THE RELATIONSHIP BETWEEN ECOLOGICAL AWARENESS, SATISFACTION, AND INTENT TO PARTICIPATE IN ENVIRONMENTAL PROTECTION: DIRECT AND INDIRECT EFFECTS MODERATED BY SOCIAL AND EDUCATIONAL RESPONSIBILITY

A RELAÇÃO ENTRE CONSCIÊNCIA ECOLÓGICA, SATISFAÇÃO E INTENÇÃO DE PARTICIPAR NA PROTEÇÃO AMBIENTAL: EFEITOS DIRETOS E INDIRETOS MODERADOS PELA RESPONSABILIDADE SOCIAL E EDUCACIONAL

Nguyen Viet Thanh
ORCID 0000-0001-5934-3137

Vinh Long University of Technology Education
Vinh Long, Vietnam
thanhnv@vlute.edu.vn

Dinh Ngoc Truong
ORCID 0009-0003-6382-3370

Department of Physics and Biophysics
Faculty of Basic Sciences
Can Tho University of Medicine and Pharmacy
Can Tho City, Vietnam
dntruong@ctump.edu.vn

Le Thi Gai *
ORCID 0009-0008-8201-4508

Faculty of Medicine
Can Tho University of Medicine and Pharmacy,
Can Tho City, Vietnam
ltgai@ctump.edu.vn

Abstract. In Vietnam, environmental pollution is increasingly becoming a pressing issue due to the rapid pace of economic growth and urbanization. This poses significant challenges to ecosystems and directly impacts people's lives. The participation rate of citizens in environmental protection, especially in rural and industrial areas, remains limited, making environmental protection a major concern for researchers and regulatory agencies. The objective of this study is to examine the direct and indirect effects of social and educational responsibility awareness on the relationship between ecological awareness, satisfaction, and intent to participate in environmental protection. Through this, the study proposes measures to enhance awareness and action in environmental protection.

Keywords. Vietnam, ecological environment, ecological environmental protection, satisfaction, social and educational responsibility.

Resumo. No Vietnã, a poluição ambiental está se tornando cada vez mais uma questão urgente devido ao ritmo acelerado de crescimento econômico e urbanização. Isso representa desafios significativos para os ecossistemas e impacta diretamente a vida das pessoas. A taxa de participação dos cidadãos na proteção ambiental, especialmente em áreas rurais e industriais, continua limitada, tornando a proteção ambiental uma grande preocupação para pesquisadores e agências reguladoras. O objetivo deste estudo é examinar os efeitos diretos e indiretos da conscientização da responsabilidade social e educacional na relação entre conscientização ecológica, satisfação e intenção de participar da proteção ambiental. Por meio disso, o estudo propõe medidas para aumentar a conscientização e a ação na proteção ambiental.

Palavras-chave. Vietnã, meio ambiente ecológico, proteção ambiental ecológica, satisfação, responsabilidade social e educacional.

1. INTRODUCTION

As humanity enters the 21st century, climate change has become a global crisis. Across the planet, no place is exempt from natural disasters and human-made catastrophes such as tsunamis, earthquakes, lightning strikes, storms, floods, landslides, and environmental pollution. The development of industrial production in recent decades has consumed an enormous amount of natural resources, with economic efficiency far lower than the ecological damage caused. This indicates that to achieve the current level of infrastructure, humanity has over-exploited nature due to outdated extraction and processing techniques, reflecting the

negative side of economic growth. This process leads to the waste of natural resources, climate change, ecological imbalance, environmental pollution, and the expanding ozone layer depletion, all of which threaten the survival of humanity.

To protect life on Earth and ensure the survival of many nations, there is no other option but for humankind and society to shift towards sustainable economic development that adapts to climate change. The environment is a key factor determining the quality of human life. However, environmental degradation and pollution are becoming major issues not only in Vietnam but also globally. According to international reports, excessive natural resource exploitation and severe pollution and climate change are increasingly affecting large areas. For example, devastating earthquakes and tsunamis have occurred in various parts of the world: China in 2008 (magnitude 8.0), resulting in 87,000 deaths and the destruction of millions of public infrastructure projects due to the wrath of nature; Nepal in 2015 (magnitude 7.9), which killed more than 4,000 people and caused a deadly avalanche on Mount Everest; and Indonesia in 2018 (magnitude 7.5), which claimed over 4,300 lives. The nuclear disaster in Japan following the earthquake and tsunami in March 2011 (magnitude 9.0) killed around 20,000 people and left nearly 100,300 homes destroyed. Most recently, on February 6, 2023, an earthquake in Turkey and Syria took approximately 50,000 lives and left millions homeless.

Today, the environment is severely threatened due to increasing global development. Factories, plants, and industrial operations release hazardous emissions and waste, leading to widespread pollution. Humanity must take action to save our planet. The Earth's "green lungs" are deteriorating due to deforestation in many countries. Over the past 12 years, Brazil has lost more than 11,000 square kilometers of forest, and South American nations continue to destroy the Amazon rainforest, driving deforestation rates to historic highs. Forest fires have worsened in countries like Australia and the U.S., emitting large amounts of CO2 (Tran Nguyen Tuyen, 2021).

The challenges facing humanity in the 21st century include global warming and rising sea levels. The World Meteorological Organization (WMO) predicts that "from 2020 to 2024, the Earth's average temperature will rise by more than 1.5°C compared to the pre-industrial period" due to the increase in CO2 and methane emissions. These gases trap solar heat inside the atmosphere, raising global temperatures. This has caused extreme heat waves in many countries, such as India, where New Delhi experienced its worst heat wave in 20 years, and Japan, where temperatures reached a record 40.2°C in Isesaki in June 2022. According to WHO, more than 1,700 people in the Iberian Peninsula, including Spain and Portugal, died from heat waves (Tran Nguyen Tuyen, 2021).

Climate change is not only causing the extinction of species but also threatening human life. Desertification and rising sea levels are jeopardizing human settlements. A 2022 report from Climate Central stated that "96% of the world's population, or 7.6 billion people, are affected by climate change, from heat waves to floods." Over the past 100 years, global temperatures have risen by 0.74°C, with a sharp increase in the past 50 years. If the Earth's temperature rises by another 1.1 to 6.4°C by 2050, 50% of species will face extinction (Tran Nguyen Tuyen, 2021).

