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Abstract

Tailoring programs based on audience needs and priorities is a critical component of effective programs. Audience segmentation research provides an opportunity to identify subgroups based on characteristics that affect their willingness to adopt a certain behavior and allows extension programs to fulfill a variety of needs and target the most important groups within a population. Currently there is minimal research exploring the factors that influence the sustained adoption of environmentally responsible pest management practices. As a result, the purpose of this study was to explore potential extension audience segmentation strategies by evaluating factors related to differences in residents' intentions to use integrated pest management (IPM) practices.We used online surveys to collect data from a sample of 3,588 residents. We found relatively high intentions to adopt IPM practices but there remains room to increase adoption levels. Responses of undecided ranged from 14.7% to 23.1% across all pest management practices, which demonstrates the potential for an audience to be influenced to adopt an IPM approach. We also found that demographics, complementary conservation behaviors and engagement with the natural environment characterize meaningful subgroups to guide extension program design. Interestingly, we found an interrelationship between the intention and actual adoption of other environmentally responsible practices and the intention to adopt IPM practices. Respondents with greater intent to engage in IPM were also more engaged in general conservation, water conservation and fertilizer best practices. This demonstrates that previous engagement with other environmentally responsible practices may influence the adoption of IPM. Respondents with greater intent to engage in IPM also had less negative experiences with water quality and availability, implying the possible role negative consequences can play as teaching tools in extension program.

Keywords

audience segmentation, pest management, practice adoption, integrated pest management, water quality, water quantity

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Introduction

The complexity of today's issues and their solutions challenge extension professionals on a global scale to develop the expertise and attitudes among various audiences to drive change. The intricacies of behavior change need to be incorporated into the educational strategies developed during program planning to produce greater outcomes with available resources (Taylor-Powell & Boyd, 2008), which starts with understanding the program's audiences (Harder et al., 2009). Extension professionals who focus on environmental issues in any location need to understand the personal and social factors that influence an audience's intention to adopt relevant behaviors and technologies (Gregory & Di Leo, 2003; Huang, Lamm, & Dukes, 2016).

The World Health Organization cites changes in ecology, climate and human behavior as factors that have increased the development of urban pests (Bonnefoy, Kampen, & Sweeney, 2008). The nexus of environment and human populations that has created this global issue requires careful examination to ensure communities are not superfluously exacerbating environmental issues, such as water quality, through pest management behaviors. Unforutunately, the common reaction to pests of public health, invasive species, and pests that can devastate landscaping is to do a broadcast application of a pesticide. The use of insecticides as the primary control method to manage insect populations has increased twenty fold since the 1960s (Atwood & Paisley-Jones, 2017). Residential consumers (i.e., home and garden) still account for more user expenditures of insecticides than agricultural, commercial, governmental and industrial users combined (Atwood & Paisley-Jones, 2017).

Landscape management, which includes pest management, is dominated by United States interests, with consumers annually spending approximately $52.3 billion USD for products and services (National Gardening Association, 2019). While pest management in other countries is largely focused on food safety and public health, the global landscaping and gardening services market projects an annual growth rate of 7.1% for the period of 2017-2026 (Business Wire, 2018). The extent of insecticide use coupled with improper use by untrained individuals draws concerns towards the degradation of water bodies. Extension is well positioned to educate homeowners on best practices and address limitations such as availability of water.

Integrated Pest Management (IPM) represents a decision-making process that offers a more effective, sustainable, and environmentally-conscious approach to controlling pest populations across the globe (Calibeo, Oi, & Oi, 2017; Cooper, Wang, & Singh, 2015; Kass et al., 2009; Wang & Bennett, 2009; Williams et al., 2005). IPM is a strategy that includes pest identification, surveillance, execution of chemical and non-chemical (i.e., communication, education, plant and turf health, excluding pests from building, and sanitation) tactics, and evaluation. While IPM has a long history of scientific success, there are consistent issues of increasing adoption by end-users in both agricultural and non-agricultural settings worldwide. One of the reasons for poor adoption may be that it is a process versus a single action such as applying a pesticide to manage pests.

The complexity of IPM coupled with the diversity of extension audiences represents a significant challenge to delivering an effective program (McDowell, 2004). According to Andreasen (2006) and Newton et al. (2013), programs that ignore the inherent variability of a potential audience and use a standard, singular approach are generally ineffective. Tailoring programs based on audience needs, priorities and lifestyles is a critical component of effective programs (McDowell, 2004; McKenzie-Mohr, 2011; Raison, 2010). Extension professionals are encouraged to conduct extensive formative audience research to identify an audience's values and perceived barriers to change (Lee & Kotler, 2011).

