

Environmental Risk Perception and Tourist Behavioral Intentions Under PM2.5 Pollution: A Mixed-Methods Investigation in Coastal Thailand

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Abstract

This study examines how fine particulate matter (PM2.5) air pollution shapes environmental risk perception (ERP) and tourist behavioral intentions at Bangsaen, a popular coastal destination in Chonburi Province, Thailand. Utilizing Protection Motivation Theory (PMT) as a guiding framework, a convergent mixed-methods design integrated qualitative semi-structured interviews with 36 tourists and a quantitative structured questionnaire administered to 123 visitors during January–February 2026. The study focused primarily on the threat-appraisal pathway, conceptualizing ERP as an intervening cognitive appraisal proxy rather than direct protection motivation, while coping appraisal was examined qualitatively and via exploratory single-item correlation. The study yielded three principal findings: (1) tourists exhibited moderate-to-high overall ERP ($M = 3.89$, $SD = 0.77$), which was positively associated with all seven behavioral dimensions, showing the strongest association with destination selection sensitivity ($r = .676$, $p < .001$); (2) adaptive coping responses dominated (78%), driven by high qualitative self-efficacy and the availability of indoor substitution activities, while trip cancellation intentions were less prevalent (22%); and (3) ERP levels differed significantly across subgroups, with older, female, and non-Asian international visitors exhibiting greater risk sensitivity, suggesting that threat appraisals are influenced by experiential familiarity. Critically, while the findings offer valuable segmented communication strategies for coastal destination managers, the study's academic value is bounded by a youth-skewed convenience sample, a cross-sectional design that prevents causal inference, and a single-item quantitative measure of response efficacy. These methodological constraints highlight the necessity for future longitudinal research with representative probability sampling.

Keywords: PM2.5 pollution; environmental risk perception; Protection Motivation Theory; tourist behavioral intentions; coastal tourism

Introduction

Fine particulate matter (PM_{2.5}) has emerged as one of the most pressing environmental threats to public health and tourism sustainability worldwide. With particle diameters of 2.5 micrometers or less, PM_{2.5} penetrates deep into the respiratory system, carrying well-documented risks of cardiovascular, pulmonary, and cerebrovascular disease (Feng et al., 2016; Sharma et al., 2020). Beyond its health consequences, PM_{2.5} pollution is increasingly recognized as a critical determinant of tourist behavior, capable of reshaping travel decisions, curtailing destination appeal, and undermining the long-term viability of tourism economies (Churchill et al., 2022). For instance, macro-level econometric panels indicate that particulate pollution significantly suppresses international travel demand, with Su et al. (2022) documenting a PM_{2.5} elasticity of -0.23 for international arrivals across 99 nations, an effect that rises to -0.31 in developing economies. Similarly, Xu et al. (2019) demonstrated that a $1 \mu\text{g}/\text{m}^3$ increase in PM_{2.5} levels corresponds to a 0.482% decline in domestic tourism and a 1.227% reduction in inbound arrivals. These empirical findings collectively demonstrate that elevated PM_{2.5} concentrations adversely affect international tourist arrivals, with negative consequences particularly pronounced in developing economies (Churchill et al., 2022).

Bangsaen, a coastal destination in Thailand's Chonburi Province, exemplifies this tension. Celebrated for its beaches, cultural vibrancy, and accessibility from Bangkok, Bangsaen attracts a growing volume of domestic and international visitors. Yet the same factors driving its tourism growth, namely urbanization, traffic, and industrial activity, also contribute to elevated concentrations of airborne pollutants including PM_{2.5} that exceed safe thresholds recommended by the World Health Organization. When tourists encounter or anticipate poor air quality, they interpret it through a lens of perceived risk. This environmental risk perception, which refers to the subjective assessment of the likelihood and severity of harm from pollution exposure, acts as an intervening cognitive appraisal (Fuchs & Reichel, 2011; Rittichainuwat & Chakraborty, 2009). This cognitive process is grounded in Protection Motivation Theory (PMT; Rogers, 1975), which posits that individuals assess environmental threats through two parallel appraisals. The first is threat appraisal, encompassing perceived severity and vulnerability, and the second is coping appraisal, encompassing response efficacy and self-efficacy. The interaction between these two appraisals determines protective behavioral intentions.