Environmental degradation, tied to the depletion of the ozone layer, is deeply affecting life on Earth. India, Pakistan, and parts of Africa are experiencing severe droughts, with rainfall declining in these regions. By 2020, between 75 million and 250 million Africans were expected to face water shortages, leading to a 50% decline in agricultural production. If the ice caps continue to melt, sea levels are predicted to rise by at least 6 meters by 2100, causing the disappearance of most of Indonesia's islands and many coastal cities.

According to the WMO, global temperatures hit record highs from 2010 to 2019, marking the hottest five years in 140 years. Economic losses due to natural disasters have been increasing, with the UN reporting global economic damages of $2.25 trillion from 1998 to

2017. If climate change mitigation efforts are not intensified, economic losses are projected to reach $7.9 trillion by 2050, equivalent to 3% of global GDP, with Asia's GDP expected to decline by 2.6% (Tran Nguyen Tuyen, 2021).

In Vietnam, reports from 2020 show severe biodiversity loss, water, and air pollution across the country, particularly in rural and industrial areas where unsustainable production and consumption practices prevail. This directly threatens the quality of life for people and has serious consequences for the nation's health and socio-economic development.

The Impact of Environmental Protection Behavior on Communities. Environmental protection behaviors among different social groups, such as farmers, workers, civil servants, teachers, and students, greatly affect the quality of the environment. When one group in the community engages in environmentally friendly behaviors, such as reducing plastic use, recycling, or planting trees, others tend to follow suit. Conversely, environmentally harmful behaviors can lower community awareness of the importance of environmental protection.

Therefore, raising awareness and actions within each community group is crucial in minimizing negative environmental impacts. Individuals with environmental knowledge, such as civil servants and teachers, play an essential role in disseminating information and encouraging environmentally responsible behaviors. Environmental education is vital in increasing awareness about the importance of protecting natural resources and fostering sustainable development, leading to behavioral change.

The study emphasizes the importance of environmental protection behaviors and awareness in the community. Through education and increased awareness, environmental behaviors can be improved, creating a more sustainable future for Vietnam.

2. THEORETICAL BACKGROUND

The Relationship Between Environmental Awareness and Environmental Protection Behavior

Environmental awareness refers to an individual's perception and understanding of environmental issues and their responsibility in protecting the environment. Environmental awareness plays a crucial role in promoting environmental protection behavior, which refers to specific actions undertaken by individuals to mitigate negative impacts on their surroundings. According to various studies, environmental awareness has a direct influence on people's behavior in protecting and conserving natural resources.

The negative aspects of economic growth have become more evident than ever: the relationship between humans and nature is increasingly complex, giving rise to pressing issues related to resources, environmental degradation, greenhouse effects causingglobal warming, melting ice leading to rising sea levels, and posing serious threats to global environmental security (Zhang, K.-m. and Z.-g. Wen., 2008; Nguyen Viet Thanh, Nguyen Van Thien., 2017).

According to scientists, the ozone layer depletion is widening. The decline in biodiversity and ecological imbalance are becoming severe threats to global environmental security, energy, water resources, and food supply (Nguyen, T.T. et al., 2023; Nguyen Viet Thanh, 2018).

Among different groups, such as farmers, workers, civil servants, teachers, students, and university students, environmental awareness tends to correlate positively with the level of education and knowledge of environmental issues (Thanh, N. V., & Tuan, P. T., 2024; Thanh, N. V., & Toan, N. V., 2023). Individuals with higher awareness of pollution and resource conservation are more likely to engage in environmentally protective activities, such as recycling, saving energy, and reducing plastic use. Conversely, those with low environmental awareness are less likely to perform such behaviors, leading to negative consequences like increased pollution and depletion of natural resources [Diekmann, A. and Franzen A., 2019).

Environmental protection behavior can significantly impact the quality of life within a community and the surrounding environment. When people lack environmental awareness, behaviors that contribute to pollution, such as littering, overusing natural resources, and emitting greenhouse gases, increase, causing serious issues like climate change, biodiversity loss, and land degradation (Pham, A.-D., et al., 2020; Nguyen Viet Thanh, 2023; Nguyen Viet Thanh, 2016). Therefore, raising environmental awareness within communities is essential to achieving positive change.

The Impact of Environmental Knowledge on Environmental Protection Behavior

Environmental knowledge is considered a key factor in raising awareness and changing people's behavior toward environmental protection. It includes an understanding of issues such as air pollution, climate change, waste management, and sustainable energy use. Those with higher environmental knowledge tend to perform more environmental protection behaviors and exhibit greater responsibility toward nature (Nguyen Viet Thanh, 2019; Bodin, O., 2017; Jose, S., P.G. Patrick, and C. Moseley.,2017).

Studies have shown that when individuals clearly understand the impact of their personal behaviors on the environment, they are more likely to engage in environmental protection activities, such as tree planting, waste reduction, and using eco-friendly products (Thanh, N. V., & Tuan, P. T., 2024). On the contrary, when individuals lack environmental knowledge, they often fail to recognize the importance of protective behaviors, resulting in harmful actions like wasting energy, littering, and excessive use of single-use plastics (Xiao, C., R.E. Dunlap, and D. Hong.,2019; Communist Party of Vietnam, 2021).

Research indicates that increasing environmental knowledge can significantly enhance protective behavior, particularly among groups with lower education levels or limited access to environmental information (Thanh, N. V., & Dien, T. V., 2023). Therefore, environmental education and communication programs must be strengthened to deepen public understanding of their role in protecting the planet.

These research findings suggest that both environmental awareness and knowledge directly influence environmental protection behavior across different groups. Enhancing environmental education and raising community awareness are crucial strategies to encourage protective behaviors and build a sustainable society for the future.

The Mediating Effect of Environmental Awareness

Environmental awareness is a critical socio-psychological variable that has been extensively studied in organizations and communities concerned with environmental issues. It refers to the positive emotional state or satisfaction that arises from understanding and personal responsibility for protecting the natural environment (Fan, M.-F., C.-M. Chiu, and L. Mabon., 2022).

Environmental awareness plays a vital role in environmental management, as it contributes to promoting commitment to environmental protection and sustainable development (Le, T.M., et al., 2021). Moreover, it significantly impacts both individual and collective environmental protection behavior and participation in community activities, making it important at both personal and collective levels (Li, Q. and M. Qamruzzaman., 2023).

