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Consumer Involvement with and Expertise in Water Conservation and Plants Affect Landscape Plant Purchases, Importance, and Enjoyment

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Abstract. **The strain on potable water supplies heightens the competition for water resources and potentially reduces the demand for outdoor plantings and landscaping. We conducted an online survey with 1543 respondents in 2016 to ascertain their water conservation and plant expertise, their involvement in water conservation and plant issues, and the importance of plants and landscaping. We also collected demographic characteristics. Cluster analysis results identified two key market segments comprising ≈50% of the sample each: those who are Actively Interested in Water Conservation and those who are Disinterested in Water Conservation. The Actively Interested segment was younger, had more adults and children in the household, and had a higher household income. In addition to having a higher mean score for water conservation involvement and expertise, the Actively Interested segment had a higher mean score for water conservation importance and impact, as well as plant expertise and involvement. The Actively Interested segment scored higher on select components relating to horticultural importance, including aesthetically beautiful landscapes, active landscape enjoyment, desire for a low maintenance landscape, and response in drought, compared with the Disinterested segment. The Disinterested segment scored higher on the Non-Landscape Use with no enjoyment. Findings suggest that pro–water-conserving attitudes are found among consumers who value outdoor landscapes and those individuals who spend more on plants. Results suggest that producers and retailers should focus marketing and communication efforts on low water use cultivar selection and operationalizing water-conserving behaviors more than convincing consumers that plant purchases and landscaping are important.**

The challenge to allocate water resources in urban, suburban, rural, and agricultural areas will likely intensify in the coming decades as competition for potable water supplies increases (Springer, 2011). About 35% of domestic potable water, water fit for human consumption, is used for irrigation, 45% is used for thermoelectric production, and only 9% is used for public potable water supplies (U.S. Geological Survey, 2017). Compared with personal direct water uses (e.g., drinking and brushing teeth), outdoor indirect water use (e.g., watering gardens, lawns, and landscapes) is discretionary. Whereas water for irrigation meets a physical need for plants, the water indirectly meets a psychological need by elevating homeowners' perceived social status through aesthetically pleasing landscapes (Seyranian et al., 2015). In addition, landscapes provide tremendous economic, environmental, and well-being benefits (Hall and Dickson, 2011). Thus, homeowner perceptions about water use and conservation may be related to their perceptions about the importance of plants and landscapes. Attitudes about water conservation, plants, and the importance of landscaping can potentially influence the investment of water resources in existing and future landscapes and, in turn, dramatically affect the future sales of landscape plants.

Demographic characteristics influence residential water use and conservation. Being female is positively correlated with the adoption of drought-tolerant plants as well as water conservation and environmentalism (Fan et al., 2017; Gilg and Barr, 2006); male heads of households were 20% less likely to adopt the use of drought-tolerant plants (Fan et al., 2017). Gregory and Leo (2003) found a slight positive relationship between income and household water use, as did Domene and Saurí (2006). Older individuals had a greater likelihood of water conservation, but increased knowledge and general education appeared to be more directly linked to conserving water (Gilg and Barr, 2006; St. Hilaire et al., 2010).

Lifestyle influences water use. For individuals with high aesthetic and recreational priorities, outdoor water use was high (Beal et al., 2013; Fan et al., 2017; Gregory and Leo, 2003; Springer, 2011; Syme et al., 2004). Jorgensen et al. (2009) and Syme et al. (2004) showed that higher outdoor water use was related to more recreational activities at the residence, higher perceived garden/landscape value, increased spending on their garden or landscape, and dislike for paying an increasing price for water. Householders who perceived that their landscape would increase the resale value of their house used more water annually, as did persons who spent more time outdoors (Syme et al., 2004). Mayer et al. (1999) reported that U.S. households with a garden used 30% more water compared with households that did not maintain one.

Recent research suggests that attitudes toward the uses of potable water supplies have changed in other countries because of greater social awareness and increasingly widespread exposure to drought conditions, which included more pro-conservation behavior (Beal et al., 2013). Education about and adoption of sustainable water use practices may help ensure an adequate supply of irrigation water while conserving water sources for human and ecosystem services. Not only have some attitudes changed but also purchase behavior has changed to include more pro-conservation products. Some research suggests that consumers are willing to pay more for plants grown using more environmentally friendly practices, including water conservation in plant production (Behe et al., 2013; Hall et al., 2010).

Knuth et al. (2018a) showed some attitudinal differences toward water conservation among three groups of subjects who accurately or inaccurately perceived they had

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been in a drought situation relative to whether they actually had experienced a drought. Among all plant types listed, a greater percentage of those who accurately perceived they were in a drought had purchased evergreen trees and shrubs compared with those who did not accurately perceive a drought. The group that did not accurately perceive the drought placed a higher value on nursery plants grown with fresh water (vs. recycled water or a blend of fresh and recycled water) compared with those who accurately perceived a drought. Knuth et al. (2018b) showed that U.S. consumers valued the production water source more than plant water use in the landscape for both herbaceous and woody shrubs. Their conclusion was that education about contents of recycled water may facilitate greater acceptance, and ultimately the use, of recycled water. Each of these studies highlights the diversity of consumer water use and perceptions of water use and conservation. Here, we address consumer perceptions of residential landscape water conservation, landscape plants, and consumer involvement and expertise.

Involvement and expertise. Involvement is defined as a person's perceived relevance of an object based on inherent interests, values, or needs; or "a state of arousal, interest, or motivation" in a product (Behe et al., 2015; Greenwald and Leavitt, 1984; Petty and Cacioppo, 1986; Zaichkowsky, 1985). Consumer involvement with a product has a strong, positive relationship with purchase intention (Lin and Chen, 2006). Involvement level affects the type of information processed before the consumers' purchase decision. For example, highly involved consumers were more likely to examine more inherent product attributes (e.g., plant form and flower color), whereas less involved consumers were more likely to consider extrinsic product cues (e.g., brand name and price) because extrinsic cues are cognitively processed compared with intrinsic cues (Behe et al., 2015; Greenwald and Leavitt, 1984).