Despite growing scholarly interest in the intersection of environmental quality and tourism, empirical research specifically examining how PM_{2.5} pollution shapes environmental risk perception and tourist behavioral intentions remains limited, particularly in Southeast Asian coastal contexts. Existing literature has addressed broader air quality concerns (Gössling et al., 2012; Churchill et al., 2022) and general environmental risk in tourism (Sönmez & Graefe, 1998), but few studies have isolated PM_{2.5} as the focal pollutant, examined perceptual mechanisms through

which it influences behavior, or adopted mixed-methods designs capable of capturing both quantitative patterns and lived qualitative experiences of tourists in affected destinations.

This research article presents empirical findings from a convergent mixed-methods study conducted at Bangsaen, integrating semi-structured interviews with structured survey data. The study contributes to a more nuanced understanding of pollution-driven risk perception in tourism and offers evidence-based guidance for destination managers, policymakers, and stakeholders seeking to sustain coastal tourism in the face of growing air quality challenges.

Objectives

1. To examine how tourists visiting Bangsaen perceive PM2.5 environmental risk and how perceived severity and vulnerability influence environmental risk perception.
2. To investigate how environmental risk perception influences protective behavioral intentions, including changing activities, cancelling visits, or using coping behaviors.
3. To explore how travel origin, age, gender, and visit frequency influence environmental risk perception and behavioral intentions within the Protection Motivation Theory framework.

Literature Review

1. PM2.5 Pollution: Global Context and Tourism Consequences

Fine particulate matter (PM2.5) represents one of the most pervasive and harmful forms of air pollution globally. Cheng et al. (2016) reviewed ambient PM2.5 pollution across 45 global megacities, illustrating that while highly polluted cities in China and India regularly recorded annual averages exceeding $89 \mu\text{g}/\text{m}^3$, cleaner megacities such as Miami and Toronto recorded concentrations below $10 \mu\text{g}/\text{m}^3$, meeting or approaching the WHO annual guideline. Zhang et al. (2020a) subsequently utilized remote sensing to monitor PM2.5 dynamics across 33 global megacities, showing that atmospheric particulate loads remain highly dynamic and geographically concentrated. A stark disparity persists between developed and developing regions: while PM2.5 levels have declined in North America and Europe, concentrations continue to rise across much of Asia and Africa (Zhang et al., 2020b). The health consequences of PM2.5 exposures are well-documented: elevated risks of cardiovascular disease, lung cancer, and chronic respiratory conditions disproportionately affecting older populations and those with pre-existing conditions (Feng et al., 2016; Sharma et al., 2020).

Tourism is increasingly affected by air quality deterioration. Churchill et al. (2022) demonstrated that PM2.5 pollution significantly suppresses international tourist arrivals across G20 economies, a finding corroborated by Su et al. (2022), who documented a PM2.5 elasticity of -0.23 for international arrivals across 99 nations. Zhang et al. (2020b) showed that air pollution shapes tourists' spatial behavior and destination selection through social media sentiment. Gössling

et al. (2012) documented that environmental quality perceptions significantly influence destination image and revisit intentions.

2. Theoretical Framework: Protection Motivation Theory

Protection Motivation Theory, originally proposed by Rogers (1975) and extended by Maddux and Rogers (1983), provides the theoretical foundation for this study. PMT posits that when individuals encounter an environmental threat, they engage in two cognitive appraisal processes. The first, threat appraisal, involves perceived severity, which refers to how serious the health consequences of PM_{2.5} exposures are judged to be, and perceived vulnerability, which refers to the individual's subjective likelihood of experiencing those consequences. The second, coping appraisal, involves response efficacy, which is the belief that a protective action will effectively reduce exposure, and self-efficacy, which refers to confidence in one's ability to execute that action. When threat appraisal is high and coping appraisal supports the feasibility of protective action, protection motivation is aroused and behavioral intention to act protectively follows. Ruan et al. (2020) applied PMT directly to air pollution and international tourist behavior in Beijing, demonstrating that perceived severity, vulnerability, response efficacy, and self-efficacy all significantly predicted tourists' protective behavioral intentions. Subedi and Kubickova (2024) further extended PMT in tourism by incorporating destination government trust, confirming that threat and coping appraisals mediate the relationship between trust and self-protective behavior