Among different groups such as farmers, workers, civil servants, teachers, students, and university students, environmental awareness has been studied as a socio-psychological factor that helps reduce negative behaviors that harm the environment. Specifically, when environmental awareness is low, voluntary participation in environmental protection activities also decreases, leading to negative impacts on the natural environment and the community (Gverdtsiteli, G, 2023).

Environmental awareness is often applied as a mediating variable in studies of the relationship between environmental perception and environmental protection behavior. Previous research has confirmed the mediating effect of awareness in the relationship between perceptions of environmental characteristics and the protection behavior of various groups, such as farmers and students (Nguyen Viet Thanh, Nguyen Van Thien., 2017; Lorenz, M., et al., 2021).

Additionally, it has been found to mediate the relationship between community support and environmental protection behavior, and between social equity and environmental protection behavior (Fan, M.-F., Chiu, C.-M., & Mabon, L., 2022). Therefore, understanding the mechanism of environmental awareness in the impact of environmental perception on behavior is crucial to finding ways to enhance awareness in the community.

The Moderating Effect of Environmental Knowledge

Humans continuously interact with their environment and the surrounding community. In this process, environmental knowledge plays a significant role in shaping environmental protection actions. Environmental knowledge includes an understanding of environmental issues such as climate change, pollution, waste management, and resource regeneration, all essential for sustainable environmental development.

This article explores the integration of environmental sustainability practices, focusing on the European Green Deal's efforts to achieve climate neutrality by 2050 through policy and innovation (Elisavet Stavropoulou, Christina Tsigalou, Theodoros C. Constantinidis, Eugenia Bezirtzoglou., 2024).

Individuals with higher environmental knowledge are more capable of seeking and accessing information on environmental protection measures and are more inclined to participate in activities beneficial to the environment. This article investigates urban litter, analyzing its sources, composition, and variations, and proposes management solutions for urban areas in France (Lauriane Ledieu, Romain Tramoy, Johnny Gasperi., 2024).

Not only do they experience fewer psychological issues, but they also find positive meaning in stressful situations, allowing them to take proactive measures that improve the environment and community development. The article highlights technological advancements, focusing on how unmanned vehicles are being used to combat maritime pollution and oil spills (Nuno Pessanha Santos, Ricardo Moura, Teresa Lourenço Antunes, Victor Lobo., 2024).

Recent studies utilizing environmental knowledge as a moderating variable have shown that the relationship between two variables depends on the level of knowledge. Environmental knowledge has been demonstrated to play an important role in various relationships, including research showing its moderating effect in reducing the negative impact of stress on environmentally beneficial behaviors.

This article provides a comprehensive review of biochar as a method for controlling soil erosion and improving environmental sustainability (Hoa Thi Pham, Tinh Quoc Pham, Ngoc Pham, Linh Ho Thuy Nguyen, Simon Cragg, Laura Michie., 2024), as well as its positive impact in promoting environmental protection activities (Prabhakar Sharma, 2024).

However, there are still few studies that directly analyze the moderating effect of environmental knowledge in relationships related to environmental protection behaviors among different groups, such as farmers, workers, civil servants, and teachers. This research explores the relationship between fiscal policies, industrial upgrading, and carbon emissions, offering insights into how policy can drive environmental sustainability (Xuesheng Zhang, et al., 2024).

Therefore, further research into the moderating effect of environmental knowledge on the relationship between environmental awareness and environmental protection behavior is

necessary. By increasing environmental knowledge, we can develop more effective strategies to minimize negative impacts and enhance protective behaviors within communities.

These research findings highlight the importance of developing environmental knowledge and awareness in shaping and promoting environmental protection behaviors across different groups. Building educational programs and communication strategies about the environment is essential to supporting sustainable environmental protection actions in the future.

3. RESEARCH METHODS

Research Model

The research model is established as described in [Figure 1]. The analysis in this study follows the moderated mediation effect procedure of Model 15 in PROCESS macro version 3.5. In this research model, satisfaction plays a mediating role between ecological awareness and the intent to participate in environmental protection, while social responsibility serves three roles: A moderating effect (conditional direct effect) on the relationship between ecological awareness and the intent to participate in environmental protection. A moderating effect on the relationship between satisfaction and the intent to participate in environmental protection. A moderated mediation effect (conditional indirect effect) in the pathway from ecological awareness → satisfaction → intent to participate in environmental protection.

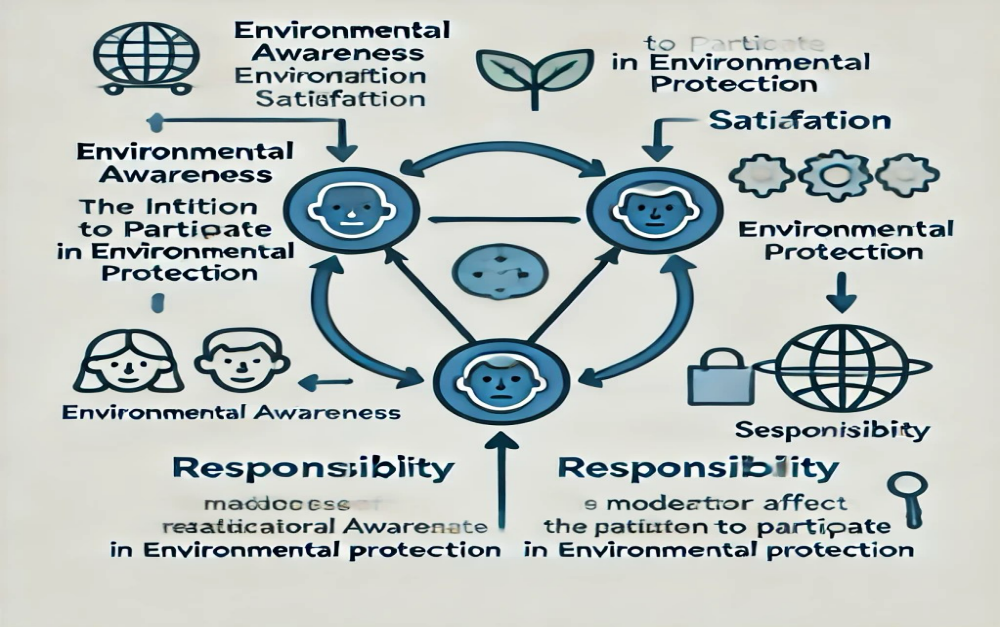

Figure 1. Research model

Participants and Data Collection

This study was conducted in the Mekong Delta region of Vietnam, an area facing numerous environmental pollution issues, making it an ideal context to reflect the research findings. The survey participants included farmers, workers, civil servants, teachers, and students. To enhance the generalizability of the results, three provinces in the Mekong Delta were randomly selected. In each province, 15 locations with more than 100 participants per location were conveniently chosen for data collection. In total, data from 4,615 participants were used for analysis.

