Eco-feedback Technology's Influence on Water Conservation Attitudes and Intentions of University Students in the USA: An Experimental Design

Janna Parker and Doreen Sams

Abstract Water conservation is a universal issue. One segment of the population with a significant future impact on water conservation is college-aged students. College students in the United States of America (USA) are typically not held responsible for their individual utility bills when living in dorms and there are little to no incentives to conserve resources. At one small public liberal arts university in the Southeastern (USA), water has been used in alarming amounts over the last few years. A sample of college students ($n = 208$) from the university participated in an experiment to determine their attitudes, behaviors, and intentions. This paper discusses relevant literature and explains the research methodology (2×2 between subjects randomized across treatments experiment) that examined attitudes and intentions as to purchasing eco-feedback technology and the role of marketing in consumers' choices. The paper identifies hypothesized relationships to be measured. It presents the findings as to the influence of novelty of eco-feedback technology, personal value (economic and emotional), attitude toward environmentalism (substantive and external), price, and knowledge of green living products influence on intentions to purchase. Further, it reports conclusions, limitations, and practical implications.

Keywords Eco-feedback technology · Water conservation · Marketing · Environmentalism

1 Introduction

It is an undeniable fact that clean water is a limited resource and that conservation is vital to long-term survival of life on Earth (Kappel and Grechenig 2009). For example, from 1987 to 1992, California, USA was in a severe drought and in some

J. Parker (✉) · D. Sams
Georgia College & State University, Milledgeville, GA, USA
e-mail: janna.parker@gcsu.edu

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places water was rationed. The current drought in California reinforces the idea that the responsibility for water conservation lies with everyone. The governor of California issued a statewide request for all individuals to cut water usage by 20 %. In an unprecedented move, he also declared that water would not be sent from the State reservoirs to local communities. This policy change affected the drinking water supply of 25 million residents and the irrigation of over one million acres of farmland (Williams and Dearen 2014). California is the number one dairy State in the USA and is also responsible for producing 50–99 % of many fruits, vegetables, and nuts in the USA. The long-term effects of the drought cannot be fully predicted; however, higher food prices across the nation are expected (CDFA 2013). This is but one example of how vital water conservation is to life on Earth. Examples of current water conservation programs in San Francisco, California focus not only on education, but also the providing of free equipment such as low-flow showerheads, free books on water reduction for gardening, and rebates for water efficiency certified appliances for both residential and business customers (SFPUC 2014). While the results are encouraging from these water conservation initiatives in California, it is important to note that San Francisco's water usage reduction is based mainly on financial incentives and free equipment. Many communities or universities throughout the USA do not have the financial resources to fund programs such as those offered by the San Francisco Public Utilities Commission.

Just as State and local communities must look for strategies that will increase the awareness for the need for water conservation, universities are focusing on water conservation as well. Reduced funding for higher education in many States has created a need to find savings in budgets. The administrations of many universities have identified water and energy as areas for reducing costs in the overall budget. Therefore, this research study examined the perceptions of college students (future business leaders, industry leaders, influencers, and residential consumers) of two types of eco-feedback water saving technologies marketed to change water saving behavior to determine the students' perceptions of, and intentions to purchase the devices, as well as the economic and psychological drivers of their consumption choices. Understanding what marketing draws millennials (18–30 year olds) in the USA to purchase water saving devices provides valuable insights into how to market to the millennial generation of consumers. Although many studies have investigated the effects of environmental learning requirements (ELRs) on college students (millennial generation) (Kagawa 2007; Moody and Hartel 2007), they have shown mixed results. This indicates that education alone may not be the answer to water conservation.

The university participating in this study reported water usage that over an extended period of time has been higher per capita than many other universities in the USA. The university's operations department and university housing office personnel conducted studies to determine where the majority of the water was being used. The source of excessive water usage was identified as occurring in the dorms. In an effort to resolve the water usage problem, management at the subject university investigated changing the existing showerheads to low-flow showerheads and/or installing other water saving devices. However, previous research

revealed that low-flow showerheads are not extremely efficient in reducing water usage in the home; therefore, other options were considered by the subject university (Heaney et al. 1999). Budget constraints, previous research on low-flow showerheads, and the university's inability to retrofit buildings with individual room water meters which would enable the university to charge students for their individual water consumption led to the current study.