3. Environmental Risk Perception and Tourist Behavior

Environmental risk perception refers to the subjective assessment of harm likelihood from environmental hazards. In tourism, it operates as the mediating construct through which PMT's threat appraisal components translate into behavioral intentions, shaped by experience, information sources, cultural background, and health sensitivity (Sönmez & Graefe, 1998). When tourists perceive risk as high, they are more likely to modify plans, avoid outdoor activities, or cancel visits (Karl et al., 2020; Gössling et al., 2012). In coastal tourism destinations where outdoor beach experiences are the primary draw, elevated PM_{2.5} perception may trigger either adaptive coping or avoidance behavior, depending on the strength of coping appraisal resources available to the individual tourist (Correia et al., 2011).

Conceptual Framework

This research is a mixed-methods study grounded in Protection Motivation Theory (PMT; Rogers, 1975; Maddux & Rogers, 1983). The conceptual framework consists of two appraisal processes. Threat appraisal encompasses perceived severity and perceived vulnerability to PM_{2.5}-related harm. Coping appraisal encompasses response efficacy and self-efficacy. Together, threat appraisal and coping appraisal generate protection motivation, which in turn drives tourists' protective behavioral intentions. In this study, environmental risk perception (ERP) is

conceptualized as a threat–appraisal proxy — capturing perceived severity and vulnerability — rather than as protection motivation itself; the behavioral intention layer operationalizes protection motivation. The study proposes that perceived severity and vulnerability are each positively associated with ERP, that higher ERP predicts protective behavioral intentions, and that ERP levels may vary across tourist subgroups defined by travel origin, age, gender, and visit frequency.

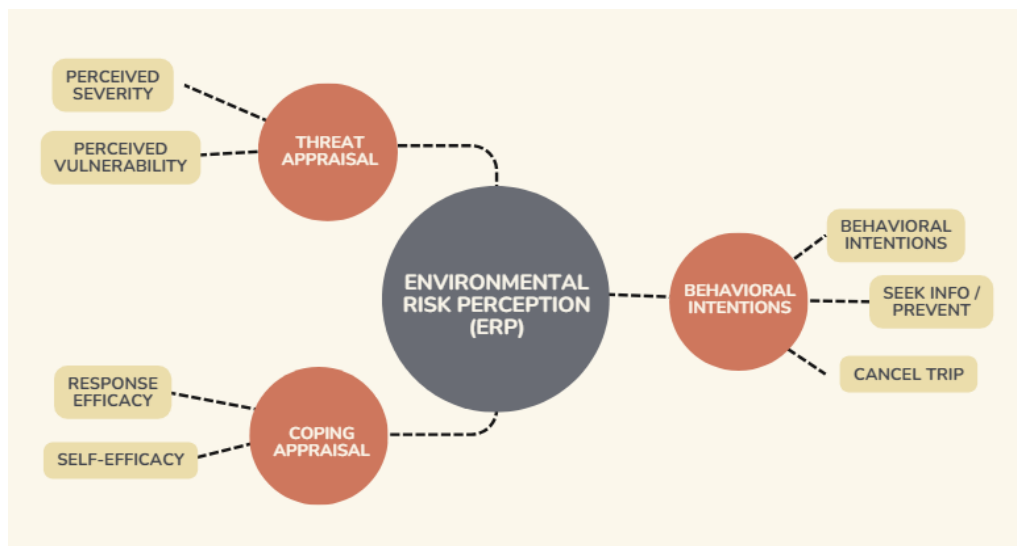


Figure 1 Research Conceptual Framework

Research Methodology

This research employs a mixed–methods design (Creswell & Creswell, 2018) conducted at Bangsaen Beach, Chonburi Province, Thailand. The population comprised tourists aged 18 years or over with at least one visit to Bangsaen within the previous twelve months. The sample consisted of 36 interviewees (qualitative strand) and 123 survey respondents (quantitative strand), selected via convenience sampling (Etikan et al., 2016).