While there are extension professionals working in the area of landscape conservation, there is not literature that identifies prevailing psychosocial elements that guide adoption of effective pest management practices. It is critical to understand how education may be used to influence adoption because the emergence and re-emergence of public pests is predicted to only increase. This study represents the first attempt to investigate the relationship between the intent to adopt landscape integrated pest management (IPM) practices with and individual's previous experience with water bodies. We also draw conclusions on the likelihood of IPM adoption based on analyses of demographic data and a homeowner's experience with other conservation behaviors.

Theoretical Framework

A behavior change approach known as social marketing could play a role in helping clientele adopt IPM. Social marketing has demonstrated longstanding success in promoting public health behaviors (Andreasen, 2006; McKenzie-Mohr et al., 2012; Rogers, 2003), resulting in recent adoption among extension professionals to encourage environmentally responsible behaviors (Shaw, 2010). Its success is underpinned by the framework's foundational recognition of audience diversity and utilizes a process known as audience segmentation that allows its users to strategically target audiences based on similar characteristics (Andreasen, 2006; Kotler & Roberto, 1989; McKenzie-Mohr et al., 2012). The audience segmentation process helps the researcher identify the most important subgroups within the larger, relevant population and results in audiences segmented by factors or characteristics that relate to likelihood of adopting a behavior (Lee & Kotler, 2011; McKenzie-Mohr et al., 2012).

Segmenting a target audience has proven to be effective in delivering prominent programs that address the segment's unique needs (Andreasen, 2006; Lai et al., 2009; Lee & Kotler, 2011) which leads to higher participant satisfaction and levels of behavior change (Andreasen, 2006; Kotler & Roberto, 1989). The key is to select a small number of subgroups as target audiences and develop a comprehensive summary of their distinctive characteristics to inform strategies that appeal to their needs (Lee & Kotler, 2011).

While countless audience segmentation strategies may be used (Andreasen, 2006), a cross-sectional approach is common. This type of audience segmentation creates subgroups based on fixed characteristics of audience members (Kim, Njite, & Hancer, 2013; Kotler & Roberto, 1989) such as behavioral characteristics (i.e., likelihood of adoption or decision-making preference), where they live, psychological traits (i.e., attitudes and values), and sociodemographic attributes (i.e. age, education, income, and social class). More recently, researchers have expanded these characteristics to include environmental factors as core variables that influence behavioral change (Clark & Finley, 2007; Lam, 2006; Trumbo & O'Keefe, 2001).

Cross-sectional audience segmentation represents a meaningful framework to identify subgroups based on audience characteristics and factors to promote IPM adoption at the household level (see figure 1). Unfortunately, audience segmentation among extension audiences, and specifically surrounding IPM practices, represents an under-researched context, so here we must review the factors that influence the adoption of pest management practices using primarily agricultural producers as a model. According to Palis, Morin, and Hossain (2005), the location of the farm in relationship to others influences the adoption of IPM, with areas with higher farm densities experiencing higher adoption rates. In the context of landscape management, Blain et al. (2012) found that whether the next door neighbor applies yard chemicals influences the application of chemicals to the surrounding yards. Closely related, the researchers found that the type of residential environment (i.e. rural, suburban, or urban) significantly influence the homeowner's practices and may be related to the population density paradigm outlined among the agricultural producers (Blain et al., 2012).