Involvement level with plants was directly related to visual attention to the plants in a recent choice experiment (Behe et al., 2015). In that study, plant involvement was measured with a 15-item scale (adapted from Zaichkowsky, 1985). Participants who had a high score on plant involvement paid more attention to the product and signage compared with participants who scored lower on that scale. Thus, more highly involved consumers processed information more deliberately than consumers with low involvement scores, which indicated that the low involvement group was quickly dismissive of the display information and may not have used information as thoughtfully in their purchase decision. Gregory and Leo (2003) found that involvement with water conservation was negatively related to water use in their study of Australian householders. They also adapted Zaichkowsky's (1985) involvement scale to measure involvement with water conservation. In addition, Joo et al. (2016) showed that both involvement and expertise affected the information consumers viewed and their purchase decision.

Expertise is an instinctive response that arises from training, practice, or time spent learning about a particular topic (Hoffman, 1998; Mylopoulos and Regehr, 2007). Prior studies have shown that consumers who are more knowledgeable about a product make purchase decisions in a different manner compared with consumers who are less knowledgeable (Grewal et al., 1998). Alba and Hutchinson (1987) and Shanteau (1992) reported that consumers with high product expertise were more selective of the information they examined before making a choice because they had a better understanding of what product attributes should be examined. Consumers with different expertise levels differ in their ability to comprehend information and discern more pertinent information from less pertinent information (Celsi and Olson, 1988; Rao and Sieben, 1992). For example, a wine expert would examine the type of grape and provenance, whereas a novice may examine the logo or brand.

Expertise may not necessarily interact with involvement because involvement is a motivational construct, whereas expertise is a sustaining construct representing a person's ability or knowledge to evaluate a particular topic (Batra and Ray, 1986; Zaichkowsky, 1985). In practice, involvement and expertise are often highly correlated, but theoretically distinct from each other (Petty et al., 1981). Therefore, we investigated these constructs separately.

A peer-reviewed study of consumer perceptions about water conservation, plant or landscape importance, and expertise and involvement was conducted with Australian consumers over a decade ago (Syme et al., 2004). Together, these studies suggested the inclusion of involvement and expertise measures in landscape and water conservation studies was important because from those findings, researchers could summarize the extent to which consumers were involved with water conservation in their landscape and how confident they were in their knowledge. The findings with Australian consumers could be used as a baseline estimate for American consumers' involvement and expertise.

Our objectives were to investigate the relationship between water conservation involvement and expertise and plant expertise and involvement as well as the perceptions of the importance of plants and landscaping. We hypothesized that water conservation involvement and expertise may be negatively related to plant expertise and involvement and the importance of landscaping because individuals with high aesthetic and recreational priorities use more water outdoors (Beal et al., 2013; Fan et al., 2017; Gregory and Leo, 2003; Springer, 2011; Syme et al., 2004). Another objective of our study was to determine how consistent U.S. consumers might be with the published Australian findings (Syme et al., 2004), given there are many similarities between the two nations, among them business ethics (Wood, 2000). Information from this investigation could inform marketing strategies of U.S. producers of landscape plants that use less water in the landscape as well as retail point-of-purchase displays, educational seminars, and events hosted by retailers for consumers. The insight gained could improve the understanding of consumer groups that do or do not engage in water conservation activities.

Materials and Methods

We developed an online survey instrument following widely accepted market research protocols to ensure a high degree of accuracy and data collection speed while reducing human error and survey expenses (Cobanoglu et al., 2001; Dillman et al., 2009; McCullough, 1998). The instrument included questions regarding a wide variety of topics related to landscape plants and water use, including plant purchases and expenditures, attitudes about water conservation and landscape plants, knowledge about water conservation and landscape plants, and demographic characteristics. The content and formatting of the survey questions were adapted from Syme et al. (2004), Behe et al. (2013), and Behe et al. (2015). The protocol and instrument were approved by the University Committee on Research Involving Human Subjects (IRB# x16-1053e Category: Exempt 2).

Researchers contracted with Lightspeed GMI (Warren, NJ) which maintains a panel of ≈1.3 million persons and has control mechanisms in place to eliminate duplicate panelists. They identified a random sample of individuals ≥18 years of age and distributed survey invitations. Parameters for the sample were ≈50% male and 50% female and people who had bought a plant within 2016 (the year the survey was administered). The survey was administered from 7 to 13 Sept. 2016. Subjects were directed to answer four quality assurance checkpoints in a specific manner after consenting to participate in the study (Zhu et al., 2017). This was to insure that respondents were reading every question. Questions were randomized to eliminate any order effect.

The survey comprised five parts: 1) types and amounts of plants purchased, 2) two series of questions in a conjoint design for perennials and (separately) woody shrubs (see Knuth et al., 2018b for a summary of those findings), 3) water conservation knowledge and involvement measures, 4) plant knowledge and involvement measures, and 5) demographic characteristics. The water conservation knowledge and involvement measures and plant knowledge and involvement measures questions used a 7-point Likert scale (1 = very unlikely; 7 = very likely) to rate each question.

