Antecedents and Pro-Environmental Consumer Behavior (PECB): The Moderating Role of Religiosity

Abstract

Purpose – The purpose of this paper is to examine the predictabilities of five intra-personal factors to predict PECB and the moderating role of religiosity in Oman.

Design/methodology/approach – The study uses the neural network to analyze the antecedents/antecedents*religiosity→PECB relationships with a sample of 306 consumers from Oman.

Findings – This study finds that the most important predictors of PECB, according to the order of importance are attitude*religiosity, knowledge, concern*religiosity, knowledge*religiosity, value, religiosity, attitude, concern, and value*religiosity.

Research limitations/implications – The convenience sample from a single Islamic country limits the generalizability of the findings. Future studies should utilize probabilistic sampling techniques and multiple Islamic countries that are located in different geographical regions.

Practical implications – To promote PECB, businesses and policy makers should provide environmental education to expand knowledge and value, leverage ecological religious values in integrated marketing communications, positive inducements to change attitude, and concern enhancing interventions.

Social implications – Since religiosity enhances PECB by moderating the impacts of environmental intra-personal factors on PECB, businesses and policy makers should find ways to utilize faith-based ecological messages in Islamic countries.

Originality/value – Determining the predictabilities of psychological factors and their interactions with religiosity to predict PECB in Islamic countries is necessary for promoting environmentally friendly products in Islamic countries and for reducing the ecological damage to the environment.

Keywords Pro-environmental consumer behavior, Oman, religiosity, neural network

Paper type Research paper

Introduction

Extant research suggests that the pro-environmental consumer behavior (PECB) is beneficial for the environment as well as for businesses. Environmental benefits of the PECB include a reduced deterioration of the natural environment, an increased consumers' well-being, an enhanced quality of life, and the achievement of a sustainable future (Felix and Braunsberger, 2016; Kalamas *et al*., 2014; Moser, 2015). The PECB brings benefits to businesses, such as,

greater returns from higher demands for environmentally friendly products, an increased employee commitment, and an enhanced customer satisfaction (Menguc and Ozanne, 2005). PECB is a voluntary behavior of a consumer whereby the consumer deliberately seeks to minimize the harmful effect of his/her actions on the natural and man-made world, such as, purchasing products that are ecologically friendly (Steg and Vlek, 2009). Because of PECB's important benefits, a considerable number of studies have explored the potential antecedents of PECB, such as, environmental value, knowledge, concern, and attitude, which are known as intra-personal/psychic variables (Ertz *et al.*, 2016; Han, 2015).

However, studies report that cultural values strongly interact with pro-environmental intra-personal factors in influencing the PECB (Belk, 1975; Soyez, 2012). Yet scholars are not comfortable to investigate the influence of religiosity, a specific cultural value, on the antecedents-PECB relationships (Felix and Braunsberger, 2016; Lindridge, 2005). This is unfortunate because religiosity is a dominant cultural value in many societies and it can influence different intra-personal factors and in-turn the PECB (Izberk-Bilgin, 2012). Defined as a belief that there is God and there are guiding principles set by God for people's behaviors and deeds in this life (McDaniel and Burnett, 1990) religiosity is believed to be an important source of morality, ethics and environmental ethics (Rice, 2006; Vitell, 2009). Recently, Felix and Braunsberger (2016) found that religiosity moderates the environmental attitude-PECB relationship in a pre-dominantly Catholic context. Several other scholars have explored the impact of religiosity on the environmentalism in Judeo-Christian contexts (e.g., Izberk-Bilgin, 2012). However, no study has yet examined the impacts of the interactions of religiosity with other environmental intra-personal factors (i.e., value, knowledge, concern and attitude) on the PECB, neither has any study explored the preceding in a predominantly Islamic context. To fill

this void, this research examines the moderating role of religiosity on the influences of four environmental intra-personal factors on the PECB in Oman, an Islamic country. This study will be helpful for various environmental stakeholders in promoting the PECB by leveraging ecological values inherent in religions through educational and promotional messages.

Also, there is a call in the literature for more research on environmentalism and religiosity in the Middle-East, a region where religion is the central cultural value that influences a large variety of intra-psychic traits and behaviors (e.g., Rice, 2006). The Middle-East includes 17 countries and has a combined GDP of over $3.6 trillion, a per capita GDP of $18,264, and a combined population of 330 million people (CIA World Fact Book, 2016). The economies of the region are growing at an average rate of 3% to 4%, while the population growth rate is over 2%, one of the highest in the world. The rapid industrialization, urbanization, and population growth are causing severe environmental degradations in areas including air, water and land. Research indicates that in addition to regulatory interventions, good environmental practices by citizens are crucial for the environmental improvement (Felix and Braunsberger, 2016). Thus, responding to the call, this research attempts to examine the PECB and its determinants in a Middle-Eastern setting, specifically in the Gulf Cooperation Council (GCC) region, which is more religious than other Muslim countries in the broader Middle-East area. The study will not only be helpful for policy makers in formulating effective interventions, it will be helpful for businesses to effectively market environmentally friendly products, such as, hybrid cars, energy efficient appliances and re-cycled materials in this almost virgin (non-availability of environmentally friendly products) market.

Further, the extant research based on explanatory statistical techniques is not clear about the relative importance and predictabilities of these different intra-personal variables (value,

knowledge, concern, and attitude) in predicting PECB (Ertz *et al.*, 2016). Even though the neural network approach is useful in better understanding the predictabilities and the relative importance of the predictabilities (Chong *et al.*, 2015) of these intra-personal variables, no study has yet integrated and examined these predictors in a predictive analytical model. The neural network captures non-linear relationships among decision variables and is not bounded by the linear compensatory assumptions. It is a powerful data-mining tool that is capable to model relationships between predictors and outcome variables. For predictive purposes, the neural network could be a better technique to use than traditional linear statistical techniques (Chong et al., 2015). The traditional statistical models, such as, multiple linear regression models and structural equation models can detect linear relationships only, which may result in an over-simplification of complicated research models (Chong et al. 2015; Sharma et al. 2015 and Liebana-Cabanillas et al. 2017). Nygaard and Dahlstrom (2002) and Singh (1998) reported that the relationships between psychological variables could be non-linear, such as, quadratic and tri-phasic and the non-linear relationships cannot be captured by linear statistical models. This study attempts to fill this gap by examining these intra-personal variables as predictors of the PECB in a single predictive model and by showing the order of importance of these predictors in a so far neglected but important context, Gulf region in the Middle East. The use of the neural network to analyze the predictive model will allow the capturing of non-linear relationships among decision variables and will not be bounded by the linear compensatory assumption (Chong *et al.*, 2015). The identification of the predictabilities and their order of importance could be helpful for policy makers and businesses in prioritizing environmental intervention strategies to influence the PECB more effectively and efficiently.

