Causality of environmental concerns, attachment to place, risk perception, and preventive behaviors in environmentally sensitive areas of Taipei, Taiwan

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Abstract. Taiwan is frequently threatened by the environmental, social and economic pressures brought about by climate change. Due to distinct synthesized vulnerabilities, coupled with the impact of the ecological footprint, cities in Taiwan obtain different environmentally sensitive areas. This investigation adopts the Structure Equation Model (SEM) to compare the causality of residents’ environmental attitudes, attachment to place, risk perception, and preventive behaviors in an environmentally sensitive district (Wanhua District) and an environmentally insensitive district (Zhongshan District) of Taipei. Questionnaires, from a stratified random sampling survey, covering these four scopes were carried out in Taipei and 600 successful questionnaires were gathered. It is found out that residents in these two districts do not concern much with the history of disasters in their districts and are unable to gain knowledge regarding how to deal with the challenges of future disasters. Furthermore, attachment to place has no obvious impacts on environmental concerns, risk perception and preventive behaviors of residents in the two environmental risk areas of Taipei.

1. Introduction
Taiwan has been severely influenced by climate change, as the island's biophysical environments enhancing the environmental sensitivity. Moreover, Taiwan's economic development policy and land use logics are based on the framework of stable population growth and sustained economic expansion, which has caused serious imbalance between urban and rural development due to the lack of relevant regulating measures.

Therefore, it is necessary to explore whether there are differences in the relationships of residents’ environmental concerns and behaviors in response to climate change. This investigation examines the causality of attitudes to climate change, risk perception and preventive behaviors vis-à-vis climate change in residents of an environmentally sensitive district and an environmentally insensitive district of Taipei. Whether attachment to place exerts an impact on these relationships will also be elucidated.

Taipei, surrounded by mountains, is situated in the Taipei Basin. Its environmental stressors are mostly induced by landslides and potential flooding areas brought about by rainstorms; whereas, its socio-economic vulnerabilities are caused by high economic growth, soaring housing properties and high population density. Based on the cross-tabulation of integrated vulnerability and ecological footprint (EF), 15 types of environmentally sensitive areas can be extracted for Taipei. If the stressors of biophysical and social vulnerability are taken into account, we can shed light on the relationships between environmental concerns and behaviors in different integrated vulnerability areas facing the threat of climate change [1,2]. Therefore, an environmentally sensitive area (high vulnerability-high
EF, Wanhua District) and an environmentally insensitive district (low vulnerability-low EF, Zhongshan District) were selected to explore the relationships of climate change attitudes, attachment to place, risk perception and preventive behaviors.

Examining environmental risks mainly focuses on natural disasters (e.g., earthquakes and typhoons). These natural disasters take place at a rather low frequency, and their incidence are often used as a criterion for assessment, often not being treated as high-risk events (such as traffic accidents), and therefore the threat of these natural disasters is often underestimated. Slovic [3] defined risk perception as “intuitive judgments of risk for individuals and groups in the face of limited and uncertain information.” The attachment to place addresses the connections of people to their environment in different processes of environmental psychology. Nevertheless, no agreements can be found regarding the function of attachment to place toward the links of "risk perception" and "responsive behaviors" [4]. Due to the links between attachment to place and individual's identity to a particular location, it is generally assumed that attachment to place plays a negative moderating role in the interaction of risk perception and responsive behaviors vis-à-vis environmental hazards [1].

This investigation explores the causality of residents of Taipei regarding their environmental concerns, attachment to place, risk perception and preventive behaviors. Second Two reviews the relevant literature. Section Three addresses the research areas and research methods. Section Four analyzes the causality of environmental concerns and behaviors in different environmentally sensitive areas. The final section puts forward conclusions.

2. Literature review

2.1. Risk perception and responsive behaviors

Risk deals with the harshness of undesirable impact and the measurement of its probability of happening [5]. It is a unique mental construct, frequently influenced by factors such as individual socio-economic background, cultural standing, and experiences of risk. Raaijmakers et al [6] interpreted risk perception through the relation of conditional risk attributes, and once the recipient adds a certain characteristics, risk perception may increase and its resilience may enhance as well.

