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The Influence of COVID-19 Fear on Generation Z's Environmental Lifestyle Behavior: A Mediation Analysis

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Abstract

The purpose of this study was to examine the direct impact of COVID-19 fear on Generation Z's environmental lifestyle behavior. In addition, the indirect effects of perceived uncertainty about COVID-19 and environmental value on the relationship between COVID-19 fear and environmental lifestyle behavior were investigated. Purposive sampling was employed to recruit 420 Generation Z respondents in Thailand between April and May 2024. The SPSS PROCESS macro (Model 6) was applied to examine both the direct and mediated effects among the study variables.

The results reveal that COVID-19 fear has a slightly positive direct effect on Generation Z consumers' environmental lifestyle behavior. Furthermore, small but positive indirect effects of COVID-19 fear on environmental lifestyle behavior were identified, both through environmental value alone and through the serial mediation of perceived uncertainty about COVID-19 and environmental value. These findings contribute to a deeper understanding of how a global pandemic such as COVID-19 has subtly shaped Generation Z's environmental lifestyle behavior and offer practical implications for policymakers, NGOs, educators, and marketers seeking to promote sustainable lifestyle behaviors among Generation Z consumers.

Keywords: COVID-19, Environmental Behavior, Environmental Value, Fear, Generation Z, Protection Motivation Theory, Sustainability

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1. Introduction

COVID-19 pandemic, a major global pandemic, has resulted in deep impacts on people around the world. From the onset of the pandemic in December 2019, the effects of the crisis are still unfolding. The widespread impacts of COVID-19 can be witnessed across environmental, public health, socioeconomic, psychological and educational areas (Dafermos, 2024).

Evidence suggests that COVID-19 may have a zoonotic source, which makes factors such as global warming and habitat destruction probable to perform a role in this phenomenon (Zebardast & Radaei, 2022). Research findings consistently warn that human-induced influences on nature, such as pollution, habitat destruction, landscape alteration, biodiversity loss, and the introduction of exotic species, can significantly intensify pathogen activity and contribute to the emergence of various diseases that seriously threaten human health (Karesh et al., 2012; Flynn, Bery, & Kaitano, 2013; Rulli, Santini, Hayman, & D'Odorico, 2017).

Drawing on protection motivation theory (Rogers, 1975), the pandemic could have possibly prompted perception of fear towards COVID-19 and perception of uncertainty about COVID-19 as threats, resulting in pro-environmental lifestyle behaviors as coping mechanisms among the public. In other words, the pandemic could have stimulated humans to reexamine the importance of environmental conservation and protection (Mi et al., 2021), in order to mitigate future threats from biologically and environmentally related diseases and pandemics.

This research seeks to investigate how the COVID-19 pandemic has shaped the environmental values and environmental lifestyle behaviors of a particular generation, Generation Z, in the context of a developing country, Thailand. Generation Z, defined as individuals born from 1997 to 2012 (Beresford Research, n.d.), age from 13 to 28 years old in 2025. This generation comprises a significant proportion of the Thai population, accounting for 20% of the total population in 2024 (National Statistical Office Thailand, 2025).

Several key research questions, related to the environmental value and environmental lifestyle behaviors of Generation Z in the COVID-19 context warrants further investigation: 1) Does fear of COVID-19 continue to persist among Generation Z? 2) Do members of Generation Z still experience uncertainty related to COVID-19? 3) What is the level of environmental value and orientations within this age cohort? 4) To what extent do Generation Z engage in environmental lifestyle behaviors? 5) Has fear of COVID-19 had any direct or indirect impact on the environmental lifestyle behaviors of Generation Z? Answering these questions is crucial for policymakers, NGOs, educators, and marketers aiming to develop strategies and campaigns to encourage sustainable practices among Generation Z, as the future stewards of the environment.

Based on the researchers' investigation of existing literature around the topic of COVID-19 and pro-environmental behaviors, some previous studies have explored the effects of COVID-19 on sustainable

consumption behaviors (e.g. Chae, 2021; Severo, De Guimarães, & Dellarmelin, 2021) and on pro-environmental behaviors (e.g. Li, Evensen, & Stedman, 2024; Matiiuk & Liobikiene, 2023; Zuo, Wang, Hong, Chan, Chiu, & Wang, 2024). Nevertheless, further empirical research studies are needed. These studies should investigate the diverse COVID-19 related antecedents on various manifestations of environmental behaviors. It is also important to conduct these studies with different populations in different cultural contexts. This will help to validate the impact of a global pandemic like COVID-19 on consumers' environmental behaviors. This research study is still one of the few that examines the impact of an unforeseen global crisis on individuals' pro-environmental behaviors (Zebardast & Radaei, 2022), and addresses the call for studies examining the impacts of COVID-19 within a non-Western setting (Hamdy & Zhang, 2025). Moreover, studies focusing on generation Z's intention to practice sustainable behaviors are still limited (Salinero, Prayag, Gómez-Rico, & Molina-Collado, 2022; Seabra, Dolnicar, Abrantes, & Kastenholz, 2013). Recent literature has shown that no direct relationship exists between fear of COVID-19 and sustainable consumption behavior in Pakistan (Batool, Shabbir, Abrar, & Bilal, 2023). In addition, a positive relationship between consumers' environmental values, specifically egoistic and social-altruistic values, and environmental lifestyle behavior has been established within the context of the general population in Thailand (Alisa Sony & Ferguson, 2024). Nevertheless, the current study goes beyond testing established findings within a different geographical and generational context, using a different timeframe.

