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Using Audience Segmentation to Tailor Residential Irrigation Water Conservation Programs

Laura A. Warner,[1] Anil Kumar Chaudhary,[2] Joy N. Rumble,[3] Alexa J. Lamm,[4] & Esen Momol[5]

Abstract

Today's complex issues require technical expertise as well as the application of innovative social science techniques within Extension contexts. Researchers have suggested that a social science approach will play a critical role in water conservation, and people who use home landscape irrigation comprise a critical target audience for agriculture and natural resources professionals. This study was conducted to examine the possible role of an audience segmentation approach in addressing the complex issue of water resources. This research used descriptive discriminant analysis to assign national irrigation users to previously identified subgroups found in the literature (the water considerate majority, the water savvy conservationists, and the unconcerned water users) and compare characteristics to identify differences on a national scale. Results revealed the nation's irrigation users are fairly water conscious. The findings implied unique subgroups exist among targeted Extension audiences relevant to specific behaviors, and Extension programs should focus on different programmatic objectives for targeting different subgroups. Differences were found among the three subgroups in water conservation behaviors, personal and social normative beliefs, use of landscape professionals for irrigation maintenance, and learning preferences. Recommendations were provided on how to use the results to develop impact-driven Extension programs.

Keywords: Audience segmentation; Extension strategies; residential irrigation users; targeted programs; water conservation

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Introduction

Throughout history, society has faced many issues and challenges that have been addressed by technological solutions (Andenoro, Baker, Stedman, & Weeks, 2016). However, future

[1] Laura A. Warner is an Assistant Professor of Extension Education in the Department of Agricultural Education and Communication and the Center for Landscape Conservation and Ecology at the University of Florida, PO Box 112060, Gainesville, FL, 32611, lsanagorski@ufl.edu.
[2] Anil Kumar Chaudhary is a doctoral candidate and graduate assistant in the Department of Agricultural Education and Communication at the University of Florida, PO Box 115040, Gainesville, FL, 32611, akchaudhary@ufl.edu.
[3] Joy N. Rumble is an Assistant Professor of Agricultural Communication in the Department of Agricultural Education and Communication and the Center for Public Issues Education at the University of Florida, PO Box 115040, Gainesville, FL, 32611, jnrumble@ufl.edu.
[4] Alexa J. Lamm is an Assistant Professor of Extension Education in the Department of Agricultural Education and Communication and the Associate Director of the Center for Public Issues Education at the University of Florida, PO Box 112060, Gainesville, FL, 32611, alamm@ufl.edu.
[5] Esen Momol is the director of the Florida-Friendly Landscaping™ program in the Department of Environmental Horticulture at the University of Florida, 114 Mehrhof Hall, Gainesville, Florida 32611, eam@ufl.edu.

environmental challenges and issues are complex, multi-faceted, and will not be solved by technological advancement alone. Many complex issues impact agriculture and natural resources. Some of these issues include global land space, food production, natural resource management, energy consumption, and climate change (Andenoro et al., 2016; Brown, 2012; Emmott, 2013; Stedman & Andenoro, 2015). Spruijt et al. (2014) defined complex issues as "uncertain and potentially risky issues that merit a transdisciplinary approach, which indicates that these risky issues are embedded in wider environmental, social, economic and political systems" (p. 17). These complex issues have arisen primarily due to population growth and modern advancement (Andenoro et al., 2016).

The complexity and evolving nature of emerging environmental issues has resulted in ambiguity in addressing them, as well as limited research to guide issue solutions (Spruijt et al., 2014). Many complex issues are challenged by contradictory concerns, where a potential approach to addressing an issue could provide economic benefit at the cost of environmental impacts (Spruijt et al., 2014). Therefore, solutions to complex issues need to come from changes in attitudes and behaviors among the public, in addition to technological advancement, to be sustainable (Andenoro et al., 2016).

Agricultural educators, Extension professionals, communicators, and leaders are well positioned to help build human capacity in addressing complex issues (Andenoro et al., 2016; Osborne, 2011). A horticulturalist may work on solving the issue of food production through advanced plant breeding, or a hydrologist may work on the issue of natural resource management through the development of water conservation technologies but neither issue can be solved without the expertise of those who can impact public perception and behavior change. Agricultural educators, Extension professionals, communicators, and leaders are trained to apply social science techniques to Extension contexts, allowing them to provide unique expertise to interdisciplinary teams working on solutions to complex issues. The American Association for Agricultural Education's National Research Agenda highlights *Addressing Complex Problems*, such as water resources, as a key priority area for research (Roberts, Harder, & Brashears, 2016). Researchers in agricultural education have been encouraged to "develop appropriate research designs relevant to the profession" (Dooley, 2007, p. 40) and today's increasingly complex problems demand increasingly innovative approaches.

Water is considered to be one of the most important complex problems in the world (Lamm, Lamm, & Carter, 2015). As the global population continues to increase, the demand for fresh water has grown and the supply has decreased (Levy & Sidel, 2011). Today, "less than 0.01% of all water worldwide is available for human use" (Levy & Sidel, 2011, p. 778). The issue is further complicated by water borne diseases, poverty, conflict, and water quality issues.

Water use in the United States is more than 215 cubic meters per person per year, compared to just four cubic meters per person per year in Mali (Fry, 2006). Each person in the United States uses an estimated 80-100 gallons of water per day (U.S. Geological Survey, 2016). While many people in low-income countries rely on water primarily for drinking and food production, people in the United States have become accustomed to having water available for a variety of purposes including irrigation for their home landscapes. The EPA (2013) estimates that 30% of water used by Americans is used outdoors.