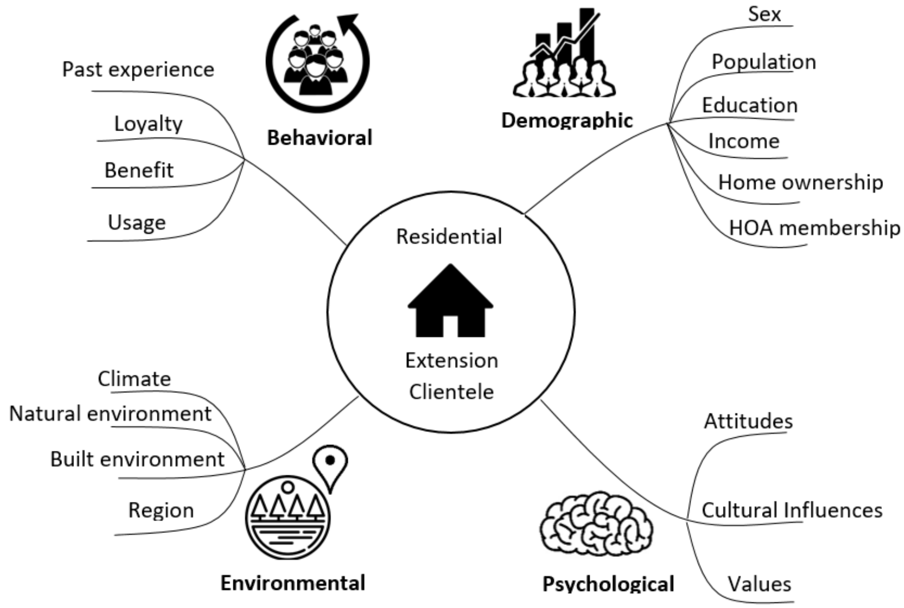

Figure 1. Potential cross-sectional approaches for audience segmentation

Several studies identified the influence of demographic factors including age (McNamara, Wetzstein, & Douce, 1991), education level (Chaves & Riley, 2001; Ridgley & Brush, 1992), farm income or wealth of farmer (Alston & Redding, 1998; Chaves & Riley, 2001), length of land ownership (Grieshop, Zalom, & Miyao, 1988), the type of enterprise (Alston & Redding, 1998); Hammond, Luschei, Boerboom, & Nowak, 2006), farm size and yield (Alston & Redding, 1998; Hammond et al., 2006). While these are all characteristics that were explored in the agricultural context, they may represent important considerations for the residential context. Even characteristics such as farm size and yield that seem very specific to agriculture could be translated to property size and landscape yield (based on the resident's landscape management goals).

Past behaviors also demonstrated significant influence on behavioral intention and actual adoption of pest management practices. According to Grieshop, Zalom, and Miyao (1988) previous experience with IPM programs outside of their current operations resulted in increased adoption on their own property. Those farmers that had previously implemented IPM practices on others' farms were likely to incorporate IPM into the pest management plan on their own farm. Additionally, farmers that participated in training and technical assistance programs that incorporated IPM practices were more likely to demonstrate an intention to adopt the same or similar approaches on their farm (McNamara, Wetzstein, & Douce, 1991; Parsa et al., 2014). The effect of past behaviors is a significant among the variables used to increase the predictive power of attitude on behavior across various contexts (Fielding, Russell, Spinnks, & Mankad, 2012; Gregory & Di Leo, 2003; Oullettee & Wood, 1998).

Evidence shows that past behaviors influence the development of an individual's attitude toward a specific behavior (Aarts, Verplanken, & Van Knippenberg, 1998). Extension has recently applied this concept to water conservation strategies. For example, Monaghan et al. (2013) found that high water users had specific demographic characteristics, which impact their engagement, attitudes, and interests in water conservation behaviors. When understood by extension professionals, there is the potential to inform strategies to successfully convince high water users to engage in water conservation behaviors. Similarly, Huang, Lamm, and Dukes (2016) identified high waters users as being older, with higher incomes and education levels, and living in communities where landscaping practices were regulated by homeowner associations, and recommended for Extension to focus on this subgroup as an important target audience.

Additionally, the literature on agricultural pest management practices outlines several factors that center on perception of self-efficacy that informs the potential psychological profile of IPM users. Knowledge of IPM (Alston & Redding, 1998; Parsa et al., 2014) and perceived control or risk (Chaves & Riley, 2001; Parsa et al., 2014) both demonstrated significant influence on IPM adoption. Farmers that reported higher knowledge levels of IPM also reported more influence on managing pest populations as well as lower perceived risk associated with IPM-related practices. This is an interesting consideration as research shows that individuals perceive having more control over water conservation than water quality behaviors (Leal et al., 2015; Warner et al., 2018) or even do not believe their landscape affects water quality. Similarly, many people may not understand or believe that landscape pest management practices can impact water quality (Blaine, Clayton, Robbins, & Grewal, 2012).

What has yet to be explored within this context is the influence of environmental factors on behavior change, which may be a result of its recent addition to the segmentation framework (Clark & Finley, 2007; Lamm, 2006; Trumbo & O'Keefe, 2001). Significant work has demonstrated an important relationship between an individual's feeling of connection to the natural environment and their willingness to take action to protect it (Brügger et al., 2011; Dutcher et al., 2007; Franz & Mayer, 2013; Leopold, 1949; Mayer & Frantz, 2004). According to Schultz (2001) when an individual believes they are a part of the natural world, they are likely to have stronger concerns over the environment and engage in more pro-environmental behaviors (Schultz, 2001). A precursor to the connection to nature is engagement, which represents a salient factor to explore its influence towards the actions that protect the environment.