A knowledge gap is still present in understanding the collective influence of COVID-19 fear, perceived uncertainty about COVID-19, and environmental value on the environmental lifestyle behavior of Generation Z, specifically within Thailand. The main contribution of the current study is in revealing the interconnectedness mechanism of these factors, specifically the mediating roles of perceived uncertainty about COVID-19 and environmental value, in activating the environmental lifestyle behavior of Generation Z within the specific context of Thailand. Moreover, the current study, conducted from April to May 2024, also contributes to an understanding of Generation Z's environmental value orientations and environmental lifestyle behaviors in the continuing COVID-19 era, which still shapes daily life albeit with varying intensity. Insights from the current research revealing the drivers of Generation Z's environmental lifestyle behavior can be leveraged by stakeholders to design effective environmental policies, education programs, and marketing campaigns that promote sustainable production and consumption, aligning with United Nation's Sustainable Development Goal 12 (SDG 12: Responsible Consumption and Production) (United Nations, n.d.).

2. Literature Review and Hypotheses Development

2.1 Protection Motivation Theory

Protection Motivation Theory (PMT) (Rogers, 1975), was initially formed to explain how individuals engage in protective behaviors in response to health threats in preventive medicine. Over time, it has been adopted widely in social psychology to understand how individuals respond to various types of threats (Wu, 2020). According to PMT, the motivation to protect oneself arises from two key cognitive processes: threat appraisal and coping appraisal.

Threat appraisal refers to how individuals assess the risks and negative consequences associated with a threat or unsafe behavior, and it comprises of two components: perceived severity and perceived vulnerability (Wu, 2020). Coping appraisal is related to how individuals evaluate their ability to manage the threat and includes three factors: (1) self-efficacy, (2) response efficacy, and (3) response cost (Li, He, Xu, Ash, Anwar, & Yuan, 2019).

It is expected that in the COVID-19 era, Generation Z consumers' health threat appraisals and environmental threat appraisals would stimulate their protection motivation, manifested through pro-environmental lifestyle behaviors, as individuals seek to mitigate both health and environmental threats. In this study, health threat appraisals are represented by 'COVID-19 fear' and 'perception of uncertainty about COVID-19'. Environmental threat appraisal is captured by the 'environmental value' construct, which reflects consumers' concern about threats to the environment. Protection motivation is then reflected through the 'environmental lifestyle behavior' construct.

The hypothesized serial mediation pathways (Figure 1) in this study explore how the initial health threat appraisal, 'COVID-19 fear', can sequentially influence 'perception of uncertainty about COVID-19' and subsequently 'environmental value,' which together contribute to 'environmental lifestyle behavior' (Protection Motivation Outcome).

2.2 COVID-19 Fear

Fear is defined as “a negatively-valenced emotion, accompanied by a high level of arousal and is elicited by a threat that is perceived to be significant and personally relevant” (Witte, 1992). In the context of the COVID-19, fear refers to an emotional response in which individuals experience psychological distress due to the perceived negative consequences of possibly being infected with the virus (Dwivedi, Pandey, Vashisht, Pandey, & Kumar, 2022). This fear concerning the possibility of being infected with COVID-19 is strongly linked to increased anxiety and stress (Ahorsu, Lin, Imani, Saffari, Griffiths, & Pakpour, 2020).

‘Fear Appeal’ theories explain how fear can persuade people to adopt specific behaviors as a response to perceived threats (Witte & Allen, 2000). Previous studies have investigated the connection

between COVID-19-related fears and pro-environmental attitudes and behaviors, generally finding the relationships positive. For instance, fear of the pandemic has led to more favorable attitudes towards companies that adopt sustainable practices (Gössling, Scott, & Hall, 2020; Jian, Yu, Yang, & Zeng, 2020). In addition, fears have been shown to enhance consumers' intentions to engage in pro-environmental behaviors, such as choosing environmentally conscious hotels (Jian et al., 2020). Moreover, a significant positive indirect effect of fear upon sustainable consumption behavior has been identified, being mediated by religiosity for example (Batool et al., 2023).

2.3 Uncertainty about COVID-19

Paek and Hove (2020) explain the perception of uncertainty connected to COVID-19 as a rational cognitive response to the outbreak, resulting in worry and mental confusion. This uncertainty reveals an individual's underlying cognitive state, which results in mental distress due to factors, such as rising infection rates, lack of medical care, increased unemployment, and the unpredictable future of the pandemic (Koster, Philbert, & Bouvy, 2021; Jian et al., 2020; Yadegaridehkordi et al., 2020).