One step in addressing the complex global issue of water resources is to improve water conservation in the United States. Those who use irrigation in their home landscape are a key target audience for improved water conservation behaviors (EPA, 2015; Warner, Rumble, Martin, Lamm, & Cantrell, 2015). To successfully improve water conservation among this audience, Extension professionals must first understand the characteristics of the audience in order to drive behavior change through communication and education (Brownlee, Hallo, Moore, Powell, & Wright, 2014; Telg & Irani, 2012).

Theoretical Framework

Extension professionals are actively seeking innovative ways to address complex water issues. The complexities of behavior change need to be incorporated into strategies to produce greater outcomes with fewer resources, and approaches that result in greater return on investment are desirable (Taylor-Powell & Boyd, 2008). Extension professionals have been encouraged to consider using social marketing, a proven yet underutilized approach to change (Rogers, 2003; Warner & Murphrey, 2015). Social marketing is defined as the application of commercial marketing tools and techniques to design, implement, and manage programs that lead to increased acceptability and ultimately voluntary behavior change among a specific target audience (Kotler & Roberto, 1989). Social marketing is characterized by a deliberate, research-based process to change that involves extensive preliminary audience research to identify an audience’s values and perceived barriers to change (Lee & Kotler, 2011). Then, a strategy is developed to reduce or remove barriers and appeal to the audience’s values (Lee & Kotler, 2011).

This study was guided by social exchange theory, a key theory applied in the practice of social marketing. A fundamental element of exchange theory is reciprocity, which explains that audience members voluntarily give up a behavior to adopt another when that action results in increased benefits (Grier & Bryant, 2005; McKim, Rutherford, Torres, & Murphy, 2011). Exchange theory describes individual behavior guided by a decision-making process that weighs tangible and non-tangible benefits and costs in a way that leads to net benefits (Napier & Tucker, 2001). For example, exchange theory predicts when an agricultural education or Extension client perceives that the costs of adopting a water conservation technology (i.e. economic cost or time requirements) will outweigh the benefits they receive, the individual will not adopt the technology.

Guided by exchange theory, Extension professionals should consider that their audience must pay some price to change an existing or adopt some new behavior and appeal to their audience by enhancing the benefits the audience values (Grier & Bryant, 2005). Accordingly, programs should be designed to appeal to the unique needs and values of an audience. Programs can be most effective when they are designed around perceived barriers and benefits. Barriers and benefits can be extremely diverse among potential audience members, even around a single behavior change. Therefore, targeting programs to subgroups, or segments, as opposed to delivering a broad mass message, is a way to ensure that delivered content enhances the net benefits of making a behavior change.

Audience segmentation is one of the key commercial marketing techniques used in social marketing and is one of the first activities when developing a social marketing campaign (McKenzie-Mohr et al., 2012). Typically, audiences should be segmented by factors and characteristics that relate to group members’ likelihood of adopting some behavior. Audience segmentation identifies the most important subgroup or subgroups within the larger, relevant population (Lee & Kotler, 2011; McKenzie-Mohr et al., 2012). The goal is to “select only one or a few segments as target audiences for the campaign and then develop a rich profile of their distinguishing characteristics that will inspire strategies to uniquely and effectively appeal to them” (Lee & Kotler, 2011, p. 135).

In a study of farm irrigators in Canada, Lafreniere, Deshpande, and Bjornlund (2015) identified six subgroups divided by their perceptions about the attributes of a political agenda on water sharing, a strategy that leads to conservation. The researchers identified a promising segment of irrigators who placed a high value on water sharing campaigns that communicated the personal benefits they would receive from a water transfer (Lafreniere et al., 2015). In a study of absentee forest landowners in Utah, Salmon, Brunson, & Kuhns (2006) identified three meaningful segments of landowners when they grouped the landowners by the perceived benefits they received from the land. The groups were: passive, multiple-benefit, and amenity-focused (Salmon et al., 2006). Both Salmon et al. (2006) and Lafreniere et al. (2015) demonstrated the value of understanding differences among subgroups in the context of natural resources management.

In their study of Floridians who use landscape irrigation, Warner, Lamm, Rumble, Martin, and Cantrell (2016) identified three subgroups: the water considerate majority (45%), the water savvy conservationists (36%), and the unconcerned water users (19%). The water savvy conservationists were described as those individuals who were highly engaged in landscape water conservation behaviors and were very concerned about water resources. The water considerate majority were those who valued water resources but still had ample capacity to improve their conservation behaviors. The unconcerned water users were unengaged in landscape water conservation and did had little motivation to change. Warner et al. (2016) reported the water considerate majority were the most appropriate audience for landscape water conservation programs because they strongly valued water resources but had not adopted all possible technologies and practices in their own landscapes. While this study provided insights into possible strategies for landscape water conservation behavior change, the authors focused on Florida residents only, and did not consider a national audience.

Purpose and Objectives

The purpose of this study was to segment a national audience of residential irrigation users into meaningful subgroups to further identify their characteristics and provide recommendations for developing targeted extension programs as a means of address the complex issue of water resources. The specific objectives were to 1) describe the demographic characteristics of home irrigators; 2) divide residential irrigation users into subgroups based on their landscape management behaviors; and 3) compare current and future water conservation behaviors, personal and social norms, hiring practices, and preferences for learning about water among members of different residential irrigation user subgroups.

Methods

We conducted this national cross-sectional study in December, 2015. The findings reported in this study are part of a larger project carried out to assess the water conservation practices of residents nationwide. We used residents who had control over their landscape irrigation as our target audience because they have high potential to conserve water if they change their water use behaviors (Bremer, Keeley, Jager, Fry, & Lavis, 2012; Warner et al., 2015; Warner et al., 2016).