This study sought solutions to water conservation on a university campus where students have no direct responsibility for paying for water usage. Saving water is strictly voluntary. Although most students have the knowledge that they are *wasting a scarce resource,* encouraging water conservation must take a *carrot approach* (eco-feedback technology), as the *stick approach* (individual fiscal responsibility) is impossible.

To date, many water conservations strategies (e.g., advertising campaigns and educational events) at the university in this study have not met campus expectations in water usage reduction. The subject university's environmental education efforts of: (1) maintaining an active sustainability council (approximately 7 years), (2) teaching sustainability at many levels across disciplines, (3) bringing in outside speakers, (4) mandating sustainability measures across campus, and (5) sponsoring events related to sustainability have not been shown to have a significant impact on students' behavior to date. This begs the question, what factors will influence students to conserve water? The current study is part of a larger study to determine ways to influence behavior in order to reduce unnecessary water usage and combat soaring utility costs. The university that participated in this study is in the process of pilot testing eco-feedback water technology for the dorms in an attempt to reduce water usage, thus reducing costs to the university. Before purchasing and installing the technology, the researchers were asked to conduct a study to determine whether the university would benefit from this purchase and if students were open to using the technology.

2 Millennials' Conservation Attitudes

Kagawa (2007) found "dissonance" between students' understanding and agreement with environmental actions, and actual behavior is based on financial and personal convenience and/or comfort. Kagawa found that students generally believe in collective sustainability efforts, but as to personal behavior changes, their proposed individual lifestyle changes do not align with their principled beliefs.

A recent study by Telefonica (2013) in conjunction with the *Financial Times* surveyed 12,171 millennials (age 18–30) in 27 developed and developing countries. The study asked millennials to rank several important problems/issues facing the world. The rankings revealed that the environment did not make the top two in any of the countries surveyed. In the USA, the economy was number one (46 %) for the respondents. This suggests that in general, millennials may not place great

concern on environmental issues (Telefonica 2013). Moody and Hartel (2007) investigated the impact of an ELR at a major university in the Southeastern USA. They found that implementing a university ELR increased student knowledge, but more importantly 26 % of students self-reported that they had made environmentally related behavioral changes due to increased knowledge of environmental issues after taking courses.

2.1 Consumers' Choice Behavior

Many companies recognize that there is a growing group of consumers that care as to whether the products they buy are sustainable (Kagawa 2007). A widely known economic theory of the consumer is one of a rational maximizing models describing how consumers should choose. However, there are situations in which consumers act in a manner that appear inconsistent with economic theory creating systematic errors in behavior predictions. In order to facilitate the economic value (e.g., it saves money or is a high-quality product based on its price), it is important to remember that price is not the sole determinant and that the functional quality offered by the product may be equally as important (Thaler 1980). Another dimension of personal value is emotional value. Emotions and functional quality of the product/service have a significant impact on purchase decisions. Emotions, defined as a state of physiological arousal, include a cognitive aspect that is context specific (Consoli 2009). Shoppers do not always choose products that just meet a need, but also choose based on emotional satisfaction. Emotional needs and functional needs thus align with psychological value of product ownership (e.g., I am saving the planet) (Consoli 2009). Consumers may not necessarily intend to purchase these products based solely on their environmental benefits. However, drivers of environmentally sustainable product purchases encompass more than intentions of saving the planet. For example, other considerations influencing purchase intention behaviors have been identified as personal values (i.e., emotions and economics) (Kaplan 2000). The assumption that good motives lead to good behavior is a dangerous assumption taken in isolation. The message of giving up something as a sacrifice for the betterment of the future of all (altruistic behavior) is often perceived as personal unhappiness and that materialism and waste are more fun (Kaplan 2000). As a pure altruistic mindset is less than realistic to incite change (e.g., sustainability), other behavioral factors must be examined.