Feeling connected to nature may be an important factor to consider when segmenting audiences and tailoring education programs focused on promoting behaviors to protect water (Church, 2015). White, Pahl, Wheeler, Fleming, and Depledge (2016) found that people that engage more frequently with water are healthier and also more likely to adopt behaviors that protect water. Similarly, Warner, Diaz, and Gusto (2019) found more exposure to water related to more positive attitudes, greater perceived behavioral control, stronger social norms, and greater intent to engage in good residential fertilizer practices in home landscapes.

In addition to an individual's frequency of exposure to water bodIes, the quality of engagement with water bodies also influences behaviors. Kelly et al. (2012) found that positive experiences with nature effectively promoted responsible behaviors for water quality in watershed education programs. Inversely, North and van Beynen (2016) found that negatives experiences may drive appropriate practice adoption and suggested using what they called "show caves" to create a cognitive dissonance where people might become unhappy with their previous ideas about their environments and consequently adopt new thoughts.

An interesting commonality among the agricultural producer IPM adoption studies was the influence of extension pest management information and programs (Alston & Redding, 1998; Parsa et al., 2014; Ridgley & Brush, 1992) on increased IPM adoption. This provides rationale for extension professionals to provide education and training on IPM to address the pest issues of residential audiences (i.e., urban communities). While the studies discussed here provide interesting considerations for exploration, there remains a dearth of inquiry regarding the implementation of IPM especially among residential audiences and reinforces the need for Extension to better understand how to influence its increased adoption.

Purpose and Objectives

The purpose of this study was to explore potential extension audience segmentation strategies by evaluating factors that related to differences in residents' intentions to use IPM practices. The specific objectives were to:

1. Describe residents' behavioral intentions to adopt IPM practices,
   Describe residents' engagement and experiences with water bodies, and
2. Describe differences in the intention to adopt IPM practices based on audience characteristics.

Methods

Approach

To achieve study objectives, we collected quantitative data from a non-probability sample of 3,588 Floridians in November and December of 2018 using a researcher-developed instrument. Potential respondents were recruited using a professional survey sampling company and given an opportunity to opt-in to the study. The use of a non-random sample creates the potential for non response and under coverage biases (Lamm & Lamm, 2019). To increase the reliability of our results, we used a combination of quota sampling to match the existing gender demographics followed by post-stratification weighting to match the age category, race, ethnicity, and county population density to that of the actual statewide population (Baker et al., 2013; Lamm & Lamm, 2019). Our protocol was reviewed and approved by the University of Florida Institutional Review Board.

Study Context

The state of Florida in the United States represents an intriguing case to explore where urban sprawl has created increases in residential pests. The U.S. Census reports that from April 1, 2010 to July 1, 2018, the population in Florida increased by 13.3%, placing it at an estimated 21.3 million, behind only California and Texas (U.S. Census Bureau, 2018). A common reason for moving to Florida is that the weather is moderate, which is related to people being able to enjoy outdoor activities virtually all year long. The presence of pests creates a significant incentive for people to purchase landscape pest control services or attempt pest control on their own. Florida was the first state to report locally-acquired Zika (Likos et al., 2016), a devastating disease to some newborns that can result in microcephaly and a shortened lifespan (Mlakar et al., 2016; Petersen et al., 2016). *Aedes albopictus* and *Ae. aegypti* are established invasive species and competent vectors of not only Zika, but Dengue (Richards et al., 2012) and Chikungunya viruses (Vega-Rúa et al., 2014) as well. In response to vector-borne threats, 70% of the pest control companies surveyed now offer mosquito control services, double that of five years ago (PCT, 2019).

Measures

The survey that was used for this study was part of a larger statewide assessment of residential landscape practices. Four sections of the survey pertained to the study objectives. The first section followed Warner et al. (2019) and used a Likert-type scale to measure exposure to water bodies by asking respondents to indicate the frequency with which they came into contact with seven types of water bodies. We also adapted this scale to measure active exposure to water bodies by asking respondents to indicate how often they *visit and spend time around* each of the same seven water bodies. Response choices for both questions included *never*, *less than once a month*, *1-3 times a month, once a week*, *2-3 times a* week, and *more than 3 times a week.* The responses were coded with values from 1 to 6, and the two sets of seven responses were each averaged to create exposure to water bodies and active exposure to water bodies indexes. *Post-hoc* reliability, as measured by Cronbach's alpha, was .752 and .828, respectively.

