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Exploring the Relationship between Critical Thinking Style and Water Conservation Behavior: Implications for Extension

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Abstract

In the past several years Cooperative Extension has focused on developing educational programs that address water conservation, specifically for individuals using exorbitant amounts of water, with limited success. However, few research studies have examined how the way people think, including their critical thinking styles, can be used to inform extension program development. The purpose of this study was to address this gap in the literature by examining how people who use a lot of water think critically and whether their critical thinking style influenced their engagement in water conservation (or lack thereof). Responses were obtained from 932 Florida residents identified as high water users via an online survey. The findings revealed respondents engaged in a low level of landscape water conservation behaviors. The results also showed relationships did exist between critical thinking style and level of engagement in landscape water conservation behaviors implying critical thinking styles should be considered when developing extension programs in this area. Recommendations include using critical thinking style to tailor programs that bring educational awareness of landscape water conservation to high water users.

Keywords: critical thinking style; water conservation; Cooperative Extension; high water users; landscape

Introduction

Current water supplies are being depleted at a rapid rate with a world population that continues to increase requiring more water consumption (Delorme, Hagan, & Stout, 2010; Lamm, Lamm, & Carter, 2015; Vörösmarty, Green, Salisbury, & Lammers, 2000). In the United States alone, the average household consumes approximately 32 gallons of water per day (United States Environmental Protection Agency, 2013) and that rate is increasing. For example, in 2030 Florida's demand for fresh water is expected to increase by 28% when compared to the state's water demand in 2005 (United States Environmental Protection Agency, 2013). If widespread water conservation action is not taken, water shortages will impact future residential water use (Olmstead & Stavins, 2009).

Cooperative Extension has focused on developing educational programs that address major water issues over the past several years (Terlizzi, 2006; Welch & Braunworth, 2010) in order to alert citizens about the dangers of future water shortages. Targeting extension programming focused on changing water consumption behaviors to groups of individuals that consume an unusually large amount of water, when compared to the general public, could offer the largest return on investment (Huang & Lamm, 2015b; Monaghan, Warner, Telg, & Irani, 2014).

Obtaining information about the way the public engages in water conservation can be useful to extension educators as they strive to encourage behavior change (Suero & Rosenberg,

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2010; Warner, Rumble, Martin, Lamm, & Cantrell, 2015). Research has shown when people gain more knowledge they will develop more positive attitudes ultimately adopting new practices that fit in with their current schema (Abu-Taleb & Murad, 1999). Therefore, as the public gains information about future water shortages, there is a better likelihood they will take action to conserve water (Jorgensen, Graymore & O'Toole, 2009; Leal, Rumble, & Lamm, 2015). Engagement in water conservation practices includes the adoption of water-saving technologies such as low-flow faucets, showerheads, and dishwashers that assist in eliminating water waste (Suero & Rosenberg, 2010) as well as engaging in proper water use in home landscapes.

A specific group of water users, labeled as high water users in the literature, consumes more than the average citizen due to their landscaping needs and preferences (Huang, Lamm, & Dukes, 2016). Recognizing this is a high impact audience, extension educators have targeted this population by examining current water usage data available from local utility companies and collected needs assessment data (Monaghan et al., 2014). Research on attitudes, demographics, lifestyles, and current behaviors have also been used to identify this audience needs with some success (Huang & Lamm, 2015a; Leal et al., 2015; Monaghan, Ott, Wilbur, Gouldthorpe, & Racevkis, 2013). When addressing water conservation specifically, research has shown extension educators need to understand that certain groups of water users have different attitudes towards conservation and, therefore, have different educational needs (Ott, Monaghan, Israel, Gouldthorpe, & Wilbur, 2015). In addition, research has shown that some audiences adopt behaviors more easily than others (Loibl, Diekmann, & Batte, 2010). This may be due to individual cognitive traits, such as critical thinking styles (Gorham, Lamm, & Rumble, 2014).