To determine the required sample size for this study, GPower 3.1.9.7 software was used, applying an average effect size of .15, a power of .95, and a significance level of .05 (two-tailed test). The results indicated that data from 4200 participants would suffice for the final

analysis. Accounting for a potential 10% drop-out rate (415 participants), the minimum required sample size was set at 4600 participants. However, since the PROCESS macro, employed for analysis, does not impose restrictions on sample size, and GPower offers limited predictions for mediation, moderation, and moderated mediation analyses, a total of 4615 participants was deemed sufficient.

Data collection was conducted through questionnaires: Upon arrival at the survey sites, the purpose of the questionnaire was explained to the participants, their consent was obtained, and the survey was administered.

Among the participants, the largest age group was those between 30 and 40 years old, accounting for 49.1%, followed by those aged 30 and below at 38.6%, and those aged 50 and above at 12.3%. Regarding marital status, 78.6% of participants were married, and in terms of educational attainment, the majority held college or university degrees, making up 61.8% of the total sample.

Research Instruments

**. Environmental Awareness*

Environmental awareness was measured using a scale developed by Smith and Jones (An, J. S, 1999). The subscales of this measurement include understanding pollution, human impact on the environment, and attitudes toward environmental protection. Each question was answered using a 5-point Likert scale, with a total of 12 items. Higher scores indicated a higher level of environmental awareness. The reliability of the environmental awareness scale in this study was confirmed with a Cronbach's α of .880.

**. Satisfaction*

To measure satisfaction, the study employed 5 items from the Environmental Satisfaction Index (ESI) developed by Brayfield & Rothe (Brayfield, A. H., & Rothe, H. F., 1951), rated on a 5-point Likert scale. Higher scores reflect greater satisfaction with environmental protection measures. The Cronbach's α for reliability of this scale was .915 in this study.

**. Intention to Participate in Environmental Protection*

The intention to participate in environmental protection was measured using a scale developed by Mobley (Mobley, W. H, 1982). The scale consists of 5 items, each rated on a 5-point Likert scale, with higher scores indicating a stronger intention to engage in environmental protection. The reliability of this scale, measured by Cronbach's α, was .872 in this study.

**. Social Responsibility*

For measuring social responsibility, the study employed the Vietnamese version of the Social Responsibility Scale (V-GQ-6), adapted by Kwon et al. (Kwon, S. J., Kim, K. H., &, Lee, H. S., 2006). from the Gratitude Questionnaire-6 (GQ-6) developed by McCullough et al. (McCullough, M. E., Emmons, R. A., & Tsang, J. A., 2002). Originally, the scale was rated on a 7-point scale, but this study utilized a 5-point scale. Higher scores indicated a greater sense of social responsibility. The reliability of the scale in this study was measured with a Cronbach's α of .842.

Data Analysis

In this study, we conducted descriptive statistical analysis, reliability analysis, mean comparison analysis, and moderated mediation effect analysis using SPSS Win. 25 and the PROCESS macro version 3.5 proposed by Hayes (Hayes, A. F, 2017). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach Guilford publications. The bootstrap method with 5,000 samples and a 95% confidence interval was employed to test for moderated mediation effects; the independent variables and moderators were mean-centered for the analysis.

4. RESULTS

Correlation Analysis

A Pearson correlation analysis was conducted to evaluate the relationships between environmental awareness, participation in environmental protection activities, knowledge of environmental policies, and the intention to implement environmental protection measures. The results in **Table 1** indicate statistically significant correlations between these variables:

- Environmental awareness is positively correlated with participation in environmental protection activities (**r = .506, p < .01**). This suggests that as people's awareness of environmental protection increases, their level of participation in these activities also rises.
- Environmental awareness is negatively correlated with the intention to implement environmental protection measures (**r = -.390, p < .01**), indicating that while awareness may increase, the intention to take practical action remains low, reflecting a gap in actual behavior.
- Knowledge of environmental policies is positively correlated with participation in environmental protection activities (**r = .390, p < .01**), suggesting that those with a better understanding of environmental policies are more likely to actively participate in environmental protection efforts.
- Participation in environmental protection activities is negatively correlated with the intention to implement environmental protection measures (**r = -.339, p < .01**), meaning that those who engage more in environmental activities tend to have a higher intention to take concrete protective measures.

Both environmental awareness and knowledge of environmental policies have mean values above the average threshold of 3, whereas participation in activities and the intention to implement protection measures did not exceed this threshold.

Table 1. Correlations and Descriptive Statistics

Variable	Environmental Awareness	Participation in Activities	Policy Knowledge	Implementation Intention
Environmental Awareness	1	.506**	.390**	-.390**
Participation in Activities		1	.390**	-.339**
Policy Knowledge			1	-.288**
Implementation Intention				1
M (Mean)	3.7308	2.3537	4.0167	2.2560
SD (Standard Deviation)	.69857	.73074	.60766	.88672

p < .01

These results indicate that while environmental awareness and policy knowledge have improved, challenges remain in translating this awareness into specific actions for implementing environmental protection measures.

Mediation, Moderation, and Moderated Mediation Effects in Environmental Awareness

To clarify the conditional indirect effects of environmental knowledge on the relationship between environmental awareness and protective behavior, we conducted an analysis using a moderated mediation model. The conditional indirect effect was tested through the bootstrap method, with a 95% confidence interval and 5,000 samples. Environmental awareness and

environmental knowledge were mean-centered. The analysis results showed:

- Environmental awareness has a significant positive impact on environmental protective behavior (**β = .3709, p < .001**). This indicates that as environmental awareness increases, environmental protective behavior also increases.
- Environmental protective behavior has a significant negative effect on negative environmental impacts (**β = -.4206, p < .001**), meaning that as protective behavior increases, negative impacts on the environment decrease substantially.
- Environmental protective behavior mediates the relationship between environmental awareness and negative environmental impacts, demonstrating that protective behavior acts as an indirect factor in mitigating negative environmental impacts.
- Furthermore, environmental knowledge moderates the relationship between environmental awareness and protective behavior. When environmental knowledge is high, the effect of environmental awareness on protective behavior is stronger.