3 Interventions to Sustainable Consumer Behavior

From a behavioral science perspective, studies have shown two sets of interventions (i.e., (1) goal setting, information, commitment, and (2) modeling and consequences) in decision making both of which are noteworthy. However, consequences

of student goal setting cannot be considered in this study, as change cannot be forced and thus it is not feasible or realistic (Kappel and Grechenig 2009). The subject university has clearly made the goal of water reduction known to the student body, but it is a university goal and due to construction constraints cannot be suggested as a measurable goal for individual students. The subject university has modeled sustainable behavior for the students by monitoring and reporting water leaks and breakage of sprinklers and faucets in a timely fashion.

4 Experimentation Study Focus

The current study focused on students' individual goals by examining whether students hold intentions to change their sustainable behavior by purchasing water conservation eco-feedback technologies after reading about and seeing eco-feedback technology. One of the technologies is relatively inexpensive and not novel, whereas the other is relatively expensive and novel. For the study, attitude toward environmentalism was measured across two dimensions: external and substantive. This was measured to determine whether significant differences in responses of those with high scores on attitude toward environmentalism as opposed to those with lower scores existed. External involves the individual's perception of the severity of environmental problems, whereas substantive is the weight of the knowledge of green living products on the individual personally (Banerjee and McKeage 1994). Personal value was also examined as a multidimensional construct consisting of: (1) economic—cost verses benefit and (2) emotional benefits—how does it make me feel. Personal value is relevant to this study, as research has shown that customer-perceived value (i.e., cost vs. benefit) (Zeithaml 1988) is weighed as to both monetary and non-monetary price factors such as risk of poor performance (Liljander and Strandvik 1993), whereas research has shown that consumers may not necessarily intend to purchase products based solely on economic value (Kaplan 2000).

5 Experimental Factors

One goal of this research study was to show whether students who have been exposed to multiple educational and marketing strategies about conservation of water usage would respond positively to either of two types of eco-feedback technology. Two types of water conservation eco-feedback technologies (i.e., high novelty and no novelty, and low and high price) were examined. This is an exploratory study that sought to determine whether knowledge, attitudes, consumer type, price, and/or personal values are drivers of intentions for behavioral change. A randomized between subjects (2×2) experimental design that examined two levels of eco-feedback technologies (High Novelty—light emitting-diode (LED)

showerhead; No Novelty—manual shower timer) at two price levels (low/high) for each type of feedback technology was conducted. Informational advertisements were presented for each treatment across four scenarios to 208 undergraduate business students at a small liberal arts university in the Southeastern USA. The current study was conducted to explore whether various forms of eco-feedback technology might encourage a mindset of water conservation among college students. In order to address this question, students' perceptions as to two types of personal value (i.e., economic and emotional) of two types of eco-feedback technologies were examined.

One factor measured in this study was a personal value construct (i.e., economic and emotional dimensions that can be examined together or in isolation as either of these dimensions of the construct may drive intentions to change). One motivator that has been lacking for students is direct immediate feedback. The two technologies in this study provide direct and immediate feedback. Eco-feedback technology is not new. For example, ambient displays creating energy awareness such as the dimming of the computer screen when not in use for a specific period of time have been available for several years; however, this technology does not have a "novelty" factor. The novelty experimental condition in this study used ambient light display showerheads (water pressure changes the color of the light over a set period of time) signaling in three light stages (green, yellow, and ending in red) when the shower should end. This color progression is familiar to USA college students as it is the same progression in traffic lights. This is a novel technology that may elicit emotions ranging from joy to annoyance depending on personal circumstances. Previous research found that novel eco-feedback technology had a positive impact on family water reduction as long as it did not appear to reward extensive usage over long periods of time, which then reduces its effectiveness (Froelich et al. 2012). The technology that is not novel used in this experiment requires observing the progress of what is equivalent to an egg timer in the shower noting when it runs out. This is not novel, thus the range of emotions may be less than for a "light show in the shower." This study examined whether novelty seekers intentions to purchase are influenced by personal value or the technology.