Literature Review

Environmental issues have become important discourses in the public, political, global, corporate, and academic spheres. For example, both the developed and developing countries are intensifying public policies and political efforts geared toward the sustainable technology, renewable energy, green growth and environmental sustainability (Elgaaied, 2012; Kotler, 2011; Kronrod *et al.*, 2012). Also, several global organizations, such as, World Business Council for Sustainable Development (WBCD) is engaged in promoting sustainable business practices among global companies, such as, Coca-Cola, General Electric, Nike, Unilever, and Walmart (WBCSD, 2010). Further, scholars contend that producing positive environmental outcomes from business activities has become a strategic perspective of many businesses around the world. In the academic sphere, a growing body of literature has been focusing on sustainable business practices and consumption behaviors (Grimmer *et al.*, 2016; Kronrod *et al*., 2012; Paul and Rana, 2012).

Among various environmental issues, the PECB is at the forefront of academic research attention for over 30 years because a big part of the environmental degradation is attributed to consumer behaviors (Grimmer *et al.*, 2016). While a large number of antecedents of the PECB have been researched, the most repeated and important ones are environmental values, knowledge, concerns and attitudes (Ertz *et al.*, 2016). As the theoretical justifications for linking these antecedents to the PECB, scholars have used theories of social psychology, such as, Ajzen's (1991) theory of planned behavior (TPB), Schwartz's (1977) norm-activation theory (NAT), and Stern, Dietz, Abel, Guagnano, and Kalof's (1999) value-belief-norms (VBN) theory. Even though the extant research has advanced our understanding of the relationships between the PECB and its various antecedents, inconsistent empirical findings related to the relationships between various intra-physic traits and PECB have also emerged across different contexts (Joshi

and Rahman, 2015). As potential hinderers or facilitators, scholars have examined different contextual factors as moderators, including religiosity, which is believed to have moderating effects on the influences of these antecedents on the PECB. In the following, this research attempts to develop a theoretical perspective that suggests that the PECB is influenced by intra-personal factors and these influences are moderated by the religiosity of consumers in a GCC country setting.

Religiosity and pro-environmental consumer behavior

As noted earlier, religiosity refers to the belief in God and a commitment to behave and act according to God's rules (McDaniel and Burnett, 1990). Scholars argue that religiosity is a key element of any cultural system, which contributes to an individual's values and thereby influences his/her behaviors (Ramasamy *et al.*, 2010). Magill (1992) contends that religiosity provides the background against which the ethics of behaviors are interpreted. Because of the environmental ethics, i.e., man's ethical responsibilities toward the natural world, embedded in the principles of most major religions, religiosity is likely to be associated with environmental values, attitudes and behaviors (Rice, 2006).

More than two-thirds of world's population consider their religions to be important in their daily lives (Diener *et al.,* 2011) and these people's values, attitudes and behaviors are influenced by their religions (Delener, 1990). Studies have related the religiosity with a variety of values, attitudes and behaviors, such as, life satisfaction and happiness, volunteering, risk preferences, future time orientation, criminal activities, internet use, consumer complaint behavior, brand loyalty, and pro-environmental values, attitude and behaviors (Bixter, 2015; Clements *et al.*, 2014; Oner-Ozkan, 2007; Reisig *et al.*, 2012; Siala, 2013).

Several prior studies have examined the religiosity's impacts on consumers' orientations toward various environmental issues. For example, Felix and Braunsberger (2016) have found that religiosity moderates the relationship between the environmental attitude and the green product purchase among Catholic respondents in Mexico. Further, evidences have appeared that challenge White's (1967) contention that the religiosity rooted in the Judeo-Christian heritage is anti-environmental, such as, Wolkomir *et al.* (1997) have found that the religious salience in the Judeo-Christian dominion is positively related to environmentally responsible behaviors. Based on the aspect of the Judeo-Christian tradition that stresses a respect for the nature and considers humans as stewards of God's creations, scholars have produced evidences in support of a favorable relationship between the religiosity based in the Judeo-Christian tradition and environmental concerns and behaviors (Felix and Braunsberger, 2016). These evidences suggest that it is important to examine the nature of the effect of religiosity, related to all major religions, in pro-environmental behavioral models.

Similar to the Judeo-Christian tradition, Islam's relationship with environmental causes are rooted in the Quran (God's revelations to the Prophet as believed by Muslims) and the Prophetic hadiths (sayings and actions of Prophet Mohammed, peace be upon him), the two main sources of Islamic teachings that dictate man's roles and responsibilities in their lives in this world (Rice, 2006). In fact, Eco-Islam is a growing literature that attempts to relate Islamic teachings to environmental issues (Abdelzaher *et al.*, 2011). Eco-Islam delineates the Islamic concept of the environment and the nature of human's environmental actions. The former, the Islamic concept of the environment, indicates that the environment is created and owned by God, is sustained and guarded by God, is a sign of God's existence to man, itself worships God, and is a witness for or against human actions (Abdelzaher *et al.*, 2011; Rice, 2006). While the latter,

the nature of human's environmental actions, views the environment as a trust given to human beings, sees the environment as a blessing of God that should not be wasted, and stresses the fact that God sees, hears, and knows all that human beings do with respect to the environment and humans will be held accountable for all his/her actions in the Hereafter (Rice, 2006). Despite Islam's possible connection with environmental ethics, a very few studies have attempted to explore Islam's association with pro-environmental consumer behaviors. Rice (2006) finds a positive relationship between religiosity and pro-environmental behaviors among a sample of Muslims in Egypt. As per our search, no study has yet examined the religiosity's associations with key environmental values, attitudes and behaviors in the Gulf Cooperation Council region, which is not only Islamic in its orientation but is also deeply religious compared to all other Muslim countries in the world (Bhuian *et al.*, 2014).

Consumer environmental value and pro-environmental consumer behavior

Environmental value is an important antecedent of the PECB. Schwartz (1999) defines values as guiding principles of people's lives composed of trans-situational goals that are desirable and vary in their importance. Among the ten motivationally distinct types of values in Schwartz's value structure theory, benevolence and universalism are connected to the environmentalism because these values promote welfare of one's in-group, all people and the nature (Rice, 2006). These two values correspond to the environmental value constructs of altruistic and biospheric values and they together represent the ecological/environmental worldview that promotes pro-environment oriented actions (Stern, 2000). The altruistic value focuses on helping others, while the biospheric value emphasizes the welfare of the environment and the biosphere. Stern and Dietz (1994) provide support for the influences of altruistic and biospheric values on various pro-environment oriented actions, such as, boycotting products of a

company that pollutes. Also, Rice (2006) finds that environmental values are related to pro-environmental behaviors. However, several other studies show that environmental values do not match with environmental activities (Gifford, 2011).