Even though critical thinking styles are known to impact how individuals process information and deal with critical issues (Blackburn, Robinson, & Lamm, 2014), very little research has examined how critical thinking styles can be used to inform extension program development (Gay, Terry, & Lamm, 2015). Critical thinking style "explains how an individual prefers one particular method to another when processing information, or critically thinking about a particular topic" (Gorham et al., 2014, p. 44). Critical thinking styles can vary between engagement and seeking information tendencies and provide guidance on how people approach and process information (Lamm, 2015b). During the initial planning stages for new programs, extension educators should align with their client's needs (Owens, Warner, Rumble, Lamm, Martin, & Cantrell, 2015). As such, having knowledge of their client's critical thinking styles may assist in the development of experiences that will appeal to a specific audience. This research directly aligns with the American Association for Agricultural Education National Research's Priority Area One which discusses the importance of enhancing " the public and policymakers with accurate information about agriculture and natural resource concepts" (Enns, Martin, & Spielmaker, 2016, p.14) because it seeks to identify best methods for delivering landscape water conservation extension programs to an important segment of the public that is overusing one of the world's most valuable resources, water.

Conceptual Framework

The conceptual framework for this study was based on the concept of critical thinking style identified by Lamm and Irani (2011). According to Facione (1990), critical thinking is defined as ". . . purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as an explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based" (p. 2). Facione (1990) mentioned critical thinkers are ". . . well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, [and] diligent in seeking relevant information . . ."

(p. 2). Lamm and Irani (2011) suggested each critical thinker has an individual style of thinking about a topic that resonates with each specific issue, such as the need to conserve water.

Critical thinking style is a preference a process thinker goes through when reaching a solution to a problem (Lamm, 2015a). Critical thinking style also represents the formalized way an individual converses through their thought process and ultimately reaches a final decision (Irani, 2006). Lamm and Irani (2011) indicated there is not a correct or incorrect way to reason critically but rather introduced the idea that people process information differently and, therefore go through the critical thinking process in a variety of ways. According to Lamm and Irani (2011), an individual's critical thinking style can be placed on a continuum between engagement and seeking information.

Individuals with a seeking information style or *seekers* are interested in seeking out large amounts of information and are concerned with knowing there was enough time to actively consider all possibilities (Lamm & Irani, 2011). Seekers are hungry learners, eager to process and consume a large amount of information. They also recognize that most situations or problems are multifaceted, and no straightforward answer is likely to be found when trying to solve problems (Lamm & Irani, 2011). In a study examining Florida residents' water conservation practices in general, Gorham et al. (2014) found seekers preferred to gain information about water conservation by searching through media sources themselves.

Individuals with an engagement critical thinking style or *engagers* are highly engaged with their surroundings, and therefore, are likely to predict problems that will require critical thinking before they happen (Lamm & Irani, 2011). Engagers also look for opportunities to employ their reasoning skills and are assertive when presented with a problem to solve. They prefer to engage with others' in discussions because they appreciate others opinions, but are also confident in discussing their own reasoning process and how they arrived at their solutions (Lamm & Irani, 2011). Research has shown engagers prefer to learn about water conservation through their environment, which involves more traditional face-to-face contact (Gorham et al., 2014).

Critical thinking style can be used to tailor programs to reach individuals' styles with suitable educational experiences that activate their natural tendencies (Gorham et al., 2014). Developing a stronger awareness of the need for water conservation is a purposeful effort that is a constant challenge requiring a strong commitment (Sindik & Araya, 2013). Understanding how high water users think critically and how their critical thinking styles relate to their engagement in water conservation practices could inform the development of extension programs that are more effective because such are targeted to the population of interest.

Purpose and Objectives

The purpose of this study was to determine how critical thinking style related to engagement in water conservation practices to offer insight into how extension educators can develop extension programs targeted at specific critical thinking styles. The following research objectives guided the study:

1. Describe respondents' level of engagement in landscape water conservation behaviors;
2. Describe respondents' critical thinking styles; and
3. Identify the relationship between respondents' levels of engagement in landscape water conservation behaviors and their critical thinking styles.

Methods

An online questionnaire was administered to Florida residents to identify the relationship between critical thinking style and levels of engagement in landscape water conservation behaviors. The population of interest was high water users in Florida. High water users in Florida were chosen because water is among Florida's most cherished resources, and population growth is putting an ever-increasing amount of pressure on a limited water supply (Barnett, 2007; Marella, 2008).

