



Abstract. *As the impact of climate change is increasingly intense, environmental educators of higher education would like to know the influencing factors for college students to proceed financial strategies, such as flood insurance or energy taxes, to adapt climate change; however, the sustainable environmental education provided by most colleagues still lags far behind the pace of business and government. The research is aimed at eight colleagues in Taiwan and is an undergraduate student taking courses in general environmental education. As diverse courses integrate climate change issues, distributed 1,000 questionnaires were proportionally allocated to each university according to the number of students who had taken the course; a total of 866 questionnaires were recovered. The pro-environmental behavior model be validated, and assess the correlations among risk perception, economic incentives, intrinsic motivation, sacrifice for the environment, place attachment, cheerful emotion, and social norm with partial least squares regression. For college students with high or medium knowledge on climate change, this research demonstrated that if pro-environmental behaviors bring cheerful feeling, they will induce their intrinsic motivation; meanwhile, because of environmental sacrifice and social norms, pro-environmental behaviors will trigger cheerful feeling.*

Keywords: *climate change, knowledge levels, partial least square, place attachment, pro-environmental behavior.*

Shyang-Chyuan Fang
National Penghu University of Science and
Technology, Taiwan



THE PRO-ENVIRONMENTAL BEHAVIOR PATTERNS OF COLLEGE STUDENTS ADAPTING TO CLIMATE CHANGE

Shyang-Chyuan Fang

Introduction

Human demands on the biosphere have surpassed the earth's ability to accommodate them, creating numerous environmental problems. Environmental problems include more waste output, energy consumption, and increased carbon dioxide emissions from the increase in the higher number of circulating transportation (Katircioglu et al., 2014; Wang et al., 2021). Meanwhile, human activities have adversely affected the Earth's ecosystem, and climate change is one of the serious outcomes, posing a major difficulty and challenge in the face of today's global and human civilization and likely causing large floods in specific areas (IPCC 2014). As the impact of climate change is increasingly intense, environmental educators of higher education would like to know the influencing factors for college students to proceed financial strategies, such as flood insurance or energy taxes, to adapt climate change. Sustainability issues facing, environmental education aims to enable everyone to make decisions to locally solve the environmental problems threatening the future (Prothero et al., 2011). Therefore, Roth (1992) proposed the concept of "citizens with environmental literacy" referring to citizens willing and able to make pro-environmental decisions and to engage in behaviors considering both life and environmental quality. Due to the specific geographical and geological factors, Taiwan has a unique regional vulnerability that especially requires the reduction of climate change risks through adaptation strategies. In the past, widespread risk control measures have been mainly used to prevent floods, while the relationship between natural and human systems (Messner & Meyer, 2005) and other risk financial techniques of climate change (flood insurance or energy taxes) have been overlooked.

Perceptions of Climate Change

Typhoons and rainfall rates are expected to increase in the western North Pacific, including Taiwan, due to climate change. As typhoons are the main causes of shallow landslides in Taiwan, landslide activity may increase as climate change continues (Chiang & Chang, 2011). For example, Typhoon Morakot hit Taiwan in 2009, causing heavy rainfall, mudslides, and huge social losses, resulting in nearly 700 deaths and 0.75% of GDP losses (Chien & Kuo, 2011). Therefore, understanding the influencing factors of financial strate-



gies related to climate change, such as the willingness of college students to purchase flood insurance (paying energy taxes), has become a crucial reference for environmental education scholars and the public institutions. The use of pro-environmental behavior models can provide effective empirical data to explore the influencing factors of actions and those interactions. Gifford and Nilsson (2014) listed 18 individual or social factors affecting the pro-environmental behavior; the individual factors included childhood experience, knowledge and education, personality and self-construal, sense of control, values, political and world views, goals, felt responsibility, cognitive biases, place attachment, age, gender and chosen activities, while the social factors included religion, urban-rural gap, norms, social classes, the "not in my backyard" problem, and moral difference. Masud et al. (2015) presented that knowledge and risk perception of climate change positively influence the attitudes toward climate change action and mediated relationship existed between knowledge, risk perception and pro-environmental behavior. Masud et al. (2016) examined the behavioral intention to adapt climate change with Theory of Planned Behavior (TPB) model and found attitudes, subjective norm and perceived behavioral control have positive influences and mediating effects on behavioral intention.

Bubeck et al. (2013) applied Protection Motivation Theory (PMT) to know influence of purchasing flood insurance among flood-prone households with three factors as response efficacy, self-efficacy, and response cost. Hudson et al. (2016) demonstrated that flood insurances could promote adaptation and strengthen the link between flood insurance and financial incentives could guide household adaptation on climate change. Few scholars applied the pro-environmental behavior model to explore the adaptation manner of economic incentives such as flood insurance for higher education students.

Research Problem

Colleges should provide students with the latest knowledge about sustainability related issues; however, the sustainable environmental education provided by most colleagues still lags far behind the pace of business and government (Lozano 2011). However, among college students, the climate change impact is well known and understood; therefore, the proportion of college students who are skeptical about climate change is lower than that in other age groups (Hibberd & Nguyen, 2013). Perera and Hewege (2013) suggested that currently, the population aged 18-25 is the most knowledgeable on climate change but is divided regarding the climate change issue; in terms of the consumer sector, young consumers are the key group for the shift toward sustainable development, and the habits cultivated by young people have a significant impact on the consumption pattern in their adulthoods (Benn 2004; Vermeir & Verbeke 2008). This awareness of sustainable development enables young people to form beliefs about specific consumer behaviors. Schwartz (2012) pointed out that individuals evaluate the outcome of consumption behaviors according to the values they deem important, and the relationship between the outcome assessment and the values can be described through the theory of cognitive dissonance. In terms of attitude and specific behaviors, individuals who experience cognitive dissonance will change attitudes, because changing an attitude is easier than altering a specific behavior. Therefore, developing sustainability values in college students through college education is a very important issue.

Research Focus

A pro-environmental behavior refers to the factors that promote behavioral change in individuals that in turn improves environmental quality, regardless of the intentions and pursuits of these individuals (Steg et al., 2014). For a pro-environmental behavior, the natural environment in which individuals reside effectively shapes their behaviors (Chawla, 2015; Ross & Nisbett, 2011) and has a positive impact on their environmental awareness, happiness, and pro-environmental behavior (Zelenk et al., 2015); in particular, environmental attitudes and knowledge exert different effects on behavior depending on various social and local geographical factors (Braun et al., 2018). After the proposal of the "Kyoto Protocol", approximately 90 universities have included sustainability education in the curriculum and universities are regarded as institutions promoting sustainability activities to the community and implementing sustainability education from the grassroots level (Anderberg et al., 2009). This research integrated place attachment into a pro-environmental behavior model and examined the inter correlation of dominant factors on risk financial strategies; and found that place attachment is a good proxy variable that can replace the behavior or intention of pro-environmental behavior (Halpenny, 2010; Ramkissoon et al., 2013), thereby forming an alternative model for predicting the behavior of climate change strategies.