Principal component analyses are used to describe the strength and direction of correlated variables in terms of their potential to quantify unobservable constructs (Jolliffe, 1986). The values that emerge show the interdependencies between observed variables which can be collapsed to a smaller set of components. The key result in a principal

component analysis is the independent variables' association with an indirectly measured construct or component. We used SAS version 9.4 (SAS Institute, Inc., Cary, NC) to conduct three separate principal component analyses: involvement, expertise, and landscape plant importance. In each analysis, we retained items with loadings ≥0.500. "Load" or "loading" is the terminology used in principal component analyses to indicate that the mean value for each item (question) is the highest among all the mean values for that item when testing for linear combinations (Costello and Osborne, 2005; Hair et al., 1998). Solutions (component values) with a Cronbach's alpha level ≥0.7 are considered to have a strong measure of internal consistency or validity (Tavakol and Dennick, 2011).

The components identified in those analyses are useful in segregating a sample into smaller clusters or market segments. Kaufman and Rousseeuw (2009) stated that cluster analysis "is the art of finding groups in data" (page 1). Using only the two components identified from the principal component analysis of water conservation expertise and involvement, we conducted an agglomerative cluster analysis using the SPSS (version 25) *k*-means clustering procedure, saving cluster membership for comparisons and mean testing using demographic characteristics and the other components identified in the prior analyses. A *k*-means cluster analysis was chosen over hierarchical cluster analysis because of past literature indicating *k*-means to be more appropriate for consumer preference studies (Lawless and Heymann, 2010).

An analysis of variance (ANOVA) test was conducted to test for differences in demographic characteristics and plant-related expenditures and purchases in nine plant categories: annuals, perennials, herb transplants, vegetable transplants, flowering shrubs, evergreen shrubs, fruiting trees, flowering trees, and evergreen trees. These variables were included to assess if there were true differences among the clusters, and if participating more with water conservation made consumers more or less aligned with purchasing plants from certain categories of plants, or overall had an effect on plant purchases.

Results

The survey was administered to 5769 potential participants. Subjects totaled 1543 or ≈26.7% of the sample frame. All U.S. states were represented except Hawaii, which was not deliberate but incidental to data collection.

Demographic characteristics. The mean age of respondents was 40 years (±16.9 years) and respondents were predominately female (57.8%). The mean household size was 1.2 adults and had a mean of 0.43 children for a mean household size of ≈2 persons. Respondents were primarily Caucasian (90%), followed by Black/African-American (4%), Hispanic (3%), Asian (2%), and Native American, Pacific Islander, and other races (1%). About a third (28.3%) had earned a 4-year college degree, followed by 21% of respondents who had some college education. A majority of the respondents lived in suburban areas (59.8%) and the mean annual household income was $60,000–$79,999.

Demographically, our study was similar to the 2016 U.S. Population Census (U.S. Census Bureau, 2017) where the mean household income from 2010 to 2015 was $79,263. The total U.S. population was ≈323 million, with an average household size of 2.6 persons. The population was 77% Caucasian, 13.3% Black/African-American, 17.6% Hispanic, 5.6% Asian, and 1.4% Native American, Pacific Islander, or other races. Nationally, 29.8% of U.S. citizens had earned a bachelor's degree or higher. Females represented 50.8% of the population and the median age was 37.9 years (U.S. Census Bureau, 2017). Without published variances of the census information, it was not possible to test for statistical differences between the samples.

The national average of horticulture-related spending in 2015 by households participating in a national gardening survey was $401, up from $317 in 2014 (Butterfield and Baldwin, 2016). The largest segment, Food Gardening, captured 36% of the consumers, followed by Flower Gardens at 34%. The largest portion of the 90 million households (75% of total U.S. households) who garden had an income of ≥$75,000, were mostly female, 55 years old and older, and held a bachelor degree. Nearly one-third (28%) of all households purchased their plants from home centers, whereas 29% bought them from mass merchandisers. The sample frame in the present study cannot be compared with the Butterfield and Baldwin (2016) sample because of the lack of published statistical variances. Even though the results cannot be statistically compared, they exhibit several similarities including similar spending habits, average income level, gender, and education level.

Principal component analysis. Results of the principal component analysis of 23 items related to water conservation expertise and involvement yielded four components identified as Water Conservation Expertise, Involvement, Importance, and Impact (Table 1).

The first component to emerge was labeled Water Conservation Expertise. Items that loaded >0.5 with it included items such as "In general, I know a lot about water conservation," "I consider myself knowledgeable about water conservation," and "I am knowledgeable about water conservation."

The second component to emerge was labeled Water Conservation Involvement. Five items loaded >0.5 on this component and included items "I think that water conservation is boring/exciting" and "I think that water conservation is mundane/fascinating."

The third component to emerge was labeled as Water Conservation Importance. Four items loaded >0.5 with this component included "I think that water conservation is unimportant/important" and "I think that water conservation means nothing/is of great importance to me."

The fourth component to emerge was labeled Water Conservation Impact and had three items with loadings >0.5. Those items included "I live in an area that had water restrictions in 2016," "The price of water restricts what I can do in the landscaped areas outside my home," and "I schedule my irrigation by using a timer/clock."

For the second principal component analysis, the analysis of items related to plant expertise and involvement produced a two-component solution with high reliability (Cronbach's alpha = 0.9753) and accounted for 72.8% of the variance in the items (Table 2). Items loading highly on the Plant Expertise component included "I am a plant expert" and "I know a lot about plants." Items loading highly on the Plant Involvement construct included "I think that plants are unappealing/appealing" and "I think that plants are uninteresting/interesting." These were the same components, "Involvement" and "Expertise," Syme et al. (2004) identified with Australian consumers.

For the third principal component analysis, the analysis of 23 items relating to horticultural importance adapted from Syme et al. (2004) produced a five-component solution with a Cronbach's alpha = 0.8571 and accounted for 67.1% of the variance in the items (Table 3). We identified and labeled the four components as Aesthetically Pleasing Landscape, Active Landscape Use and Enjoyment, Non-Landscape Use and Enjoyment, Low Maintenance Landscape Desire, and Response in Drought.