Study Participants

We secured the national sample for the study using a web-based survey sampling company based on defined screening criteria. The participants were recruited using non-probability opt-in sampling, where participants with specific characteristics were allowed to participate in the study. The screening criteria for the study were: minimum 18 years of age, residents who had landscape and/or lawn as well as landscape irrigation over which they had decision-making power. According to Burns and Bush (2003), the selected sampling frame may have “potential sample frame error, but it is used due to the lack of any other sample frame. It is the researcher’s responsibility to seek out a sample frame with the least amount of error at a reasonable cost" (p. 326). Non-probability opt-in panels are often used to make inferences about target population in the absence of a target population's sampling frame (Baker et al., 2013). The use of this type of panel can produce results comparable to or sometimes better than probability-based samples (Abate, 1998; Twyman, 2008; Vavreck & Rivers, 2008).

Out of 3,140 individuals who responded to an invitation to participate in the study, 2,448 belonged to the target population according to their responses to the screening questions. We included quality control questions throughout the survey to ensure quality of data; those who did not respond as instructed were removed (Lavrakas, 2008). After removing these respondents, 1,052 responses were considered complete for the purpose of data analysis.

Instrumentation

We collected data for the study using a researcher-developed survey instrument. Respondents were asked whether they hired a professional company for specific landscape tasks, which water conservation behaviors they currently engaged in, whether they intended to adopt specific behaviors to conserve water in the future, how they perceived personal and social norms surrounding irrigation water conservation, how they preferred to learn, and to identify their demographic characteristics. We measured hiring a professional landscape company for various tasks by asking respondents to select all of the tasks that applied from a list of multiple responses. Responses included tasks such as *irrigation services* and *lawn maintenance*. Current water conservation behaviors were identified using 17 bipolar statements (1 = *yes*, 2 = *no*) with an *unsure* option. Some examples of current water conservation behavior statements were *I use high efficiency sprinklers*, *I seasonally adjust irrigation times*, and *I calibrate my sprinklers*. Behavioral intentions to conserve water were measured using 19 five-point Likert scale statements (1 = *very unlikely,* 2 = *unlikely*, 3 = *undecided*, 4 = *likely*, 5 = *very likely*) with an additional scale option *not applicable*. Examples of the behavioral intention statements included: *replace high volume irrigated areas with low volume irrigation*, *calibrate my sprinklers*, *use a rain barrel or cistern*. We created a behavioral intention index using the mean score of 16 behavioral intention statements. The behavioral intention index ranged from 1 = *low behavioral intention* to 5 = *high behavioral intention*. We excluded *not applicable* responses from data analysis.

Personal and social norms towards irrigation water conservation were measured using five Likert scale statements (1 = *strongly disagree*, 2 = *disagree*, 3 = *undecided*, 4 = *agree*, 5 = *strongly agree*) each for personal and social norms. Some personal norm statements were: *it is important to manage my landscape using the smallest amount of water possible* and *I feel a personal obligation to minimize my personal impact on local water resources*, while example of social norm statements were: *it is expected that I will manage my landscape using the smallest amount of water possible*, and *the people that I am close to think I should encourage others to protect our water resources*. We created indexes for both personal and social norm variables by calculating a mean of the five statements associated with each. The personal and social norm indexes ranged from 1 = *weak perceived norm* to 5 = *strong perceived norm*.

We measured preferences for learning about water by asking respondents to select all of the learning opportunities they preferred from a list of 11 along with an addition of *I am not interested in any of these learning opportunities* and *other* options. The learning options included *visit a web site*, *watch TV coverage*, and *watch a video*. The seven demographic questions identified sex, age, total household income, homeownership, residence within a homeowners' association, education, and race.

We used a panel of experts specialized in survey methodology, water conservation outreach programming, and agricultural and biological engineering to establish face and content validity of our instrument. After a panel of experts reviewed the instrument, we pilot tested it. We made minor changes as a result. We tested the reliability of the study variables using *post hoc* Cronbach's alpha and determined that the reliability for behavioral intentions (0.90), social norms (0.90), and personal norms (0.88) were suitable for use (Santos, 1999). This research was approved by the University of Florida Institutional Review Board (Protocol #2015-U-1102).

Data Analysis

We used frequency and percentages to describe the demographic characteristics of respondents. We used descriptive discriminant analysis (Brown & Wicker, 2000) to predict the group membership of national respondents into three subgroups identified in a previous study – the water considerate majority, water savvy conservationists, and unconcerned water users (Warner et al., 2016). These three subgroups were identified by Warner et al. (2016) using a combination of hierarchical and non-hierarchical cluster analysis. To conduct discriminant analysis, we used the set of pre-identified variables (hiring of professional landscapers, current water conservation behaviors, and behavioral intentions to conserve water) that had high correlation with three pre-identified subgroups in the Warner et al. (2016) study. There are multiple methods that can be used to predict group membership when membership is unknown. The approach we selected entailed combining the cases with unknown membership with the cases with known membership and running descriptive discriminant analysis to predict membership for the unknown cases (Brown & Wicker, 2000). First we merged the data from the Warner et al. (2016) study to our dataset to create a unified dataset. The merged dataset contained pre-identified group membership, known as a training dataset, from the Warner et al. (2016) study; and the cases and missing group membership for our national data.

We ran descriptive discriminant analysis using SPSS with the merged data by entering all predictor variables together (LaFollette, Knobloch, Schutz, & Brady, 2015). This descriptive discriminant analysis with the merged dataset predicted the group membership for the national dataset (Brown & Wicker, 2000). We then separated the national data from the merged dataset with predicted group membership, and ran further descriptive discriminant analysis with our national dataset to check the accuracy of predicted group membership. The results of the descriptive discriminant analysis indicated there were two distinct significant discriminant functions (see Table 1), but only the 1st discriminant function was of practical importance based on Wilks's lambda and eigenvalue (Brown & Wicker, 2000).