From literature reviewed for this study, the following were hypothesized.

H1: College students' knowledge of green living products or product price does not influence their intention to purchase water conservation eco-feedback technology, whereas personal value has a significant influence on intentions to purchase water conservation eco-feedback technology.

H2: College students' intentions to purchase water conservation eco-feedback technology are influenced by personal value and not by price or attitude toward environmentalism.

H3: Novelty seeking college students' likelihood to purchase water conservation eco-feedback technology is influenced by personal value and not the novelty of the technology.

6 Study Methodology

Juniors and seniors (*n*, 208) from the business college took part in this laboratory experiment. These students were previously exposed to various forms of education on environmental sustainability through lectures, multiple events, and advertisements on campus over their 4 years at the university. Further, this sample was chosen because all of the students in the study have taken at least one and typically two economic courses prior to engaging in this study and thus are exposed to Milton Friedman's rational choice theory (i.e., balancing cost against benefits to maximize advantage in which consumption motivations is not considered) (Friedman 1953). These students are future paying consumers of utilities such as water. However, at this time many do not directly (i.e., do not pay for water usage outside of tuition and housing fees) hold any responsibility for the payment of water used let alone excessive use of water. This sample was also selected because as college graduates with business degrees, their influence based on income earning potential in the USA currently ranges from a starting average salary of around $41,400 to mid-career salary potential of approximately $70,000 (PayScale Inc. 2013). Therefore, as future consumers educated in environmental sustainability practices and economic theory earning business degrees affords them the potential for substantial earning power, they are an ideal sample for this study.

7 Research Design

A between subjects 2 × 2 experimental design is employed to test the hypothesized relationships (See Fig. 1).

8 Study Measures

The scales measuring the constructs in this study are established scales that have previously demonstrated validity and reliability. This exploratory study fills a gap in the literature by determining whether knowledge of green living products (i.e., eco-feedback technology), personal values, attitude toward environmentalism, price, or consumer type (i.e., novelty seekers) are drivers of intentions for purchasing water conservation eco-feedback technology.

According to most philosophers in knowledge theory, there are three kinds of knowledge (i.e., propositional [knowledge by facts], personal [knowledge by

Fig. 1 Eco-feedback novelty seeking technology

		Novelty	
Price		Novel/High Price	Not Novel/High Price
		Novel/Low Price	Not Novel/Low Price

acquaintance], and procedural [knowing how to do something]). Only two dimensions are relevant for this study (propositional and personal). Procedural was not part of the study as the usage procedure for each product was part of the product description in the experiment. The Mukherjee and Hoyer (2001) two-dimensional knowledge scale (i.e., propositional knowledge and personal knowledge) consists of two items measured on seven scale points (1 = not at all knowledgeable and 7 = very knowledgeable) and one item measured on seven scale points (1 = very little experience and 7 = a lot of experience) was adapted for this study of green living products. The scale reliability for the Mukherjee and Hoyer (2001) study was 0.81. The scale is amenable to either one product category or multiple product categories and thus is appropriate for this study. The personal value construct for this study was measured with a two-dimensional scale [i.e., (1) emotional—five items (e.g., *this eco-feedback technology offers value for the money*) and (2) economic—four items (e.g., *the eco-feedback technology makes me happy*)] (Sweeney and Soutar 2001). This scale was developed to measure consumers' perception of products prior to actual purchases or immediately after a purchase making it relevant to this study. This is a nine item scale with endpoints of 1 = strongly disagree to 6 = strongly agree. Scale reliability was high ranging between 0.80 and 0.94. These two-scale dimensions were correlated at 0.74 (CI) with a standard error of 0.03 demonstrating discriminant validity. An adapted attitude toward environmentalism scale [i.e., two of three dimensions: (1) substantive environmentalism and (2) external environmentalism)] was modified from the Banerjee and McKeage (1994) scale. Scale reliability for the substantive environmentalism dimension was reported as 0.79 and for the external environmentalism was 0.87. Both demonstrate high reliability. The substantive environmentalism dimension examines, "individual perceptions of the severity of environmental problems." The external environmentalism dimension examines, "convenience, economic trade offs, and external perception of environmental problems (e.g., media attention)" (Banerjee and McKeage 1994, p. 149). The excluded dimension of the scale measured internal environmentalism was believed by the researchers to foster social responding bias. Price was measured with the actual and doubled prices of the product. For the non-novel product, the prices were ($5.99–$11.99) and for the novelty product, the prices were ($29.95–$59.95). Novelty seeking is broadly defined to include social coolness (i.e., good, hip, or fashionable) and technical coolness (i.e., technologically interesting or advanced) (Bodine and Gemperle 2003). This three-item novelty seeking seven-point (1 = strongly disagree to 7 = strongly agree) scale was used to measure consumer type in the current study (Oliver and Bearden 1985). The Oliver and Bearden scale (reliability 0.72) was originally used to measure the effect of heavily promoted time-released diet suppressants. The Burton et al. (1999) scale measuring the intention to purchase in this study is an established scale that has demonstrated validity and reliability. The scale was appropriate for this study as it is measures information read about the product to measure respondents' intentions to purchase (e.g., the eco-feedback technology). This three-item semantic differential scale has endpoints of more likely/less likely; very probably/not probable; and very likely/very unlikely. The Burton et al. (1999) study revealed a high reliability of 0.89. However, analysis of scale validity was not described in the original study.