The first component to emerge was Aesthetically Pleasing Landscape which contained items with responses to "How important is each of the following to the preferred lifestyle of you and your family" including "A lush landscape," "A landscape that is the envy of the neighbors," "A well-irrigated landscape," "Large areas of lawn at your property," "A vibrant landscape," "A landscape that adds value to my home," "Large areas of garden beds at your property," and "A landscape that is into the neighborhood." All of the items in the Aesthetically Pleasing Landscape component were related to landscape beautification and maintenance.

The second component to emerge was identified as Active Landscape Use and Enjoyment and contained six items: "Working with plants outdoors is a valuable way to spend time," "Working with plants outdoors is a pleasant break from my other activities," "I get great satisfaction from working in the outdoor landscaped areas around my home," "I like to enjoy the harvest from my outdoor vegetables and herbs," "I like to enjoy the look and feel of a nicely landscaped outdoor area," and "I do not like working with outdoor plants." All of the items in Active Landscape Use and Enjoyment were related to positive landscape experiences.

Table 1. Principal component analysis of 23 items with oblique rotation (Promax) consisting of loadings from 28 initial items relating to water conservation expertise and involvement.[z] Five items were removed because of loadings lower than 0.500 or less with all components. Four components emerged from the 23 item loadings. The four components that emerged were Water Conservation Expertise, Water Conservation Involvement, Water Conservation Importance, and Water Conservation Impact. A univariate procedure was conducted using SAS software.[y]

Item	Water Conservation Expertise	Water Conservation Involvement	Water Conservation Importance	Water Conservation Impact
In general, I know a lot about water conservation	**0.9377**	0.0205	–0.0425	–0.0548
I consider myself knowledgeable about water conservation	**0.9133**	0.0449	–0.0081	–0.0586
I am knowledgeable about water conservation	**0.9065**	0.0391	0.0033	–0.0493
I know a lot about water conservation	**0.8213**	0.1454	–0.0541	–0.0627
I automatically know how to conserve water	**0.7891**	–0.1467	0.2161	–0.0509
My knowledge of water conservation helps me to understand very technical information about it	**0.7540**	0.1467	–0.1237	0.1350
I am involved with water conservation	**0.7346**	–0.0082	0.1369	0.0688
I keep current on the most recent developments about water conservation	**0.6856**	0.1636	–0.0008	0.1657
I am a water expert	**0.6505**	0.2502	–0.2815	0.1538
Compared with other people, I am interested in water conservation	**0.6085**	0.3094	0.0676	–0.0763
I use fixtures that help me to conserve water at home	**0.5513**	–0.1403	0.2789	0.1435
I think that water conservation is (1: "boring" to 5: "exciting")	0.0317	**0.8619**	0.0280	0.0419
I think that water conservation is (1: "mundane" to 5: "fascinating")	0.0229	**0.8536**	0.0903	–0.0039
I think that water conservation is (1: "uninteresting" to 5: "interesting")	0.0194	**0.6934**	0.3043	–0.0397
I think that water conservation is (1: "unappealing" to 5: "appealing")	0.0765	**0.6768**	0.2690	–0.0430
I enjoy learning about water conservation	0.3430	**0.5951**	0.0530	–0.0018
I think that water conservation is (1: "unimportant" to 5: "important")	–0.1026	0.1821	**0.8052**	–0.0025
I think that water conservation (1: "means nothing to me" to 5: "is of great importance to me")	–0.0114	0.2722	**0.7541**	0.0221
I think that water conservation is (1: "of no concern to me" to 5: "of great concern to me")	–0.0051	0.2475	**0.7491**	0.0591
I conserve water in and around my home	0.5849	–0.2266	**0.5582**	–0.0155
I live in an area that had water restrictions in 2016	–0.0074	–0.1030	0.0776	**0.8292**
The price of water restricts what I can do in the landscape areas outside my home	–0.0501	0.1456	0.0030	**0.7362**
I schedule my irrigation by using a timer/clock	0.3045	–0.0660	–0.0131	**0.5692**
Percent of variance	34.2%	16.9%	13.2%	7.7%
Variance explained (before rotation)	11.6967	2.6261	1.1742	1.0809
Variance explained (orthogonal rotation)	7.3294	3.9615	3.2085	2.0785
Variance explained eliminating other components (oblique rotation)	4.2365	2.0845	1.9822	1.3144
Variance explained ignoring other components (oblique rotation)	10.2607	7.7097	5.2268	4.0951
Cronbach coefficient alpha—raw variables	0.9494	0.9510	0.9534	0.9528
Cronbach coefficient alpha—standardized variables	0.9520	0.9533	0.9555	0.9557
Cronbach coefficient alpha—raw variables (overall)		0.9509		
Cronbach coefficient alpha—standardized variables (overall)		0.9534		

[z]Loadings in bold indicate item component assignments. These loadings indicate which component the item was categorized with based on the highest item value.
[y]SAS for Windows, version 9.4; SAS Institute, Inc.

The third component to emerge was called Non-Landscape Use and Enjoyment and contained four items: "I hardly ever use the outdoor space at my home for recreation," "I never entertain friends outdoors," "The outdoor space around my home is an important place for my leisure activities" (negatively), and "My family makes a lot of use of the outdoor space at our home" (negatively). All of the items in Non-Landscape Use and Enjoyment were related to negative views or lack of experiences in the landscape or landscape use.

The fourth component to emerge contained three items and was labeled Low Maintenance Landscape Desire. This component contained "A landscape with low maintenance," "A landscape that uses no supplemental irrigation," and "A landscape that uses plants with low water requirements." All of the items in Low Maintenance Landscape Desire were related to low effort or low input in landscape maintenance.