A panel of experts with a background in water conservation, public opinion research, and survey design was used to review the entire instrument for face and content validity. These individuals were selected based on their content and survey construction knowledge. The panel of experts included the director of the UF/IFAS Center for Landscape Conservation and Ecology, the director of the UF/IFAS Center for Public Issues Education in Agriculture and Natural Resources (PIE Center), and a professor with a specialty in questionnaire design.

This research was part of a larger study. Respondents were presented with a 132-item online instrument; however, only two sets of questions were germane to this study. The first set of questions were adapted from Patterson's (2012) RBC Canadian Water Attitudes Study to measure respondents'level of engagement in landscape water conservation behaviors. Respondents were offered seven items to choose from that referenced landscape water conservation behaviors. Respondents were then asked to use a scale to select from two options either *yes I engage* or *no I do not engage* in this landscape water conservation behavior. If a respondent indicated they did engage in a practice, they were given a point. The total number of points were summed to create an overall behavior score, that could have ranged from zero to seven, used in further data analysis.

The second set of questions consisted of the University of Florida Critical Thinking Inventory or UFCTI (Lamm & Irani, 2011). The UFCTI identifies how an individual prefers to gather information about a topic by providing a score that distinguishes between individuals with a seeking information critical thinking style (seekers) and those with an engagement critical thinking style (engagers). The UFCTI consists of 20 items. The respondents were requested to indicate their level of agreement or disagreement with each statement on a five-point Likert-type scale ranging from 1= *Strongly Disagree*, 2 = *Disagree*, 3 = *Neither Agree nor Disagree*, 4 = *Agree*, 5 = *Strongly Agree*. Thirteen of the items are designated as seeking-type questions and seven as engager questions. The responses from the 13 seeker items were summed to create a seeker score. The responses from the seven engager items were summed to create an engager score. To create the overall UFCTI score, the responses to the engager items were reverse coded, summed, and multiplied by 1.866. The overall seeker and reverse coded engager score were then calculated to create an overall UFCTI score. Respondents with a score of 79 or higher were identified as seekers and those with a 78.99 or lower were identified as engagers (Lamm & Irani, 2011). In addition, *a priori* reliability of the overall UFCTI was a Cronbach's α of .95. The engager construct had a Cronbach's α of .89, and the seeker construct had a Cronbach's of .92. Finally, respondents were asked to identify their sex, race, ethnicity, age, residential zip code, and political affiliation.

A non-probability opt-in sampling technique was used to obtain the eligible participants. Non-probability sampling methods strive to represent the population of interest, in this case, high water users, therefore, participation rates were used rather than response rates (Baker et al., 2013). A total of 3,494 Florida residents were asked to participate in the study. However, a resident only qualified as a high water user and allowed to complete the survey if they met certain criteria that included being 18 years of age or older, living in specific counties identified as using high amounts of water in the state of Florida, having an annual household income greater than $50,000, having an irrigated landscape, and hiring an outside company to maintain that landscape (Davis & Dukes, 2014). Participants were gradually invited to participate in the study until specific quotas were filled (Baker et al., 2013). A participation rate of 26.7% (N = 932) was obtained based on those who

qualified and completed the survey. Quotas were set *a priori* to recognize targeted respondents; therefore, the data was not weighted.

The data were analyzed with descriptive and correlational statistics with Statistical Package for the Social Sciences® 21.0. A significance level of $p \leq .05$ was established *a priori*. To examine the shared characteristics between respondents' levels of engagement in water conservation behaviors and critical thinking style scores, a relationship coefficient (r) was used (Kotrlik, Williams, & Jaber, 2011). It was also used to measure the effect size between the two parameters. The coefficients were interpreted using Davis' (1971) correlational strengths with .01 to .09 indicating a negligible relationship, a .10 to .29 indicating a low level relationship, a .30 to .49 indicating a moderate relationship, a .50 to .69 indicating a substantial relationship, and a score greater than .70 indicating a very strong relationship.

Results

Demographics

Detailed demographics of high water user respondents in the state of Florida are displayed in Table 1. Descriptive analysis showed there was a fairly even gender split within the respondents. The majority of respondents were Caucasian/White (Non–Hispanic) followed by Hispanics. More than 65% of the respondents had at least a four-year college degree and an annual family income of more than $75,000 a year. Although all political affiliations were represented, the largest group indicated they were Republican (37.1%).