A number of studies have linked religiosity with environmental values and PECB (Rice, 2006). Based on a meta-analysis, Saroglou *et al.* (2004) claim that religiosity relates to the conservation values of tradition and conformity of Schwartz's (2004) value theory. Tradition refers to respecting and accepting the customs and ideas that one's culture advances, while conformity means restraining from actions, inclinations and impulses that can upset social expectations (Schwartz, 1999; White and Simpson, 2013). Elsewhere scholars argue that religiosity unifies values, moral codes, and beliefs into an integrative whole, which then triggers real behaviors, such as, prosocial and environmental behaviors (Schwartz and Bardi, 2001). That is, when the environmental value becomes a demand of the culture and a social expectation, consumers high in religiosity will tend to engage in behaviors that will uphold the environmental value owing to their respect for and acceptance of the tradition and conformity. Consequently, this study suggests that for consumers with high levels of religiosity, the environmental value will be strongly related to PECB, while for consumers with low levels of religiosity, the environmental value's influence on PECB will be weaker. In sum, this study will not only use the environmental value as a predictor of PECB but will also apply the religiosity as a moderator of the environmental value-PECB relationship.

Consumer environmental knowledge and pro-environmental consumer behavior

Environmental knowledge is another important antecedent of PECB. Fryxell and Lo (2003, p. 45) define the environmental knowledge as "a general knowledge of facts, concepts, and relationships concerning the natural environment and its major ecosystems." While

examining environmental actions, Schahn and Holzer (1990) classify the environmental knowledge into an abstract and a concrete environmental knowledge. An abstract environmental knowledge concerns environmental issues, such as, problems, causes, and solutions, while a concrete environmental knowledge relates to actionable behaviors. Several studies have linked the environmental knowledge to PECB. For example, based on a meta-analysis, Hines *et al.* (1987) report that the ecological knowledge is significantly correlated with PECB. Further, Stern (1992) finds that individuals with more knowledge about the environmental discourses are also more engaged with environmental issues. However, other research shows that the environmental knowledge has no or only an indirect influence on environmentally friendly acts (Mostafa, 2007). Some other studies claim that the knowledge is closely intertwined with the rationality of the action. The rationalization of actions stems from the expected utility and the subjective credence (Hawthorne and Stanley, 2008). Religiosity has the potential to contribute to both the dimensions of the expected utility and the subjective credence related to environmental actions. Scholars posit that Christianity, Islam and Judaism perceive the environment as a creation of God and consider humans as stewards of the natural world (Felix and Braunsberger, 2016; Rice, 2006). A good stewardship would imply pro-environmental behaviors, which will, in turn, earn God's favors and rewards (the expected utility), while the belief in the certainty of God's evaluations of pro-environmental behaviors and consequent rewards and punishments is likely to form the basis for the subjective credence (Abdelzaher *et al.*, 2011). Thus it can be argued that by influencing the expected utility and the subjective credence related to the pro-environmental behaviors, religiosity can augment the rationality of actions that stem from the environmental knowledge. Scholars argue that the subjective beliefs of most major religions about the environment are generally pro-environmental, such as, man is entrusted with the stewardship of

the earth, preservation and protection of all creations, respect for all species, and to use only what is necessary (Felix and Braunsberger, 2016; Schultz *et al.*, 2000). Therefore, this study will use environmental knowledge and an interaction of the environmental knowledge and religiosity to predict PECB.

Consumer environmental concern and pro-environmental consumer behavior

Literature considers the consumer environmental concern as an important determinant of the PECB. Based on a summary of the past research, Fransson and Garling (1999, p. 370) define the environmental concern as "an evaluation of, or an attitude towards facts, one's own behavior, or others' behavior with consequences for the environment." Authors have also conceptualized environmental concerns as emotional manifestations of environmental values, which have been treated as distinctive constructs in relations to environmental behaviors (Joshi and Rahman, 2015; Mostafa, 2007). Literature has linked four value orientations that evolved into environmental concerns (Stern, 1992). One value orientation refers to the New Environmental Paradigm (NEP) (Dunlap and Van Liere, 1978), which stresses on having a concern about the ecosystem for its own sake. The second value represents a concern for the environmental quality because of the well-being of the people, which is known as an anthropocentric altruism. The third value orientation of the environmental concern relates to self-interest, that is, concerned about personal threats due to the environmental degradation. The fourth value orientation stems from some deeper causes, such as, religious beliefs or post-materialistic values (Stern, 1992). Empirical studies linking the environmental concern to the PECB have produced mixed results. For example, purchases of deodorant containers, laundry detergents, and cosmetics have been found to be influenced by the environmental concern (Barr *et al.*, 2003). Other research,

however, finds no direct influence of the environmental concern on the PECB (Hines *et al.*, 1987). By and large, the behavioral predictive power of the environmental concern is low.

We argue that the religiosity can moderate the effect of the environmental concern on the PECB based on the multiple motive framework, which asserts that a specific behavior results from multiple motives, such as, normative, hedonic, and gain motives (White and Simpson, 2013). Normative motive is the motivation to act appropriately as expected by the culture and the society. In that sense, the values of the new environmental paradigm and the anthropocentric altruism closely correspond to the normative motive. On the other hand, the hedonic motive (seeking a personal comfort and a better feeling right now) and gain motive (seeing an improvement of one's own resources) relate closely to the self-interest value orientation of the environmental concern (White and Peloza, 2009). Scholars note that people are gradually shifting from the self-interest and the anthropocentric altruism values to the ecological value. The pro-environmental beliefs, inherent in the religiosity, can augment the normative motive (representing the ecological value) and can make the latter a dominant driver of the PECB. That is, the normative motive (fueled by the ecological value) will be higher for consumers high in religiosity and their concerns for the environment and a higher normative motive will result into a stronger environmental concern-PECB relationship. Thus, this study will use the environmental concern and an interaction between the environmental concern and the religiosity as possible predictors of PECB.

Consumer environmental attitudes and pro-environmental consumer behavior

Numerous studies have linked the consumer environmental attitude to the PECB based on Azjen's (1985) theory of planned behavior (Ertz *et al.*, 2016). Environmental attitude refers to a psychological tendency represented by a favorable or unfavorable evaluation of the natural

environment (Felix and Braunsberger, 2016). Previous research is inconclusive about the direct impact of the environmental attitude on the PECB. There are studies that find the environmental attitude to be a strong predictor of pro-environmental behaviors. For example, Tanner and Wolfing (2003) find that the green behavior resulting from the green attitude in the food context. Other studies find that the environmental attitude predicts environmental behaviors related to political participations, recreational activities, energy conservations and ecological product purchases (Mostafa, 2007). However, some other studies report a low or weak correlation between the environmental attitude and behaviors (Peattie, 2001). This attitude-behavior gap in the environmentalism has enticed scholars to investigate various other factors that can possibly moderate this relationship, such as, habits and lifestyles, convenience, cost and performance (Peattie, 2001).