9 Experimentation Study Materials

Students consisting of juniors and seniors across six classes in the college of business of the subject university were given the opportunity to participate in the experiment. Incentives were provided in the form of extra credit points. Those wishing not to participate were given alternative opportunities to gain points.

The procedures used by the researchers were consistent across courses and sections. Students were given folders that were randomized as to treatment order and students were instructed to not open them until otherwise instructed. The product photos and descriptions (1) novel product and (2) non-novel product were randomized within the folders. Each folder contained two separate scenarios for a water conservation eco-feedback product at different prices. Packet #1 [scenario #1—high price/novel; scenario #2 low price/not novel, etc.] Treatments were randomized to address order bias. Participants signed an agreement of confidentiality and two consent forms prior to beginning the experiment. Throughout the experiment, the students saw one treatment at a time. After each treatment, students filled out a questionnaire measuring the relevant variables discussed above.

10 Scale and Model Purification

The three-item novelty scale demonstrated reliability of 0.678, which was not acceptable and thus was not included in the Confirmatory Factor Analysis (CFA). As demonstrated in the Bergkvist and Rossiter (2007) study, a single-item predictor can have better predictive validity than a multiple item measure for concrete concepts. Thus, if scale items #1 and #3 were removed, the reliability would have been 0.797; therefore, it was determined that scale item #2 would be used as the measure (i.e., *I am usually among the first to try new products*). This item was the only scale item specifically related to the purchase of a novel product. The other two were generic in nature. A CFA was conducted using AMOS2 for these four constructs: Personal value [i.e., economic value (EconVal) and perceived emotional value (EmotVal)], knowledge (product category of green living products—know), attitude toward environmentalism (i.e., substantive environmentalism and external environmentalism), and purchase intentions (i.e., likelihood to purchase water conservation eco-feedback technology—likely). After running the full model, it was determined that some items needed to be dropped in order to achieve a "good fit," acceptable reliability, and average variance extracted for one of the constructs. Two items were dropped from the external environmentalism dimension and three items were dropped from substantive environmentalism dimension of the attitude toward environmentalism scale leaving a minimum of three scale items per dimension as needed for the constructs to be identified. Items were selected for deletion due to low standardized regression weights (Hair et al. 2010). Table 1 contains the results of the CFA for both the "full" model and the "respecified" model.

All indices for the respecified model fell within accepted ranges (Hair et al. 2010). After determining that the measurement model had good fit, the reliability and validity were assessed. The estimated loadings (E.L.), standard errors (S.E.), critical ratios (C.R.), standardized regression weights (S.R.W.), reliability (α), and average variance extracted (AVE) are found in (Table 2).