Table 1

Descriptive Discriminant Analysis Summary Data in a National Audience Segmentation Study (N = 1,052)

Discriminant Function	Wilks's Lambda	Chi-square	Canonical Correlation (R_c)	Eigenvalue
1	0.18	1791.55*	0.89	3.90
2	0.86	157.17*	0.38	0.17

Note.*Significant at $p \leq 0.01$

The Wilk's lambda value for Function 1 was 0.18 which signifies that 82% of variability in function 1 can be attributed to group differences, while for function 2, Wilk's lambda of .86 signifies that only 14% of variability in function 2 was attributed to group differences (Brown & Wicker, 2000; Gliem, 2000). Eigenvalues represent the ratio of between-groups variability to with-in group variability for the calculated function and higher eigenvalue represents a stronger relationship (Brown & Wicker, 2000). Between the two discriminant functions, function 1 had a very high eigenvalue compared to function 2. Based on canonical correlation values, the 79.2% (R_c = 0.89) variance in discriminant function 1 can be accounted by three group differences, while only 14.4% (R_c = 0.38) variance in discriminant function 2 can be accounted by three group differences. We used a chi-square test to determine whether the variability in functions attributed by group difference was significant, and the results indicated variability in both functions (1 and 2) could be significantly attributed to group differences (Brown & Wicker, 2000).

Group centroids generated by descriptive discriminant analysis indicate how and in what ways groups are loaded on different functions (Brown & Wicker, 2000). The absolute value of group centroid represent degree of differentiation of a group on a discriminant function, while sign of group centroid represents the direction in which groups were differentiated (Brown & Wicker, 2000). The results of group centroids indicated that function 1 discriminated water savvy conservationists (1.90) from the water considerate majority (-1.06) and the unconcerned water users (-4.17). The water savvy conservationists were located at the positive end of the bipolar discriminant function, while water considerate majority and unconcerned water users were located on the far negative and negative end of the bipolar discriminant function, respectively.

Finally, the most important finding from descriptive discriminant analysis was the classification table which verifies how accurate our groups were compared to those initially predicted with the use of Warner et al. (2016) data. The classification table indicated that based on the discriminant score, 95.1% of our initially predicted groups were correctly classified (see Table 2) by descriptive discriminant analysis of the national sample (Gliem, 2000). This confirmed robustness of the initial prediction and therefore we proceeded to use that group classification for further analysis.

Table 2

Re-classification of Predicted National Home Irrigation User Subgroups Through Descriptive Discriminant Analysis

		Predicted Group		
Actual Group	No. of Cases	Water Considerate Majority	Water Savvy Conservationists	Unconcerned Water Users
Water considerate majority	463	445 (96.1%)	12 (2.6%)	6 (1.3%)
Water savvy conservationists	485	25 (5.2%)	460 (94.8%)	0
Unconcerned water users	104	9 (8.7%)	0	95 (91.3%)

Note. 95.1% of original grouped cases were correctly classified

The combined group plot produced by descriptive discriminant analysis of the national sample clearly indicated there were three distinct subgroups based on their landscape management behaviors (see Figure 1).

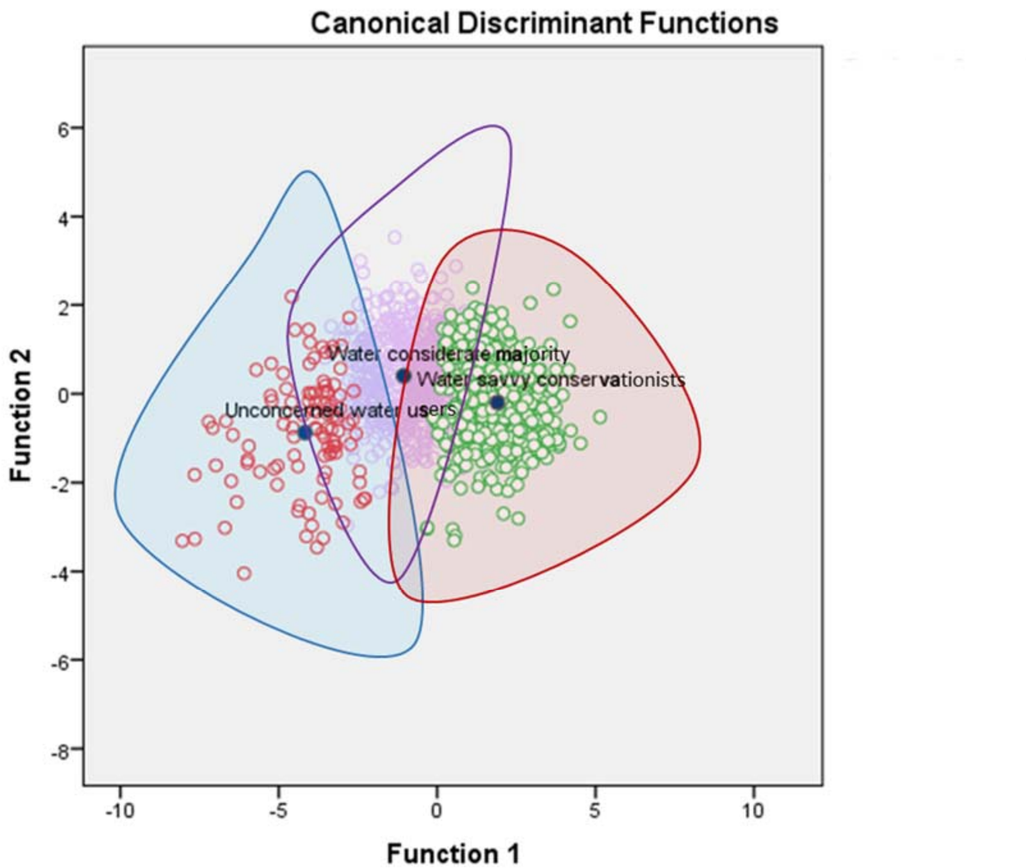

Figure 1. Combined group plot for national home irrigation user respondents based on canonical discriminant functions

The data satisfied all the assumptions of descriptive discriminant analysis (assumption of independent observation, multivariate normality) excluding the assumption of homogeneity of covariance matrices. We did not reject the null hypothesis of equal population covariance based on Box's M statistics. To address this violation, we used separate covariance matrices for each group rather than using the pooled within-group covariance matrix.