Two research instruments were used. First, a semi–structured interview guide examined tourists' lived experiences of PM_{2.5} risk perception, information–seeking behaviors, and behavioral adaptation strategies across four PMT–aligned thematic domains: environmental information–seeking, risk perception and health concern, behavioral intentions and adaptive responses, and destination image. Interviews were conducted face to face or online during January–February 2026, lasting approximately 20 minutes each. Second, a structured questionnaire measured environmental risk perception using a three–item ERP composite (air quality importance, pollution concern, and health vulnerability) alongside behavioral intention items. Internal consistency of the ERP composite was acceptable (Cronbach's $\alpha = .704$), with an average inter–item correlation of $r = .44$ and composite reliability of $CR = .72$. Although individual items are ordinal, the composite

score exhibits sufficient interval-like properties for parametric analysis consistent with established practice (Norman, 2010; Carifio & Perla, 2008). The sample of $n = 123$ provides adequate power ($1 - \beta \geq .80$) to detect medium and large effect sizes ($r \geq .30$) at $\alpha = .05$ (Cohen, 1988); the one small-effect correlation ($r = .190$) is reported for completeness.

To ensure the trustworthiness of the qualitative strand, the study adhered to the criteria established by Nowell et al. (2017). Credibility was established through investigator triangulation, with two researchers independently coding the transcripts, and peer debriefing within the research team. Transferability was supported by providing thick descriptions of the Bangsaen coastal setting and participant characteristics. Dependability was maintained through an auditable decision trail documenting how raw codes were clustered into categories and synthesized into themes. Confirmability was addressed through reflexive journaling, wherein researchers recorded their assumptions about air pollution and tourism to minimize subjective bias. Thematic saturation was reached at $n = 36$, defined as the point at which the final six interviews yielded no new unique codes or conceptual insights.

Quantitative data were analyzed using descriptive statistics and Pearson correlation; Spearman's ρ was used for single-item ordinal variables. Qualitative data were analyzed through thematic analysis incorporating narrative inquiry principles (Murray, 2009). Ethical approval was granted by the Institutional Review Board (protocol HU005/2568).

Research Results

Qualitative Findings

Thematic analysis of 36 semi-structured interviews identified four overarching themes. Interview participants are identified by code names (I01–I36) to preserve anonymity.

Theme 1: Environmental Information–Seeking Behavior and Source Credibility

Three distinct profiles emerged: proactive monitors ($n = 11$ of 36), who routinely utilized mobile applications to track real-time AQI values and consisted primarily of non-Asian international visitors; reactive seekers ($n = 16$ of 36), who only consulted air quality data in response to visible haze or peer reports; and non-seekers ($n = 9$ of 36), who rarely consulted air quality information, actively normalizing risk as a baseline condition of travel, a profile dominated by frequent Thai domestic visitors. A persistent concern was the inadequacy of hyper-local, real-time pollution data for Bangsaen specifically:

“I check the AQI app but it gives Bangkok data, not here...so I don’t really know what I’m breathing at the beach.” (I14, non-Asian international visitor, female, age 34)

Theme 2: PM2.5 Risk Perception and Health Concern

Three perceptual profiles emerged: high-salience perceivers ($n = 14$ of 36), comprising parents, older tourists, and visitors from low-pollution environments who exhibited heightened

threat appraisal; moderate-salience perceivers ($n = 15$ of 36), who acknowledged long-term health risks but showed lower immediate anxiety; and low-salience risk normalizers ($n = 7$ of 36), who discounted severity through comparative optimism:

“With my child here, any haze makes me worried...we stayed indoors most of the afternoon.” (I03, Thai domestic visitor, female, age 38, parent)

“Back home the air is worse. This feels fine by comparison.” (I27, Asian international visitor, male, age 29)

Theme 3: Behavioral Intentions and Adaptive Responses Under Poor Air Quality

Four behavioral response patterns were identified: proactive prevention and monitoring ($n = 15$ of 36), involving mask use and itinerary adjustment; activity substitution ($n = 13$ of 36), where tourists redirected to indoor venues rather than leaving the destination; continued engagement with residual risk acceptance ($n = 5$ of 36); and avoidance or cancellation ($n = 3$ of 36), the least common pattern. The dominant pattern was adaptive, with destination loyalty and indoor substitute availability enabling continued engagement:

“I wouldn’t cancel...I’d just move inside. There’re the aquarium and the market, so it’s still worth coming.” (I09, Thai visitor, male, age 24)

Theme 4: Destination Image, Attraction Factors, and Eco-Friendly Services

Tourists distinguished between Bangsaen’s beach appeal and its air quality management capacity. Eco-friendly services were viewed positively but insufficiently available. Non-Asian international visitors expressed the strongest demand for AQ-transparent accommodation and green certification:

“If hotels showed their air filtration rating alongside price, I’d absolutely pay more for cleaner indoor air.” (I21, non-Asian international visitor, female, age 41)

Quantitative Findings

The survey sample ($n = 123$) was predominantly male (67.5%), aged 18–25 (47.2%), and Thai domestic visitors (55.3%). ERP was moderate-to-high overall ($M = 3.89$, $SD = 0.77$). The three items constituting the ERP composite registered at moderate-to-high levels: air quality importance ($M = 4.02$, $SD = 1.05$), pollution concern ($M = 3.67$, $SD = 0.94$), and health vulnerability ($M = 4.00$, $SD = 0.91$). ERP was positively correlated with all seven behavioral outcome variables (all $p < .05$), as shown in Table 1.

Table 1: Pearson Correlations and Spearman’s ρ between ERP and Behavioral Outcome Variables ($n = 123$)

Behavioral Outcome Variable	r / ρ	p-value	Interpretation
Destination selection sensitivity	.676	< .001	Strong positive
Eco-friendly service valuation	.607	< .001	Strong positive
Response efficacy (Q15: indoor preference) [ρ]	.508	< .001	Moderate positive
Willingness to pay for AQ services	.476	< .001	Moderate positive

Activity modification intention	.412	< .001	Moderate positive
Trip cancellation propensity [ρ]	.361	< .001	Moderate positive
Information-seeking behavior [ρ]	.190	< .05	Weak positive

*All correlations significant at $p < .05$. Dominant behavioral response: adaptive (43.9% seek information/prevent; 34.1% alter activities; 22.0% cancel).

Coping appraisal components also provided empirical support for Protection Motivation Theory. Response efficacy was operationalized through a single exploratory item (Q15: indoor preference) and showed a significant positive association with ERP ($\rho = .508$, $p < .001$). Self-efficacy was evidenced qualitatively through participants' descriptions of concrete protective actions, including mask use, indoor venue selection, and AQI monitoring. Together, these findings offer partial quantitative support for the threat-appraisal pathway of PMT, with coping appraisal corroborated qualitatively, providing convergent evidence for the PMT framework in this coastal tourism context.

Subgroup Analysis

Subgroup comparisons of ERP means are presented in Table 2.

Table 2: ERP Mean Scores by Tourist Subgroup with Inferential Statistics (n = 123)

Variable	Subgroup	n	M	SD	Test statistic	p	Effect size	Significant post-hoc comparisons (Tukey HSD)
Travel origin	Non-Asian international	24	3.83	0.61	$F(2, 120) = 7.485$	.001	$\eta^2 = .111$	Non-Asian > Asian ($p = .001$)
	Thai domestic	68	3.54	0.51				
	Asian international	31	3.28	0.48				
Age group	18–25	58	3.57	0.52	$F(3, 119) = 19.011$	< .001	$\eta^2 = .324$	26–35 < all others ($p < .001$) 18–25 vs 46+ ($p = .005$) 36–45 vs 46+ ($p = .028$)
	26–35	30	3.00	0.36				
	36–45	18	3.56	0.49				
	46 and above †	17	4.00	0.35				
Gender	Female	40	3.76	0.29	Welch's $t(120.3) = 3.499$	.001	$d = 0.528$	Female > Male
	Male	83	3.46	0.66				
Visit frequency	Once/year (infrequent)	38	3.39	0.58	$F(2, 120) = 5.169$	.007	$\eta^2 = .079$	Once < 2–3x ($p = .008$)
	2–3 times/year (moderate)	45	3.78	0.55				
	4+ times/year (frequent)	40	3.49	0.61				