Research indicates that the uncertainty surrounding COVID-19 has resulted in positive environmental outcomes. For example, it has fostered favorable attitudes towards companies' green initiatives (Gössling et al., 2020; Jian et al., 2020), strengthened behavioral intentions to support environmentally responsible businesses (Altuntas & Gok, 2021; Jiang & Wen, 2020), and fostered environmental behaviors among travelers (Hamdy & Zhang, 2025). Given that Thailand exhibits a slight preference for uncertainty avoidance (The Culture Factor, n.d.), and its Generation Z has grown up in a high uncertainty-avoidant society (Farrell & Tipnuch Phungsoonthorn, 2020), they may be particularly motivated to mitigate uncertainty. This suggests that the COVID-19 related uncertainty could drive Thai Generation Z citizens to hold distinctive environmental values and engage in pro-environmental behaviors as a way to reduce their sense of insecurity.

2.4 Environmental Value

Values are defined as individuals' enduring belief system, which influences their attraction to or rejection of certain phenomena (Saranyapong Thiangtam, 2016). Environmental value is an extension of personal values and reflects the importance of environmental protection and sustainability for individuals within their broader value system. Stern and Dietz (1994) introduced the concept of environmental values, categorizing them into egoistic, altruistic, and biospheric values. Egoistic values focus on protecting the environment for personal benefit, while altruistic values prioritize the well-being of others. Biospheric values emphasize the broader ecosystem beyond human concerns. While environmental value, as a construct examined in the current study, is enduring, a closely related concept noteworthy is environmental concern. Environmental concern describes individuals' emotional responses that express their worries, kindnesses,

and hatred towards the environment (Aman, Harun, & Hussein, 2012; Lee, 2009). Recent research highlights that among Thai Generation Z, sustainability is a core concern (Farrell & Tipnuch Phungsoonthorn, 2020). In 2019, environmental pollution was identified as the second most pressing issue for Generation Z in Thailand, with 43% expressing concern, closely following economic issues at 45% (Statista, 2024). This strong environmental concern is not unique to Thailand, as Generation Z globally share similar anxieties. A global survey reveals that 62% of Generation Z worldwide are worried about climate change (Deloitte, 2024).

It has been established in marketing literature that consumers' behaviors are influenced by their personal values (Weng & de Run, 2013; Costa & McCrae, 2001; Schwartz, 1994). In the environmental domain, research has found a positive link between individuals' environmental values and green behaviors (Negm, 2024; Hwang, Kim, & Kim, 2020; Chou, 2014; Andersson, Shivarajan, & Blau, 2005; Schultz, Gouveia, Cameron, Tankha, Schmuck, & Franěk, 2005).

2.5 Environmental Lifestyle Behavior

Industrialization, globalization, and rapid technological growth have increased production and consumption, leading to numerous environmental problems, including resource depletion, pollution, and climate change. While environmental sustainability is crucial for the planet's future, many businesses are more likely to adopt sustainable practices if market conditions support them, as their primary goal is to meet consumer demands and generate profit. Understanding Generation Z's environmental behaviors is key to evaluating their responsiveness to sustainability policies, designing environmental education programs, and developing green marketing strategies and campaigns. Previous research that investigated Generation Z's environmental behaviors, revealed an increasing trend of eco-friendly actions, such as reusing product packaging, selecting eco-friendly goods, and supporting locally sourced products (Ertmańska, 2021). Understanding the factors that drive these green behaviors is essential, with studies emphasizing the necessity for businesses to align their strategies with the sustainability preferences of Gen Z (Sherlywati & Simangunsong, 2023). Research on sustainable consumer behavior consistently detects values as key motivators for environmentally conscious actions (Rahman, Zahid, Ullah, & Al-Faryan, 2023).

Grounded in Protection Motivation Theory, the literature review suggests that COVID-19, a salient health and environmental threat, is likely to induce perceptions of fear and uncertainty among environmentally conscious Generation Z within Thailand's uncertainty-avoidant culture. It is proposed that fear and uncertainty of COVID-19, in conjunction with environmental value, may interact to predict the environmental lifestyle behaviors of Generation Z as a protection mechanism. This leads the researchers to propose the following hypotheses for testing:

H1: There is a positive relationship between fear of COVID-19 and environmental lifestyle behavior

H2: There is a positive relationship between fear of COVID-19 and uncertainty about COVID-19

H3: There is a positive relationship between fear of COVID-19 and environmental value.