In the second section of the survey, we collected information about respondents' positive and negative experiences with water availability and quality. Four new variables were designed for the purposes of this study. Positive experiences with water availability was measured using four statements such as *there is enough water in the water bodies around me*. Negative experiences with water availability was measured using four statements such as *The water levels around me are too low*. Positive experiences with water quality was measured using four statements such as *the water around me is clean*. Negative experiences with water quality was measured using four statements such as *there is poor quality water around me*. Respondents could indicate their level of agreement with each of these statements across five points ranging from *strongly disagree* (1) to *strongly agree* (5). We averaged each set of four items to create the four indexes: positive experiences with water availability, negative experiences with water availability, positive experiences with water quality, and negative experiences with water quality. *Post-hoc* reliability, as measured by Cronbach's alpha, was .818, .876, .848, and .893, respectively.

The third section of the survey was researcher-developed for the purpose of this study and used to measure intent to engage in seven pest management practices. There were six desirable behaviors: a) manage yard pests with as few chemicals as possible, (b) walk around their yard frequently to detect any pest problems early, (c) spot treat only the portions of the yard where there are significant pest problems, (d) obtain a positive identification before treating any possible pest problems in their yard, (e) ensure their yard is a healthy environment for beneficial insects, (f) use integrated pest management, which includes non-chemical options and treatments that pose the least risk, and one undesirable behavior: (g) treat their entire yard with pesticides without identifying pests. Five response choices ranged from *very unlikely* (1) to *very likely* (5). Respondents could also indicate a practice was *not applicable*. We added the responses of the seven items to create an intent to engage in IPM score. We used respondents' intent to engage in IPM score to split the sample into low-IPM-intent (n = 1,663) and high-IPM-intent (n = 1,690) groups for data analysis purposes.

The final section of the survey pertaining to the study collected demographics. In this section, we collected gender, homeownership, age, education, membership in a homeowners association, family income from the previous year, and postal code. Postal code was later used to assign respondents to a category defined by the density of their county's population.

Prior to using the instrument we asked an expert panel to review the instrument for face and content validity. The expert panel included seven individuals beyond our research team who each had some combination of extension education, technical science knowledge (i.e., landscape management, horticulture, integrated pest management), familiarity with the target audience (residents across Florida), and survey research expertise. We made minor adjustments to a few items to increase clarity following the panel's recommendations, and then conducted a pilot test (n = 50) to check reliability of the instrument prior to the full study (data not reported).

Data Analysis

After weighting the data we used descriptive statistics to evaluate the current state of pest management practices being used as well as quantify exposure to water bodies, and experiences with water (Objectives one and two). We used the high- and low-IPM-intent variables to conduct chi-square analysis to determine if any differences in demographic characteristics of the study respondents existed based on IPM intent (Objective three). We ran independent *t*-tests for equality of means to identify any further relationships between active and total water body exposures, experiences with positive and negative water quality and quantity, general conservation intent, intention and actual adoption fertilizer and water conservation best practices, and pest best management practice intentions.

Respondent Demographics

Of the 3,588 respondents, just over half (f = 1,855; 51.7%) were female and about one in five (f = 757; 21.1%) were Hispanic or Latino(a). The average age of respondents was 48 years old. Most respondents indicated they identified as white (f = 3,259; 90.6%) with a small proportion identifying as black (f = 200; 5.6%). Respondents most commonly owned their home (f = 2,409; 67.1%), had earned a 4-year college degree as their highest level of education (f = 991; 27.6%), and reported \$25,000 to \$49,000 USD as their total family income in the previous year (f = 914; 25.5%).

Results

Objective 1: Describe residents' behavioral intentions to adopt IPM practices

To simplify data presentation and aid interpretation of IPM behavioral intent, we collapsed *very unlikely* and *unlikely* into one category (indicating general unlikelihood) and *very likely* and *likely* into one category (indicating general likelihood). Table 1 outlines the respondents' likelihood of engagement across seven pest management practices. The practice with the highest likelihood of engagement (76.8%) is managing yard pests with as few chemicals as possible. Interestingly, the item with the least frequency of engagement is the undesirable behavior, treating the entire yard with pesticides without identifying pests (27.6%). While the aforementioned practice represents that with the least frequency, it accounts for about a quarter of the respondents, or approximately 855 households. Of the desirable practices, respondents were most likely to intend to use as few chemicals as possible to manage yard pests.