Non-Asian international visitors recorded the highest ERP ($M = 3.83$, $SD = 0.61$), significantly higher than Asian international visitors ($M = 3.28$, $SD = 0.48$), with Thai domestic

visitors at a moderate level ($M = 3.54$, $SD = 0.51$), $F(2, 120) = 7.485$, $p = .001$, $\eta^2 = .111$. ERP varied significantly across age groups, $F(3, 119) = 19.011$, $p < .001$, $\eta^2 = .324$, with the 26–35 cohort showing the lowest ERP ($M = 3.00$, $SD = 0.36$), significantly lower than all other groups ($p < .001$), and the 46 and above cohort the highest ($M = 4.00$, $SD = 0.35$). Female respondents showed significantly higher and more consistent ERP ($M = 3.76$, $SD = 0.29$) than male respondents ($M = 3.46$, $SD = 0.66$), Welch's $t(120.3) = 3.499$, $p = .001$, $d = 0.528$. Moderate-frequency visitors showed the highest ERP ($M = 3.78$, $SD = 0.55$), significantly higher than infrequent visitors ($M = 3.39$, $SD = 0.58$), $F(2, 120) = 5.169$, $p = .007$, $\eta^2 = .079$, while frequent visitors showed habituation-driven attenuation ($M = 3.49$, $SD = 0.61$).

Mixed Methods Integration

Qualitative and quantitative findings converged across all three objectives. The three qualitative perceptual profiles mapped directly onto quantitative subgroup differences by origin, age, and gender. The 78% dominance of adaptive behavior was explained qualitatively by destination loyalty and flexibility in substituting indoor activities. Differences in ERP by travel origin were further explained through qualitative accounts of comparative optimism among Thai visitors and time pressure adaptation among non-Asian tourists, confirming environmental risk perception as a significant and culturally moderated mediating construct between PM2.5 and tourist behavioral intentions. Coping appraisal was also evidenced across both strands. Response efficacy (Q15: $\rho = .508$, $p < .001$) provided quantitative confirmation, while qualitative self-efficacy accounts, including mask use, indoor substitution, and AQI monitoring, explained the mechanism through which tourists translated threat appraisal into adaptive rather than avoidant behavior, consistent with the PMT framework in this coastal tourism context.

Discussion

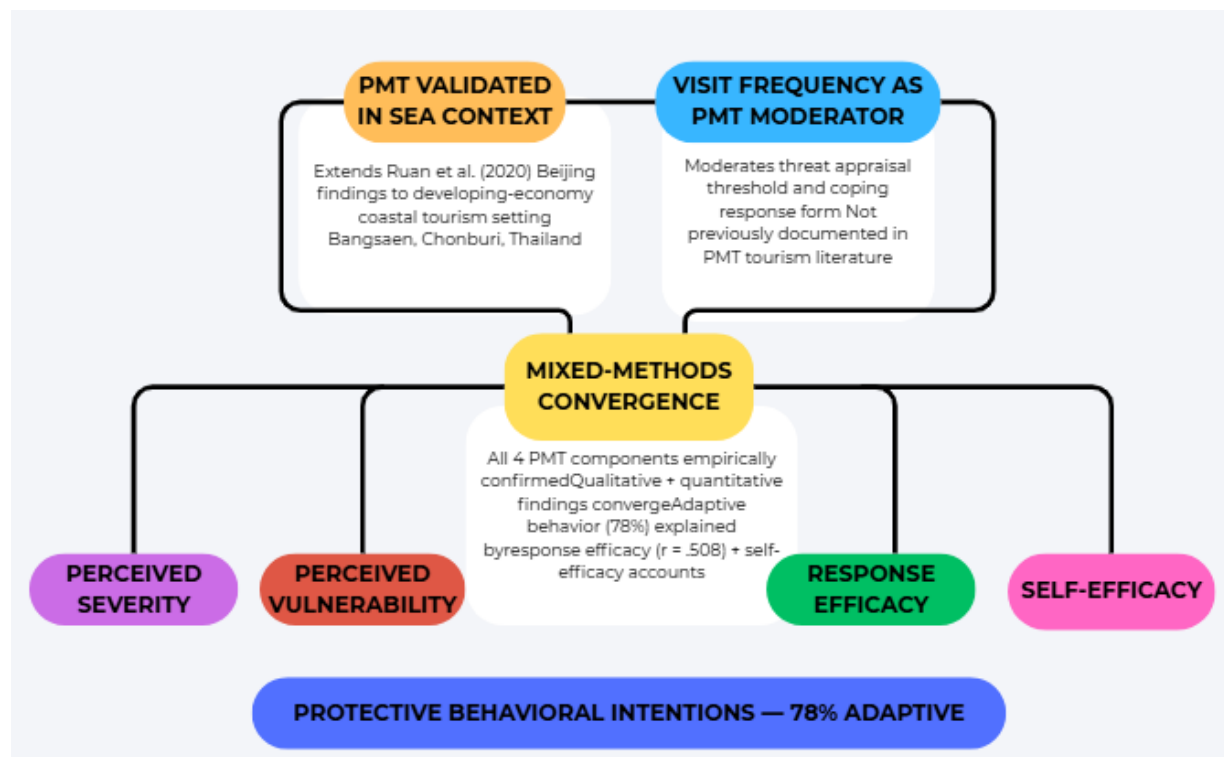
This study confirms a perception behavior pathway consistent with Protection Motivation Theory in a Southeast Asian coastal tourism context. ERP ($M = 3.89$) reflects moderate-to-high threat appraisal, with health vulnerability ($M = 4.00$) and pollution concern ($M = 3.67$) as its two strongest components, consistent with PMT's threat appraisal predictions. The increasing ERP pattern across age groups (Table 2), consistently higher ERP among female respondents, and reduced ERP among frequent visitors are consistent with PMT predictions regarding differences in threat appraisal based on vulnerability and travel experience.