Based on the consistency theory, Felix and Braunsberger (2016) posit that the religiosity is likely to moderate the environmental attitude-PECB relationship because religious beliefs are generally consistent with the pro-environmental attitudes and thus will amplify the linkage. Using the attitude-behavior-context (ABC) theory (Stern, 2000; Stern *et al.*, 1999), we suggest that the pro-environmental attitude will predict pro-environmental behaviors for consumers high in religiosity. Lewin (1939) contends that a behavior is a product of an interaction between intra-psychic attitudinal variables and contextual factors. Based on the ABC theory, contextual factors, such as, busyness, wealth and power have been found to be moderating the environmental attitude-PECB linkage. In sociology and business literature, the religiosity represents an important contextual factor among others (Felix and Braunsberger, 2016). When pro-environmental attitudes interact with pro-environmental beliefs that are generally promoted by most major religions (Rice, 2006), the combined effect on the pro-environmental behavior

can become stronger. Therefore, in this study the environmental attitude and the interaction between the environmental attitude and religiosity will predict PECB.

In light of the above discussions, this study will use environmental value, knowledge, concern, attitude, and their interactions with religiosity to predict the PECB. The conceptual research model is given in Figure 1.

[Figure 1 about here]

Methodology

Data collection and measures of variables

The survey was conducted in the city of Muscat, the capital of the Sultanate of Oman, a Gulf-Cooperation Council State (GCC). Culturally (the language of Arabic and the religion of Islam) and economically (oil and gas driven), the GCC states are largely homogeneous. The combined population of the GCC states is 51 million with an average per capita GDP of $33,005. The population of Muscat is 838,000, while the country's population is 3.4 million. The pre-dominant religion is Islam: 86 percent Muslims, 7 percent Christians, 6 percent Hindus, and 1 percent other religions. The influences of US consumption habits are very widespread as are evident from the presence of a large number of US retailers, restaurants, and other businesses and the wide-scale use of disposable gadgets and cars for transportations (Carrete *et al.*, 2012). Oman faces its share of environmental challenges, such as, scarcity/pollution of water, air pollution, desertification, irresponsible waste-disposals, and a very little share of environmentally safe products.

A group of 55 fourth-year BBA students from Sultan Qaboos University, the premiere university in the country, were employed for the data collection. Each student distributed 6 questionnaires among respondents from the university community, households, and business establishments in Muscat and later on they picked them up. This drop-off and pick-up method of data collection is common in the GCC region because of the difficulties in getting random samples and contacting respondents. The survey was distributed to 330 respondents who completed and returned 306 usable questionnaires. Data were analyzed using the statistical package for social sciences (SPSS) in all sections of this paper. Out of the 306 respondents, 168 are males and 138 females. The majority, 77.2%, is in the age group of 25 to 35 years and has a graduate level of education, 74.2%. In terms of income, the majority, 54.3%, have a monthly income of less than $2,600. Also, the vast majority, 77.1%, were Omanis. The respondent profiles indicate that they are likely to have the information asked for in the survey. The respondent profiles are presented in Table 1.

[Table 1 about here]

The 5 constructs in this study were measured by 31 items on a 7-point Likert format. The demographics of gender, age, education, income and nationality were assessed by single item scales. The constructs of environmental value (5 items), knowledge (5 items), concern (5 items), attitude (3 items), and behavior (3 items) were adapted from Mostafa (2007), while the religiosity (10 items) construct was adopted from Koenig and Bussing (2010).

Reliability and validity measures

The confirmatory factor analysis was performed to assess the scale properties. The composite reliability (CR) and average variance extracted (AVE) were computed to assess the reliabilities and validities of the constructs. The CR values of all constructs are greater than

0.843, i.e., they all exceeded the recommended threshold of 0.70 (Hair, 2010) indicating that the scales were reliable. The convergent validity was examined using AVE and CR. The CR values are greater than AVE values (0.50), which ensure the convergent validity of all constructs. In addition, discriminant validity (DV) was also examined to understand the extent to which constructs are distinct and uncorrelated. The DV suggests that constructs should relate more strongly to their own factor than to another factor. The values of maximum shared variance (MSV) and average shared variance (ASV) were lower than the values of AVE and the square root of AVEs were greater than inter-construct correlations. The values of CR, AVE, MSV and ASV are reported in Table 2. The results of confirmatory factor analysis were indicative of a good fit: $\chi 2$/df= 1.563; NFI= 0.907; GFI=0.916; IFI= 0.952; AGFI= 0.913; CFI= 0.945; TLI=0.941 and RMSEA = 0.041.

[Table 2 about here]

Multiple Linear Regression

Multiple linear regression (MLR) was used to understand the significant factors that are influencing the pro-environmental consumer behavior. The objective of using MLR is to compare the performance of MLR with the neural network (NN) model and to justify the superiority of the NN model over the MLR model. The results obtained from the MLR are summarized in Table 3. Environmental attitude, environmental knowledge, environmental attitude*religiosity, environmental concern*religiosity are statistically significant at 5% level of significance whereas other factors are not statistically significant.

[Table 3 about here]

Neural network modeling

A neural network model is an advanced data-mining model that works similar to the human brain by analyzing the data for learning purposes. Haykin (2001) defined neural network as a massively parallel distributed processor made up of simple processing units that have a natural propensity to store the experimental knowledge and make it available for use. It is one of the most powerful data-mining tools that can model complex relationships among input and output variables. The knowledge acquired is stored by synaptic weights (Haykin, 2001). The back propagation neural network model was employed to analyze the data using a specialized statistical software SPSS 21.0. This predictive modeling has been employed in the information system studies (Chong *et al.*, 2015; Sharma *et al.*, 2015) in order to capture non-linear relationships and to avoid the oversimplification of complex relationships committed by traditional explanatory statistical techniques. The performance of neural network models has been found superior to traditional linear statistical models, such as, multiple linear regression and structural equations modeling (Chong *et al.*, 2013; Sharma *et al.*, 2015). Furthermore, the neural network model can overcome the mandatory assumptions, such as, linearity, normality, and independence of predictors employed in traditional statistical models (Golmohammadi, 2016). The back propagation neural network is a commonly used model in business research. The back propagation neural network involves three layers, namely, input layers containing predictors, hidden layers containing processing units and output layer containing response variables. Synaptic weights are given to all predictors in input layers and are passed to hidden layers. A neural network output is given by the following nonlinear activation function:

$$y_k = \varphi(\sum w_{kn} v_k) = \varphi(v),$$

where w_{kn} is representing the synaptic weight between the output of neuron *k* and the input of neuron *n.* The function $\varphi(v)$ is a hyperbolic tangent that is a nonlinear activation function (Sharma *et al.*, 2015). In the neural network model, input layers receive data and process results produced by the output layer. Initial weights and biases are assigned random values between 0 and 1. In this research, the inputs are environmental value, knowledge, concern, attitude, value*religiosity, knowledge*religiosity, concern*religiosity, and attitude*religiosity. The output is PECB. This study's neural network model is shown in Figure 2. The neural network algorithms model the process in which the input is mapped against the output. The training process iterates to decrease the estimation errors between the actual and desired output of the network (Chong *et al.*, 2013).