Table 1
Frequency of likelihood of engagement in pest management practices

	Very unlikely or unlikely % (*f*)	Undecided % (*f*)	Likely or very likely % (*f*)
Manage yard pests with as few chemicals as possible	8.0 (250)	15.3 (481)	76.8 (2414)
Spot treat only the portions of the yard where there are significant pest problems	10.6 (332)	15.7 (492)	73.7 (2304)
Walk around yard frequently to detect any pest problems early	13.3 (427)	14.7 (470)	72.0 (2305)
Obtain a positive identification before treating any possible pest problems in their yard	11.5 (357)	19.2 (598)	69.3 (2152)
Ensure yard is a healthy environment for beneficial insects	12.2 (382)	21.8 (686)	66.0 (2074)
Use integrated pest management, which includes non-chemical options and treatments that pose the least risk	11.1 (343)	23.1 (713)	65.8 (2035)
Treat their entire yard with pesticides without identifying pests[a]	52.9 (1642)	19.5 (606)	27.6 (855)

Note. Very likely and likely combined into one category and unlikely and very unlikely combined into one category to aid data presentation. Rows may not total 3596 because *not applicable* responses were excluded from this analysis. [a]indicates reverse-coded item (non-desirable behavior).

Objective 2: Describe residents' engagement and experiences with water bodies

The respondents' average exposure to water bodies was nearly three on a six point scale while active exposure to water bodies was about two on the same scale (see Table 2). Respondents reported moderately positive experiences with having enough water and moderately negative experiences with poor water quality, as indicated by these variables falling above the mean. Respondents generally had more positive experiences with water availability and more negative experiences with water quality.

Table 2
Mean values for frequency and quality of exposure to blue space

Characteristic	Overall sample *M* (*SD*)
Exposure to water bodies[a]	2.93 (1.08)
Active exposure to water bodies[a]	2.05 (.98)
Experiences with water[b]	
Positive exp. avail	3.51 (.92)
Negative exp. avail	2.68 (1.03)
Positive exp. qual	2.90 (1.00)
Negative exp. qual	3.21 (1.03)

Note. [a]real limits 1 and 6. [b]real limits 1 and 5.

Objective 3: Describe differences in intentions to adopt IPM practices based on audience characteristics

The results of the chi-square analyses (see Table 3) shows that there were statistically significant differences based on gender, homeownership, education level, and county population. Females, homeowners, and those individuals with some college were more engaged in pest best management practices. The low-IPM-intent group was more likely to hold a Master's degree. The high-IPM-intent group was more likely to live in a metro area with 250,000 to 1 million residents. The rest of the demographic characteristics did not demonstrate any statistically significant difference in the adoption of pest best management practices.

Table 3

A comparison of demographic characteristics among Floridians with low-intent and high-intent to engage in IPM practices

Characteristic	Low-IPM intent (*n* = 1663) % (*f*)	High-IPM intent (*n* = 1690) % (*f*)	*p*	χ^2	Cramer's *V*
Gender*			.001	11.38	.06
Female	48.6 (809)[a]	54.5 (920)[b]			
Male	51.4 (854)[a]	45.5 (769)[b]			
HOA membership	43.6 (725)	42.9 (725)	.91	.19	.07
Home ownership*			.01	9.51	.05
Own	65.5 (1089)[a]	70.2 (1186)[b]			
Rent	30.9 (514)[a]	27.2 (459)[b]			
Other	3.6 (60)	2.6 (44)			
Education*			< .001	32.37	.10
Less than high school	2.9 (48)[a]	1.1 (18)[b]			
High school/GED	19.0 (316)[a]	16.4 (277)[b]			
Some college	22.1 (367)[a]	25.1 (424)[b]			
2-year college degree	10.8 (180)[a]	12.5 (211)[a]			
4-year college degree	26.3 (438)[a]	28.7 (485)[a]			
Master's degree	14.2 (237)[a]	11.2 (187)[b]			
Doctoral degree	1.7 (28)[a]	2.2 (38)[a]			
Professional degree (JD, MD)	3.0 (50)[a]	3.0 (50)[a]			
Family income (2017)			.42	10.28	.06
Less than $24,999	15.9 (265)	15.3 (259)			
$25,000 to $49,999	24.3 (405)	25.9 (437)			
$50,000 to $74,999	23.0 (383)	21.4 (362)			
$75,000 to $99,999	14.2 (236)	17.0 (287)			
$100,000 to $124,999	7.9 (131)	7.6 (129)			
$125,000 to $149,999	5.6 (94)	5.3 (90)			
$150,000 to $174,999	2.8 (46)	2.7 (45)			
$175,000 to $199,999	2.3 (39)	1.6 (27)			
$200,000 to $224,999	1.1 (18)	.9 (16)			

$225,000 to $249, 999	1.0 (16)	.9 (15)			
$250,000 or more	1.9 (31)	1.4 (23)			
Rural-urban area*			.01	15.75	.07
Metro area (population of 1 million or more)	63.9 (1063)[a]	61.1 (1031)[a]			
Metro area (population of 250,000 to 1 million)	24.4 (405)[a]	27.7 (468)[b]			
Metro area (population of less than 250,000)	4.9 (81)[a]	4.8 (81)[a]			
Nonmetro - urban population of 20,000 or more	3.2 (54)[a]	4.0 (68)[a]			
Nonmetro - urban population of 2,500 to 19,999 or more	3.4 (57)[a]	1.9 (32)[b]			
Nonmetro - rural area with population less than 2,500	.2 (3)[a]	.5 (8)[a]			

Note. * indicates significant. For reference, Cramer's *V* values were interpreted as 0.10 to 0.19 = weak effect (Rea & Parker, 1992). Different superscript letters indicates significant differences across row as identified by post-hoc z-tests using Bonferroni method.