Incentives for Pro-Environmental Behavior

Intrinsic motivation is an important factor affecting pro-environmental behavior (Van der Werff et al., 2013). Individuals' main motivations in participating in a particular activity begin with behavioral interest and with internal emotional factors that influence behavior, such as satisfaction, a cheerful feeling, or fondness rather than an external pressure or push, for example when buying ecologically packaged products (Schwepker & Cornwell, 1991), energy-saving automobiles (de Groot & Steg, 2010), throwaway products (Ando et al. 2010), or replacing/reducing vehicle use by walking (Abrahamse et al., 2009). Moreover, for pro-environmental behavior, economic incentives are an important factor (Van der Werff et al., 2013). Steg et al. (2014) argued that high costs may lead to pro-environmental behavior becoming unsustainable. Extrinsic motivation can have incentives on individuals (e.g., payment, reward, punishment waive, embarrassment avoidance), and the ultimate behavior-based value or reward drives the individual's tendency to participate. By encouraging pro-environmental behavior, economic incentives or tax relief can be seen as external motivation. Rode et al. (2015) analyzed the economic incentives affecting environmental conservation policies and found that the complexity of different countries' cultural backgrounds poses as an important challenge; with the widespread adoption of economic incentives in each country, the intrinsic motivation seems to be more important. However, regarding emerging payments for environmental services (PES), Vatn (2010) found that the trading cost of environmental conservation facilities is high, in which the buyers are usually public agencies or communities, and the introduction of the concept of payment can strengthen community relations while simplifying environmental protection actions; however, the system also likely discourages personal environmental virtues, leading to environmental degradation. Muradian et al. (2013) assessed PES and found that it can improve environmental governance, but an overreliance on PES as a solution may lead to an ineffective outcome. Gneezy et al. (2011) proposed the impact of economic incentives on carbon dioxide emissions and found that tax incentives affect an individual's behavior of carbon dioxide emissions but exert only a neutral impact on emissions standards.

Davis et al. (2011) proposed an environmental commitment model and showed that environmental commitments positively affect individuals' motivations to make environmental sacrifices, which positively affects environmental ecological behavior. Considering environmental commitments and environmental sacrifices, Rahman and Reynolds (2016) established consumer behavior models to predict individuals' behavioral intentions in selecting green hotels and found the environmental sacrifice motivation was the mediating variable of ecological value and behavioral intention. Macias (2015) argued that environmental knowledge can simultaneously improve individuals' motivations to make environmental sacrifices and environmental risk awareness, that environmental risk awareness can enhance the motivation on environmental sacrifices, and that a generalized trust in society can act as a catalyst for environmental behavior.

A cheerful feeling is also an important factor in the decision to participate in environmentally friendly behavior. Gu et al. (2015) used air pollution as their research target and found that an individual's subjective cheerful feeling is negatively correlated with air pollution level. Fuentes (2014) examined individuals' intentions to buy green products and showed that positive marketing tactics such as joy or achievement can be adopted to prompt consumers to generate the intention to purchase. In this research, the implementation of green education be observed in consumer behavior from the perspective of the individual's purchasing of risk financial products (flood insurance, energy taxes, etc.).

Research Methodology*General Background*

The United Nations encouraged global awareness of environmental protection and investment in environmental action also emphasizes the balance of social, economic, and environmental issues. Taiwan's Ministry of Education has promoted environmental education in schools to better understand the 17 goals of UN Sustainable Development Goals (<https://sdgs.un.org/goals>) to understand major international issues and the context of sustainable development. Liberal arts (general) education courses are divided into science and humanities. At the same time, climate change planning is an appropriate curriculum for environmental education and risk awareness, through which it stimulates students' risk perception and enhances the critical role of effective learning in the context of the changing environment.



Sample

The research is aimed at four comprehensive colleges and four science and technology colleges in Taiwan and is an undergraduate student taking courses in general environmental education. As diverse courses integrate climate change issues, this study provides an eight-hour course on climate change and pro-environmental behavior that gives students an idea of the risks of climate change. For students taking the course, in the sample survey, the college students who participated in the study were completely voluntary and asked to complete the questionnaire.

The survey, conducted between March and October 2020, distributed 1,000 questionnaires proportionally allocated to each university according to the number of students who had taken the course; a total of 866 questionnaires were recovered. Meanwhile, to understand whether knowledge level makes differences in pro-environmental behavior, the score of the questions testing climate-change knowledge was used as a control variable (seven questions; high score: more than 5 correct; medium score: 4 correct; low score: less than 3 correct). In the preliminary analysis, 53.2% of the students interviewed were male, and 46.8% are women. The average age of the sample was 21.55 years (standard deviation was 1.65).

Table 1 lists the demographic characteristics of the sample. A total of 866 valid questionnaires were published and collected for this research. The majority of respondents were 20-22 years of age (66.65%) and female (60.78%). Many people study in the second year (46.05%).

Table 1

Statistics of Research Participants

Variables	Type	Percentage (%)
Age	19 or less	29.51
	20-22	66.65
	23 or older	3.84
Gender	Male	39.22
	Female	60.78
Grade	First-year student	15.45
	Second-year student	46.88
	Third-year student	26.17
	Fourth-year student	12.50
How many courses have you taken are related to climate change?	0-1	34.38
	2-3	46.05
	4-5	14.66
	6-7	2.55
	>7	2.36

Instrument and Procedures

Three experts were invited to review the questionnaire and the constructs of the research. The questionnaire was reviewed in the form of a pre-test and selected 50 students who completed the general environmental education course, including six hours of global climate change content from the previous semester. The pre-test was conducted in two stages through the interview: (1) the participants were asked to fill out a questionnaire and to evaluate the questionnaire item, express any doubts or confusion, and (2) after completing all objects in the questionnaire, the interviewer explains the project to the subjects to ensure that there is no misunderstanding. Subsequently, a pilot study was conducted on 45 college students from the School of Business Administration who completed the general environmental education course, and 45 valid questionnaires were obtained. Select the three metrics that are common to the project, correlation coefficient, discriminating power, and commonality of the items to test the measurement item.

During the validation, questionnaires were provided to 50 participating students. After deleting the incomplete questionnaire, there were 45 valid questionnaires. Refer to the following points when preparing the test questionnaire. (1) After calculating the correlation coefficient matrix for all problems, if there is a problem where



the number of words is similar and the correlation is high (it is found that the correlation coefficient is greater than .9), one of the questions is deleted, or two questions are merged into one. (2) The total scores of all samples in the forecast questionnaire are sorted in descending order by internal consistency. The total score for each 25% interval will be selected to form a high and low evaluation group. The difference between the two groups was identified as a problem, but discrimination was not excluded. (iii) Similar problems below .5 were eliminated through Hair et al. (2010) recommendations.

The above three priorities are used to review all questionnaires to ensure their reliability and effectiveness. At the same time, the determination between the testing of correlation coefficients and discrimination and similarity of the problem has been strengthened. All research questions are measured on seven similar scales (from strong opposition to strong agreement).

This questionnaire also designed three negative-worded items to examine whether the respondents 309 carefully answered the questions, if the respondent inconsistently answered these questions, the questionnaire was deemed invalid and excluded. In addition, questionnaires with more than 10% of regular answers were excluded. Ultimately, 789 valid questionnaires were recovered, with a questionnaire sample validity of 91.1%. Preliminary results show that the overall reliability of the coefficients of Cronbach is .853, .897, .912, .885, .925, .919 and .871, which means that the evaluation is an appropriate measure to study the structure.

Data Analysis

Most research studies proposed formative indicators use the PLS model, and this study used the SmartPLS3.0 software, developed by Ringle et al. (2005), to analyze the measurement model and structural model. Petter et al. (2007) believed that PLS analysis tools are mainly based on the component-based model, while LISREL and AMOS are covariance-based models. The component-based model can widely replace the common covariance-based model and can simultaneously process measurement and structural models. The partial least squares (PLS) is a statistical method for exploring or constructing a linear model, at least one set of independent variables and one set of dependent variables are included for a general model. The general regression analysis equation can only process one dependent variable, and PLS can handle complex array arguments and a set of dependent variables simultaneously. After confirming the research theme, the author first surveyed the literature related to pro-environmental behavior, climate change risk perception, place attachment, social norms, etc., and established a conceptual framework.