[Figure 2 about here]

Validation of neural networks

The multilayer perceptron training algorithm was employed to train and validate the neural network (Chong *et al.*, 2015). Cross validations of the neural network model were performed to avoid the over-fitting of the model. There is no algorithm available in the literature to determine the number of hidden nodes in the neural network model (Sexton *et al.*, 2002). Therefore, Wang and Elhag (2007) and Sexton *et al.* (2002) proposed to examine a range of 1-10 hidden nodes. Our neural network includes 10 predictors and 1 output variable, which should be complex enough to map the dataset with no added errors to the neural network model.

Root mean squared error (RMSE) is a commonly used accuracy measure of statistical models (Sharma et al. 2015; Sharma et al. 2016 and Liebana-Cabanillas et al. 2017). A 10-fold cross validation process was employed wherein 90% of data (i.e. 275) was used to train the neural

network model, while the rest 10 % (i.e., 31) data was used to measure the accuracy of the neural network model. The RMSE of 10-fold validations are summarized in Table 4. The key objective of the 10 fold validation was to avoid an over fitting in the neural network model. The RMSEs of the training and testing data sets for all ten neural networks were computed and presented in Table 4. The average RMSE for the training model was 0.454 and testing model was 0.413. These results obtained from the neural network were benchmarked with multiple regression analysis. The RMSE of multiple linear regression model was 0.607. We can, therefore, conclude that the performance of our neural network model was better than the regression model.

[Table 4 about here]

The Figure 3 is a scatter plot produced by the neural network model in SPSS, which is similar to the regression scatter plot. This scatter plot is showing the predicted versus the observed data points and provides a very useful information about the fitness of the neural network model. The plot shows that most of the data points are plotted along a straight line at 45 degree, which indicates the appropriateness of the neural network model in this study.

[Figure 3 about here]

Sensitivity analysis

The sensitivity analysis was performed by calculating the average of the importance of predictors to predict PECB using 10 networks (Chong *et al.*, 2015; Sharma et al. 2016). Table 5 demonstrates that all 10 predictors are important for the 10 networks. The results revealed that the most important predictors of PECB are (1) environmental attitude * religiosity, followed by, in order of importance, (2) environmental knowledge, (3) environmental concern * religiosity,

(4) environmental knowledge * religiosity, (5) environmental value , (6) religiosity, (7) environmental attitude, (8) environmental concern, and (9) environmental value * religiosity

Compared to environmental attitude, knowledge, concern and their interactions with religiosity, environmental value and its interaction with religiosity have lower importance in predicting PECB.

[Table 5 about here]

Discussion and conclusion

Research has sought to predict PECB by different variables that are classified into intra-personal/psychic factors and contextual/situational factors (Ertz *et al.*, 2016). The behavioral predictive powers of most intra-psychic variables are still sketchy (Kalamas *et al.*, 2014). Consequently, some research has simultaneously considered different sets of intra-psychic and contextual variables and examined their interactive effects on environmental behaviors (Grimmer *et al.*, 2016; Steg and Vlek, 2009). Our study extends prior research on PECB by examining the salient intra-personal factors and their interactions with religiosity as predictors of PECB in a developing country setting that is predominantly Islamic in its socio-cultural orientation. We also extend prior research on the antecedents-PECB relationships based on causal-explanatory statistical techniques by using the neural network that has a better predictive power.

Our results show that all intra-personal factors and their interactions with religiosity are relevant predictors of PECB. The key finding is that in Islamic countries the degree of religiosity is a key moderating variable in determining PECB. However, the order of importance of these predictors varies according to the results of neural network analysis. Specifically, the most

important predictor of PECB is environmental attitude*religiosity, which supports the theory that attitude is the most immediate and important determinant of the behavior (Fishbein and Ajzen, 1974) and environmental attitude's influence can be augmented by the extent of the religiosity possessed by consumers. Further, this result is consistent with several prior studies that found the environmental attitude to be a strong predictor of pro-environmental behaviors (Tanner and Wolfing, 2003). The finding related to the moderating role of the religiosity is consistent with Felix and Braunsberger's (2016) finding that the religiosity moderated the environmental attitude-PECB linkage among a sample of Catholics in Mexico. The second most important determinant of PECB appears to be the environmental knowledge. This finding is consistent with the finding of Hines *et al.*'s (1987) meta-analysis that the ecological knowledge is significantly correlated to PECB. As per the order of importance, the third most important predictor is the interaction between environmental concern and religiosity. This finding supports the view that because it is consistent with the ecological world view, the religiosity can impart a strong justification for the concern to translate into a behavior (Felix and Braunsberger, 2016). This finding also supports the theory that by promoting the ecological concern, religiosity can provoke the normative motive of acting in consistent with the expectation of the culture and thereby can convert environmental concerns into behaviors (Rice, 2006). This finding is consistent with several prior studies that found environmental concern to be playing an important role in consumers' purchase of certain environmentally friendly products (Barr *et al.*, 2003).

Environmental knowledge*religiosity appears as the fourth most important predictor of PECB. This finding supports the view that by providing the rationality of action, religiosity can augment the importance of PECB and can convert the environmental knowledge into behaviors (Hawthrone and Stanley, 2008). Environmental value, religiosity, environmental attitude,

environmental concern and environmental value*religiosity emerge as the fifth, sixth, seventh, eight, and ninth most important predictors of PECB. Several studies found support for the influence of the environmental value on PECB (Rice, 2006; Stern and Dietz, 1994). The findings also support the contention that by unifying values, moral codes, and beliefs into an integrative whole, religiosity can trigger real behaviors (Schwartz and Bardi, 2001). As mentioned earlier, several extant research found the environmental attitude to be a strong predictor of pro-environmental behaviors (Tanner and Wolfing, 2003). Even though most previous studies found that the environmental concern indirectly influenced PECB, this study's finding shows that the environmental concern can be a direct determinant of PECB. Further, this the first study, as per our literature search that shows that the direct influence of the environmental value on PECB can also be moderated by religiosity.