Construct reliability was established using coefficient alpha and all constructs met the minimum level of 0.7. Convergent validity was established by determining the AVE for each construct. The desired level is 0.50 (Hair et al. 2010). All constructs met this requirement with the exception of the substantive environmentalism dimension of the attitude toward environmentalism construct (Substantive Env) at 49.10 %. Since only one dimension of one construct missed this by less than a percentage point, the measurement model should be considered to have convergent validity. Additionally, the critical values for each variable were significant ($p < 0.05$). Discriminant validity was assessed by comparing the AVE for each construct with the squared inter-construct correlation estimates (SIC).

Table 1 Results of confirmatory factor analysis $n = 208$

Measurement of fit	"Full" model	"Respecified" model
Chi square	566.112	345.051
Degrees of freedom	309	194
Probability	0.000	0.000
CMIN/DF	1.832	1.779
Comparative Fit Index (CFI)	0.906	0.937
Root mean square error of approximation (RMSEA)	0.063	0.061
Confidence interval for RMSEA	(0.055; 0.072)	(0.051; 0.072)

Table 2 Indicators of reliability and validity

Construct	Variable	E.L.	S.E.	C.R.	S.R.W.	Reliability	AVE (%)
PriceHi						**0.88**	**71.84**
	Price1R	1.000[a]			0.919		
	Price2	0.823	0.055	15.028	0.811		
	Price3R	0.907	0.061	14.895	0.808		
External env.						**0.79**	**49.10**
	Prob2R	1.000[a]			0.796		
	Prob3R	1.114	0.126	8.838	0.671		
	Prob4R	1.139	0.139	8.176	0.619		
	Prob5R	1.214	0.132	9.229	0.705		
Substantive env.						**0.87**	**53.73**
	Action1	0.532	0.075	7.136	0.533		
	Action3	1.366	0.137	9.976	0.835		
	Action4	1.000[a]			0.794		

(continued)

Table 2 (continued)

Construct	Variable	E.L.	S.E.	C.R.	S.R.W.	Reliability	AVE (%)
Likely						**0.87**	**69.38**
	Likely1R	1.000[a]			0.851		
	Likely2	1.054	0.073	14.468	0.859		
	Likely3R	0.961	0.074	12.956	0.787		
Know						**0.91**	**76.75**
	Know1	0.997	0.069	14.393	0.874		
	Know2	1.057	0.070	15.090	0.958		
	Know3	1.000[a]			0.789		
EconVal						**0.89**	**61.62 %**
	EconVal1	1.000[a]			0.692		
	EconVal2	1.087	0.100	10.878	0.820		
	EconVal3	1.301	0.109	11.926	0.927		
	EconVal4	0.953	0.105	9.058	0.674		
						0.86	55.43 %
	EmotVal1	1.444	0.130	11.123	0.887		
	EmotVal2	1.581	0.137	11.529	0.944		
	EmotVal3	1.084	0.131	8.267	0.626		
	EmotVal4	0.792	0.116	6.852	0.510		
	EmotVal5	1.000[a]			0.664		

[a]Loading set to 1.0. Not estimated

Table 3 Squared interconstruct correlation estimates

	Substantive	External	Likely	Knowledge	EconVal	EmotVal
Substantive env.	1.00					
External env.	0.31	1.00				
Likely	0.09	0.11	1.00			
Knowledge	0.00	0.00	0.00	1.00		
EconVal	0.03	0.08	0.41	0.00	1.00	
EmotVal	0.05	0.14	0.41	0.00	0.08	1.00

The AVE for constructs was higher than the SIC for each construct pair indicating discriminant validity. The SICs are found in Table 3. Nomological validity was assessed by evaluating the covariances between the constructs. Table 4 below contains the significant covariances between constructs.

Likely to purchase had a significant positive covariance with every construct except for *knowledge of green living products*. It would not be expected that all constructs would be significantly related to each other. It was important to find significant covariances between likely to purchase and the independent variables in the study. Additionally, since many green living products are new, many people are still seeking information about these product categories; therefore, the lack of a positive covariance is not surprising.