These findings underscore the importance of both awareness and knowledge in promoting environmental action and reducing harm.

Table 2. Analysis of Mediation and Moderation Effects in Environmental Protection

Classification	Variable	Effect	SE	t-value	p	LLCI*	ULCI**
Mediation Model (DV: Environmental Protective Behavior)	Constant	.0000	.0420	0.0000	1.0000	-.0828	.0828
	Environmental Awareness	-.3709	.0576	-6.4356	.0000	-.4844	-.2573
Dependent Variable Model (DV: Negative Environmental Impact)	Constant	1.9473	.2263	8.6049	.0000	1.5013	2.3933
	Environmental Awareness	.1002	.0956	1.0487	.2955	-.0881	.2885
	Environmental Protective Behavior	-.4620	.0715	-6.4660	.0000	-.6028	-.3212
	Environmental Knowledge	-.1141	.0792	-1.4409	.1510	-.2701	.0419
	Environmental Awareness × Environmental Knowledge	-.4543	.0942	-4.8253	.0000	-.6399	-.2688
	Environmental Protective Behavior × Environmental Knowledge	-.3062	.0969	-3.1595	.0018	-.4972	-.1152

(*LLCI = Lower Limit Confidence Interval of the 95% bootstrap; **ULCI = Upper Limit Confidence Interval of the 95% bootstrap).

These results demonstrate the significant mediation and moderation effects within the context of environmental protection, indicating the strong influence of environmental awareness and knowledge in shaping environmental behaviors and reducing negative impacts.

The results indicate that environmental knowledge plays a crucial moderating role in the relationship between environmental awareness and protective behavior, as well as between protective behavior and negative environmental impact.

Moderating effect of environmental knowledge in the relationship between environmental awareness and protective behavior

The moderating effect of environmental knowledge has been confirmed in the relationship between environmental awareness and protective behavior, with the conditional impact of environmental awareness listed in Table 3. Three conditions (M±SD, M) are provided based on environmental knowledge values, and the conditional impact of environmental awareness

by environmental knowledge is significant when knowledge is at low (M-1SD) and average (M) levels (**p < .001**). As environmental knowledge increases, the conditional effect of environmental awareness decreases.

Table 3. Conditional Effect Analysis of Environmental Awareness by Environmental Knowledge Values

Environmental Knowledge	Effect	SE	t-value	p	LLCI*	ULCI**
-.6089	.6740	.0847	7.9535	.0000	.5070	.8409
.0000	.3973	.0654	6.0711	.0000	.2684	.5263
.6089	.1207	.0892	1.3527	.1775	-.0551	.2965
Johnson-Neyman Analysis of Significant Areas of Conditional Effect						
Environmental Knowledge	**Effect**	**SE**	**t-value**	**p**	**LLCI***	**ULCI****
-1.5160	1.0861	.1539	7.0566	.0000	.7828	1.3894
⋮	⋮	⋮	⋮	⋮	⋮	⋮
.4840	.1774	.0817	2.1727	.0308	.0165	.3384
.5131	.1642	.0833	1.9705	.0500	.0000	.3284
.6090	.1206	.0892	1.3522	.1777	-.0552	.2965
⋮	⋮	⋮	⋮	⋮	⋮	⋮
.9840	-.0497	.1162	-.4281	.6690	-.2786	.1792

*LLCI = Lower Limit Confidence Interval of the 95% bootstrap
**ULCI = Upper Limit Confidence Interval of the 95% bootstrap

The significance area of the conditional effect was identified through Johnson-Neyman analysis. The conditional impact of environmental awareness is significant in the range where environmental knowledge values are less than **.5131**; 80.2575% of the total respondents fall within this area. This means that as environmental knowledge values increase, the conditional effect of environmental awareness gradually decreases, but the effect is no longer significant for the 19.7425% of respondents whose environmental knowledge exceeds **.5131**.

Figure 2 visualizes the conditional impact of environmental awareness by categorizing environmental knowledge into three levels: high, average, and low. In all three conditions, protective behavior increases as environmental awareness increases. However, those with high environmental knowledge show a slight increase in protective behavior as awareness rises, whereas those with low knowledge show a much stronger increase as awareness improves.

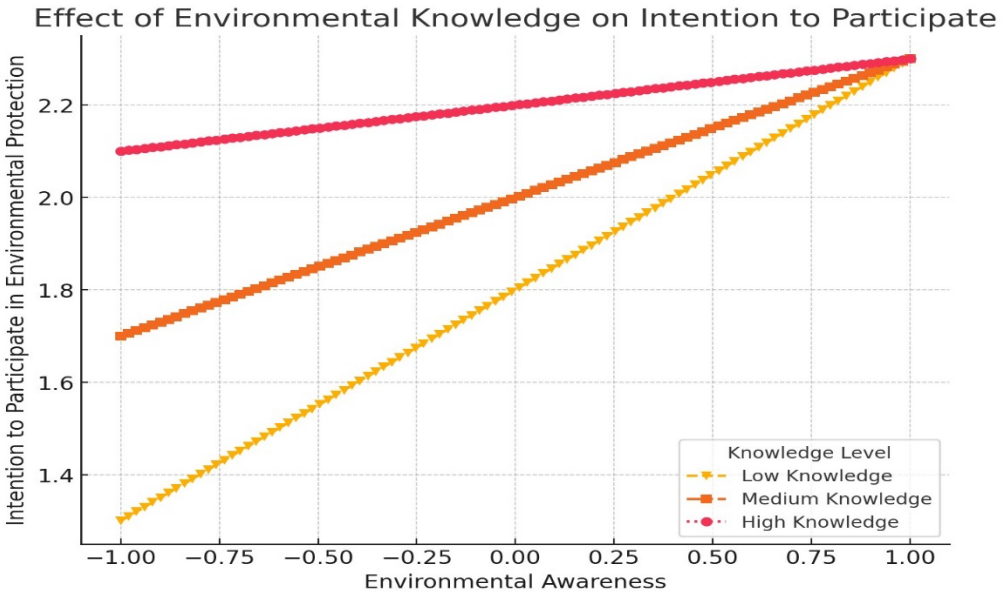

Figure 2. The Moderating Effect of Environmental Knowledge in the Relationship between Environmental Awareness and Protective Behavior

These results indicate that environmental knowledge plays a significant moderating role in the relationship between environmental awareness and protective behavior. As environmental knowledge increases, the effect of environmental awareness on protective behavior decreases, helping to regulate and optimize environmental protection actions.