The fifth factor to emerge was labeled Response in Drought and contained two items: "In a water crisis, we should not buy or try to maintain outdoor landscape plants" and "I have decreased my outdoor plant purchases because of water restrictions in my neighborhood."

Cluster analysis. Two clusters emerged from the analysis using the principal component analyses based only on only two dimensions: water conservation expertise and water conservation involvement. The two clusters that emerged were labeled Disinterested in Water Conservation (49.7% of the sample) and Actively Interested in Water Conservation (50.3% of the sample).

We conducted a non-polynomial ANOVA test of the demographic characteristics of the clusters including gender, age, ethnicity, household number of adults and children, education level, income, and expenditures on plant-related products in 2016 (Table 4). Overall, the Actively Interested cluster had younger, more ethnically diverse members who were more highly educated and had larger households and higher incomes compared with the Disinterested cluster members.

The Actively Interested cluster spent 91% more ($156.06) on plant-related products in 2016 compared with the Disinterested cluster ($81.91) (Table 5). Furthermore, a higher percentage of members of the Actively Interested in Water Conservation cluster purchased the eight plant types listed (Table 5) in 2016. The Disinterested cluster did make plant purchases, but not to the extent the Actively Interested cluster did. For the herbaceous plant material (e.g., annuals, vegetables, herbs, and perennial transplants), twice as many Actively Interested cluster members purchased plants. For the woody plants, three to five times the percentage of Actively Interested cluster members bought flowering and evergreen shrubs as well as fruit, shade, and evergreen trees.

Last, we compared the mean component scores of the two clusters on the 11 components identified in prior analyses (Table 6). The Actively Interested in Water Conservation cluster members had a higher mean score on 10 of the 11 components, including Water Conservation Expertise and Involvement, Water Conservation Importance and Impact, Plant Expertise and Involvement, Aesthetic Landscape Beauty, Desire for Low Maintenance Landscape, and Response in Drought. The exception was the component labeled Non-Landscape Use or Enjoyment for which the Disinterested in Water Conservation cluster members scored higher compared with the Actively Interested in Water Conservation members.

Table 2. Principal component analysis of 26 items with oblique rotation (Promax) with loadings of 27 initial items relating to plant expertise and involvement.[z] Two components emerged from the 26 item loadings. Items were removed from the analysis if they loaded 0.500 or less with all components. The two components that emerged were Plant Expertise and Plant Involvement, which were distinctly similar to Syme et al. (2004). A univariate procedure was conducted using SAS software.[y]

Item	Plant Expertise	Plant Involvement
I am a plant expert	**0.9532**	–0.2263
I know a lot about plants	**0.9328**	–0.0119
In general, I know a lot about plants	**0.9322**	–0.0211
I am knowledgeable about plants	**0.9190**	0.0062
I can recall specific attributes about plants	**0.8658**	0.0199
My knowledge of plants helps me to understand very technical information about them	**0.8631**	–0.0283
I consider myself knowledgeable about plants	**0.8578**	0.0681
I can recognize many types of plants	**0.8305**	0.0437
I automatically know which plants to buy	**0.8229**	–0.0064
I can recognize many names of plants	**0.7963**	0.0437
I can recall many plants from memory	**0.7931**	0.0437
I keep current on the most recent developments about plants	**0.7726**	0.0791
I can immediately identify my preferred plants even if they are displayed with others	**0.6914**	0.1833
I will search the latest information on plants before I make a purchase	**0.6829**	0.1015
At the place of purchase, I can visually detect my preferred plants without much effort	**0.6290**	0.2356
Compared with other people, I am interested in plants	**0.6177**	0.3313
Because of my personality, I would rate plants as being of the highest importance to me, personally	**0.5929**	0.2811
I am involved in growing plants	**0.5706**	0.3176
I enjoy learning about plants	**0.5611**	0.4023
I think that plants are (1: "unappealing to 5: "appealing")	–0.1517	**0.9419**
I think that plants are (1: "uninteresting" to 5: "interesting")	–0.0122	**0.9114**
I think plants are (1: "unimportant" to 5: "important")	–0.0459	**0.8693**
I think that plants are (1: "mundane" to 5: "fascinating")	0.0292	**0.8580**
I think that plants (1: "mean nothing to me" to 5: "are of great importance to me")	0.1478	**0.8100**
I think plants are (1: "boring" to 5: "exciting")	0.1220	**0.7962**
I think that plants are (1: "of no concern to me" to 5: "of great concern to me")	0.1339	**0.7954**
Percent of variance	52.1%	20.7%
Variance explained (before rotation)	16.1829	2.7430
Variance explained (orthogonal rotation)	11.8818	7.0441
Variance explained eliminating other components (oblique rotation)	7.8984	3.8692
Variance explained ignoring other components (oblique rotation)	15.0567	11.0275
Cronbach coefficient alpha—raw variables	0.9764	0.9773
Cronbach coefficient alpha—standardized variables	0.9764	0.9772
Cronbach coefficient alpha—raw variables (overall)	0.9755	
Cronbach coefficient alpha—standardized variables (overall)	0.9753	

[z]Loadings in bold indicate item component assignments.
[y]SAS for Windows, version 9.4; SAS Institute, Inc.

Discussion

The objectives of this study were to explore the relationship between water conservation involvement and expertise, and plant expertise and involvement, and correspondingly understand the perceptions of the importance of plants and landscaping for American consumers. Behe et al. (2015) and Joo et al. (2016) conducted a principal component analysis of scales using the same terminology as in the current study and found only two dimensions: expertise and involvement. In this study, we found similar results with the emergence of two dimensions of plant expertise and plant involvement. However, four components emerged in the water conservation analysis. Both importance and impact of water conservation emerged as distinct from expertise and involvement. The difference between the present findings and that of Syme et al. (2004) may indicate that water conservation may be a more complex set of constructs, than in Syme et al. (2004), which includes distinct dimensions for importance and impact. The components had sufficiently high reliability and validity that they can be replicated in future studies.