Research Results

Measurement Model Analysis

According to the recommendation of Bagozzi and Yi (1988), three most commonly used indicators were chosen (Table 2) to evaluate the measurement models of reflective indicators. The individual item reliability was used to evaluate the statistical significance of the factor loading of the measurement variable on the latent variable. The factor loadings of each of the variables in this research were all greater than the recommended value of .5 and were significant. The factor loadings of all tested samples were in the range of .531 to 1.00. Those high-score groups on the climate-change knowledge were in the range of .217 to 1.000; range of .398 to .999 for the medium-score group; range of .447 to .999 for the low-score group. Two measurement items on intrinsic motivation in the high-score group, one measurement item on intrinsic motivation in the medium-score group, and one measurement item on place attachment in the low-score group did not reach the recommended value by Hair et al. (2010). Cross-group data were used in this research, and in the measurement model portion, items consistent with the samples of each group were needed. Although the reliability indicator of some items was slightly lower, these items were not excluded from the final model.



Table 2*Reliability and Validity Indicators of Research Model for Varied Knowledge Levels*

Latent variables	Indicators	Knowledge level		
		High	Medium	Low
	Count	235	296	258
Intrinsic Motivation	CA	.526	.832	.712
	CR	.591	.900	.836
	AVE	.425	.750	.648
Local Attachment	CA	.844	.667	.806
	CR	.906	.817	.885
	AVE	.764	.627	.723
Cheerful Feeling	CA	.860	.892	.882
	CR	.935	.949	.944
	AVE	.878	.903	.895
Risk Perception	CA	.998	.998	.998
	CR	.998	.997	.999
	AVE	.997	.995	.997
Environmental Sacrifice	CA	.801	.792	.812
	CR	.909	.905	.914
	AVE	.997	.995	.841
Social Norm	CA	.750	.837	.808
	CR	.823	.891	.873
	AVE	.553	.672	.636
Economic Incentives	CA	.989	.895	.806
	CR	.994	.952	.897
	AVE	.989	.914	.857

Note: CA: Cronbach's Alpha; CR: Composite reliability, AVE: Average Variance Extracted
High, Medium and Low present the knowledge level of climate change

The composite reliability (CR) value of the latent variable is the reliability of all measurement items, with a similar meaning as Cronbach's alpha, representing the internal consistency of the construction indices. The high reliability indicates high internal consistency of latent variable. Fornell and Larcker (1981) recommended a value of .6 or higher, and our results showed that the CR values of the high-score group ranged from .591 to .999, .816 to .996 for medium-score group, and .838 to .998 for low-score group. Only the CR value of intrinsic motivation variable of the high-score group was below .6, while those of all the measurement items were above .6, indicating the internal consistency of the research model is good. The Cronbach's alpha coefficients of high-score group ranged from .526 to .998, .665 to .997 for medium-score group, and .716 to .998 for low-score group, and the reliability of the low-score group was greater than threshold value of .7 (Nunnally & Bernstein 1994). This research compared cross-group data in the measurement model, and the consistence with each group was needed; although the reliability indicators of some items were slightly lower, these items were not excluded from the final model.

The sample data of the groups were also consistently reliable in terms of the tests of reliability and validity. In the past, the test on whether the path relations of models of different group samples were significantly different has been mostly performed through the joint t-test suggested by Keil et al. (2000) and Tsang (2002). However, this indicator is susceptible to the effect of sample size. Especially in the case of groups with a large sample size, the path relations tend to be significantly different. To address this issue, we adopted the method recommended by Henseler et al. (2014) and Henseler et al. (2016) in which multi-group data are analyzed using partial least squares (PLS) and the confidence level is lowered to .1 by adopting the $t_{\text{Permutation}}$ value (Table 3). The author used the high-score and the low-score group, as well as the medium-score and the low-score group to examine the path relations of intrinsic motivation → place attachment. The data of two sample sets showed a significant difference, while the data of two sample sets of the medium-score and the low-score group showed a significant difference in the path relation of social norms → place attachment.



Table 3
Multiple Test Indicators for Multiple Groups

Path Relationships	Items	Abs	$t_{\text{Parametric}}$	$t_{\text{Permutation}}$	p_{Henseler}	Shi(1992)
Intrinsic Motivation → Local Attachment	H & M	.067	.613	.615	.539	Nsig
	H & L	.209*	1.872	1.870	.063	Sig*
	M & L	.277**	2.633	2.639	.009	Sig*
Cheerful Feeling → Intrinsic Motivation	H & M	.051	.617	.616	.538	Nsig
	H & L	.086	.932	.939	.349	Nsig
	M & L	.137	1.567	1.554	.121	Sig*
Cheerful Feeling → Local Attachment	H & M	.038	.427	.429	.668	Nsig
	H & L	.067	.781	.776	.439	Nsig
	M & L	.029	.344	.347	.729	Nsig
Risk Perception → Local Attachment	H & M	.074	1.034	.963	.337	Nsig
	H & L	.070	.736	.735	.463	Nsig
	M & L	.005	.066	.064	.949	Nsig
Environmental Sacrifice → Local Attachment	H & M	.019	.202	.206	.837	Nsig
	H & L	.018	.195	.196	.845	Nsig
	M & L	.038	.386	.388	.698	Nsig
Environmental Sacrifice → Cheerful Feeling	H & M	.021	.225	.226	.821	Nsig
	H & L	.058	.575	.577	.564	Nsig
	M & L	.036	.375	.373	.709	Nsig
Social Norm → Local Attachment	H & M	.062	.652	.645	.520	Nsig
	H & L	.145	1.523	1.513	.132	Sig*
	M & L	.206**	2.480	2.483	.014	Sig*
Social Norm → Local Attachment	H & M	.062	.652	.645	.520	Nsig
	H & L	.145	1.523	1.513	.132	Sig*
	M & L	.206**	2.480	2.483	.014	Sig*
Social Norm → Cheerful Feeling	H & M	.021	.217	.222	.824	Nsig
	H & L	.056	.580	.584	.560	Nsig
	M & L	.077	.764	.765	.445	Nsig
Economic Incentive → Local Attachment	H & M	.036	.760	.779	.437	Nsig
	H & L	.034	.480	.494	.622	Nsig
	M & L	.071	1.025	.991	.323	Nsig

Note: Abs: absolute value of difference for path coefficients; *: $p < .1$; **: $p < .05$; H: High Knowledge, M: Medium Knowledge; L: Low Knowledge

Although Hensler et al. (2016) agreed the $t_{\text{Permutation}}$ value can test the difference between grouped data, as the compared numbers increase, the Type I error cannot be avoided. Therefore, the multi-group confidence interval (CI) method of Shi (1992) was also adopted (Table 3). If the path relation of the group was within estimated CI, the group was not significantly different from the compared group. This method can prevent the expansion of the Type I error in multiple comparisons while allowing a fixed confidence level of 5%. The statistical analyses of the test results, together with the judgment based on the $t_{\text{Permutation}}$ value, indicated that two additional path relations, i.e., the path relation of a cheerful feeling \rightarrow intrinsic motivation of medium-score and low-score groups and that of social norms \rightarrow place attachment of high-score and low-score groups were significant.

While performing the PLS analysis in the past, the analysis software did not provide the fitting indicators of the model. To test the overall fit of the structural models (Table 4), we adopted the Goodness-of-Fit (GoF) indicator recommended by Tenenhaus et al. (2005), which is mainly based on minimum partial correlation method to calculate the approximated parameters through the maximum likelihood estimation for structural model analysis. Marcoulides et al. (2009) argued that the use of the GoF indicator alone is inappropriate, and Hair et al. (2014) also performed a series of empirical investigations and showed that the use of the GoF indicator to 387 measure the overall fitting is inappropriate. These researchers recommended that the Standardized Root Mean Square Residual (SRMR) value of the saturation mode should be below .08 and that the RMS theta value should be as low as possible, and they showed these parameters were better than the GoF indicator. While setting the threshold value of the Normed Fit Index (NFI) indicator to .9 is controversial, the principle remains that when the coefficient is greater, the fitting is better. The research therefore listed only the NFI values, while providing other fitting indices for the readers' reference in this research. In summary, the author provided a variety of indicators to assess the fitting of the models based on the threshold values for model fitting recommended by the literature, and the results of this research demonstrated that all indicator values of these four models (overall, high-score, medium score and low score) are all within acceptable ranges.