Table 1

Demographics (*N* = 932)

	n	*%*
Sex		
Female	484	51.9
Male	448	48.1
Race/Ethnicity		
African American	41	4.4
Asian	14	1.5
Caucasian/White	871	93.5
Hispanic	63	6.8
Native American	5	.5
Age		
18 - 29	21	2.3
30 - 39	92	9.9
40 - 49	108	11.6
50 - 59	188	20.2
60 - 69	313	33.6
70 - 79	188	20.2
80 years and older	22	2.4
Education		
Did not obtain a high school diploma	1	.1
High school diploma	55	5.9
Some college education	153	16.4
2 year college degree	94	10.1
4 year college degree	355	38.1
Graduate degree	274	29.4
Annual Household Income		
$50,000 to $74,999	244	26.2
$75,000 to $149,999	461	49.5
$150,000 to $249,999	167	17.9
$250,000 or more	60	6.4
Political Affiliation		
Democrat	281	30.2
Republican	346	37.1
Independent	211	22.6
Non Affiliated	84	9.0
Other	10	1.1

Level of Engagement in Landscape Water Conservation Behaviors

Respondents were asked to indicate the landscape water conservation behaviors they engaged in by marking whether or not they engaged in seven behaviors (see Table 2). The behavior in which respondents reported being most engaged in the most was installing a smart irrigation controller (f = 428, 51.9%). Respondents also indicated they used low water consuming plant materials in their yards to help conserve water (f = 395, 51.2%). In addition, almost half of the respondents had installed high efficiency sprinklers.

Table 2

Landscape Water Conservation Behavior Engagement (N = 932)

Behaviors	*f*	%
I use a smart irrigation controller.	428	51.9
I have low-water consuming plant materials in my yard.	395	51.2
I use high efficiency sprinklers.	361	48.5
I used recycled wastewater to irrigate my lawn landscape.	210	22.5
I have retrofitted a portion of my landscape so that it is not irrigated.	162	18.6
I use drip micro irrigation.	109	13.2
I used rain barrels to collect water for use in my garden/lawn.	72	7.8

For each landscape water conservation item a respondent reported engaging in, they were assigned a point. The points were then summed to create an overall score. The total landscape water conservation scores could have ranged from zero to seven. Upon analysis, the mean landscape water conservation behavior enagement score was a 2.15 (SD = 1.51) indicating a low overall level of engagement in landscape water conservation behaviors.

Critical Thinking Styles

Critical thinking styles were examined by using the UFCTI. On the UFCTI a respondent can score between a 26 and a 130 with a score of 79 or above designating a respondent as a seeker and a score of 78.99 or lower designating a respondent as an engager. The overall critical thinking style scores of the respondents ranged from 65.17 to 103.67, with a mean score of 77.79 (SD = 3.87) indicating the respondents tended toward being engagers (see Table 3).

Table 3

Respondents' Critical Thinking Styles (N = 932)

	M	*SD*
Overall UFCTI Score	77.79	3.87
Seeker Score	52.60	5.92
Engager Score	28.26	3.57

Relationships between Engagement in Landscape Water Conservation Behaviors and Critical Thinking Styles

Respondents' levels of engagement in landscape water conservation behaviors and their overall critical thinking style scores were analyzed using correlations to determine if relationships existed (see Table 4). Davis' (1971) description of correlational strengths was used to identify magnitude. UFCTI score was found to be negatively correlated with the respondents' level of engagement in landscape water conservation behaviors (r = -.08, p = .02). Therefore, the lower the UFCTI score (the less likely to seek information when thinking critically), the less likely the individual was to engage in landscape water conservation behaviors. While this relationship was significant, it was also negligible in terms of strength.

Relationships between seeking information and engagement scores with landscape water conservation behaviors were also examined. The seeking information score had a positive significant relationship with engagement in landscape water conservation behaviors (r = .15, p < 0.01). This result indicated that, while a low association, the more someone has a preference for seeking information when thinking critically, the more likely they are to engage in landscape water conservation behaviors. The engager score had a significant negative correlation (r = -.18, p = .00) with the level of engagement in landscape water conservation behaviors. This result revealed that the more respondents indicated they engaged when thinking critically, the lower the respondents' engagement in landscape water conservation behaviors. Again, this is a low association by Davis's (1971) convention, but is statistically significant.