Theoretical implications

The findings of this study have several theoretical implications. First, this study integrates the environmental value, knowledge, concern, attitude, and intention into a model to predict the PECB and finds support for the predictive abilities of these intra-psychic variables in predicting PECB. Our findings, in a new context, indicate that the predictive power of PECB models can be improved by incorporating environmental knowledge, concern, attitude, and value as direct predictors of PECB. Second, our findings show that it is important to incorporate religiosity in PECB models as a moderator or enhancer of the predictive abilities of the intra-psychic variables. By incorporating the religiosity as a moderator of intra-personal variables, this study contributes to the growing body of literature that explores the important role of religiosity in consumer behavior models, including PECB models (Felix and Braunsberger, 2016). Third, this

study extends the PECB and religiosity research into a context that is predominantly Islamic in its orientation. Finally, this is the first study that applies a predictive analytic approach, i.e., neural network, to examine a predictors-PECB linkages model. The results indicate that an integration of the environmental knowledge, concern, attitude, value, and their interactions with the religiosity can offer a good prediction of the PECB.

Practical implications

This study has several practical implications. First, our results imply that promoters (in public, political, global, corporate and academic spheres) of PECB should try to take a multi-pronged approach in inducing various intra-psychic factors. In order of importance, appropriate steps should be taken to stimulate pro-environmental attitude, enhance environmental knowledge, promote environmental concern, publicize environmental value, and highlight environmental ethics of religiosity. For instance, , environmental attitude, knowledge, concern, and value can be promoted through various means, such as, curriculums of educational institutions; programs and communications in public broadcasting media; pro-environmental promotional activities of businesses; environmental news in popular media; funding research in areas of environmental attitudes, knowledge, concern, and value; enhancing the availability of environmentally friendly products and infrastructure; and increasing the accessibility to the environmentally friendly facilities. More specifically, in Islamic societies, the Friday prayer sermons could be an important and effective vehicle to reach the mass population with faith-based environmental messages (Rice, 2006). Also, in these societies, local religious leaders (Imams), such as, Imams of Mosques could be used as opinion leaders in promoting environmental attitudes, knowledge, concern and values among Muslim masses in Islamic societies. Further, all concerned parties, such as, businesses, public authorities, activists, civil

societies, politicians and international organizations can play important roles. Research shows that the promotional activities and media have substantial influences upon people's development of pro-environmental personal traits (White and Peloza, 2009). Lastly, our findings indicate that combining the religiosity with the environmental movements will be effective in producing the expected PECB. Scholars posit that only a secular approach to achieve the ecological objectives may not be effective (Chishti, 2003). Ecological principles contained in religions should be promoted along with the environmental attitude, knowledge, concern, and value in societies that have strong religious orientations. Concerned stakeholders, such as, government agencies and non-governmental groups should use faith-based messages in their intervention strategies targeted at the grassroots levels. For instance, in ablution places, where Muslims undertake their ritual washings before prayers, posters/sticker can be displayed highlighting faith-based teachings, such as, God loves the ones who doesn't waste water (Abdelzaher *et al.*, 2011). Likewise businesses may be better off using faith-based messages to promote pro-environmental products and services, such as, promotional messages can focus on the faith-based principle that humans are stewards of the natural environment and the consumption of environmentally friendly products will help in fulfilling the stewardship responsibility of man.

Future studies

This study has limitations. For instance, this research was undertaken in the capital city of Muscat in Oman, one of the 60 countries in the world that have Islam as the major religion. To enhance the generalizability, future studies should be conducted in other Muslim countries located in different geographical areas. Also, even though a set of salient intra-personal factors were used as predictors of PECB in this study, there are other possible predictors of the PECB, such as, subjective norm, personal norm, behavioral control, habits, and ascription of

responsibility, which can be included in future predictive models. Further, even though Oman's literacy rate is high, 98%, almost 75% of the respondents have a graduate education, which can limit the generalizability of the findings to the rest of the population of Oman. A more inclusive sample representing different education levels should be used in future studies. Further, although this is the first study to use the neural network to predict PECB with a set of intra-personal variables and their interactions with the religiosity because the neural network is useful for predictive purposes, future studies should also employ a fuzzy-set qualitative comparative analysis (fsQCA) to gain more insights from the possible relationships among decision variables because the fsQCA is gaining popularity among various business research disciplines due to its superiority over the structural equations modeling and the multiple linear regression (Woodside, 2013). Finally, because of the use of the neural network, this study incorporates direct influences of the environmental value, knowledge, concern, and attitude and their interactions with religiosity on the environmental behavior, even though several previous studies connected these intra-physic factors hierarchically. For analyzing the hierarchical models, future studies have to use traditional statistical techniques.