Syme et al. (2004) reported their factor of analysis landscape and horticultural importance (items we adapted are listed in Table 3) without publishing the item loadings, amount of variance accounted for, and fit statistics. Their solution contained five factors: lifestyle, garden recreation, garden interest, conservation attitude, and social desirability. Our first component to emerge (Aesthetically Beautiful Landscape) was similar to Syme et al.'s (2004) lifestyle factor. Their garden recreation factor emerged as two components in our analysis: Active Landscape Use and Enjoyment, and Non-Landscape Use and Enjoyment. Their conservation attitude factor was similar to our component Low Maintenance Landscape Desire. Our reduced plant use component was similar to their social desirability factor. Yet, without the publication of their item loadings and fit statistics, it is not possible to make a more detailed comparison. Although we cannot test statistically for similarities (or differences), we see consistency in the findings of the present study and Syme et al. (2004).

The two-solution cluster analysis provided evidence that the market is not homogeneous based on water conservation involvement and expertise attitude dimensions. We did find differences in the sample of participants by plant and water conservation expertise and involvement as well as horticultural importance and demographic characteristics. The resulting two-cluster solution indicated that there are two key target markets for marketers to communicate with, and they appear to have opposite perceptions of water conservation involvement and expertise as well as plant involvement and expertise. Their demographic and attitudinal characteristics can also help facilitate the development of marketing strategies to target them. For example, to target active water conservers, it may be helpful to provide more water-conserving plants and communicate the benefits of including water-conserving plants in their landscape.

Demographically, the Actively Interested cluster was younger than the Disinterested group, which was opposite to the findings of Gilg and Barr (2006) and St. Hilaire et al. (2010). The Actively Interested cluster also had more adults and children in the household, consistent with Behe et al. (2016) and Mayer et al. (1999). This cluster also had a higher household income compared with the Disinterested in Water Conservation segment, which was more consistent with Gregory and Leo (2003) but not Domene and Saurí (2006). A younger and more affluent segment that is actively concerned about water conservation could represent changing perceptions of younger generations. Also, because their average plant expenditures were higher, this could

Table 3. Principal component analysis of 23 items with oblique rotation (Promax) with loadings of 27 initial items relating to landscape and plant importance adapted from Syme et al. (2004). Five components emerged based on the 27 item loadings. Items were removed from the analysis if they loaded 0.500 or less with all components.[z] The five components that emerged were Beautiful Landscape, Active Landscape Enjoyment, Non-Landscape Enjoyment, Low Maintenance Landscape Desire, and Response in Drought. A univariate procedure was conducted using SAS software.[y]

Item	Aesthetically Pleasing Landscape	Active Landscape Use and Enjoyment	Non-Landscape Use and No Enjoyment	Low Maintenance Landscape Desire	Response in Drought
A lush landscape	**0.8431**	0.0286	0.0058	–0.0700	–0.0326
A landscape that is the envy of the neighbors	**0.8118**	–0.0098	0.0961	–0.0378	0.0307
A well-irrigated landscape	**0.7929**	–0.0425	0.0282	0.0377	0.0081
Large areas of lawn at your property	**0.7537**	–0.0535	–0.1257	–0.1259	0.0761
A vibrant landscape	**0.6454**	0.1263	0.0223	0.2319	–0.1212
A landscape that adds value to my home	**0.5420**	–0.0100	–0.0117	0.4484	–0.1620
Large areas of garden beds at your property	**0.5326**	0.3706	–0.0866	–0.1333	0.0646
A landscape that fits into the neighborhood	**0.5142**	–0.1194	0.0078	0.4712	–0.1388
Working with plants outdoors is a valuable way to spend time	0.0243	**0.9252**	0.0530	0.0160	0.0007
Working with plants outdoors is a pleasant break from my other activities	0.0294	**0.9231**	0.0434	0.0109	0.0021
I get great satisfaction from working in the outdoor landscaped areas around my home	0.1278	**0.8231**	–0.0336	–0.0447	0.0437
I like to enjoy the harvest from my outdoor vegetables and herbs	–0.0513	**0.6332**	–0.0812	0.0297	0.1249
I like to enjoy the look and feel a nicely landscaped outdoor area	0.1568	**0.5010**	–0.0158	0.2721	–0.0834
I do not like working with outdoor plants.	0.1924	**−0.8278**	0.0217	0.0477	0.3579
I hardly ever use the outdoor space at my home for recreation	0.1124	0.0325	**0.9179**	–0.0081	0.1815
I never entertain friends outdoors	0.0604	0.0425	**0.8526**	–0.0251	0.2103
The outdoor space around my home is an important place for my leisure activities	0.1879	0.1606	**−0.6973**	0.0106	0.1652
My family makes a lot of use of the outdoor space at our home	0.1629	0.0990	**−0.7500**	–0.0090	0.1987
A landscape with low maintenance	–0.1229	–0.0986	–0.0404	**0.8663**	0.0189
A landscape that uses no supplemental irrigation	–0.0521	0.0857	0.0145	**0.7297**	0.1973
A landscape that uses plants with low water requirements	0.0839	0.2480	0.0055	**0.5976**	0.1475
In a water crisis, we should not buy or try to maintain outdoor landscape plants	–0.2408	–0.0147	0.0048	0.2087	**0.7398**
I have decreased my outdoor plant purchases because of water restrictions in my neighborhood	0.1677	–0.0275	0.0984	–0.0532	**0.7234**
Percent of variance (total = 67.1%)	21.9%	18.3%	13.7%	8.1%	5.1%
Variance explained (before rotation)	8.4805	2.6737	1.6311	1.3893	1.2638
Variance explained (orthogonal rotation)	4.3570	4.2127	2.8040	2.5451	1.5197
Variance explained eliminating other components (oblique rotation)	2.6631	2.5392	1.9873	1.8537	1.4431
Variance explained ignoring other components (oblique rotation)	6.5053	6.5292	4.5158	3.8770	1.6321
Cronbach coefficient alpha—raw variables	0.8517	0.8563	0.8797	0.8578	0.8640
Cronbach coefficient alpha—standardized variables	0.8653	0.8700	0.8927	0.8705	0.8779
Cronbach coefficient alpha—raw variables (overall)			0.8390		
Cronbach coefficient alpha–standardized variables (overall)			0.8571		