Once the individual cases were assigned to subgroups, we used one-way ANOVA to assess the differences in behavioral intentions, personal norms, and social norms among the three newly identified subgroups. The data satisfied all of the assumptions of a one-way ANOVA (normality, and independence of obervations) except homogeneity of variance. Therefore, we used the Welch test to calculate one-way ANOVA *F*-statistics and Games-Howell test as a *post hoc* test. To examine the differences among subgroups for their current water conservation behaviors, hiring practices, and learning preferences, we used Pearson chi-square test. We used Fisher's exact test for some current water conservation behavior statements because some cells did not have the minimum cell count required for analysis. We calculated effect sizes using Cramer's *V* for differences between categorical variables and eta-squared ($\eta 2$) for quantitative variables (Huck, 2012, Rea and Parker 1992). We interpreted Cramer's *V* as .10 and lower = *negligible*, .10 to .19 = *weak*, .20 to .39 = *moderate*, 0.40 to 0.59 = *relatively strong*, 0.60 to 0.79 = *strong*, 0.80 to 1.00 = *very strong* (Rea & Parker, 1992). We interpreted eta-squared values of .01 as *small*, .06 as *medium*, and .14 as *large* (Huck, 2012). We analyzed all data using SPSS (version 22.0; IBM Corp., Armonk, NY). We used an *a priori* alpha level of 0.05 to determine the significance of our findings.

Findings

Objective 1- Demographics of the Respondents

Females comprised just over half (51.4%; *n* = 541) of the total sample among the 1,052 national respondents. The average age of respondents was 40 years, and most of the respondents were white (83.7%; *n* = 881). Just over half of the respondents (51.1%; *n* = 538) had at least a 4-year college degree, and 83.9% (*n* = 883) of respondents owned their home. Just less than half (41.8%; *n* = 440) of respondents were member of a homeowners' association. The most common income categories were *$50,000 to $74,999* (21.0%; *n* = 221), *$25,000 to $49,999* (20.6%; *n* = 217), and *$75,000 to $99,999* (17.5%; *n* = 184). The top states represented by the panel were California (21.2%; *n* = 223), Florida (12.5%; *n* = 132), Texas (6.9%; *n* = 73), New York (4.5%; *n* = 47), and Ohio (3.4%; *n* = 36). The demographic characteristics of home irrigation users, such as ethnic and state dispersion, were notably different from the general public and census data, as previously reported by Warner et al. (2015).

Objective 2 – Classification into Subgroups Based on Respondents' Landscape Management Behaviors

Using the known group membership from the Florida segmentation study (Warner et al., 2016) study, we found 44% (*n* = 463) of the respondents belonged to the water considerate majority, 46.1% (n = 485) of the respondents belonged to the water savvy conservationists, and the remaining 9.9% (n = 104) of the respondents belonged to the unconcerned water users.

Objective 3 – Comparison of Current Water and Future Water Conservation Behaviors, Personal and Social Norms, Hiring Practices, and Learning Preferences among the Subgroups

Comparisons among the three subgroups (water savvy conservationists, water considerate majority and unconcerned water users) revealed differences in current and future landscape water conservation practices, normative beliefs, and learning preferences. Pearson chi-square tests indicated there were significant differences among the three subgroups for all 17 current water conservation behaviors (see Table 3). The differences in all 17 current water conservation behaviors had weak to moderate effect sizes based on Cramer's *V* scores (Rea & Parker, 1992).

Table 3

Comparison of Current Water Conservation Behavior Among National Residential Landscape Irrigation Users (N = 1,052)

Current behavior	*Water Considerate Majority* (*n* = 463)	*Water Savvy Conservationists* (*n* = 485)	*Unconcerned Water Users* (*n* = 104)	Chi Square χ^2	Cramer's *V*
I use rain barrels to collect water for use in my garden/lawn*	22.5% (104)	66.8% (324)	14.4% (15)	228.86	0.33
I have replaced high volume irrigated areas with low volume irrigation*	39.7% (184)	74.4% (361)	14.4% (15)	194.91	0.30
I have installed smart irrigation controls (such as soil moisture sensors (SMS) or an evapotranspiration device (ET)) so irrigation won't turn on when it isn't needed*	21.2% (98)	54.4% (264)	11.5% (12)	143.56	0.26
I have replaced high water plants with drought tolerant plants*	46.0% (213)	73.8% (358)	19.2% (20)	140.10	0.26
I use recycled waste water to irrigate my lawn/landscape*	21.4% (99)	52.6% (255)	13.5% (14)	125.95	0.25
I use a rain gauge to monitor rainfall for reducing/skipping irrigation*	34.1% (158)	65.2% (316)	22.1% (23)	120.88	0.24
I have turned off zone(s) or capped irrigation heads for established woody plants*	41.9% (194)	66.4% (322)	18.3% (19)	111.29	0.23
I use drip (micro) irrigation*	29.8% (138)	58.4% (283)	20.2% (21)	108.24	0.23
I have low-water consuming plant materials in my yard*	59.0% (273)	80.2% (389)	36.5% (38)	96.42	0.21