Based on the results of the *t*-tests, we found that the high-IPM-intent group had greater intent to engage in fertilizer best practices and landscape water conservation (see Table 4). The high-IPM-intent group was also currently more engaged in the use of landscape and general water conservation and fertilizer best practices. The high-IPM-intent group spends more active and total time around various water bodies. The low-IPM-intent group is less likely to have had negative experiences with water availability and quality, meaning a relationship exists between exposure to inadequate or unclean water and engaging in IPM. The low-IPM-intent group is slightly more likely to have had positive experiences with water quality, highlighting a relationship that indicates people that see clean water are less likely to use environmentally responsible pest management practices.

Table 4
A comparison of water conservation and relationships with water among Floridians with low-engagement and high-engagement in pest BMPs

Characteristic	Low IPM intent (n = 1663)	High IPM intent (n = 1690)	t	p	d
Fertilizer BMP intent index*	3.06 (1.07)	4.03 (.80)	-13.77	<.001	1.02
Water conservation intent index*	2.81 (.96)	3.49 (.87)	-12.54	<.001	.74
Water conservation score*	5.06 (3.83)	7.66 (4.40)	-10.66	<.001	.63
General water conservation index*	3.47 (.74)	3.83 (.74)	-13.98	<.001	.49
Fertilizer BMP index*	3.15 (.74)	3.34 (.68)	-7.93	<.001	.27
Water body frequency index*	2.82 (1.05)	3.07 (1.10)	-6.88	<.001	.23
Water body active frequency	1.97 (.92)	2.17 (1.02)	-5.99	<.001	.21
index*	3.15 (.95)	3.28 (1.10)	-3.86	<.001	.13
Negative experiences with water quality*	2.62 (.98)	2.75 (1.09)	-3.84	<.001	.13
Negative experiences with water availability*	2.95 (.91)	2.85 (1.09)	2.68	.007	.10
Positive experiences with water quality*	3.52 (.86)	3.49 (.98)	.80	.426	
Positive experiences with water availability					

Note. * indicates significant. Cohen's *d* values were interpreted as 0.2 = small, 0.5 = medium, 0.8 = large (Cohen, 1988). The real limits of the three index variables was 1 and 5 and the real limits of water conservation score was 5 and 50.

Conclusion, Recommendations, and Implications

Understanding how to tailor extension programs for the unique needs of diverse target audiences will continue to be a paradigm that researchers need to explore as issues and solutions evolve. Our study represents an initial inquiry to better understand residential pest management audiences and identify meaningful subgroups to target with extension programming to drive behavior change and practice adoption. Additional inquiries are needed to develop comprehensive audience profiles, especially pertaining to IPM, and this study represents an important step in that process.

We found that the respondents demonstrate relatively high intentions to adopt pest management best practices but there remains room to increase adoption levels. Responses of undecided ranged from 14.7% to 23.1% across all practices, which demonstrates the potential for an audience to be swayed to adopt an IPM approach. Additionally, almost half (47.1%) of respondents that selected either *highly likely, likely* or *undecided* in regards to treating their entire yard with pesticides without identifying the pest or pests that are the issue. This represents a group where further inquiry should be explored to understand this choice of practice that can help to inform their audience profile for program design.

We also found that multiple audience characteristics including some demographics, complementary conservation behaviors and engagement with the natural environment that characterize meaningful subgroups to guide extension program design. Our findings align with those of Chaves and Riley (2001) and Ridgley and Bush (1992) that demonstrated how educational level influences the adoption of pest management practices. We did not identify a gradient of adoption based on increases to education levels but noticed significant differences among those who had completed high school, had less than a high school level of education, or Master's degrees (more likely to have low-IPM-intent) and some college (more likely to have high-IPM-intent). A new demographic characteristic that our study found that did not exist in the inquiry of agricultural producer adoption of IPM was the significant difference in adoption based on gender. Females were more likely to be in the high-IPM-intent group than their male counterparts. Interestingly, there was no significant difference in IPM intent based on family income contrary to the findings of Alston and Redding (1998) and Chaves and Riley (2001). The high-IPM-intent group was more likely to live in a metro area with 250,000 to 1 million residents, revealing a possible relationship between more urban areas and more engagement in IPM, although this finding did not appear in the most urban designation.