[z]Loadings in bold indicate item component assignments.
[y]SAS for Windows, version 9.4; SAS Institute, Inc.

Table 4. Analysis of variance of "Actively Interested in Water Conservation" and "Disinterested in Water Conservation" clusters' demographics comprising age, gender, ethnicity, household size for both adults and children, income, and education level. The test statistic abbreviations are "*t*" for the *t* test, χ^2 for the chi-square test, "F" for the F-statistic, and "*P*" for *P* value.[z] Degrees of freedom are noted in parentheses along with the test statistic. Tests were conducted using SAS software with adjustments for any unequal variances.[y]

	Cluster			
Demographic characteristic	Disinterested in Water Conservation [mean (SE)]	Actively Interested in Water Conservation [mean (SE)]	Test statistic	*P*
Age	58.6 (0.56)*	55.3 (0.65)*	$T(1,508.2) = 3.87$	0.0001
Gender	28%	30%	$\chi^2(1) = 2.06$	0.1511
Percent Caucasian	91.9%	83.0%	$\chi^2(1) = 31.26$	0.001
Percent African-American	3.0%	4.5%	$\chi^2(1) = 1.59$	0.207
Percent Asian	1.4%	7.1%	$\chi^2(1) = 29.76$	0.0001
Percent other	2.9%	3.0%	$\chi^2(1) = 1.59$	0.207
Number of adults in a household	1.1 (0.03)*	1.3 (0.03)*	$t(1,508.8) = 4.28$	0.0001
Number of children in a household	0.3 (0.03)*	0.6 (0.04)*	$t(1,420.9) = 6.90$	0.0001
Income	$63,526.0 ($1,706.25)*	$71,840.4 ($1,720.21)*	$t(1,508.8) = 4.28$	0.0001
Percent obtained bachelor's degree	57.7%	42.5%	$\chi^2(1) = 31.08$	0.0001

[z]Asterisk (*) indicates significant differences between columns at $P < 0.010$.
[y]SAS for Windows, version 9.4; SAS Institute, Inc.

be construed as a positive finding for the green industry; plant purchases and water conservation are compatible.

Behaviorally, the two clusters differed substantially. It was not that the Disinterested did not purchase plants, because they did. In fact, about half of the Disinterested segment purchased herbaceous transplants of annuals, vegetables, herbs, and perennials. However, purchases of woody plants were three to five times as great for Actively Interested individuals compared with Disinterested individuals. The Actively Interested individuals were more interested in their landscapes and substantially invested in the infrastructure of their landscape consisting of woody plants that will persist and increase in size and value. This finding could be great news for woody plant producers who can offer woody plants that would perform well under low water use conditions.

Table 5. Analysis of variance of "Actively Interested in Water Conservation" and "Disinterested in Water Conservation" clusters' demographics comparing spending on plant-related products in 2015 and 2016, and purchases of annuals, vegetable transplants, herb transplants, flowering shrubs, evergreen shrubs, fruiting trees, evergreen trees, and shade trees. The test statistic abbreviations are χ^2 for the chi-square test, "F" for the F-statistic, and "*P*" for *P* value. Degrees of freedom are noted in parentheses along with the test statistic. Tests were conducted using SAS software with adjustments for any unequal variances.[z]

	Cluster			
Plant-related productions	Disinterested in Water Conservation [mean (SE)]	Actively Interested in Water Conservation [mean (SE)]	Test statistic	*P*
Amount spent on plants and related supplies excluding equipment in 2015	$82.79 ($4.36)	$152.98 ($4.95)	F = 106.011	0.0001
Amount spent on plants and related supplies excluding equipment in 2016	$82.36 ($4.31)	$147.95 ($4.79)	F = 97.701	0.0001
Percent purchasing annual plants	0.40 (0.019)	0.58 (0.017)		
Percent purchasing vegetable transplants	37.8%	62.1%	$\chi^2(1) = 63.28$	0.0001
Percent purchasing herb transplants	35.39%	64.6%	$\chi^2(1) = 55.224$	0.0001
Percent purchasing perennials	39.18%	60.8%	$\chi^2(1) = 29.254$	0.0001
Percent purchasing flowering shrubs	28.76%	71.23%	$\chi^2(1) = 65.086$	0.0001
Percent purchasing evergreen shrubs	15.25%	84.74%	$\chi^2(1) = 60.672$	0.0001
Percent purchasing fruit-producing trees	25%	75%	$\chi^2(1) = 38.786$	0.0001
Percent purchasing evergreen trees	14.95%	85.05%	$\chi^2(1) = 55.553$	0.0001
Percent purchasing shade trees	21.37%	78.63%	$\chi^2(1) = 40.675$	0.0001

[z]SAS for Windows, version 9.4; SAS Institute, Inc.