Table 3 (continued)

Comparison of Current Water Conservation Behavior Among National Residential Landscape Irrigation Users (N = 1,052)

Current behavior	*Water Considerate Majority* (*n* = 463)	*Water Savvy Conservationists* (*n* = 485)	*Unconcerned Water Users* (*n* = 104)	Chi Square χ^2	Cramer's *V*
I have converted turfgrass areas to landscaped beds*	28.7% (133)	54.2% (263)	16.3% (17)	91.54	0.21
I have retrofitted a portion of my landscape so that it is not irrigated*	34.3% (159)	57.7% (280)	21.2% (22)	85.49	0.20
I use different irrigation zones/zone run times based on plants' irrigation needs*	59.2% (274)	75.5% (366)	37.5% (39)	65.12	0.18
I use a rain sensor to turn off irrigation when it is not needed*	34.8% (161)	57.1% (277)	33.7% (35)	56.28	0.16
I seasonally adjust irrigation times*	80.8% (374)	84.1% (408)	54.8% (57)	46.13	0.15
I use high efficiency sprinklers*	65.7% (304)	75.7% (367)	53.8% (56)	37.84	0.13
I calibrate my sprinklers*	59.6% (276)	71.1% (345)	51.0% (53)	26.26	0.11
I follow watering restrictions imposed by local government and/or water management districts**	87.9% (407)	87.8% (426)	76.0% (79)	12.96	0.11

Note.* Significant at $p \leq 0.01$. ** Significant at $p \leq 0.05$. Numbers in table represent percentage who responded *yes* to current water conservation behavior with values in parenthesis represent corresponding actual responses. Possible responses were *yes*, *no*, and *unsure*. *p* values were reported based on either Pearson chi-square test or Fishers' exact text.

The mean water conservation behavioral intention scores were measured on a five-point Likert-type scale (1 = *low behavioral intention* to 5 = *high behavioral intention*) and compared among the subgroups. The one-way ANOVA with Welch test identified significant differences in behavioral intentions among all three subgroups (see Table 4). The post-hoc Games Howell test revealed that water savvy conservationists group had significantly higher behavioral intentions to conserve water compared to the water considerate majority and unconcerned water users subgroups. The significant differences in behavioral intentions among water savvy conservationists and the other two subgroups were interpreted as large practical effect based on eta-squared (Huck, 2012).

Table 4

Likelihood of Engaging in Water Conservation Practices and Advocacy Actions in The Future Among National Residential Landscape Irrigation Users (N = 1,052)

	Water Considerate Majority (n = 463)		Water Savvy Conservationists (n = 485)		Unconcerned Water Users (n = 104)			
	M	SD	M	SD	M	SD	F	η^2
Water conservation behavioral intentions	3.75*	(.34)	4.51*	(.32)	2.74*	(.55)	1025.67	.71

Note.*Significant at $p \leq 0.01$. Likelihood was measured by asking respondents to "Please indicate how unlikely or likely you are to engage in the following conservation behaviors in the future." Numbers presented are the mean of 19 possible behaviors. Scale: 1 (*low behavioral intention*) to 5 (*high behavioral intention*).

The mean personal norms and social norms scores were measured on a five-point Likert-type scale (1 = *weak perceived norm* to 5 = *strong perceived norm*). One-way ANOVA with Welch test revealed that both personal norms and social norms were different for all three subgroups (see Table 5). The post-hoc Games Howell test exhibited that the water considerate majority had higher personal and social norms than the unconcerned water users and lower personal and social norms than the water savvy conservationists group. These significant differences for personal norms and social norms were interpreted as large practical effect sizes (Huck, 2012).

Table 5

Social and Personal Norms Among National Residential Landscape Irrigation Users (N = 1,052)

	Water Considerate Majority (n = 463)		Water Savvy Conservationists (n = 485)		Unconcerned Water Users (n = 104)			
	M	(SD)	M	(SD)	M	(SD)	F	η^2
Social norms***	3.74	(.71)	4.32	(.62)	3.16	(.97)	155.72	.23
Personal norms***	4.08	(.62)	4.51	(.51)	3.59	(.90)	121.56	.19

Note. *** Significant at $p \leq 0.001$. Scale: 1 (*weak perceived norm*) to 5 (*strong perceived norm*)

Pearson chi-square revealed that there were no significant differences in hiring a professional landscape company for various purposes among three groups except for irrigation services (see Table 6). This meant that membership in a subgroup was not related to whether home irrigation users hired a professional or not. The exception was that the water savvy conservationists were more likely to use a professional for irrigation work. The Cramer's *V* scores exhibited that the use of professionals for *irrigation services* had a weak effect size (Rea & Parker, 1992).

Table 6

Comparison of Hiring a Professional Landscape Company for Various Purposes Among National Residential Landscape Irrigation Users (N = 1,052)

Hiring purpose	Water considerate majority	Water savvy conservationists	Unconcerned water users	χ^2	Cramer's *V*
Irrigation services	33.7% (156)	47.8% (232)	26.9% (28)	27.51*	0.16
Lawn maintenance	40.6% (188)	47.8% (232)	44.2% (46)	5.02	0.07
Pest management	37.4% (173)	37.9% (184)	29.8% (31)	2.52	0.05
Tree pruning	33.7% (156)	34.0% (165)	27.9% (29)	1.52	0.04
Landscape design and installation	23.8% (110)	26.2% (127)	21.2% (22)	1.50	0.04

Note. * Significant at $*p < 0.01$. Numbers in table represent percentage who responded yes to hiring a professional landscape company for various purposes with values in parenthesis represent corresponding actual responses. Possible responses were yes and no. *p* values were reported based on Pearson chi-square test.