One study suggested that perception may not necessarily affect behaviors. Once an individual is lack of accessible opportunities or available resources, even if he or she has a high attitude and subjective will, they will have fewer intentions to behave accordingly [7]. For example, it is generally assumed that the higher the public's awareness of the greenhouse effect, the greater the effect of its anti-greenhouse effects, but the empirical result showed that Taipei residents have no significant difference in greenhouse effect perception and greenhouse effect behaviors [8].

2.2. Attachment to place

Studies regarding attachment to place and other similar concepts (e.g., sense of place, identity of place and place branding) have developed rapidly [9,10]. Attachment to place originates from the study of environmental psychology, which covers the relationship between people and their home (house), and then gradually extends to the neighborhood and the community, and so on, to address the relationships between individuals and specific settings [11].

Attachment to place and a sense of place also attach great meaning to the subjective assessment of people, but the difference is that the sense of place is dependent on the phenomenological discursive viewpoint, giving emphasis to the idiosyncratic perception and explanation of intangible affection from the perspective of humanism whereas attachment to place favors positivism. Attachment to place is arguably one of the most essential psychosocial perspectives in the relations between people and a place [4,12].

Bailey et al [9] suggest that strong attachments to place are not just based on the length of residence; they are built on continuity with the places of residence. Social support systems, on the other hand, propose a model in which place continuity is considered "natural", while living elsewhere is considered as "unnatural" interpersonal and attachment to place [13].
2.3. Links between environmental concerns and responsive behaviors

Literature has pointed out that related knowledge, past involvements, previous engagements and duration of residence are factors that influence people’s perception toward hazards and risks [14]. Existing disaster literature persistently underlines concerns regarding lack of trust, inefficient or irrelevant information conveyance to elucidate why risk communication usually functions poorly [15].

Once people acknowledge the environmental risks, they are cognizant of the necessity to prevent themselves from impacts of dangerous incidences including torrential rain and flooding in the monsoon season, and others. Nonetheless, personal and group decisions that take action or do not take action are dependent on numerous variables, such as personal perception, the priority of day-to-day life and the harmony between their day-to-day life and the capability to devote to disaster risk reduction actions [16].

Awareness and preparation in response to crises and disaster risk reductions (e.g. fire protection requirements documents) are not necessarily associated with increased awareness and preparation for other crises and disaster risk reductions (such as storms and earthquakes, and so on) [15]. Place and technological significance are commonly interpreted as pluralistic, often contended, dynamic rather than fixed, and are found on the wider social and cultural discourse regarding landscape and rurality [9].

3. Research methods

3.1. Questionnaire survey

This investigation is established on a multi-year project subsidized by Taiwan’s Ministry of Science and Technology. The investigation period was from August 2016 to July 2018. A stratified random sample survey was carried out and a total of 600 valid questionnaires were collected. This study categorized different environmentally sensitive areas in Taipei. According to the cross-tabulation of ecological footprint (EF) (high, medium and low) and synthesized vulnerability (V1-V5), 15 types of environmentally (in)sensitive areas were obtained. Based on these 15 types, this study compares causalities in one environmentally sensitive district (high vulnerability-high EF, Wanhua District) and one environmentally insensitive district (low vulnerability-low EF; Zhongshan District). Whether attachment to place plays a significant role in mediating these causalities is elucidated as well.

3.2. Structural equation modelling (SEM)

The Structural Equation Model (SEM) is a statistical technique which allows the relationships among one or more independent variables and one or more dependent variables to be examined. This investigation puts forward several hypotheses of SEM paths, according to relevant literature review. These hypotheses are built upon factor analyses and are designed to confirm the measurement variables of each measurement models in different dimensions. This study performs path analyses to verify the structural causal models and elucidate whether paths are confirmed by these hypotheses. Furthermore, path analyses are adopted to examine the coefficients of different SEMs of environmentally (in)sensitive districts to explore the causality of environmental concerns, risk perception, attachment to place and preventive behaviors.