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Figure 1: Research model

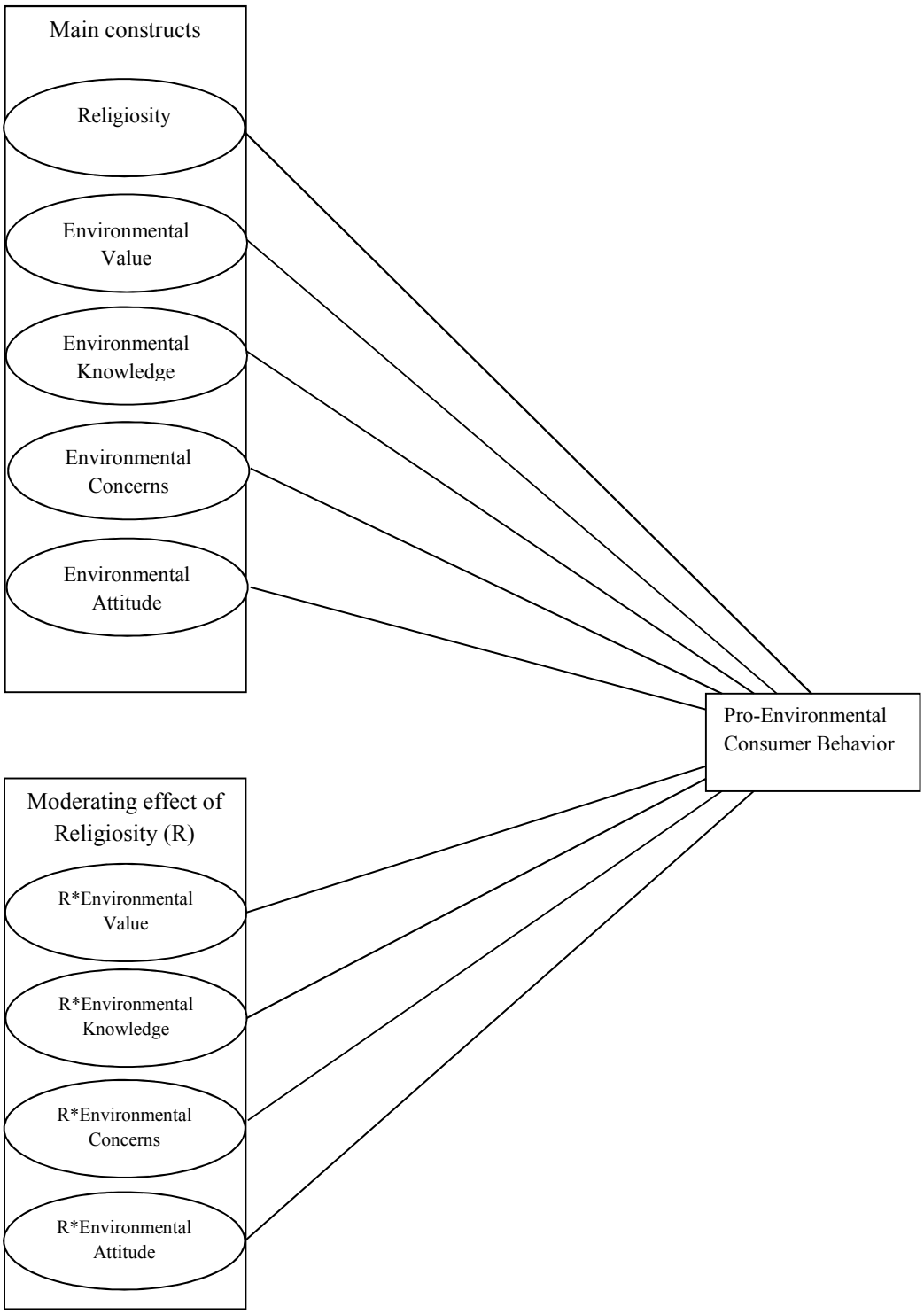
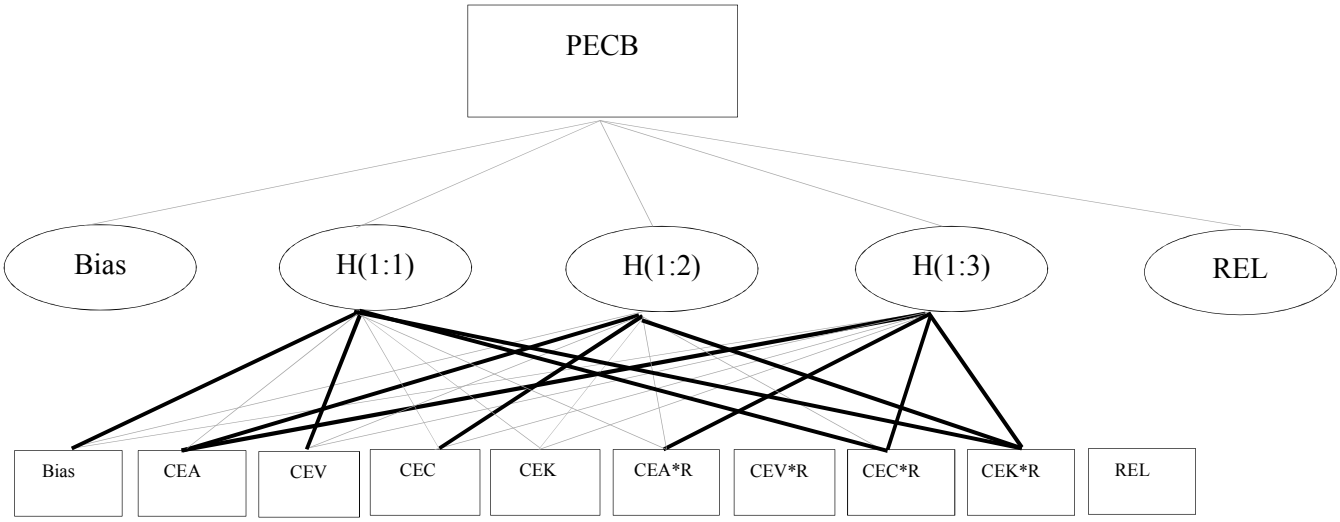


Figure 2: Neural network model



PECB Pro Environmental Consumer Behavior
CEA Consumer Environmental Attitude
CEV Consumer Environmental Value
CEC Consumer Environmental Concerns
CEK Consumer Environmental Knowledge
REL Religiosity

Synaptic Weight > 0
Synaptic Weight < 0

Figure 3: Predicted-by-observed chart

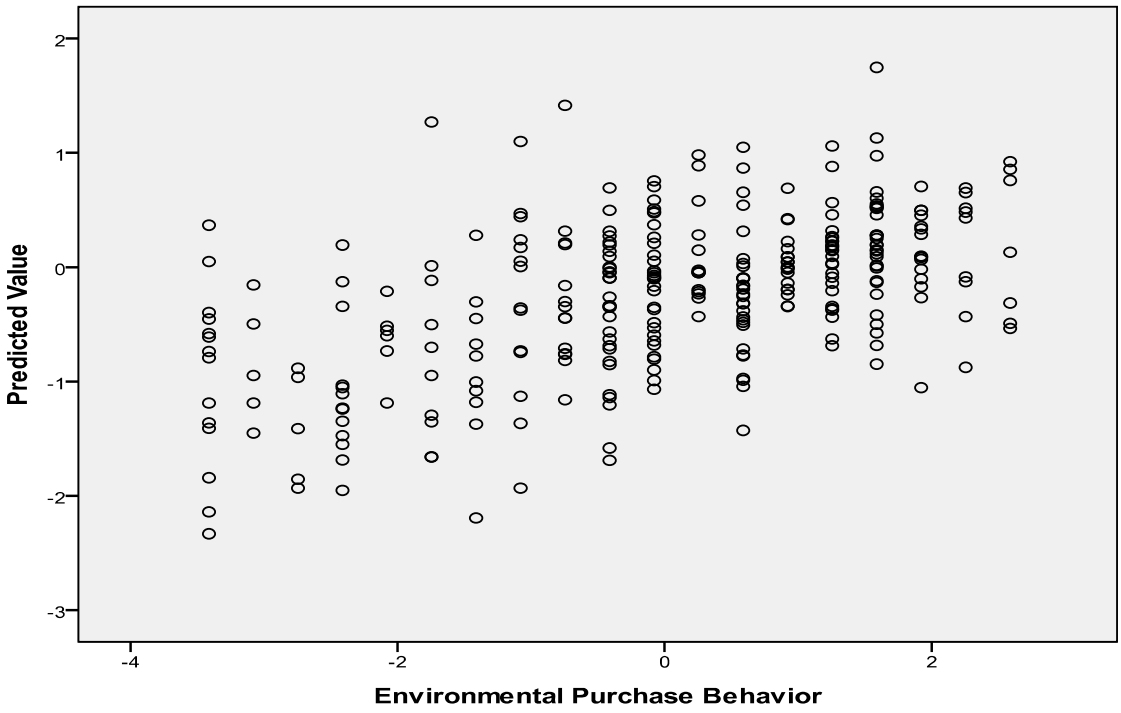


Table 1: Demographic statistics

Demographic Variables	Category	Frequency	Percentage
Gender	Female	138	45.1
	Male	168	54.9
Age	Below 25 years	20	6.5
	Between 25 and 35 years	236	77.2
	Above 35 years	50	16.3
Education	Diploma	33	10.8
	Graduate	227	74.2
	Post Graduate	46	15
Income	Below 1000 OMR	166	54.3
	Between 1000 and 1500	94	30.7
	Between 1500 and 2000	31	10.1
	Above 2000 OMR	15	4.9
Nationality	Omani	236	77.1
	Non-Omani	70	22.9