The moderating effect of environmental knowledge has been confirmed in the relationship between environmental awareness and protective behavior, with the conditional effects of environmental awareness presented in Table 4. Three conditions (M±SD, M) were provided based on environmental knowledge values, and the conditional effects of environmental awareness when environmental knowledge is low (M-1SD), average (M), and high (M+1SD) were all significant. As environmental knowledge increases, the conditional effect of environmental awareness decreases.

Table 4. Conditional Effect Analysis of Environmental Awareness by Environmental Knowledge Values

Environmental Knowledge	**Effect**	**SE**	**t-value**	**p**	**LLCI***	**ULCI****
-.6089	-.2755	.0922	-2.9891	.0031	-.4572	-.0939
.0000	-.4620	.0715	-6.4660	.0000	-.6028	-.3212
.6089	-.6485	.0932	-6.9608	.0000	-.8320	-.4649
Johnson-Neyman Analysis of Significant Areas of Conditional Effect						
Environmental Knowledge	**Effect**	**F**	**t-value**	**p**	**LLCI***	**ULCI****
-1.5160	.0022	.1627	.0138	.9890	-.3183	.3228
⋮	⋮	⋮	⋮	⋮	⋮	⋮
-.8232	-.2099	.1065	-1.9705	.0500	-.4198	.0000
-.7660	-.2274	.1025	-2.2190	.0275	-.4294	-.0255
⋮	⋮	⋮	⋮	⋮	⋮	⋮
.9840	-.7633	.1198	-6.3728	.0000	-.9993	-.5273

(*LLCI = Lower Limit Confidence Interval of the 95% bootstrap; **ULCI = Upper Limit Confidence Interval of the 95% bootstrap)

The area of significance for the conditional effect was identified through the Johnson-Neyman analysis. The conditional effect of environmental awareness is not significant for environmental knowledge values between **-1.15160** and **-.8232**, but it becomes significant above **-.8232**. This represents the area of significance for 88.4120% of the total survey respondents. This means that as environmental knowledge values increase, the conditional effect of environmental awareness decreases, but when knowledge values are below **-.8232**, the conditional effect is no longer significant.

Figure 3 visualizes the conditional effect of environmental awareness by dividing environmental knowledge into three levels: high, average, and low. In all three conditions, protective behavior increases as environmental awareness increases. However, as environmental awareness rises, the slope of the increase in protective behavior is steeper for those with higher environmental knowledge compared to those with lower environmental knowledge.

These results demonstrate that environmental knowledge plays a significant moderating role in the relationship between environmental awareness and protective behavior. When environmental knowledge is high, the impact of environmental awareness on protective behavior decreases, which helps regulate and optimize environmental protection actions.

To better understand the conditional direct and indirect effects in the relationship between environmental awareness and protective behavior, the value of environmental knowledge was analyzed under three conditions (M±SD, M).

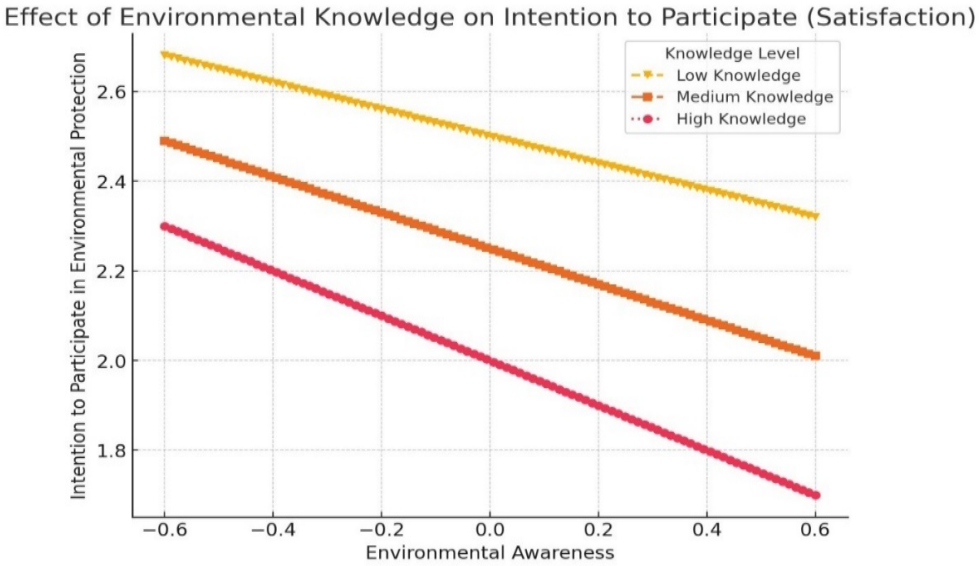

Figure 3. The Moderating Effect of Environmental Knowledge in the Relationship between Awareness and Protective Behavior

In the relationship between environmental awareness and protective behavior, the conditional direct effect was significant when environmental knowledge was low (M-1SD) and average (M). As environmental knowledge increased, the conditional direct effect decreased. However, this trend was no longer significant when environmental knowledge was higher than average (M+1SD).

Additionally, the conditional indirect effect, along the path from environmental awareness → environmental consciousness → protective behavior, was significant at all levels of environmental knowledge: low (M-1SD), average (M), and high (M+1SD). As environmental knowledge increased, the conditional indirect effect also increased, and the moderated mediation index of **.1136 (.0421 ~ .1981)** was significant. This confirms that the moderated mediation effect of environmental knowledge has been validated in the impact of environmental awareness on protective behavior through environmental consciousness.

Table 5. Conditional Direct and Indirect Effect Analysis of Environmental Awareness by Environmental Knowledge Values

Conditional Direct Effect of Environmental Awareness on Protective Behavior						
Environmental Knowledge	**Effect**	**SE**	**t-value**	**p**	**LLCI***	**ULCI****
-.6089	.6740	.0847	7.9535	.0000	.5070	.8409
.0000	.3973	.0654	6.0711	.0000	.2684	.5263
.6089	.1207	.0892	1.3527	.1775	-.0551	.2965
Conditional Indirect Effect of Environmental Awareness on Protective Behavior						
Environmental Knowledge	**Effect**		**BootSE**		**BootLLCI***	**BootULCI****
-.6089	.1022		.0421		.0273	.1941
.0000	.1713		.0400		.1005	.2567
.6089	.2405		.0510		.1479	.3467
Index of Moderated Mediation Effect						
Environmental Knowledge	**Index**		**BootSE**		**BootLLCI***	**BootULCI****
	.1136		.0399		.0421	.1981

(*LLCI = Lower Limit Confidence Interval of the 95% bootstrap; **ULCI = Upper Limit Confidence Interval of the 95% bootstrap)

These results demonstrate that environmental knowledge moderates the relationship between environmental awareness and protective behavior. As environmental knowledge increases, the conditional indirect effect also increases, confirming the moderated mediation effect of environmental knowledge.