An interesting finding was the interrelationship between the intention and actual adoption of other environmentally-protective behaviors and the intention to adopt IPM practices. The practical differences of these relationships were much greater than those of the demographic characteristics, signaling the need to understand how extension clientele intend to engage in related landscape maintenance tasks and generally interact with the natural world. Respondents with greater intent to engage in IPM were also more engaged in general conservation, landscape water conservation and fertilizer best practices. These differences provide a new lens to the influence of complementary behaviors, demonstrating that previous engagement with other environmentally-responsible practices may influence the adoption of IPM. This new view of complementary behaviors expands the work Grieshop, Zalom and Miyao (1988) and makes connections to a larger body of research (Fielding, Russell, Spinnks, & Mankad, 2012; Gregory & Di Leo, 2003; Oullettee & Wood, 1998) that shows how past environmentally responsible behaviors may transcend contexts and may be a predictive tool for the adoption of IPM practices.

Our study also demonstrated the relationship between water body exposure and the adoption of IPM practices. High-IPM-intent respondents spent more total time as well as active time around various water bodies. This connection with engagement with water bodies aligns with the work of Warner, Diaz and Kumar Chaudhary (2019) whose findings show that exposure to water bodies relates to increased likelihood of individuals to engage in good fertilizer practices. The relationship between total exposure to water bodies and IPM hints at the value of indirect connections to water quality as intentional exposure to water bodies may occur in areas that do not suffer from extensive water quality issues (i.e., public beaches). Further, active exposure may provide a similar experience to that of passive exposure respondents that may be exposed to more impaired water bodies. Interestingly, low-IPM-intent individuals had more positive experiences with water quality (i.e., they were exposed to clean water). This contradicts the work of Kelly et al. (2012) and suggests that fewer experiences with good water quality relates to high IPM engagement. The high-IPM-intent group reported more negative experiences with both water quality and availablility (i.e., they were more exposed to unclean and inadequate water), suggesting experiencing the negative consequences of failing to protect water might be influential upon behaviors.

Returning to audience segmentation, this work demonstrated a modest audience segmentation analysis, yet the distinct differences between the high- and low-IPM-intent groups revealed opportunities to tailor extension programming to the two groups but also guide extension IPM programming in general. Based on our findings, we recommend that globally, extension IPM education efforts target females to influence the household and potentially change pest management approaches. This supports the National Pest Management Association (Hampshire, 2017) findings that show that women make about 80% of purchasing decisions, which includes pest control. We also believe there is an opportunity to couple IPM education with education on fertilizer use and other conservation practices to enhance the adoption of the practices with those groups that are more likely to adopt based on the past experiences with environmentally responsible behaviors. Further, there may be an opportunity for extension professionals to target individuals and groups they know are using other best practices as they may be more likely to adopt IPM. Finally, we believe that those incorporating exposure to water bodies within the confines of the program should consider the influence that increased frequency with water bodies in general as well as poor water quality and availability may have on potential, residential IPM users and make decisions on the expsosure experience accordingly.

We also recommend continued inquiry and analyses into the characteristics and factors that influence IPM adoption. While our data were drawn from a large sample in a location especially prone to pest concerns, extension professionals working elsewhere globally should consider our findings and also conduct audience research to guide local programs. We believe our study provides rationale for more rigorous, regression analysis to understand the most salient characteristics and factors that increase the likelihood to influence pest management practice adoption. Additional factors that should be explored include (1) past IPM practices, (2) knowledge and perceptions of self-efficacy of IPM, (3) public's attitudes towards IPM (4), the connection between other environmentally responsible behaviors and the adoption of an IPM approach, and (5) differences in audience intentions based on complementary conservation behaviors. As these factors are better understood, we suggest our profession will discover more complex audience segmentation strategies driven by a number of audience characteristics in addition to IPM engagement.

We also believe continued inquiry is needed within the paradigm of exposure to water bodies to provide additional clarity on the influence that active and passive engagement with water bodies has on IPM adoption as well as the influence of water quality experiences. There is an opportunity to evaluate these factors and others that may hold promise in changing residential users' intentions to adopt an IPM approach. This study took an essential first step at understanding potential audience segments to guide future adoption of IPM practices in the residential context, there is more research needed to develop comprehensive audience profiles to promote the extent of change needed.

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