Table 4
The Fitness Indicators of Saturated and Estimated Models

Items	Overall		High		Medium		Low	
	Sa	Es	Sa	Es	Sa	Es	Sa	Es
SRMR	.072	.076	.082	.092	.060	.097	.063	.103
RMStheta	.232		.250		.231		.233	
d_ULS	.892	.975	1.138	1.457	.624	1.614	.689	1.826
d_G1	.978	.985	1.899	1.949	1.707	1.760	1.546	1.634
d_G2	.450	.456	.614	.652	.449	.491	.464	.535
Chi-Square	2,331	2,347	839	869	881	925	785	858
NFI	.767	.766	.795	.788	.812	.803	.781	.761

Note: Sa : Saturated Model, Es: Estimated Model

After testing the model fitting indicators to prediction effect of the structural model and to compare the difference between the original value and the predicted value, we adopted the blind solution method to evaluate the prediction correlation of the path models (Table 5). All the endogenous variables were analyzed using the blind solution method, and the prediction correlation coefficients of the models (Q^2) were all greater than 0, indicating the models have predictability on endogenous variables. Lastly, to meet prediction correlation requirements, various indicators were used to assess the response of exogenous variables to endogenous variables, and effect values (f^2 and q^2) were calculated, which were then evaluated according to the effect size criteria of Cohen (1988) (low: .02; medium: .15; high: .35). All exogenous variables on the effect values of endogenous variables were low and caused little changes to the predictability, indicating the models established in this research are stable and within the predictable range.



Table 5*The Prediction Indicators of Research Model*

Items	Overall				High				Medium				Low			
	R^2	Q^2	f^2	q^2	R^2	Q^2	f^2	q^2	R^2	Q^2	f^2	q^2	R^2	Q^2	f^2	q^2
IM	.03	.01	.00	.00	.15	.05	.01	.00	.19	.14	.00	.00	.09	.05	.00	.00
LA	.33	.17	.04	.04	.34	.24	.06	.04	.41	.21	.07	.04	.38	.25	.01	.05
CF	.21	.17	.00	.00	.19	.15	.00	.00	.23	.19	.00	.00	.22	.18	.00	.00

Note: IM: Intrinsic Motivation; LA: Local Attachment; CF: Cheerful Feeling

The discriminant validity of the difference is tested by comparing the correlation coefficients of the constructs with the square root of the AVEs. It can be said that the effectiveness of discrimination can be satisfied if the square root of AVEs is greater than the relevant coefficient of the constructs. As noted in table 6, the discriminatory validity effectiveness of the measurements is good.

Table 6*Discriminant Validity and Correlation Coefficient*

	Intrinsic Motivation	Local Attachment	Cheerful Feeling	Risk Perception	Environmental Sacrifice	Social Norm	Economic Incentives
Intrinsic Motivation	0.855						
Local Attachment	0.348	0.842					
Cheerful Feeling	0.318	0.322	0.842				
Risk Perception	0.319	0.333	0.315	0.817			
Environmental Sacrifice	0.305	0.381	0.385	0.335	0.816		
Social Norm	0.324	0.383	0.318	0.351	0.325	0.826	
Economic Incentives	0.433	0.321	0.327	0.324	0.351	0.356	0.833

Notes: All the correlation coefficients are significant at the .001 levels; The diagonal element is the square root of AVE, which should definitely be greater than the diagonal correlation coefficient.

Path Relationships

The PLS manner estimated path relations among different dimensions, and some path values were expressed in normalization coefficient value. Among the nine path relations of the models, six were significant at $\alpha = .05$, of which five reached significance of $\alpha = .01$. For the model depicting the intrinsic influences of social norms, individuals, and the environment, the path coefficients were as follows: social norms \rightarrow place attachment (.133); social norms \rightarrow cheerful feeling (.126). These two path relations were significant and supported by the empirical data. In terms of the individual's intrinsic motivation on the environment, the path coefficients were as follows: cheerful feeling \rightarrow intrinsic motivation (.168); intrinsic motivation \rightarrow place attachment (.056). When the situation of pro-environmental behavior generates a cheerful feeling in individuals, it triggers an intrinsic motivation for pro-environmental behavior, causing this path relation to be significant. As to antecedent effects, such as an individual's environmental sacrifice and risk perception, the path coefficients were as follows: environmental sacrifice \rightarrow cheerful feeling (.390); environmental sacrifice \rightarrow place attachment (.309); and risk perception \rightarrow place attachment (-.017). Among these correlations, the path coefficient for risk perception \rightarrow place attachment was not



significant. To encourage individuals to engage in pro-environmental behavior, the government and manufacturers provide substantial economic incentives; however, in this research, we found the path coefficient of economic incentives → place attachment (-.007) was not significant, i.e., the promoting effect of economic incentives on place attachment was poor. The above path relations were all based on the overall samples (See Figure 1 for details). To understand these path relations in each group based on the score on the general knowledge of climate change, we also plotted the path relations for each of the score groups (Figures 2, 3 and 4).