Table 6. Comparison of two clusters, "Disinterested in Water Conservation" and "Actively Interested in Water Conservation," identified in *k*-means cluster analysis on Water Conservation Expertise, Involvement, Importance, and Impact; Plant Expertise and Involvement; and Landscape Beauty, Active Landscape Enjoyment, Non-Landscape Enjoyment, Low Maintenance Landscape Desire, and Response in Drought. The abbreviation "F" means F-statistic and "*P*" means *P* value. Tests were conducted using SAS software with adjustments for any unequal variances.[z]

	Cluster			
Landscape components	Disinterested [mean (SE)] (*n* = 767)	Actively Interested [mean (SE)] (*n* = 776)	F	*P*
Water Conservation Expertise	–0.681 (0.027)*	0.673 (0.026)*	1,303.59	0.0001
Water Conservation Involvement	–0.658 (0.028)*	0.651 (0.026)*	1,155.97	0.0001
Water Conservation Importance	–0.487 (0.039)*	0.481 (0.022)*	472.26	0.0001
Water Conservation Impact	–0.476 (0.027)*	0.471 (0.036)*	445.8	0.0001
Plant Expertise	–0.502 (0.033)*	0.496 (0.03)*	511.05	0.0001
Plant Involvement	–0.414 (0.04)*	0.409 (0.023)*	314.35	0.0001
Landscape Beauty	–0.36 (0.033)*	0.356 (0.034)*	226.26	0.0001
Active Landscape Enjoyment	–0.444 (0.037)*	0.439 (0.026)*	372.99	0.0001
Non-Landscape Enjoyment	0.245 (0.038)*	–0.242 (0.032)*	97.22	0.0001
Low Maintenance Landscape Desire	–0.286 (0.039)*	0.283 (0.029)*	135.73	0.0001
Response in Drought	–0.251 (0.027)*	0.248 (0.041)*	102.32	0.0001

[z]SAS for Windows, version 9.4; SAS Institute, Inc.
*Indicates significant differences between columns at $P < 0.010$.

Attitudinally, the two clusters differed on every (principal component) attitude identified in the study. The Actively Interested in Water Conservation cluster considered water conservation more important and having a bigger impact on their lifestyle compared with the Disinterested segment. Actual water use of individuals who are Actively Interested in Water Conservation would be interesting to measure because Gregory and Leo (2003) demonstrated that involvement with water conservation was negatively related to water use in their study of (Perth) Australian householders. Their findings may be due, in part, to prolonged and severe drought periods experienced in Australia, especially in the cities. Still, prior research showed that individuals with high aesthetic and recreational priorities (Beal et al., 2013; Fan et al., 2017; Gregory and Leo, 2003; Springer, 2011; Syme et al., 2004) or who spent more time outdoors (Syme et al., 2004) used more water.

Furthermore, the Actively Interested segment had greater plant expertise and involvement, indicating that they believe they know more about plants and are more interested in plants compared with the other segment. Lin and Chen (2006) demonstrated that consumer involvement with a product has a strong, positive relationship with purchase intention and we documented a higher level of plant involvement was positively related to more plant purchases. The Actively Interested segment valued aesthetically beautiful landscapes more, actively enjoyed landscapes more, had a greater desire for low maintenance landscapes, and had a more positive response in drought. Plants and landscaping are important to the segment of Americans who are interested in (involved) and have knowledge about (expertise) water conservation. The proactive water-conserving attitudes of the Actively Interested segment also appear to be consistent with Gregory and Leo (2003). This is very good news for the horticulture industry because professionals may concentrate on marketing messages that highlight differences in landscape plant performance under drought conditions rather than needing to make the landscape an important part of the potential consumers' lifestyle. Although garden retailers do not typically focus on marketing messages which make the landscape a priority for consumers' dollars and water, a message including those items could be combined with information on water-saving cultivars. In other words, landscaping does not have to be a large water user.

The disconcerting aspect of the half of the sample that comprised the Disinterested in Water Conservation segment is that they did not use or enjoy their outdoor landscapes very much. They also spent half the amount on plants compared with the Actively Interested in both 2015 and 2016. The implication from this is that growers, wholesalers, and retailers should focus more on educating potential consumers about which plants to buy and, ultimately, why they should buy plants. Marketing messages could help them place a higher priority on landscaping and the tremendous economic, environmental, and health and well-being benefits derived from having plants around residences and businesses (Hall and Dickson, 2011).

Conclusions

Horticultural industry stakeholders should be encouraged by these findings. Americans who are actively interested in water conservation find plants important, have an active use and enjoyment of the landscape, and have

a desire for lower inputs in those landscapes, especially water. This appears to be good news because Mayer et al. (1999) reported that households that maintained a garden used 30% more water than those without a garden. Thus, the 50% of homeowners who are actively interested in conservation would likely place a high priority on water availability for outdoor uses even when water resources are scarce. They derived enjoyment from their landscape and were active in it. The industry should capitalize on that enjoyment by directing future purchases to species and cultivars with lower water needs.

The implications for the green industry are clearer. Their energy should be invested in marketing and communication strategies that emphasize cultivar selection for low inputs, including water. It would appear that the industry does not need to convince individuals with high water conservation involvement that plants are important, nor do they need to promote water conservation importance to individuals with high plant involvement. The value of both plants and water conservation is related. However, three to five times more individuals who value the landscape (and scored high on water conservation involvement and expertise) are investing in the backbone of the landscape, which is woody plants.

Limitations of this study include potential biases in the panel used to supply respondents to the survey. The unintentional omission of Hawaii through subject recruitment may influence generalizability to the U.S. populations slightly. Last, actual water use measures would have strengthened the results but dramatically increased the survey length and response time. Future work should investigate the relationships between actual water use and the principal components identified here.

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