The Pearson chi-square test revealed significant differences among three subgroups on learning preferences for all learning options excluding *read printed factsheets, bulletins, or brochures*, *read a newspaper article or series* and *watch a video* (see Table 7). The water savvy conservationists were most interested in nearly all of opportunities to learn about water and the unconcerned water users were the least interested. All the significant differences in learning preferences had weak effect sizes based on Cramer's *V* (Rea & Parker, 1992).

Table 7

Comparison of Learning Preferences for Learning About Water Topics Among National Residential Landscape Irrigation Users (N = 1,052)

Learning preference	Water considerate majority	Water savvy conservationists	Unconcerned water users	χ^2	Cramer's *V*
Attend a short course or website*	15.6% (72)	28.7% (139)	11.5% (12)	30.82	0.17
Take part in a one-time volunteer activity (e.g., water monitoring, stream side restoration, or education)*	21.4% (99)	33.8% (164)	17.3% (18)	23.91	0.15
Get trained for a regular volunteer position (e.g., as a watershed steward or a water quality monitor)*	11.7% (54)	22.3% (108)	9.6% (10)	23.31	0.15
Look at a demonstration or display*	22.7% (105)	32.8% (159)	15.4% (16)	19.84	0.14
Visit a website*	71.1% (329)	70.7% (343)	51.0% (53)	17.38	0.13
Attend a seminar or conference*	11.9% (55)	19.4% (94)	8.7% (9)	14.11	0.12
Attend a fair or festival*	15.8% (73)	21.2% (103)	7.7% (8)	12.59	0.11
Watch TV coverage*	46.0% (213)	54.0% (262)	38.5% (40)	11.18	0.10
Read a newspaper article or series	32.6% (151)	39.4% (191)	32.7% (34)	5.19	0.07
Read printed factsheets, bulletins, or brochures	44.3% (205)	48.9% (237)	38.5% (40)	4.53	0.07
Watch a video	39.5% (183)	39.8% (193)	29.8% (31)	3.84	0.06

Note.* Significant at $p \leq 0.01$. Numbers in table represent percentage who responded *yes* to a learning preference for learning more about water topics. Values in parenthesis represent corresponding actual responses. Possible responses were *yes* and *no*. *p* values were reported based on Pearson chi-square test.

Conclusions, Implications and Recommendations

There is a slightly higher percentage of females among the residential irrigation users under study (51.4%) compared to the general public (50.8%; United States Census Bureau, 2015). Residential irrigation users also have more education and higher income levels than the general population (United States Census Bureau, 2015). Compared to the general population, irrigation users are also more likely to own their home (United States Census Bureau, 2015) and are twice as likely to live in a homeowners' association (Community Associations Institute, 2015). As there is no database of irrigation users nationwide, this study provided insight into the states where irrigation was used the most and can serve as a baseline. The top states using irrigation are California, Florida, Texas, and New York, which are also the states with the greatest domestic water withdrawals and deliveries (Maupin et al., 2014). Descriptive characteristics of residential irrigation users nationwide revealed key differences from the general public. The findings implied it is important to focus on residential irrigation users as a key group that should targeted for water conservation (Warner et al., 2016).

This study compared residential irrigation users nationwide with the subgroups identified by Warner et al. (2016) among Florida residential irrigation users. We identified similar distinct subgroups to those identified in Florida. The presence of distinct subgroups implies that Extension audiences are extremely different with respect to behaviors, even within targeted audience groups such as home irrigation users.

Findings revealed that among residential irrigation users nationwide, 44% belong to the water savvy conservationists, 46% belong to the water considerate majority, and 9% belong to the unconcerned water users. There is a larger percentage of water savvy conservationists and a smaller percentage of unconcerned water users among the nationwide audience compared to group membership in Florida. The water considerate majority is nearly the same proportion as the Florida study. This finding implies that the nation is, overall, very water conscious. Although it has been stated that Floridians who use irrigation in the home landscape are more water conscious than the general population (Warner et al., 2016), it is possible that California and Texas may have an even higher level of awareness and concern over water availability, which would explain the greater percentage of water conscious people in this national sample. Alternatively, it should be noted that there was a year between Warner et al.'s Florida data collection (2016) and our national study, and it is possible that publicity about water issues during the year between these studies may have resulted in greater awareness.

The water savvy conservationists are most likely to engage in a number of landscape irrigation conservation practices than the other two subgroups among residential irrigation users nationwide. While they are more engaged in water conservation behaviors, they do not differ from the other subgroups on their use of landscape management professionals, except they were more likely to use professionals for irrigation services. This subgroup is also most likely to conserve water through good irrigation practices in the future. Conversely, the unconcerned water users are least likely to engage in water conservation behaviors in the home landscape or to adopt landscape irrigation best practices in the future. The unconcerned water users perceiv low personal norms and social norms surrounding the use of good irrigation practices, while the water savvy conservationists exhibit strong normative beliefs. That the highest perceived social and personal norms exists in the subgroup that is most engaged in water conservation confirms the power of normative beliefs on behaviors.

The water considerate majority has moderate engagement in water conservation practices, aspirations to conserve water in the future, and personal and social normative beliefs. These findings imply that the water considerate majority has the greatest potential as well as likelihood to adopt new water conservation practices.