Table 4 Construct covariances

Constructs	Estates	S.E.	C.R.	$p < 0.001$
Likely ↔ Substantive	0.324	0.093	3.483	***
Likely ↔ External	0.470	0.125	3.752	***
Likely ↔ EconVal	0.638	0.114	5.614	***
EmotVal ↔ Likely	0.641	0.104	6.141	***
Substantive ↔ External	0.462	0.086	5.381	***
EmotVal ↔ External	0.289	0.070	4.111	***
EmotVal ↔ EconVal	0.180	0.053	3.414	***

***Indicates significance at <0.001

11 Findings

11.1 Manipulation Check

Upon closing the experiment treatment folders, students were instructed to "not look back into the folder" when answering the manipulation check question (what was the price of the eco-feedback technology you saw last?). All respondents answered the manipulation check correctly.

11.2 Hypotheses Testing

Based on the knowledge that students at the subject university were exposed across their 4 years of education to sustainability education and initiatives, it was important to determine their level of concern for the environment. The findings (Table 5) demonstrate that all of the constructs directly related to environmentalism suggest that most of the students in the sample do have some level of concern for the environment. All constructs were measured with seven-point scales.

The CFA findings (Table 4) revealed that all covariances were significant except for knowledge of green living products. Results from an ANCOVA supported Hypothesis #1 [*f* 43.041, *p* 0.000—knowledge of green living products *p* 0.098 and personal value (i.e., emotional *p* 0.000 and economic 0.000), r^2 0.461, alpha 0.05]. Personal value was shown to have a significant influence on intentions, whereas knowledge of green living products or product price did not have a significant influence on their intentions.

Hypothesis #2 was supported based on the results from an ANCOVA. Findings revealed [*f* 24.538, *p* 0.000—personal value (i.e., emotional *p* 0.000 and economic 0.000), attitude toward environmentalism (i.e., substantive *p* 0.535 and external *p* 0.072), price 0.491, r^2 463, alpha 0.05]. Thus, it was concluded that the sample's intention to purchase water conservation eco-feedback technology is influenced by personal value not price or attitude toward environmentalism.

Hypothesis #3 was not supported based on the results from the ANCOVA. Findings revealed [*f* 41.929, p 0.000—novelty seeking *p* 0.469, type of technology

Table 5 Descriptive statistics

	N	Minimum	Maximum	Mean	Std. deviation
Substantive Env.	207	1.33	7.00	5.6554	1.13936
External Env.	208	1.75	7.00	5.6274	1.00361
Knowledge	208	1.00	7.00	3.4810	1.28370
Goal	208	1.00	7.00	5.0756	1.03920
EconVal	208	1.00	6.00	3.7100	0.99978
EmotVal	208	1.00	6.00	4.2952	0.93373
Likely	208	1.00	7.00	3.1907	1.45406

p 0.291, personal values (i.e., emotional p 0.000 and economic p 0.000), r^2 0.452, alpha 0.04]. This finding revealed that novelty seeking college students' likelihood to purchase water conservation eco-feedback technology is not influence by personal value or the novelty of the technology. However, this finding should be taken with caution as the degree of novelty seeking was only 3.59 on a six-point scale (3 = somewhat disagree and 4 = somewhat agree), indicating a measurable portion of sample that may not have self-identified as being novelty seeking individuals.

12 Conclusions

Through this experimental design study, the researchers were able to establish a generalizable cause–effect relationship that is a true representation of actual behavior of college students (millennials) in the USA.

The 2010 Pew Research Center report was a comprehensive study of millennials. Millennials consist of 77+ million individuals. This makes their consumption potential greater than even that of the Babyboomers (i.e., *ages* 49–67 in 2013) (Pew Research Center 2010). Based on the sheer size of the population, understanding their "personality" as a group is important to the successful marketing of water conservation products. Water conservation products that meet the personal value standards along with water conservation education for this large demographic segment of the population (millennials) are expected to significantly reduce water management needs as the behaviors of the individual within a reference group (e.g., colleagues at work) is expected to influence other members of the group (Asch 1952).