H4: There is a positive relationship between uncertainty about COVID-19 and environmental value

H5: There is a positive relationship between uncertainty about COVID-19 and environmental lifestyle behavior

H6: There is a positive relationship between environmental value and environmental lifestyle behavior

H7: Uncertainty about COVID-19 positively mediates the relationship between fear of COVID-19 and environmental lifestyle behavior

H8: Environmental value positively mediates the relationship between fear of COVID-19 and environmental lifestyle behavior

H9: Uncertainty about COVID-19 and environmental value serially and positively mediate the relationship between fear of COVID-19 and environmental lifestyle behavior

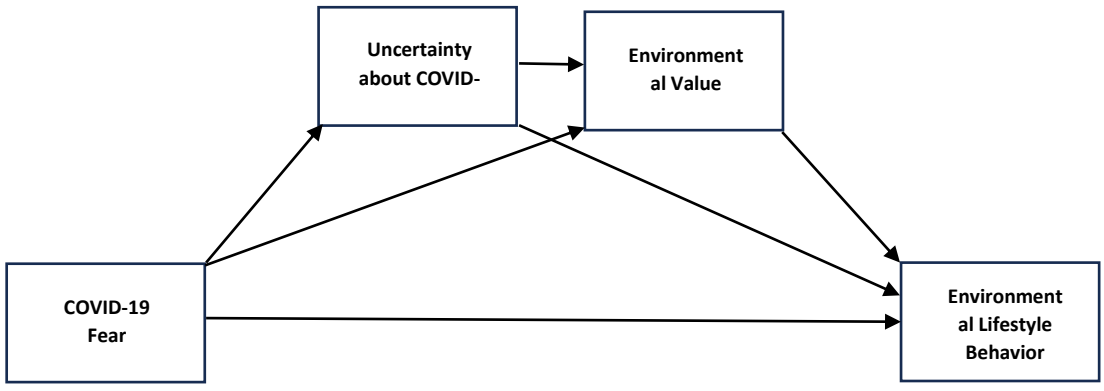

Figure 1 presents the conceptual framework for the current study, Multiple Mediation Model

3. Research Methodology

3.1 Research Design, Sample, and Data Collection

The current study employed a quantitative research methodology. An online cross-sectional self-administered structured survey using Google Form was employed to assess Generation Z's fear of COVID-19, uncertainty about COVID-19, environmental value, and environmental lifestyle behavior. Purposive sampling, relying on the researchers' judgment that the sample would reflect the population of interest, was employed (Khomson Tunsakul, 2020) in order to capture responses from Generation Z consumers born from 1997 to 2012 residing in Thailand. The Generation Z participants in this study were university students in Bangkok, Thailand, from institutions where the researchers are employed. 520 students were contacted via class-specific Line application groups from April to May 2024. In total, 420 responses were received (80.77% response rate).

Since the participants were Thai, the questionnaire was translated into Thai, then back into English by two independent language experts to ensure accuracy in wording, phrases, and terminology. This double translation process ensures the research instrument is validated through independent checks (McGorry, 2000). The statements in the questionnaire for each construct were shuffled to reduce the potential for order bias. All the questions were set to be required questions to ensure the completeness of responses. The researchers adhered to ethical standards by ensuring informed consent, respecting privacy, and maintaining confidentiality of participants. The research posed no risk to participants' physical or mental health, as it only involved collecting opinions on COVID-19 fear, uncertainty, environmental value, and environmental lifestyle behavior, without requesting any personal identifying information from respondents. Additionally, clear and unbiased criteria were applied for participant inclusion and exclusion. Participants indirectly benefited by contributing to this research in that the findings of the current study could possibly inform policies and programs promoting pro-environmental lifestyle behavior among Generation Z.

3.2 Measurements

To measure fear related to COVID-19, a 4-item scale employed by Dwivedi et al. (2022) was adopted. Generation Z respondents were asked to rate their agreement with the following statements on a 5-point Likert scale.

Table 1 Generation Z's Fear of COVID-19 Measures

Fear of COVID-19	
1	I am afraid of the coronavirus.
2	It makes me uncomfortable to think about the coronavirus.

Fear of COVID-19	
3	I am afraid of losing my life because of the coronavirus.
4	When watching news and stories about the coronavirus on social media, I become nervous or anxious.

To measure perceptions of uncertainty related to COVID-19, a 3-item scale utilized by Dwivedi et al. (2022) was applied. Generation Z respondents were asked to indicate their level of agreement with the following statements using a 5-point Likert scale.

Table 2 Generation Z's Perception of Uncertainty about COVID-19 Measures

Uncertainty about COVID-19	
1	I perceive the context of COVID-19 as very complex.
2	I perceive the context of COVID-19 as unpredictable.
3	I perceive the context of COVID-19 as changing rapidly.

To assess Generation Z's environmental value level and orientations, measures were adopted from those employed by Alisa Sony and Ferguson (2017). The statements were categorized into three value orientations: egoistic, social-altruistic, and biospheric, as shown in Table 3. Respondents were asked to rate their agreement with each of the 10 statements on a 5-point Likert scale.

Table 3 Generation Z's Environmental Value Measures

Egoistic Value Orientation	
1	I think air pollution by industry is dangerous for me and my family.
2	Pesticide in farming is dangerous for me and my family.
3	The pollution of rivers, lakes, and streams is dangerous for me and my family.
4	The rise in world temperature is dangerous for me and my family.
Social-Altruistic Value Orientation	
5	I am willing to pay higher prices to protect the environment.
6	I am willing to pay higher taxes to protect the environment.
7	I am willing to accept a cut in living standards to protect the environment.
Biospheric Value Orientation	
8	Change in nature makes things worse.
9	Modern life harms the environment.

Egoistic Value Orientation	
10	Animals have the same moral rights as humans.