Figure 1
Path Relations for Overall Subject Samples

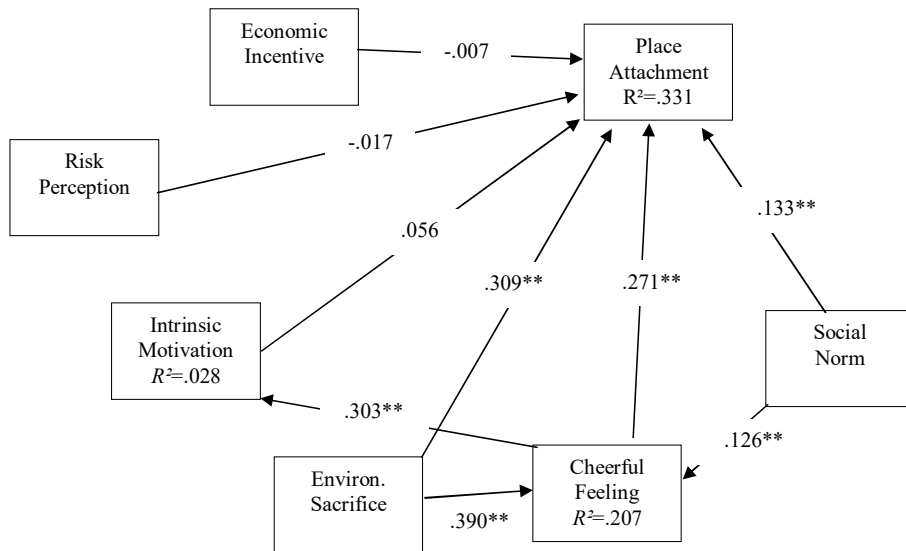


Figure 2
Path Relations for High-level Knowledge Respondents

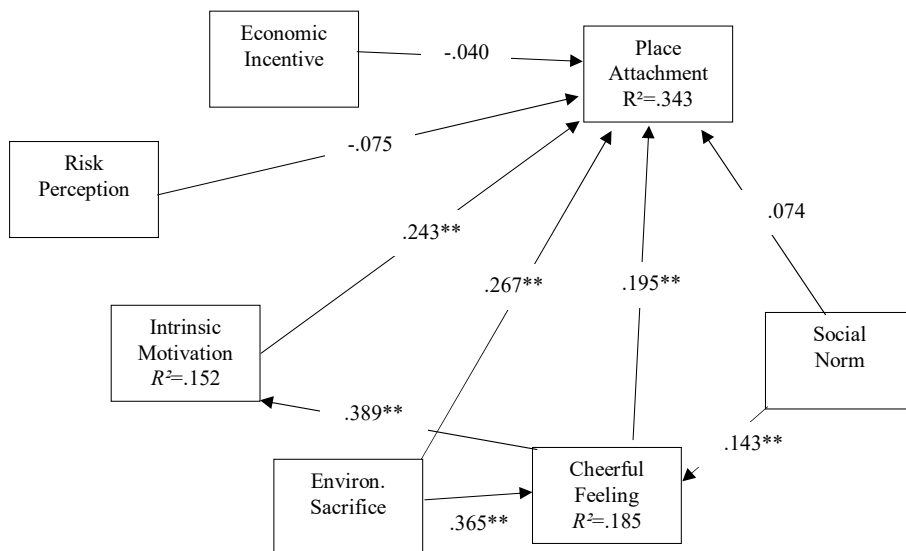


Figure 3
Path Relations for Medium-level Knowledge Respondents

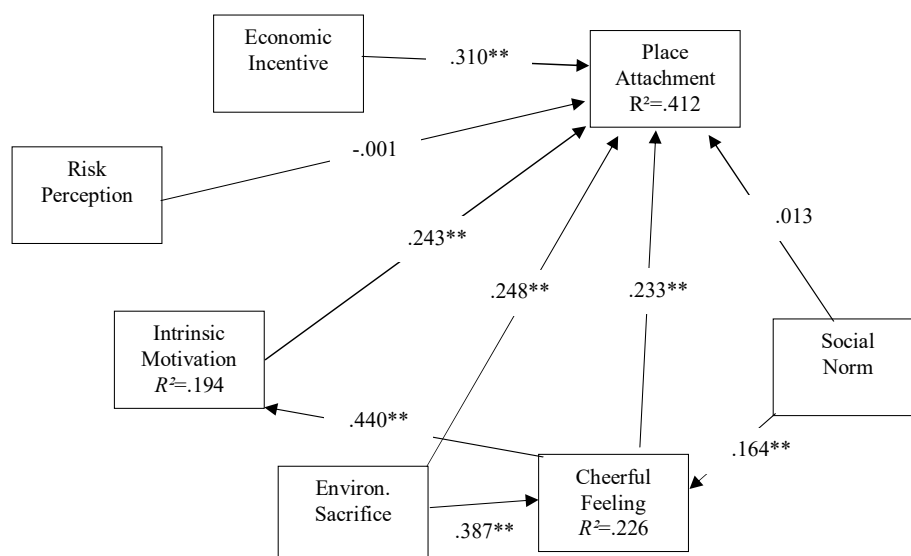
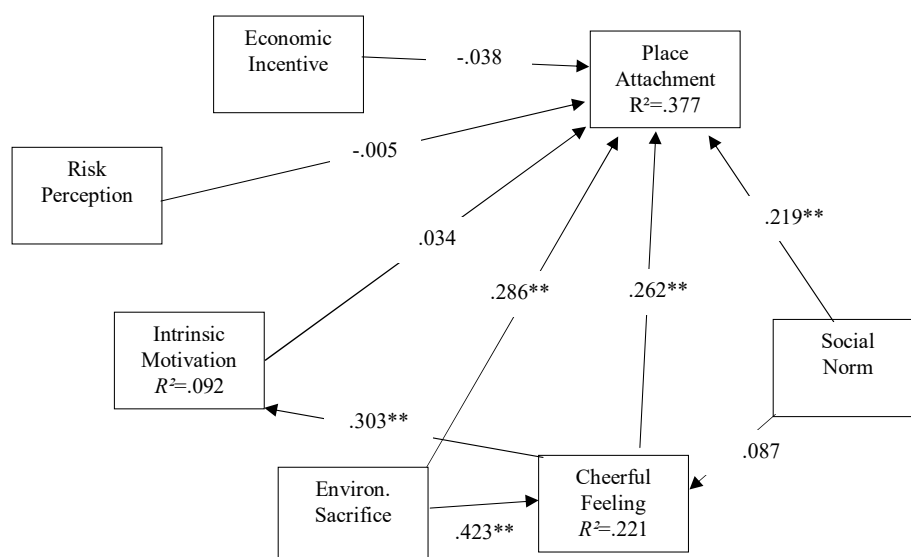


Figure 4
Path Relations for Low-level Knowledge Respondents



When individual is willing to engage in a transaction that seems to be deficient, the individual assesses the final benefits of the transaction and chooses small losses and large gains. The individual is willing to carry partial inconvenience and increase behavior cost for pro-environmental behavior, and this action can avoid harming the environment and continuing to endanger humans and the environment. The effect of environmental knowledge intervention on pro-environmental behavior has been a central issue for green educators. In this research, we divided the subjects into three groups based on their knowledge levels on climate change issues, and the models showed two path relations (intrinsic motivation → place attachment and social norms → cheerful feeling) of high-

score and medium-score groups were significant, and those of low-score group were not significant. Therefore, if the pro-environmental behavior generates a cheerful feeling in individuals of high-score and medium-score groups, it can also induce the intrinsic motivation in these individuals to engage in pro-environmental behavior.

Discussion

The research models established in this research were purported to assess and construct the latent variables of the models, hoping to change or shape an individual's behavior through the intervention of green education so they will lean toward pro-environmental behavior. Human factors are the main cause of global warming (IPCC 2014). The influencing variables of the pro-environmental behavior established in this research included various latent variables such as risk perception, economic incentives, intrinsic motivation, environment sacrifice motivation, cheerful feeling, place attachment, and social norms. In terms of the internal impacts of social norms on individuals and the environment, the paths of social norms → place attachment (.133) and social norms → cheerful feeling (.126) were empirically significant, which is consistent with the conclusions of Steg (2016) and Alló and Loureiro (2014) that the influence of social norms provides actors with behavioral information about other people or groups, affecting the behavioral feedback of the actors' group. When the majority of people are more environmentally friendly than the actors, information from social norms becomes more effective, while in the comparison and feedback process within the group, individuals can obtain information about the environmentally friendly performance of others, thereby gaining a cheerful feeling and more place attachment. In terms of an individual's intrinsic motivation on the environment, the path coefficients were as follows: cheerful feeling → intrinsic motivation (.133); intrinsic motivation → place attachment (.056). These findings are consistent with those of Abrahamse et al. (2009), Ando et al. (2010), and Rode et al. (2015) that many people are naturally motivated to participate in pro-environmental behavior because the beneficial outcomes cause individuals to feel good about themselves, thereby bringing them a cheerful feeling. When the pleasant feeling is in line with the needs and values of the actors, it enables individuals to gain sustained motivation for pro-environmental behavior. In particular, the emotional reactions obtained frequently and immediately after the behavior can stimulate individuals' intrinsic incentives to engage in pro-environmental behavior, which causes an anchoring effect in their environmental behavior choices, so they automatically avoid environmentally harmful behaviors and form a stable source of lasting environmental behavior. In terms of antecedents such as environmental sacrifice or environmental risk perception, the path coefficients were as follows: environmental sacrifice → cheerful feeling (.390) and environmental sacrifice → place attachment (.309). Thus, when environmental sacrifices and environmental objectives are clearly correlated, and if the inconvenience caused by pro-environmental behavior is tolerable, then the participator will have rational reasoning about their behavioral choices and increase their environmental sacrifice motivation, which can improve environmental values and guide the decision on the environmentally friendly place attachment, while enhancing cheerful feelings and place attachment.