The most popular preference for learning about water conservation is through visiting a website, which was followed by watching television and reading printed materials among the three subgroups. While there are significant differences on nearly all of the learning opportunities, the greatest differences occur in the more active options, with the water savvy conservationists being the most likely to engage in activities such as volunteering or attending a course. The water savvy conservationists are most likely to hire a professional to service their irrigation system while the unconcerned water users are least likely. Given that best practices in irrigation management recommend regular maintenance of an irrigation system as well as periodic calibration to ensure the appropriate amount of water is applied, this finding may indicate that these individuals are ensuring they follow best management practices by enlisting the help of a professional. Alternatively, it is possible that irrigation professionals are playing some role in educating irrigation users about water conservation.

This study was guided by social exchange theory as applied to the practice of social marketing. Exchange theory explains that people will adopt a behavior that results in the greatest benefit (Grier & Bryant, 2005; McKim et al., 2011). Extension professionals should consider the role of exchange theory and that their audience must pay some price to adopt a new behavior (Grier & Bryant, 2005). Accordingly, programs are effective when built around enhancing perceived benefits and reducing or removing perceived barriers and should be designed to maximize the value an audience receives from making a change. Targeting programs to subgroups, or segments, is a way Extension professionals can ensure programs enhance the net benefits of making a behavior change. The water savvy conservationists are already highly engaged in landscape water conservation, and therefore would not perceive much benefit to adopting conservation behaviors. However, there may be other actions that this subgroup would find valuable, such as training others and engaging in advocacy activities. It is likely that Extension professionals could help the water considerate majority to see a net benefit in engaging in landscape water conservation behaviors, given that this subgroup values water resources and has existing social support. The unconcerned water users are least likely to see a net benefit to engaging in water conservation because they do not value water resources or have social support for engaging in conservation.

We confirmed that residential irrigation users are different from the general public in important ways. Further, within this important target audience, there are subgroups that exhibit meaningful differences. The diversity identified among the subgroups reveals that a "one-size fits all" approach is unlikely to be the most appropriate strategy for encouraging the adoption of landscape water conservation practices. Audience segmentation is a strategy to identify the most important subgroup or subgroups within the larger, relevant population (Lee & Kotler, 2011; McKenzie-Mohr et al., 2012), and this study confirmed the value of this approach for Extension professionals nationwide. Similar to the recommendations of Warner et al. (2016), we concluded the water considerate majority should be the first and primary target of landscape irrigation water conservation programs. The water savvy conservationists are already highly engaged, and the unconcerned water users are uninterested in conservation actions and education. We considered implications very positive in that less than 10% of residential irrigation users nationwide belonged to the latter subgroup.

The existence of subgroups points to the need for different programmatic objectives for targeted programs. For example, Extension professionals should consider behavioral objectives, such as the adoption of specific water conservation behaviors, as appropriate for the water considerate majority. Programming for the water savvy conservationists might aim to engage these individuals in teaching others, engaging in advocacy action and contributing to policy making. Increased knowledge or awareness would be appropriate for the unconcerned water users.

Extension professionals who encourage home landscape irrigation conservation should recognize that the people who need to adopt conservation technologies and practices likely own their homes and live in a homeowners' association. Programs should be developed to appeal to homeowners and residents who make decisions about their landscape management. People who are more likely to conserve water are actively seeking out opportunities to attend educational programs and volunteer at water-related events while the people who need to adopt landscape water conservation practices are not as likely to engage in Extension programs. Therefore, other strategies are needed, and educational programs should incorporate the web, television, and printed materials that are preferred across all groups. Strategies may also incorporate participatory programming within communities so that residential irrigation users can play a role in planning water conservation programs that meet their needs. The findings revealed that residential irrigation users were much more likely to reside in homeowners' associations, and we agree with others who have emphasized the importance of working within these communities to help people to conserve water (DeLorme, Hagen, & Stout, 2003). Extension professionals should work with homeowners' associations to establish programs that benefit the community while helping residents to adopt irrigation conservation practices that are appropriate for the local culture and environment. Extension professionals can also work to establish stronger social norms within homeowners' associations by conducting programs within a community and using community members to demonstrate techniques. They can also use visual cues to build a sense of pride an new normative beliefs around conservation-minded behaviors and to remind residents to engage in important tasks, such as calibrating their sprinklers.

This study revealed opportunities for future research. While it was outside the scope of this study to explore the relationship between hiring irrigation professionals and engaging in water conservation, and this finding should be further examined. It is not known whether people who are more engaged in landscape water conservation are more likely to seek out professional irrigation services or if irrigation professionals are playing a role in encouraging conservation behaviors. Finding the latter would have important implications for targeting programs to irrigation professionals.

Because there are different group proportions between home irrigation users nationwide and in Florida, there may be important differences among individuals based on where they live. This should be examined to further reveal differences among residential irrigation subgroups as a function of geographical location. Finding differences based on location could reveal new opportunities to education residential irrigation users nationwide.

While findings suggest that the water savvy conservationists are most likely the subgroup most engaged with Extension programs, research should be conducted to confirm this. If this is the case, some in-person Extension water conservation programs should revisit their use of how-to format, because the people in attendance are already engaged in water conservation practices. Extension programs could then focus on empowering participants to be educators and advocates to help increase conservation engagement within their communities. Research should be used to test Extension programs designed to reach the other two subgroups who are not likely to personally engage in traditional group classes. Educational strategies should be designed to capitalize on the differences among the groups and appeal to their different characteristics. It is not known whether a person's membership in a subgroup is fluid or not, and future research should conduct a longitudinal study paired with educational treatments to explore this concept.

Audience segmentation provided insight into possible strategies that can be applied to solving complex water issues by illuminating unique subgroups, their relationships with water conservation, and possible ways to best appeal to their needs. Extension can professionals can use audience segmentation in the future to recruit Extension participants. This strategy can also be applied to other complex issues such as land use decisions and energy consumption.

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