently.

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