To encourage individuals to engage in pro-environmental behavior, the government and manufacturers provide substantial economic incentives, because individuals cannot directly perceive the actual costs and benefits generated through the behavioral choice. Even if individuals have been involved in pro-environmental behaviors, the environmental outcomes derived from particular behaviors are impossible to estimate from an economic perspective, and adequate environmental outcome information and feedback mechanisms are lacking; thus, in this research, the path relation of economic incentives and the attachment to the local environment was not significant. This finding is inconsistent with the results of Gneezy et al. (2011), who recommended that to ensure public acceptability, local subsidies and compensation should be increased for economic incentives, the one-time personal financial compensation for local residents should be changed, and risk financial products should be collectively purchased for locals or local funds should be allocated through special funding so that the energy expenditures of local residents can be reduced.

The influence of environmental education intervention on pro-environmental behavior is an issue of great concern to green educators. Effective knowledge of environmental behavior (the understanding of the benefits or effectiveness of pro-environmental behavior) can predict individuals' environmental behaviors. Based on the findings of Esa (2010) that college students are generally aware of the importance of sustainable development, we divided the respondents into three groups in this research according to scores on climate change knowledge—i.e., the high-score, medium-score, and low-score groups—and effectively showed that respondents with high or medium scores have a positive spillover effect, which increases the likelihood that they will be willing to repeatedly engage



in various pro-environmental behaviors. Meanwhile pro-environmental place attachment generates cheerful feelings in individuals with high or medium scores and stimulates intrinsic motivations for pro-environmental place attachments, which is particularly strengthened after participating in pro-environmental behaviors. Meanwhile, social norms will enhance their participation in pro-environmental behaviors, all of which will generate cheerful feelings, making them believe environmental problems caused by climate change can be mitigated through pro-environmental behavior. The findings of Al-Naqbi and Alshannag (2018), Esa (2010), and He et al. (2011) also support that individuals with a high level of environmental knowledge have a higher level of enthusiasm for environmental concerns, sustainability attitude, and sustainability behavior than those with a low level of environmental knowledge, and the former are more willing to reduce their own carbon dioxide emissions and energy consumption as well as to improve the efficiency of energy use in the production, transportation, and disposal of goods.

Conclusions

The research establishes and verifies a pro-environmental behavior model, and explores the interactions among internal motivations, local dependencies, social norms, risk perceptions, environmental sacrifice, economic incentives, and knowledge, and their impact on pro-environmental behaviors. On the basis of climate change knowledge, this research classifies college students, respondents into three categories: high, medium, and low, and assesses the reliability indicators and the model fitness of three distinct groups. Heterogeneity of the data can emerge due to different features of the models, and it usually occurs due to path relations between different groups. To expand the external validity and ensure the inferential correctness of this research, we grouped the respondents according to knowledge on climate change (high-, medium-, and low-score groups) and adopted multi-indicator evaluation methods ($t_{\text{Permutation}}$, CI, p_{Henseler}) to improve the independent sample t-test on the inference of the models. For college students with high or medium knowledge on climate change, this research demonstrated that if pro-environmental behaviors bring cheerful feeling, they will induce their intrinsic motivation; meanwhile, because of environmental sacrifice and social norms, pro-environmental behaviors will trigger cheerful feeling. In this research, the implementation of green education be observed in consumer behavior from the perspective of the individual's purchasing of risk financial products (flood insurance, energy taxes, etc.) and assessed the impact of intrinsic motivation, external economic incentives, risk perception, and social norms on place attachment to understand the consumer behavior of college students in purchasing risk financial products to sustain place attachment under the influence of climate change. For environmental education educators and policy organizations, improvements of climate change knowledge could raise the intentions of college students to purchase flood insurance and pay energy taxes.

Research Limitations

In measuring the intention of buying green products using the self-evaluation questionnaire, when the same respondent answers all the questions, the common methods bias may occur. In addition to the comprehensive use of the respondent information concealment method, the item meaning concealment method, the design of negative-worded items, and the placement of the behavior-oriented measurement items at the end of the questionnaire, all the variables were subjected to principal component analysis using the methods of Harman (1976) and Sanchez, Korbin and Viscarra (1995). This was done to test whether one factor explains most of the variance and to verify the related post hoc models through the covariate matrix analysis, which can partially reduce the effect of the covariates but cannot completely eliminate the effect, which is a major limitation of this research.

References

- Abrahamse, W., Steg, L., Gifford, R., & Vlek, C. (2009). Factors influencing car use for commuting and the intention to reduce it: A question of self-interest or morality? *Transportation Research Part F: Traffic Psychology and Behaviour*, 12, 317-324. <https://doi.org/10.1016/j.trf.2009.04.004>
- Alló, M., & Loureiro, M. L. (2014). The role of social norms on preferences towards climate change policies: A meta-analysis. *Energy Policy*, 73, 563-574. <https://doi.org/10.1016/j.enpol.2014.04.042>
- Al-Naqbi, A. K., & Alshannag, Q. (2018). The status of education for sustainable development and sustainability knowledge, attitudes, and behaviors of UAE University students. *International Journal of Sustainability in Higher Education*, 19, 566-588. <https://doi.org/10.1108/ijshs-06-2017-0091>