The ERP behavior pathway was supported across all seven behavioral dimensions (Table 1). The strongest relationship was found for destination selection sensitivity ($r = .676$) rather than cancellation intention ($r = .361$), suggesting that threat appraisal has the greatest influence during the pre-trip planning stage. The dominance of adaptive responses (78%) was also consistent with PMT predictions when coping appraisal is high. This finding was supported by response efficacy

(Q15: $\rho = .508$) and qualitative self-efficacy accounts, including mask use, AQI monitoring, and indoor activity substitution. Together, these findings indicate that tourists perceived PM2.5 as a real threat while also believing they could effectively manage the risk. This reflects a degree of destination resilience, particularly when supported by real time air quality communication and the availability of indoor tourism alternatives.

Subgroup differences in ERP and behavioral responses were observed across all four moderating variables. Travel origin influenced both threat appraisal and coping appraisal: non-Asian visitors demonstrated higher threat appraisal and stronger coping efficacy, while Thai visitors showed moderate threat appraisal but lower coping efficacy for indoor alternatives, reflected in a proportionally higher tendency toward trip cancellation (22.0% overall; Table 1). Asian visitors demonstrated lower threat appraisal, consistent with habituation effects. Age was associated with perceived vulnerability, gender with threat appraisal intensity, and visit frequency with coping strategy selection. These patterns are consistent with PMT and suggest that experiential familiarity may differentially shape threat and coping appraisals across tourist groups, a relationship that warrants formal investigation in future research (Ruan et al., 2020; Subedi & Kubickova, 2024).

New knowledge from research



This study generates three principal contributions. First, this study applies Protection Motivation Theory to explain PM2.5-related tourist behavioral intentions in a Southeast Asian coastal context, contributing empirical evidence from a developing economy setting that

complements Ruan et al.'s (2020) Beijing findings. Second, the findings suggest that visit frequency is associated with differing threat appraisal and coping response patterns, a relationship that warrants formal testing in future research. Third, the convergent mixed-methods design demonstrates partial quantitative support for the threat-appraisal pathway alongside qualitative corroboration of coping appraisal, with the two strands complementing one another. The dominance of adaptive behavior (78%) was best explained through the integration of quantitative response efficacy findings ($p = .508$) and qualitative self-efficacy accounts.