To assess Generation Z's environmental lifestyle behaviors, the environmental lifestyle behavioral measures employed by Alisa Sony and Ferguson (2017) were applied. Generation Z respondents were asked to rate their level of agreement with each of the 7 statements using a 5-point Likert scale. The seven statements are presented in Table 4.

Table 4 Generation Z's Environmental Lifestyle Behavior Measures

Environmental Lifestyle Behavior	
1	Recycle bottles, cans, or glass
2	Recycle newspaper
3	Compost garden waste
4	Take your own bags to the supermarket
5	Cut down on car use
6	Contribute money to environmental causes
7	Volunteer for an environmental group

3.3 Data Analysis

IBM SPSS Statistics Version 22 was used to analyze the data. The researchers evaluated the reliability of the constructs using Cronbach's alpha and examined the potential for common method bias through Harman's Single-Factor Test (Unidimensionality Test). Then, descriptive statistics were prepared for the constructs, including respondents' profile, Generation Z' COVID-19 fear, perception of uncertainty about COVID-19, environmental value, and environmental lifestyle behavior. Following that, the researchers tested the 9 hypotheses of this study. Pearson product-moment correlation coefficients were computed to assess the relationship among various constructs (**H1-H6**). Finally, Model 6, from Hayes's SPSS macro-PROCESS (Hayes, 2012), was employed to examine the mediating and serial mediating roles of uncertainty about COVID-19 and environmental value on the relationship between COVID-19 fear and environmental lifestyle behavior (**H7-H9**).

4. Results

4.1 Validation of the Measurement Model and the Harman Single-Factor test

The reliability of the constructs with multiple test items was evaluated using Cronbach's alpha coefficient (α). The results indicated that the Cronbach's alpha values for all constructs in this study ranged from 0.77 to 0.90, exceeding the recommended minimum threshold of 0.7 (Diaz, Bajo-Sanjuan, Gil, Rosales-Pérez, & López Marfil, 2023), which suggests a satisfactory level of reliability. The Cronbach's alpha values for each construct are listed in Table 8.

Since all responses were collected from a single source, Generation Z university students, the issue of common method bias was assessed using Harman's Single Factor Test. An Exploratory Factor Analysis was conducted, treating all the variables as indicators of a single factor, to determine whether a single factor dominates in explaining the variance of the study. The result reveals that a single factor explained only 27.45% of the total variance, suggesting that common method bias is not a significant concern in this study.

4.2 Descriptive Statistics

Of the 420 responses collected from Generation Z students studying in universities, 67.4% were females and 27.1% were males. The average age of respondents was 20.84 years. Around three-fourths of the respondents had a monthly income of less than THB 15,000. Table 5 displays the profile of Generation Z respondents in the current study.

Table 5 Profile of Respondents

Items	Frequency	Percentage
Gender		
Male	114	27.1%
Female	283	67.4%
Others	23	5.5%
Total	**420**	**100%**
Age		
17	6	1.4%
18	20	4.8%
19	44	10.5%
20	107	25.5%
21	141	33.6%

Items	Frequency	Percentage
22	56	13.3%
23	12	2.8%
24	18	4.3%
25	5	1.2%
26	7	1.6%
27	4	1.0%
Total	**420**	**100%**
Monthly Income		
Less than THB 15,000	313	74.5%
THB 15,000 – 29,999	92	21.9%
THB 30,000 – 44,999	11	2.6%
THB 45,000 – 59,999	1	0.2%
THB 60,000 or more	3	0.7%
Total	**420**	**100%**

Table 6 presents the means and standard deviations for the constructs of the current study

Table 6: Means and Standard Deviations of Constructs

Construct	Mean	SD
(1) COVID-19 Fear	3.70	1.04
(2) Uncertainty about COVID-19	4.26	0.74
(3) Environmental Value	4.25	0.55
(4) Environmental Lifestyle Behavior	3.47	0.80

It can be observed that perception of uncertainty about COVID-19 is stronger than the fear of COVID-19, and environmental value is higher than environmental lifestyle behavior, suggesting a value-behavior gap. Figure 2 depicts the means of Generation Z's different environmental value orientations.

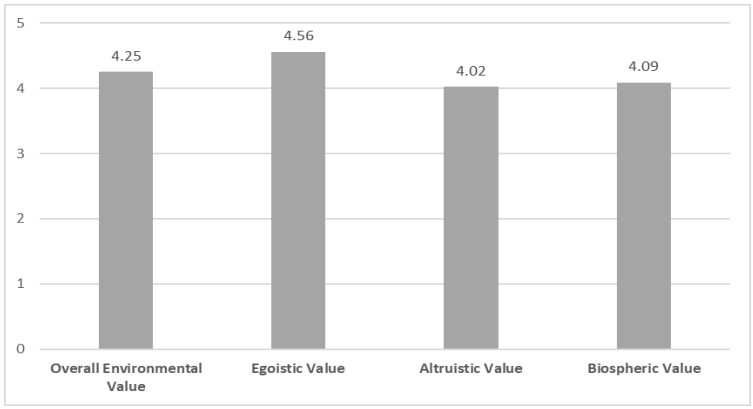

Figure 2 Generation Z's Environmental Value Orientations

Egoistic value is the dominant value orientation among Generation Z consumers. Figure 3 presents the diverse environmental lifestyle behaviors practiced by Generation Z.