- Anderberg, E., Nordén, B., & Hansson, B. (2009). Global learning for sustainable development in higher education: recent trends and a critique. *International Journal of Sustainability in Higher Education*, 10, 368-378. <https://doi.org/10.1108/14676370910990710>
- Ando, K., Ohnuma, S., Blöbaum, A., Matthies, E., & Sugiura, J. (2010). Determinants of individual and collective pro-environmental behaviors: Comparing Germany and Japan. *Journal of Environmental Sciences (China)*, 38, 21-32. <http://hdl.handle.net/2115/44021>
- Bagozzi, R. P., & Yi, Y. (1988). On the Evaluation for Structural Equation Models. *Journal of the Academy of Marketing Science*, 16, 74-94. <https://doi.org/10.1007/BF02723327>
- Bandura, A. (2007). Impending ecological sustainability through selective moral disengagement. *International Journal of Environment and Sustainable Development*, 2, 8-35. <https://doi.org/10.1504/IJISD.2007.016056>
- Benn, J. (2004). Consumer education between 'consumership' and citizenship: experiences from studies of young people. *International Journal of Consumer Studies*, 28, 108-116. <https://doi.org/10.1111/j.1470-6431.2003.00364.x>
- Bernstein, I. H., & Nunnally J. (1994). *Psychometric theory*. New York, McGraw-Hill.
- Braun, T., Cottrell, R., & Dierkes, P. (2017). Fostering changes in attitude, knowledge and behavior: demographic variation in environmental education effects. *Environmental Education Research*, 24, 899-920. <https://doi.org/10.1080/13504622.2017.1343279>
- Bubeck, P., Botzen, W. J., Kreibich, H., & Aerts, J. C. (2013). Detailed insights into the influence of flood-coping appraisals on mitigation behaviour. *Global Environmental Change*, 23, 1327-1338. <https://doi.org/10.1016/j.gloenvcha.2013.05.009>
- Chawla, L. (2015). Benefits of nature contact for children. *Journal of Planning Literature* 30, 433-452. <https://doi.org/10.1177/0885412215595441>
- Chiang, S. H., & Chang, K. T. (2011). The potential impact of climate change on typhoon-triggered landslides in Taiwan, 2010-2099. *Geomorphology* 133, 143-151. <https://doi.org/10.1016/j.geomorph.2010.12.028>
- Chien, F. C., & Kuo, H. C. (2011). On the extreme rainfall of Typhoon Morakot 2009. *Journal of Geophysical Research-Atmospheres*, 116, D05104. <https://doi.org/10.1029/2010JD015092>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd Ed.). Lawrence Erlbaum Associates.
- Davis, J. L., Le, B., & Coy, A. E. (2011). Building a model of commitment to the natural environment to predict ecological behavior and willingness to sacrifice. *Journal of Environmental Psychology*, 31, 257-265. <https://doi.org/10.1016/j.jenvp.2011.01.004>
- de Groot, J. I. M., & Steg, L. (2010). Relationships between value orientations, self-determined motivational types and pro-environmental behavioural intentions. *Journal of Environmental Psychology*, 30, 368-378. <https://doi.org/10.1016/j.jenvp.2010.04.002>
- Esa, N. (2010). Environmental knowledge, attitude and practices of student teachers. *International Research in Geographical & Environmental Education*, 19, 39-50. <https://doi.org/10.1080/10382040903545534>
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18, 39-50. <https://doi.org/10.1177/002224378101800104>
- Fuentes, C. (2014). Green materialities: Marketing and the socio-material construction of green products. *Business Strategy and the Environment*, 23, 105-116. <https://doi.org/10.1002/bse.1768>
- Gibbs, J. C. (2003). *Moral development and reality: Beyond the Theories of Kohlberg and Hoffman*. Sage.
- Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *Journal of Environmental Psychology*, 49(3), 141-157. <https://doi.org/10.1002/ijop.12034>
- Gneezy, U., Meier, S., & Rey-Biel, P. (2011). When and why incentives (don't) work to modify behavior. *Journal of Economic Perspectives*, 25, 191-210. <https://doi.org/10.1257/jep.25.4.191>
- Grossi, P., Kunreuther, H., & Windeler, D. (2005). An introduction to catastrophe models and insurance. In *Catastrophe modeling: A new approach to managing risk*, 23-42, Springer. https://doi.org/10.1007/0-387-23129-3_2
- Gu, D., Huang, N., Zhang, M., & Wang, F. (2015). Under the dome: Air pollution, wellbeing, and pro-environmental behaviour among Beijing residents. *Journal of Pacific Rim Psychology*, 9, 65-77. <https://doi.org/10.1017/prp.2015.10>
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis: A global perspective* (7th ed.). Macmillan.
- Hair, J. F., Sarstedt, J., Hopkins, M. L., & Kuppelwieser, G. V. (2014). Partial least squares structural equation modeling (PLS-SEM) An emerging tool in business research. *Eurasian Business Review*, 26, 106-121. <https://doi.org/10.1108/EBR-10-2013-0128>
- Hair, J. F., Sarstedt, M., Ringle, C. M., & Mena, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science*, 40, 414-433. <https://doi.org/10.1007/s11747-011-0261-6>
- Halpenny, E. A. (2010). Pro-environmental behaviours and park visitors: The effect of place attachment. *Journal of Environmental Psychology*, 30, 409-421. <https://doi.org/10.1016/j.jenvp.2010.04.006>
- Harman, H. H. (1976). *Modern factor analysis*. University of Chicago Press.
- He, X., Hong, T., Liu, L., & Tiefenbacher, J. (2011). A comparative research of environmental knowledge, attitudes and behaviors among university students in China. *International Research in Geographical & Environmental Education* 20, 91-104. <https://doi.org/10.1080/10382046.2011.564783>
- Henseler, J., Dijkstra, T. K., Sarstedt, M., Ringle, C. M., Diamantopoulos, A., Straub, D. W., & Calantone, R. J. (2014). Common beliefs and reality about PLS: Comments on Rönkkö and Evermann (2013). *Organ Research Methods*, 17, 182-209. <https://doi.org/10.1177/1094428114526928>
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2016). Testing measurement invariance of composites using partial least squares. *International Economic Review*, 33, 405-431. <https://doi.org/10.1108/IMR-09-2014-0304>
- Hibberd, M., & Nguyen, A. (2013). Climate change communications & young people in the Kingdom: a reception research. *International Journal of Media and Cultural Politics*, 9, 27-46. https://doi.org/10.1386/macp.9.1.27_1
- Hudson, P., Botzen, W. W., Feyen, L., & Aerts, J. C. (2016). Incentivising flood risk adaptation through risk-based insurance premiums: Trade-offs between affordability and risk reduction. *Ecological Economics*, 125, 1-13. <https://doi.org/10.1016/j.ecolecon.2016.01.015>