Table 2: Reliability and validity of constructs

Constructs	CR	AVE	MSV	ASV	PECB	ENV	ENC	ENK	REG	ENA
PECB	0.879	0.707	0.370	0.114	0.841					
ENV	0.804	0.507	0.243	0.095	0.034	0.712				
ENC	0.855	0.542	0.026	0.014	0.157	0.115	0.736			
ENK	0.837	0.508	0.370	0.153	0.608	0.186	0.160	0.713		
REG	0.917	0.527	0.243	0.088	0.026	0.493	-0.052	0.109	0.726	
ENA	0.849	0.653	0.324	0.173	0.415	0.428	0.052	0.569	0.429	0.808

CR: Composite Reliability; AVE: Average Variance Extracted; MSV: Maximum Shared Variance; ASV: Average Shared Variance; REG: Religiosity; ENV: Environmental Value; ENC: Environmental Concern; ENK: Environmental Knowledge; ENA: Environmental Attitude; PECB: Pro-Environmental Consumer Behavior

Table 3: Regression results

Model	Beta Values	Sig.
Constant	-------	0.322
*Religiosity	0.037	0.544
Environmental Attitude	0.209	0.000
Environmental Concern	0.087	0.075
Environmental Knowledge	0.448	0.000
Environmental Value	0.069	0.203
Environmental Attitude*Religiosity	0.175	0.020
Environmental Concern*Religiosity	0.114	0.025
Environmental Knowledge*Religiosity	0.015	0.819
Environmental Value*Religiosity	0.002	0.981

Dependent Variable: PECB

Table 4: NN model's full validation results

Network	Testing	Training
1	0.414	0.438
2	0.406	0.443
3	0.412	0.442
4	0.421	0.471
5	0.428	0.432
6	0.398	0.446
7	0.409	0.478
8	0.424	0.483
9	0.438	0.464
10	0.382	0.442
Mean	0.413	0.454
Standard Deviation	0.0159	0.0183

Table 5: Predictor importance

Predictors	Importance	Normalized Importance (%)
Environmental Attitude * Religiosity	0.273	100
Environmental Knowledge	0.209	76.8
Environmental Concern * Religiosity	0.126	46.3
Environmental Knowledge * Religiosity	0.092	33.6
Environmental Value	0.089	32.7
Religiosity	0.066	24.1
Environmental Attitude	0.054	19.8
Environmental Concern	0.050	18.2
Environmental Value * Religiosity	0.041	15.2

Appendix: Descriptive statistics and other statistical measures

Indicators	Mean	Std. Deviation	Skewness	Kurtosis	Factor loading	Communalities	Cronbach' Alpha
Consumer Environmental Value							
Humans are only part of nature.	5.108	1.6391	-0.592	-0.644	0.783	0.657	
Humans should adapt instead of master the environment.	5.023	1.5543	-0.592	-0.600	0.769	0.616	0.803
Humans should live peacefully on earth in harmony with the cosmos and the environment.	5.742	1.5667	-0.322	0.910	0.792	0.726	
Human's activity that exploit natural and biological resources do endanger the environmental equilibrium.	5.176	1.5728	0.615	-0.541	0.738	0.599	
Consumer Environmental Concern							
The earth does not have plenty of resources that we can develop.	3.255	1.8378	0.414	-0.959	0.799	0.658	
The earth is like a spaceship with only limited room and resources.	3.794	1.9720	0.106	-0.229	0.828	0.704	
The balance of nature is not strong enough to cope with the impacts of modern industrial nations.	4.124	1.8352	0.111	-0.107	0.797	0.654	0.854
The so-called ecological crisis facing humankind has not been greatly exaggerated.	4.042	1.5811	-0.110	-0.636	0.771	0.623	
Human does not have the right to modify the natural environment to suit their needs.	3.696	1.8258	0.177	-0.098	0.760	0.619	
Consumer Environmental Knowledge							
I know that I buy products and packages that are environmentally safe.	4.039	1.7476	0.058	-0.069	0.729	0.599	
I know more about recycling than the average person.	4.471	1.7237	0.451	-0.761	0.799	0.707	
I know how to select products and packages that reduce the amount of waste ending up in landfills.	4.297	1.7424	-0.232	-0.953	0.793	0.684	0.850
I understand the environmental phrases and symbols on product packages.	4.376	1.6494	-0.337	-0.774	0.772	0.623	
I am very knowledgeable about environmental issues.	4.673	1.6249	-0.491	-0.658	0.725	0.643	
Consumer Envirornmenal Attitude							
I like the idea of purchasing green.	5.359	1.6580	0.963	0.076	0.774	0.800	
Purchasing green is a good idea.	5.565	1.6208	-1.190	0.602	0.824	0.799	0.846
I have a favorable attitude toward purchasing a green version of a product.	5.000	1.5806	-0.697	-0.198	0.661	0.700	
Pro-Enviornmental Consumer Behavior							
I buy the products because they are less polluting.	4.373	1.7097	0.355	-0.755	0.903	0.816	
I switch to other brands for ecological reasons.	4.261	1.6547	-.392	-0.639	0.907	0.822	0.878
While shopping I choose products that are environmentally safe	4.601	1.8156	0.535	-0.706	0.880	0.775	

Moderating construct [Religiosity]

Indicators	Mean	Std. Deviation	Skewness	Kurtosis	Factor loading	Communalities	Cronbach' Alpha
My faith involves all of my life.	5.729	1.5111	1.185	0.373	.740	0.552	
In my life, I experience the presence of the Divine (i.e., God).	5.902	1.3944	-1.138	0.695	.770	0.597	
I am religious person and I let religious considerations influence my everyday affairs.	5.719	1.3548	-1.286	0.432	.757	0.573	
Nothing is as important to me as serving God as best as I know how.	5.974	1.2852	1.199	0.139	.742	0.552	0.905
My faith sometimes restricts my actions.	5.608	1.4337	1.176	0.026	.647	0.619	
My religious beliefs are what really lie behind my whole approach to life.	5.556	1.4321	1.060	0.716	.649	0.622	
I try hard to carry my religion over into all my other dealings in life.	5.840	1.2243	-1.142	0.901	.759	0.577	
One should seek God's guidance when making every important decision.	6.098	1.1861	-1.168	0.360	.774	0.601	
Religion is the most important thing in life.	6.255	1.1903	1.030	0.280	.753	0.568	
Religion is important to lead a moral life.	6.278	1.1270	-1.191	0.664	.794	0.630	