4. Results

4.1. High integrated vulnerability / high EF – Wanhua District

Wanhua District was categorized as an environmentally sensitive district due to its "high integrated vulnerability" and "high EF". It can be seen in figure 1 that "climate change attitudes" positively influences "attachment to place" (a coefficient of 0.11); "climate change mitigation behaviors" is indirectly influenced by "attachment to place", which further influences "climate change mitigation behaviors" (a coefficient of 0.05 (0.11*0.47=0.0517)); the coefficient of "climate change adaptation behaviors" is 0.05. "Climate change attitudes" influences both "climate change mitigation behaviors"
(a coefficient of 0.17) and "climate change adaptation behaviors" (a coefficient of 0.11). "Risk perception" affects "climate change mitigation behaviors" (a coefficient of 0.09), and negatively influences "climate change adaptation behaviors" (a coefficient of -0.05). "Risk perception" affects "attachment to place" (a coefficient of 0.09), which indirectly affects "climate change mitigation behaviors" (a coefficient of 0.04); and the coefficient of "climate change adaptation behaviors" is 0.04.

Note: “ATT6” is a measurement for “X1: ATT,” and is calculated from the question of the survey questionnaire: “Increased greenhouse emissions will cause Earth’s surface temperature to rise.”

**Figure 1. SEM for Wanhua District.**

Regarding the path relationship in Wanhua District, people's attitudes toward climate change and knowledge of mitigation behaviors are not high compared with other districts in Taipei. Risk perception is not strongly correlated with mitigation and adaptation behaviors. Moreover, risk perception has fewer impacts on attachment to place. It can be inferred that residents in Wanhua District are less likely to exhibit their mitigation or adaptation behaviors through risk perception and disaster experiences; whereas they have an intention to act on their climate change attitudes, but overall respondents in Wanhua District are still less likely to take mitigation or adaptation actions. Wanhua District is an area with high degree of integrated vulnerability and personal EF; it will strengthen residents in post-disaster reflective ability. Furthermore, because disasters are more frequent, it should learn from each disaster experience to improve the adaptability of Wanhua to face the disaster responsive behaviors. There is no causality among attachment to place, climate change attitudes, risk perception and responsive behaviors.

**4.2. Low integrated vulnerability / low EF – Zhongshan District**

Zhongshan was categorized as an environmentally insensitive district due to its "low integrated vulnerability" and "low EF". Figure 2 indicates that "climate change attitudes" affects "attachment to place" (a coefficient of 0.05). Via "attachment to place", "climate change attitudes" indirectly influences "climate change mitigation behaviors" (a coefficient of 0.02), and indirectly influences "climate change adaptation behaviors" (a coefficient of 0.00). "Climate change attitudes" directly influences "climate change mitigation behaviors" (a coefficient of 0.29) and "climate change adaptation behaviors" (a coefficient of 0.18). "Risk perception" directly influences "climate change mitigation behaviors" (a coefficient of 0.19). “Risk perception” directly and negatively affects "climate change adaptation behaviors" (a coefficient of -0.09). Additionally, "risk perception" negatively affects "attachment to place" (a coefficient of 0.16), and through the impact of "attachment to place", indirectly affects "climate change and mitigation behaviors", with a coefficient of 0.06, but
also indirectly affects "climate change mitigation behaviors", with a coefficient of 0.00.

Figure 2. SEM model for Zhongshan District.

From the path relationship of Zhongshan, the impact of attitudes to mitigation/adaptation behaviors is high, and the influence of risk perception to mitigation/adaptation behaviors is significantly low, but the impact on attachment to place is not significant. It can be inferred that, compared with the risk perception of past experiences, residents of Zhongshan District exhibit mitigation and adaptation behaviors through awareness of climate change.

Taipei has mitigation or adaptation behaviors based on climate change attitudes. However, within the same place, there is no significant correlation among climate change attitudes, risk perception, and preventive behaviors and attachment to place.

5. Conclusions
The analytic results concentrate on whether risk perception and attachment to place will affect people's mitigation and adaptation behaviors in the face of climate change. The results are classified according to different vulnerabilities and EF of Taipei. Only in districts of high vulnerability and low EF, people's risk perception and mitigation behaviors are negatively related. Risk perception in low vulnerability/high EF areas positively relates to the responsive behaviors.

These results imply that whether risk perception has positive or negative influences on the responsive behaviors, there is no obvious difference in the classification of different environmentally sensitive areas. From the results of attachment to place, whether it is different environmentally sensitive area, attachment to place has no significant influence on climate change attitudes, risk perception and responsive behaviors.

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