- Hungerford, H. R., & Volk, T. L. (1990). Changing learner behavior through environmental education. *Journal of Environmental Education*, 21, 8-21. <https://doi.org/10.1080/00958964.1990.10753743>
- IPCC Climate Change, (2014). *Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.
- Kagawa, F. (2007). Dissonance in students' perceptions of sustainable development and sustainability: Implications for curriculum change. *International Journal of Sustainability in Higher Education*, 8, 317-338. <https://doi.org/10.1108/14676370710817174>
- Katircioglu, S. T., Feridun, M., & Kilinc, C. (2014). Estimating tourism-induced energy consumption and CO2 emissions: The case of Cyprus. *Renewable and Sustainable Energy Reviews*, 29, 634-640. <https://doi.org/10.1016/j.rser.2013.09.004>
- Keil, M., Tan, B. C., Wei, K. K., Saarinen, T., Tuunainen, V., & Wassenaar, A. (2000). A cross-cultural research on escalation of commitment behavior in software projects. *MIS Quarterly*, 24, 299-325. <https://doi.org/10.2307/3250940>
- Lindell, M. K., & Perry, R. W. (2000). Household adjustment to earthquake hazard: A review of research. *Environment and Behavior*, 32, 461-501. <https://doi.org/10.1177/00139160021972621>
- Lo, A. Y. (2013). The role of social norms in climate adaptation: Mediating risk perception and flood insurance purchase. *Global Environmental Change*, 23, 1249-1257. <https://doi.org/10.1016/j.gloenvcha.2013.07.019>
- Lozano, R. (2011). The state of sustainability reporting in universities. *International Journal of Sustainability in Higher Education*, 12, 67-78. <https://doi.org/10.1108/14676371111098311>
- Macias, T. (2015). Risks, trust, and sacrifice: social structural motivators for environmental change. *Social Science Quarterly*, 96, 1264-1276. <https://doi.org/10.1111/ssqu.12201>
- Marcoulides, G. A., Chin, W. W., & Saunders, C. (2009). A critical look at partial least squares modeling. *MIS Quarterly*, 33, 171-175. <https://doi.org/10.2307/20650283>
- Masud, M. M., Akhtar, R., Afroz, R., Al-Amin, A. Q., & Kari, F.B. (2015). Pro-environmental behavior and public understanding of climate change. *Mitigation and Adaptation Strategies for Global Change*, 20, 591-600. <https://doi.org/10.1007/s11027-013-9509-4>
- Masud, M. M., Al-Amin, A. Q., Junsheng, H., Ahmed, F., Yahaya, S. R., Akhtar, R., & Banna, H. (2016). Climate change issue and theory of planned behaviour: relationship by empirical evidence. *Journal of Cleaner Production*, 113, 613-623. <https://doi.org/10.1016/j.jclepro.2015.11.080>
- Messner, F., & Meyer, V. (2005). Flood damage, vulnerability and risk perception challenges for flood damage research. *UFZ Discussion Paper*, 13/2005, 24 p. <http://hdl.handle.net/10419/45258>
- Miceli, R., Sotgiu, I., & Settanni, M. (2008). Disaster preparedness and perception of flood risk: A research in an Alpine valley in Italy. *Journal of Environmental Psychology*, 28, 164-173. <https://doi.org/10.1016/j.jenvp.2007.10.006>
- Muradian, R., Arsel, M., & Pellegrini, L. (2013). Payments for ecosystem services and the fatal attraction of win-win solutions. *Conservation Letters*, 6, 274-279. <https://doi.org/10.1111/j.1755-263X.2012.00309.x>
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory*, 3rd ed., McGraw-Hill, New York, NY.
- O'Neill, S., & Nicholson-Cole, S. (2009). "Fear won't do it" promoting positive engagement with climate change through visual and iconic representations. *Journal of Science Communication*, 30, 355-379. <https://doi.org/10.1177/1075547008329201>
- Perera, L. C. R., & Hewege, C. R. (2013). Climate change risk perceptions and environmentally conscious behaviour among young environmentalists in Australia. *Young Consumers*, 14, 139-154. <https://doi.org/10.1108/17473611311325546>
- Petter, S., Straub, D., & Rai, A. (2007). Specifying formative constructs in information systems research. *MIS Quarterly*, 31, 623-656. <https://doi.org/10.2307/25148814>
- Pidgeon, N., & Fischhoff, B. (2011). The role of social and decision sciences in communicating uncertain climate risks. *Nature Climate Change*, 1, 35-41. <https://doi.org/10.1038/nclimate1080>
- Prothero, A., Dobscha, S., Freund, J., Kilbourne, W. E., Luchs, M. G., Ozanne, L. K., & Thøgersen, J. (2011). Sustainable Consumption: Opportunities for Consumer Research 708 and Public Policy. *Journal of Public Policy & Market*, 30, 31-38. <https://doi.org/10.1509/jppm.30.1.31>
- Rahman, I., & Reynolds, D. (2016). Predicting green hotel behavioral intentions using a theory of environmental commitment and sacrifice for the environment. *International Journal of Hospitality Management*, 52, 107-116. <https://doi.org/10.1016/j.ijhm.2015.09.007>
- Ramkissoon, H., Weiler, B., & Smith, L. D. G. (2012). Place attachment and pro-environmental behaviour in national parks: the development of a conceptual framework. *Journal of Sustainable Tourism*, 20, 257-276. <https://doi.org/10.1080/09669582.2011.602194>
- Ringle, C. M., Wende, S., & Becker, J. M. (2014). *SmartPLS 3*. Hamburg, Germany: SmartPLS.
- Rode, J., Gómez-Baggethun, E., & Krause, T. (2015). Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. *Ecological Economics*, 117, 270-282. <https://doi.org/10.1016/j.ecolecon.2014.11.019>
- Ross, L., & Nisbett, R. E. (2011). *The person and the situation: Perspectives of social psychology*. Pinter & Martin Publishers.
- Roth, C. E. (1992). *Environmental literacy: It's roots, evolution, and direction in the 1990s*. ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Columbus, Ohio, USA.
- Sanchez, J. I., Korbin, W. P., & Viscarra, D. M. (2017). Corporate support in the aftermath of a natural disaster: effects on employee strains. *The Academy of Management Journal*, 38, 504-521. <https://doi.org/10.5465/256690>
- Schwartz, S. H. (2012). An overview of the Schwartz theory of basic values. *Online readings in Psychology Culture*, 2(1). <https://doi.org/10.9707/2307-0919.1116>
- Schwepker, C. H., & Cornwell, T. B. (1991). An examination of ecologically concerned consumers and their intention to purchase ecologically packaged products. *Journal of Public Policy & Marketing*, 10, 77-101. <https://doi.org/10.1177/074391569101000205>
- Shi, S. G. (1992). Accurate and efficient double-bootstrap confidence limit method. *Computational Statistics and Data Analysis*, 13, 21-32. [https://doi.org/10.1016/0167-9473\(92\)90151-5](https://doi.org/10.1016/0167-9473(92)90151-5)



- Steg, L. (2016). Values, norms, and intrinsic motivation to act proenvironmentally. *Annual Review of Environment and Resources*, 41, 277-292. <https://doi.org/10.1146/annurev-environ-110615-085947>
- Steg, L., Bolderdijk, J. W., Keizer, K., & Perlaviciute, G. (2014). An integrated framework for encouraging pro-environmental behaviour: The role of values, situational factors and goals. *Journal of Environmental Psychology*, 38, 104-115. <https://doi.org/10.1016/j.jenvp.2014.01.002>
- Tenenhaus, M., Vinzi, V. E., Chatelin, Y. M., & Lauro, C. (2005). PLS path modeling. *Computational Statistics and Data Analysis*, 48, 159-205. <https://doi.org/10.1016/j.csda.2004.03.005>
- Thomas, C., & Sharp, V. (2013). Understanding the normalisation of recycling behaviour and its implications for other pro-environmental behaviours: A review of social norms and recycling. *Resources, Conservation & Recycling*, 79, 11-20. <https://doi.org/10.1016/j.resconrec.2013.04.010>
- Tsang, E. W. (2002). Acquiring knowledge by foreign partners from international joint ventures in a transition economy: learning by doing and learning myopia. *Strategic Management Journal*, 23, 835-854. <https://doi.org/10.1002/smj.251>
- Van der Werff, E., Steg, L., & Keizer, K. (2013). It is a moral issue: The relationship between environmental self-identity, obligation-based intrinsic motivation and pro-environmental behaviour. *Global Environmental Change*, 23, 1258-1265. <https://doi.org/10.1016/j.gloenvcha.2013.07.018>
- Vatn, A. (2010). An institutional analysis of payments for environmental services. *Ecological Economics*, 69, 1245-1252. <https://doi.org/10.1016/j.ecolecon.2009.11.018>
- Vermeir, I., & Verbeke, W. (2008). Sustainable food consumption among young adults in Belgium: Theory of planned behaviour and the role of confidence and values. *Ecological Economics*, 64, 542-553. <https://doi.org/10.1016/j.ecolecon.2007.03.007>
- Vicente-Molina, M. A., Fernandez-Sainz, A., & Izagirre-Olaizola, J. (2013). Environmental knowledge and other variables affecting pro-environmental behaviour: comparison of university students from emerging and advanced countries. *Journal of Cleaner Production*, 61, 130-138. <https://doi.org/10.1016/j.jclepro.2013.05.015>
- Wang, J., Wang, S., Wang, H., & Zhang, Z., Ru, X. (2021). Examining when and how perceived sustainability-related climate influences pro-environmental behaviors of tourism destination residents in China. *Journal of Hospitality and Tourism Management*, 48, 357-367. <https://doi.org/10.1016/j.jhtm.2021.07.008>
- Weinstein, N. D., & Nicolich, M. (1993). Correct and incorrect interpretations of correlations between risk perceptions and risk behaviors. *Health Psychology*, 12, 235-245. <https://doi.org/10.1037/0278-6133.12.3.235>
- Zelenski, J. M., Dopko, R. L., & Capaldi, C. A. (2015). Cooperation is in our nature: Nature exposure may promote cooperative and environmentally sustainable behavior. *Journal of Environmental Psychology*, 42, 24-31. <https://doi.org/10.1016/j.jenvp.2015.01.005>
- Zsóka, Á., Szerényi, Z. M., Széchy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production*, 48, 126-138. <https://doi.org/10.1016/j.jclepro.2012.11.030>

Received: August 30, 2021

Accepted: October 02, 2021

Cite as: Fang, S.-C. (2021). The pro-environmental behavior patterns of college students adapting to climate change. *Journal of Baltic Science Education*, 20(5), 700-715. <https://doi.org/10.33225/jbse/21.20.700>

Shyang-Chyuan Fang

PhD, Associate Professor, Department of Tourism and Leisure, National Penghu University of Science and Technology, 300, Liu-Ho Rd., Makung, Penghu 880, Taiwan.

E-mail: chyansf2012@gmail.com

ORCID: <https://orcid.org/0000-0002-8384-0317>