Conclusion

This study examined how PM2.5 air pollution shapes environmental risk perception (ERP) and tourist behavioral intentions at Bangsaen, Thailand, using a convergent mixed-methods design grounded in Protection Motivation Theory (PMT). Three principal conclusions emerge from the findings.

First, ERP conceptualized as a threat-appraisal proxy rather than direct protection motivation was moderate to high overall ($M = 3.89$, $SD = 0.77$) and positively associated with all seven dimensions of protective behavioral intentions. The strongest association was with destination selection sensitivity ($r = .676$, $p < .001$), indicating that threat appraisal exerts its greatest influence at the pre-trip planning stage.

Second, on-site tourist behavior was dominated by adaptive coping rather than avoidance. Specifically, 78.0% of respondents expressed adaptive intentions such as activity modification and indoor substitution, while 22.0% indicated trip cancellation. This adaptive pattern was supported by strong response efficacy, as reflected in a moderate positive association between ERP and indoor preference (Q15: $p = .508$, $p < .001$), and by qualitative self-efficacy accounts describing mask use, AQI monitoring, and venue substitution.

Third, ERP levels differed across tourist subgroups. Risk sensitivity was higher among older visitors (46–55: $M = 3.89$; above 55: $M = 4.16$; combined $M = 4.00$, $SD = 0.35$), female visitors ($M = 3.76$, $SD = 0.29$; Welch's $t(120.3) = 3.499$, $p = .001$, $d = 0.528$), and non-Asian international visitors ($M = 3.83$, $SD = 0.61$; $F(2, 120) = 7.485$, $p = .001$, $\eta^2 = .111$). A non-linear pattern was also observed across visit-frequency groups, with moderate-frequency visitors showing the highest ERP ($M = 3.78$, $SD = 0.55$) and frequent visitors showing lower ERP ($M = 3.49$, $SD = 0.61$), consistent with habituation effects.

This study contributes to the PMT literature by applying the theory to a seasonal coastal pollution context and demonstrating that ERP functions as a threat-appraisal proxy linking pollution perception to behavioral intentions. The convergent mixed-methods design allowed qualitative and quantitative findings to reinforce one another. Generalizability is limited, however, by a youth-

skewed convenience sample (47.2% aged 18–25), a cross-sectional design that prevents causal inference, and the use of a single exploratory item to measure response efficacy quantitatively.

Suggestions

Based on the research findings, the researchers make the following recommendations:

1. Suggestion for Implementing the Research Findings

The findings pertaining to the first research objective revealed that ERP was moderate to high overall, with notable variation across tourist subgroups defined by origin, age, gender, and visit frequency (Table 2). Destination managers and relevant stakeholders should therefore implement segmented risk communication strategies, encompassing targeted health messaging for older and female visitors, culturally tailored adaptive guidance for non-Asian international tourists, and promotion of indoor alternative activities for domestic visitors during periods of elevated pollution.

Regarding the second research objective, destination selection sensitivity exhibited the strongest association with ERP ($r = .676$), while response efficacy demonstrated a moderate positive association ($\rho = .508$), indicating the predominance of adaptive behavioral responses among the sampled tourists (Table 1). These results suggest that destination managers should prioritize real-time PM2.5 monitoring and disseminate air quality information through destination websites, QR codes at tourist attractions, and social media platforms, while actively developing indoor tourism infrastructure to reinforce response efficacy and self-efficacy among visitors.

With respect to the third research objective, ERP and behavioral responses varied across subgroups through distinct PMT mechanisms, with cultural background and visit frequency emerging as particularly influential factors. Sustainability-oriented services should therefore be positioned as integral components of destination quality, and loyalty programs should prioritize engagement with moderate-frequency visitors, who demonstrated the highest risk sensitivity ($M = 3.78$) and greatest behavioral flexibility.

2. Suggestions for Future Research

Future research should focus on (1) longitudinal studies examining changes in tourists' environmental risk perception across different PM2.5 seasons, (2) experimental studies investigating causal relationships between pollution information and tourist behavior, (3) comparative studies across coastal destinations in Southeast Asia to test the applicability of the Protection Motivation Theory framework, and (4) the role of real time air quality applications and social media in shaping tourists' risk perceptions and adaptive behaviors.

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