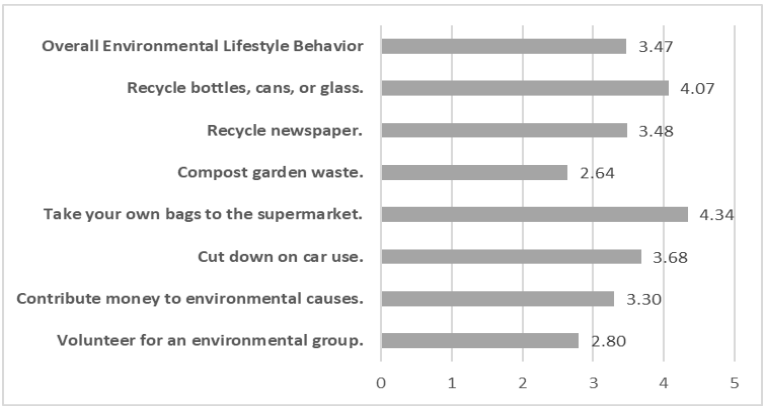

Figure 3 Generation Z's Environmental Behaviors

'Taking your own bags to the supermarket' is the most highly practiced environmental behavior among Generation Z in Thailand. This could possibly stem from a campaign launched in Thailand since 1 January 2020 to stop giving free single use plastic bags in major retail stores (Aweewan Panyagometh, Ittisak Jirapornvaree, & Angkana Keeratiratanalak, 2023). Recycling bottles, cans, or glass ranks second, while cutting down on car use ranks third in attracting Generation Z's behavioral engagement. Meanwhile, composting garden waste is the least practiced pro-environmental lifestyle behavior among Generation Z consumers.

4.3 Test of Hypotheses

To test the 9 hypotheses proposed, Pearson correlation and mediation analyses were required. Prior to running the tests, data normality was assessed using skewness (Range: -0.83 to 0.17) and kurtosis (Range: -0.48 to -0.06) from descriptive statistics as presented in Table 7. As the values were within the acceptable range of ±1 (Hair, Black, Babin, & Anderson, 2010), approximate normality of the data was assumed.

Table 7 Skewness and Kurtosis of Constructs

Construct	N	Minimum	Maximum	Mean	SD (Construct)	Skewness	SE (Skewness)	Kurtosis	SE (Kurtosis)
COVID-19 Fear	420	1.00	5.00	3.70	1.04	-0.56	0.12	-0.30	0.24
Uncertainty about COVID-19	420	2.00	5.00	4.26	0.74	-0.83	0.12	-0.06	0.24
Environmental Value	420	2.60	5.00	4.25	0.55	-0.59	0.12	-0.13	0.24
Environmental Lifestyle Behavior	420	1.29	5.00	3.47	0.80	0.17	0.12	-0.48	0.24

To test the correlations among the constructs (**H1-H6**), Pearson correlation coefficients were computed. Table 8 presents the means, correlations, and reliabilities for the constructs examined in this study.

Table 8 Descriptive Statistics, Correlations, and Reliabilities

Construct	Mean	SD	1	2	3	4
(1) COVID-19 Fear	3.70	1.04	(0.90)			
(2) Uncertainty about COVID-19	4.26	0.74	0.45**	(0.84)		
(3) Environmental Value	4.25	0.55	0.33**	0.42**	(0.82)	
(4) Environmental Lifestyle Behavior	3.47	0.80	0.35**	0.22**	0.42**	(0.77)

Note: N = 420. Reliability coefficients (Cronbach's alpha) for the constructs are shown in parentheses along the diagonal.

** $p < 0.01$

It is widely recognized that a Pearson correlation coefficient greater than 0.7 indicates a strong linear relationship between two variables (X and Y), while a coefficient less than 0.3 suggests a weak relationship, with values in between indicating a moderate relationship (Rusakov, 2023). Moderately positive correlations were detected between COVID-19 fear and environmental lifestyle behavior ($r = 0.35$, $p < 0.01$), COVID-19 fear and uncertainty about COVID-19 ($r = 0.45$, $p < 0.01$), COVID-19 fear and environmental value ($r = 0.33$, $p < 0.01$), uncertainty about COVID-19 and environmental value ($r = 0.42$, $p < 0.01$), environmental value and environmental lifestyle Behavior ($r = 0.42$, $p < 0.01$), so **H1**,**H2**,**H3**,**H4** and **H6** are accepted. In addition, albeit weak, a positive correlation exists between uncertainty about COVID-19 and environmental lifestyle behavior ($r = 0.22$, $p < 0.01$), thus **H5** is accepted.