Table 4

Relationship between Landscape Water Conservation Score and Critical Thinking Style

	r	*p*	Strength of relationship
Overall UFCTI Score	-.08	.02*	Negligible
Seeker	.15	.00**	Low
Engager	-.18	.00**	Low

Note. *p < .05; **p < .01.

Conclusions, Implications, and Recommendations

The findings from the study revealed respondents classified as high water users in Florida engaged in a low level of landscape water conservation behaviors. These results align with similar findings from both Monaghan et al. (2013) and Huang et al. (2015), further supporting high water users should be a target audience for extension. Although the lack of engagement reiterates there is an opportunity for extension educators to engage residents that use a high amount of water in the landscape it also implies there are barriers to engagement since the work done in this area (Monoghan et al., 2014) does not seem to be having the desired effect.

The findings from this study confirm what Jorgensen et al. (2009) found, indicating that residents will take some level of responsibility towards their action pertaining to the amount of water they consume. This was evident by the respondents reporting the use of low water-consuming plant materials in their yards, and using smart irrigation controllers for their landscapes. It is important to note that "Florida is one of just a few states with a rain sensor statute" (Dukes & Haman, 2013, p. 1). This statute may have impacted the number of homes with smart irrigation controllers, rather than it being a homeowners' choice to purchase the product for water conservation reasons.

In addition to distinguishing the level of engagement of Florida high water users in landscape water conservation behaviors, this study focused on critical thinking styles of the respondents. The overall critical thinking score determined a majority of the respondents were engagers of information. The results also revealed relationships did exist between critical thinking style and levels of engagement in landscape water conservation behaviors. The findings support previous research that identified differences in the way seekers and engagers use their information processing routes to make choices around actual engagement in behaviors (Gorham et al., 2014; Lamm & Irani, 2011). More specifically, the results indicated the higher the respondents' seeker score (an increased tendency to seek information when thinking critically) the more likely the individual was to engage in landscape water conservation behaviors. The results also indicated the more respondents showed they engaged with others when thinking critically, the lower respondents' level of engagement in landscape water conservation behaviors. While it is important to recognize the effect sizes were low, Steinberg (2011) points out that low associations can assist in exploring relationships.

The findings from this study showed, that as extension educators continue to educate stakeholders about the importance of landscape water conservation, it is important to understand critical thinking styles as a tool for enhancing program planning (Huang & Lamm, 2015b). More specifically, extension educators should use critical thinking style to tailor programs that bring educational awareness about landscape water conservation behaviors to high water users. Since the majority of high water users are engagers, and are less likely than their seeker counterparts to engage in water conservation behaviors, extension educators should think about how engagers consume information when developing their programs. Engagers obtain information by engaging in conversations (Lamm & Irani, 2011). This implies high water users are most likely conversing with other high water users (potentially their neighbors and friends) that are reinforcing their negative behaviors through social norms. To counteract this behavior, extension educators should get groups of neighbors and friends together to discuss the value of engaging in landscape water conservation efforts so they can proactively encourage one another and hold each other accountable. In addition, extension educators could provide programming within a neighborhood by collaborating with the homeowner's association or being present at a local clubhouse rather than their county extension office so the program is being delivered within the established social system and may attract more high water users. Extension programs targeting engagers should include face-to-face interactions and group discussions to emphasize the social side of information-gathering and decision-making (Gorham et al., 2014).

Although not the majority, a large group of high water users were also seekers. To reach this audience, extension educators should create more distance learning materials with tutorials, interactive blogs, and fact sheets. These materials would allow seekers the ability to find the information they need to make personal decisions regarding their landscapes, and the use of water (Lamm & Irani, 2011).

Considering the low effect size of the relationship, it is important to further explore this area of inquiry. First, it is suggested the study be replicated in other states that have high water users and are dealing with larger water shortages than Florida, such as California. It would also be important to examine the impacts of statewide regulation, such as the rain sensor statute mentioned previously, to determine if governmental regulation has more impact than educational initiatives and to determine if extension educators should be partnering with those regulating water use. Lastly, it would be good practice to develop programs with engagers and seekers in mind and then create an experimental design, introducing the different approaches to individuals with both critical thinking styles, to see if behavior changes are more evident in programs directly focused on reaching participants through their critical thinking styles

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