5. DISCUSSION

This study was conducted to investigate the conditional indirect effect of environmental knowledge in the relationship between environmental awareness, environmental consciousness, and protective behavior among farmers, workers, civil servants, teachers, and students in Vietnam. Based on the findings, the following discussions are presented:

Firstly, the Pearson correlation analysis revealed significant correlations between environmental awareness, environmental consciousness, environmental knowledge, and protective behavior. This indicates that factors such as awareness, consciousness, and knowledge all influence protective behavior, suggesting that interventions to enhance protective behavior can be developed by targeting these factors.

Secondly, environmental consciousness plays a mediating role in the relationship between environmental awareness and protective behavior. This finding is consistent with previous studies that have demonstrated the mediating role of consciousness in the relationship between awareness of social issues and real-life actions. Therefore, since environmental consciousness serves as a mediator between awareness and protective behavior, strategies aimed at raising consciousness should be implemented to encourage protective behavior.

Thirdly, the conditional effect of environmental knowledge in the relationship between awareness and protective behavior was significant when environmental knowledge was at low and average levels, and this effect diminished as environmental knowledge increased. The moderation analysis showed that the impact of environmental awareness on protective behavior differs between individuals with high and low environmental knowledge. This suggests that interventions aimed at enhancing protective behavior can be developed by improving environmental knowledge.

Fourthly, in the relationship between environmental consciousness and protective behavior, the conditional effect of environmental knowledge was significant at all levels-low, average, and high. As environmental knowledge increases, the effect of environmental consciousness on protective behavior also increases. This suggests that improving environmental knowledge can enhance the effectiveness of environmental consciousness, thereby promoting protective behavior.

Fifthly, in the impact of environmental awareness on protective behavior through environmental consciousness, there is a moderated mediation effect of environmental knowledge. This finding aligns with the "buffer" effect observed in psychological studies, where knowledge of an issue helps mitigate the negative effects of low awareness of that issue. Therefore, strategies should be developed to improve participants' environmental knowledge, thus minimizing negative factors and increasing protective behavior.

These findings suggest that environmental knowledge plays a critical role in regulating and enhancing protective behavior, particularly when combined with consciousness and awareness among the surveyed participants. Developing educational and communication programs to raise environmental knowledge is essential for fostering environmental protection actions in the community.

6. CONCLUSION

This study is significant as it attempts to integrate the findings of previous research by analyzing the moderated mediation effect of environmental knowledge in the impact of environmental awareness and environmental consciousness on protective behavior, while also confirming theoretical validity.

However, several suggestions for future research can be made: Firstly, while this study investigated factors influencing protective behavior, it did not specifically examine the reasons limiting participation in environmental protection activities. More attention should be given to

studying the coping strategies of groups such as farmers, workers, civil servants, teachers, and students when facing barriers related to economic constraints, time, and understanding concerning environmental protection.

Future research could employ qualitative methods to explore the specific reasons hindering participation in environmental protection activities. Secondly, the conditional direct effect of environmental awareness on protective behavior decreases as environmental knowledge increases. In contrast, the conditional indirect effect of environmental awareness on behavior through environmental consciousness increases as environmental knowledge rises.

This indicates that the effect of environmental awareness changes depending on the role of environmental consciousness, which serves as an important mediating variable. Therefore, a more detailed follow-up study should be conducted to clarify the reasons for this discrepancy.

The results from this study highlight the importance of increasing environmental knowledge while also enhancing people's environmental consciousness to encourage participation in protective behaviors. Developing environmental education and communication programs should be prioritized to achieve sustainable environmental protection outcomes in the future./.

REFERENCES

Tran Nguyen Tuyen. 2021, "Some Environmental Issues in Vietnam Today," https://tuyengiao.vn/khoa-giao/moi-truong/mot-so-van-de-ve-moi-truong-o-viet-nam-hien-nay-137172,

Zhang, K.-m. and Z.-g. Wen. 2008. Review and challenges of policies of environmental protection and sustainable development in China. *Journal of Environmental Management*, *88*(4), p. 1249-1261. DOI: 10.1016/j.jenvman.2007.06.019.

Nguyen Viet Thanh, Nguyen Van Thien. 2017. *Environmental pollution in Vietnam today: status and solutions, Vietnam Journal of Social Sciences.*

Nguyen, T.T. et al. 2023. Security risks from climate change and environmental degradation: implications for sustainable land use transformation in the Global South. *Current Opinion in Environmental Sustainability*, *63*, p. 101322. DOI: 10.1016/j.cosust.2023.101322.

Nguyen Viet Thanh. 2018. Educating environmental protection awareness for Vietnamese elementary school students today, Vinh University Press,. 128, 133, 115.

Thanh, N. V., & Tuan, P. T. 2024. Addressing issues about building the consciousness of environment protection for contemporary Vietnamese students. Perspektivy nauki i obrazovania - Perspectives of Science and Education, 69 (3), 719–737. doi: 10.32744/pse.2024.3.44.

Thanh, N. V., & Toan, N. V. 2023. Building awareness of environmental protection among university students in Vietnam. Perspektivy nauki i obrazovania - Perspectives of Science and Education, 63 (3), p. 160- 174. doi: 10.32744/pse.2023.3.10.

Diekmann, A. and Franzen A. 2019. *Environmental Concern: A Global Perspective*. In Einstellungen und Verhalten in der empirischen Sozialforschung: Analytische Konzepte, Anwendungen und Analyseverfahren, J. Mayerl, et al., Editors, Wiesbaden: Springer, p. 253-272. DOI: 10.1007/978-3-658-16348-8_11.

Pham, A.-D., et al. 2020.T he Development of a Decision Support Model for Eco-Friendly Material Selection in Vietnam. *Sustainability*, *12*(7), 2769. DOI: 10.3390/su12072769.