The study assessed the mediation effects on the relationship between COVID-19 fear and environmental lifestyle behavior using Model 6, from Hayes's SPSS macro-PROCESS (Hayes, 2012), with 5,000 bootstrap. A p-value of less than 0.05 was considered statistically significant for the total effect and direct effects. The indirect effects were regarded as significant if the 95% confidence interval did not include zero. Results reveal that the indirect effect of uncertainty about COVID-19 on the relationship between COVID-19 fear and environmental lifestyle behavior was not significant, necessitating the rejection of **H7**. However, a significantly weak positive indirect effect of COVID-19 fear on environmental behavior through environmental value was detected ($b = 0.05$, $t = 2.74$), thus confirming **H8**. Moreover, results disclose a significantly positive serial mediation effect, albeit small, of COVID-19 fear on environmental lifestyle behavior through uncertainty about COVID-19 and environmental value ($b = 0.04$, $t = 3.91$), supporting **H9**. The statistical results are provided in Table 9.

Table 9 Total, Direct, and Indirect Effects in the Mediation Model

Path	Coefficient (Effect)	SE	t-value	p-value	95% Confidence Interval (LLCI - ULCI)	Completely Standardized Effect (c_cs)
Total Effect (FCOV⟶EB) *Without control for the mediator	0.26	0.04	7.50	0.00	0.1952-0.3337	0.34
Direct Effect (FCOV⟶EB) *With control for the mediator	0.19	0.04	5.02	0.00	0.1151 - 0.2633	0.24

Path	Coefficient (Effect)	SE	t-value	p-value	95% Confidence Interval (LLCI - ULCI)	Completely Standardized Effect (c_cs)
Indirect Effect 1 (FCOV⟶UCOV ⟶ EB)	-0.01	0.02	0.80	N/A	-0.0457 - 0.0185	-0.01
Indirect Effect 2 (FCOV⟶EV⟶ EB)	0.05	0.02	2.74	N/A	0.0160 - 0.0835	0.06
Indirect Effect 3 (FCOV⟶UCOV⟶EV⟶ EB)	0.04	0.01	3.91	N/A	0.0231 - 0.0645	0.05

Note: FCOV = Fear of COVID-19, UCOV = Uncertainty about COVID-19, EV = Environmental Value, EB = Environmental Behavior

To summarize the results of the hypotheses tests in this study, eight hypotheses are supported, while one hypothesis is rejected, as summarized in Table 10.

Table 10 Results of Hypotheses Tests

Hypotheses	Results
H1: There is a positive relationship between fear of COVID-19 and environmental lifestyle behavior.	Accept
H2: There is a positive relationship between fear of COVID-19 and uncertainty about COVID-19.	Accept
H3: There is a positive relationship between fear of COVID-19 and environmental value.	Accept
H4: There is a positive relationship between uncertainty about COVID-19 and environmental value.	Accept
H5: There is a positive relationship between uncertainty about COVID-19 and environmental lifestyle behavior	Accept
H6: There is a positive relationship between environmental value and environmental lifestyle behavior.	Accept
H7: Uncertainty about COVID-19 positively mediates the relationship between fear of COVID-19 and environmental lifestyle behavior.	Reject
H8: Environmental value positively mediates the relationship between fear of COVID-19 and environmental lifestyle behavior.	Accept

Hypotheses	Results
H9: Uncertainty about COVID-19 and environmental value positively and serially mediate the relationship between fear of COVID-19 and environmental lifestyle behavior.	Accept

5. Discussion

5.1 Theoretical Contributions

Based on the protection motivation theory (PMT) (Rogers, 1975), this research has revealed a complex relationship between COVID-19 fear, perception of uncertainty about COVID-19, environmental value, and environmental lifestyle behavior. Findings of the current study extends PMT by investigating how various forms of threat appraisal interact to shape adaptive behaviors. The support for **H1** indicates that fear of COVID-19 has a positive direct effect on Generation Z's environmental lifestyle behavior. The current study also supports fear appeal theory, which explains how fear can induce behavioral changes as a reaction to perceived threats (Witte & Allen, 2000). However, this finding is contradictory to the finding of Batool et al. (2023), which did not detect the direct impact of COVID-19 fear on sustainable consumption behavior; the authors explained that this could possibly be attributed to the likelihood that fear, as an emotion, may not directly result in a change in behavior (Witte, 1992). A synthesis of these findings suggests that the extent to which fear impacts pro-environmental behaviors may vary across different cultures. The current study detected a positive relationship between two distinct negative emotions: fear and the perception of uncertainty (**H2**). This finding is consistent with existing literature, such as research by Hamdy and Zhang (2025), which investigated 'COVID-19 fear-uncertainty' as a single construct, implicitly supporting the interconnectedness of these two emotional states.

The establishment of the positive relationships between COVID-19 fear and environmental value and between uncertainty about COVID-19 and environmental value (**H3 and H4**) in the current study adds insights to the exiting literature by revealing how negative ephemeral emotions such as fear and feelings of uncertainty can influence more enduring environmental value.