The majority of the students (millennials) in the current study have been exposed repeatedly over four years of college to environmental sustainability issues: yet, this study found environmental knowledge among the respondents was not a significant driver of intention to purchase eco-feedback technology. This supports the findings of the Telefonica's (2013) study in conjunction with the *Financial Times* that millennials in the USA are not as concerned with societal issues, but rather focus on personal values. Therefore, one important takeaway

from this study is that despite an ongoing educational program at the university, students' intentions to purchase water conservation eco-feedback technology regardless of price or novelty were influenced solely by personal values with no indication that educational experiences had a direct influence on their choice. It further supported the Kagawa (2007) study, in that college students believe in collective sustainability efforts, but not personal responsibility. One possible explanation for this is that although their beliefs do not consciously influence personal behavior, it may occur subconsciously and should be considered in future research.

Another interesting conclusion from the study is that students who self-reported as, "novelty seekers" were no more influenced by the "egg timer-type eco-feedback technology" than the "lightshow eco-feedback technology" novelty when it came to their likelihood to purchase water eco-feedback technology. The findings showed that it is all about the "personal value." Whether marketing a novel product or a non-novel product, findings of this study show that the millennial consumer seeks out personal value. As long as personal value is apparent, then the purchase decision between these two types will fall on the one with the most personal value to the consumer. From this, it is possible to draw the conclusion that the management of water resources on the college campus must address the personal value of using the technology properly (stopping when the red light goes out) coupled with continuing education.

Although previous research on advertising appeals (financial vs. green) for *green* products found that purchase intentions differ across levels of environmental involvement (Schuwerk and Lefkoff-Hagius 1995), the current study did not. From the current study findings, the research team found that advertising appeals that focus on personal value appeal to college of business students regardless of the extent of their individual environmental education. The findings of this study informed the research team that regardless of strength of environmental attitudes, perceived personal value influenced likelihood to purchase among this sample of college students. From this knowledge, the research team was able to develop advertisements (focusing on personal value rather than societal benefits) and select an eco-feedback technology, from the two in this study, to be pilot tested in an upcoming longitudinal experiment to be conducted on the subject college campus dorms.

This study was a first step in the investigation of a very complex water management issue in a highly bureaucratic government institution and was never intended to be all inclusive of such a massive issue. Although findings revealed that personal value is the most significant factor as to water conservation among the target population, the strong emphasis on environmental sustainability education must be considered as a contributing (although unconscious) factor. However, other variables should be included in future studies such as goal seeking and usage behavior overtime. This study informs research as to factors that influence whether eco-feedback technology has its place in water conservation among millennials. It also demonstrates the worthiness for testing eco-feedback water saving technology in a real-world application. This study was limited by the sample from only the college of business. Students in a college of business and those studying environmentalism

and the sciences may report differing beliefs and purchase intentions. Therefore, an interdisciplinary study may be more revealing of the true environmental nature across millennials.

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Authors Biography

Janna Parker DBA (2013), Assistant Professor, Marketing (Georgia College & State University). Janna has published at conferences and in academic journals on sustainability. Prior to joining the Georgia College & State University faculty, she taught as an instructor at Louisiana Tech University and Cameron University. She has worked as a political consultant, an independent marketing consultant with local businesses and nonprofit organizations as well as the United States Air Force in Europe.

Doreen (Dee) Sams Ph.D. (2005), Associate Professor, Marketing (Georgia College & State University).Founder of GC Shades of Green, served on GC Sustainability Council, Sustainability Council for the State of GA Boys & Girls Club, developed a sustainability session for SMA, participated in Sustainability Across the Curriculum Train the Trainer Workshop, received 2011 Hometown Heroes “Go Green” award for sustainability, developed a session & served as track chair for 2012 MMA Fall Educators’ Conference on “Teaching Sustainability Across the Business Curriculum.” Board of Directors Heart of Georgia Energy Coalition & publishes articles at academic conferences and in academic journals on sustainability.