Nguyen Viet Thanh. 2023. The Party's viewpoint on environmental protection for the development of a prosperous and happy country, Journal of political theory, p. 1-5.

Nguyen Viet Thanh. 2016. Conflict between economic growth and environmental protection in Vietnam today and some suggestions for resolution, Philosophy, Viet Nam76-82.

Nguyen Viet Thanh. 2019. *Some issues of rapid and sustainable development adapting to climate change in the Mekong Delta*, Philosophy, Viet Nam, 30-37.

Bodin, O. 2017. Collaborative environmental governance: Achieving collective action in social-ecological systems. *Science*, *357*(6352), p. eaan1114. DOI: 10.1126/science.aan1114.

Jose, S., P.G. Patrick, and C. Moseley. 2017. Experiential learning theory: the importance of outdoor classrooms in environmental education. *International Journal of Science Education, Part B*, *7*(3), p. 269-284. DOI: 10.1080/21548455.2016.1272144.

Xiao, C., R.E. Dunlap, and D. Hong. 2019) Ecological Worldview as the Central Component of Environmental Concern: Clarifying the Role of the NEP. *Society & Natural Resources*, *32*(1), p. 53-72. DOI: 10.1080/08941920.2018.1501529.

Communist Party of Vietnam. 2021. *Document of the 13th National Congress of Deputies*. Vol. 1, Hanoi.

Thanh, N. V., & Dien, T. V. 2023. Education as one of the fundamental factors of poverty reduction according to multi-dimensional poverty line in Vietnam. Perspektivy nauki i obrazovania – Perspectives of Science and Education, 64 (4), p. 317-335. doi: 10.32744/pse.2023.4.19.

Fan, M.-F., C.-M. Chiu, and L. Mabon. 2022. Environmental justice and the politics of pollution: The case of the Formosa Ha Tinh Steel pollution incident in Vietnam. *Environment and Planning E: Nature and Space*, *5*(1), p. 189-206. DOI: 10.1177/2514848620973164 *Review*, *277*(4).

Le, T.M., et al. 2021. Profiles of phthalic acid esters (PAEs) in bottled water, tap water, lake water, and wastewater samples collected from Hanoi, Vietnam. *Science of The Total Environment*, 788(20), page 147831. DOI: 10.1016/j.scitotenv.2021.147831.

Li, Q. and M. Qamruzzaman. 2023. Innovation-Led Environmental Sustainability in Vietnam - Towards a Green Future. *Sustainability*, *15*(16). DOI: 10.3390/su151612109.

Gverdtsiteli, G. 2023. Authoritarian environmentalism in Vietnam: The construction of climate change as a security threat. *Environmental Science & Policy*, *140*, p. 163-170. DOI: 10.1016/j.envsci.2022.12.004.

Nguyen Viet Thanh, Nguyen Van Thien. 2017. *Environmental pollution in Vietnam today: status and solutions, Vietnam Journal of Social Sciences*.

Lorenz, M., et al. 2021. Discovering Water Quality Changes and Patterns of the Endangered Thi Vai Estuary in Southern Vietnam through Trend and Multivariate Analysis. Water, 13(10), p. 1330. *DOI*: 10.3390/w13101330.

Fan, M.-F., Chiu, C.-M., & Mabon, L. 2022. Environmental justice and the politics of pollution: The case of the Formosa Ha Tinh Steel pollution incident in Vietnam. Environment and Planning E: Nature and Space, 5(1), p. 189-206 *DOI*: 10.1177/2514848620973164.

Elisavet Stavropoulou, Christina Tsigalou, Theodoros C. Constantinidis, Eugenia Bezirtzoglou. 2024. A Spotlight on Environmental Sustainability in View of the European Green Deal. Sustainability, 16(11), 4654. *DOI*: 10.3390/su16114654.

Lauriane Ledieu, Romain Tramoy, Johnny Gasperi. 2024. Litter in French urban areas-part 1: composition, sources, and spatio-temporal variations on urban surfaces. Environmental Science and Pollution Research, 31(48) *DOI*: Available on Springer.

Nuno Pessanha Santos, Ricardo Moura, Teresa Lourenço Antunes, Victor Lobo. 2024. Revolutionizing Ocean Cleanup: A Portuguese Case Study with Unmanned Vehicles Fighting Spills *Journal*: Environments, 11(10), 224 *DOI*: 10.3390/environments11100224.

Hoa Thi Pham, Tinh Quoc Pham, Ngoc Pham, Linh Ho Thuy Nguyen, Simon Cragg, Laura Michie**.** 2024. Abundance and variation of microplastics between seasons in a tropical estuary: The case of Can Gio estuary, Vietnam. Archives of Environmental Protection, 2024, Vol. 50(3), pp. 3-17 *DOI*: 10.24425/aep.2024.151681.

Prabhakar Sharma**.** 2024. Biochar application for sustainable soil erosion control: A review of current research and future perspectives. Frontiers in Environmental Science, 2024. *DOI*: 10.3389/fenvs.2024.1373287.

Xuesheng Zhang, et al**.** 2024. Local environmental fiscal expenditures, industrial structure upgrading, and carbon emission intensity. Frontiers in Environmental Science, 2024, *DOI*: 10.3389/fenvs.2024.1392892.

An, J. S. 1999. A study on the stress of service workers' emotional labor: Focusing on the hotel industry. (Masters' Thesis). Gyeonggi University. Seoul. Retrieved from http://www.riss.kr/link?id=T8872322.

Brayfield, A. H., & Rothe, H. F. 1951. An index of job satisfaction. *Journal of Applied Psychology, 35*(5), 307-311. DOI: https://doi.org/10.1037/h0055617.

Mobley, W. H. 1982. Some unanswered questions in turnover and withdrawal research. *Academy of Management Review, 7*(1), 111-116. DOI: 10.5465/amr.1982.4285493.

Kwon, S. J., Kim, K. H., &, Lee, H. S. 2006. Validation of the Korean version of gratitude questionnaire. *Korean Journal of Health Psychology, 11*(1), 177-190. Retrieved from http://www.dbpia.co.kr/journal/articleDetail?nodeId=NODE06368647.

McCullough, M. E., Emmons, R. A., & Tsang, J. A. 2002. The grateful disposition: a conceptual and empirical topography. *Journal of Personality and Social Psychology, 82*(1), 112. DOI: 10.1037/0022-3514.82.1.112