In the current study, the support for **H5**, **H6**, **H8**, and **H9** reveals the impact of psychological factors, such as uncertainty and environmental value, on environmental lifestyle behavior. The serial mediation effect of uncertainty about COVID-19 and environmental value on the relationship between COVID-19 fear and environmental lifestyle behavior extends the current literature by showing how ephemeral emotions, such as feelings of uncertainty, alongside more enduring values, such as environmental value, can together interact to subtly but positively impact environmental lifestyle behaviors. It could be explained that negative emotions may have possibly evolved to serve humans' protective and adaptive functions, keeping us safe (Harper, Satchell, Fido, & Latzman, 2021).

In addition, the study found an environmental value-behavior gap. While the mean score for environmental value was 4.25, the mean score for environmental lifestyle behavior was lower at 3.47. The current study also confirms that attaining Sustainable Development Goal 12 (Responsible Consumption and Production) (United Nations, n.d.) is possible, as Generation Z in Thailand exhibit strong environmental value and moderate pro-environmental lifestyle behavior.

5.2 Managerial Implications

The findings from this research suggest that heightened fear of COVID-19 and increased perception of uncertainty have strengthened Generation Z's environmental value, encouraging them to adopt pro-environmental lifestyle behaviors as a measure to protect themselves (egoistic value orientation is the dominant value orientation among Generation Z), which is in line with the protection motivation theory discussed earlier.

This finding urges policymakers, environmental non-profit organizations, education institutes, and businesses to leverage the still fresh feelings of fear and uncertainty about COVID-19 to encourage stronger environmental value and pro-environmental lifestyles behaviors that could endure, even as fear and uncertainty about COVID-19 diminish over time. For example, research as shown that sustainable pro-environmental behaviors like teleworking, which was introduced on a large scale during the pandemic, can be taken as a successful new normal (Austin-Egole, Iheriohanma, & Iheanacho, 2021).

Among the three environmental value orientations, egoistic value is the strongest among Generation Z. With regards to environmental behavior, the top three pro-environmental lifestyle behaviors that Generation Z engage in are 'taking your own bags to the supermarket', 'recycling bottles, cans, or glass', and 'cutting down on car use.' It can be noted that these behaviors correspond to the dominant egoistic value orientation of Generation Z in that these pro-environmental lifestyle behaviors directly benefit Generation Z by helping them save money. As mentioned earlier, in 2019, economic issues were the foremost concern for Generation Z in Thailand, with 45% expressing worry, followed closely by environmental pollution at 43% (Statista, 2024). Policy makers and NGOs can frame environmental protection policies and campaigns around personal benefits. For instance, environmental campaigns to encourage more use of public transportation, which is an already adopted environmental lifestyle behavior among Generation Z, can use 'better respiratory health and lower travel expenses' as the key selling point. Meanwhile, marketers can frame the marketing message around the concept that 'sustainable products and services offer better quality and potential savings', which align with the self-interest oriented motivation for environmental protection. Such mutually self and environmentally beneficial products and marketing communication can contribute to the simultaneous attainment of the 3Ps of socially responsible marketing – people, planet, and profit.

An environmental value-behavior gap was identified, highlighting the need for innovative strategies to incentivize Generation Z's engagement in pro-environmental lifestyle behaviors by capitalizing

on their egoistic environmental value orientation. For example, integrating solar panels in homes not only contributes to mitigating climate change but also reduces energy costs.

The findings of the current study also encourage pro-environmental businesses to target Generation Z consumers, as they support Sustainable Development Goal 12 (Responsible Consumption and Production) (United Nations, n.d.) through their strong environmental value and moderate pro-environmental lifestyle behaviors.

6. Limitations and Future Research

This research has some limitations. Firstly, the sample consists of Generation Z university students in Thailand and may not generally represent the entire Generation Z cohort born from 1997 to 2012. Secondly, the responses are self-reported and could potentially be subject to social desirability bias (SDB), which could possibly impact the validity of the findings. However, the extent to which SDB affects self-reported responses also reflects the cultural importance of those issues (Fisher & Katz, 2000). Hence, if Thai Generation Z consumers in Thailand inflate their COVID-19 fear, perception of uncertainty, environmental values, and environmental lifestyle behaviors, it may indicate the high importance they place on these areas, necessitating more future studies surrounding these issues. In addition, the study is cross sectional, and COVID-19 fear and perception of uncertainty are expected to fade with time. Furthermore, the researchers would like to provide some caveats for generalizing the findings of the current study. The current study focused on Generation Z consumers, and different generations likely received varied extents of impacts from COVID-19. Moreover, although COVID-19 was a pandemic which impacted the humanity, the current study was conducted in Thailand, and the population in different countries were not impacted to the same extent by the pandemic. In addition, cultural differences could limit the generalizability of the findings.

Future qualitative studies are encouraged to explore the barriers to adopting pro-environmental lifestyle behaviors as the current study detected a gap between environmental value and environmental lifestyle behavior. Focus groups could help uncover consumer-driven solutions to bridge the environmental value-behavior gap. Additionally, cross-country research examining pro-environmental values and behaviors in the context of COVID-19 is vital for shaping global policies and business strategies, thereby accelerating the progress towards the United Nations' environmentally sustainable development goals.

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