Pathways of Place Dependence and Place Identity Influencing Recycling in the Extended Theory of Planned Behavior

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Abstract

Studies have been providing increasing evidence of the direct relationship between place attachment and environmentally responsible behavior and intentions. However, research on potential indirect and moderating effects of place attachment sub-constructs (i.e., place dependence and place identity) on recycling intention is scarce. This paper addresses the gap by assessing effects of place dependence and place identity on recycling intention in conjunction with the extended theory of planned behavior (TPB). 1,071 Hong Kong respondents recruited using an online survey indicated their intention to participate in recycling behavior. Results suggest that place dependence indirectly influence recycling intention via place identity in the theoretical structure of the TPB. Place identity significantly moderates the relationships between instrumental attitude and recycling intention, and between perceived behavioral control and recycling intention, while the relationship between experiential attitude and recycling is not subject to place identity. This study provides insights into person-place bonding of performing recycling behavior and assesses the importance of place attachment as a personal factor influencing environmental outcomes.

Keywords: recycling; place dependence; place identity; TPB; mediation; moderation

1. Introduction

Place attachment is the psychological bond between individuals and their environmental settings (Lewicka, 2011; Low & Altman, 1992). A large body of literature suggested that possessing a sense of attachment to a place in which one lives is likely to have a beneficial effect on taking pro-environmental behavior (e.g., Daryanto & Song, 2021; Korpela, 2012; Raymond, Brown, & Robinson, 2011; Scannell & Gifford, 2010a, 2010b; Song, Daryanto, & Soopramanien, 2019; Vaske & Kobrin, 2001) or facilitating the development of environmental intentions (e.g., Halpenny, 2010; Korpela, 2012; Kyle, Absher, & Graefe, 2003; Stedman, 2002; Walker & Chapman, 2003; Wan, Shen, & Choi, 2021). The increasing number of studies calls attention to a better comprehension of the pathways that place attachment influences decision-making of taking pro-environmental behavior.

Recently, a small number of studies has attempted to investigate the effects of place attachment on pro-environmental behavior using the theory of planned behavior (TPB) framework. For example, Anton and Lawrence (2016) assessed parallel effects of place attachment and the TPB on protesting for place change. The study operationalized place attachment as place

dependence–which refers to functional attachment to a place (Stokols & Shumaker, 1981) and place identity–which is defined as symbolic or ideological connection between an individual and a place (Stedman, 2002). Logistic regression analysis showed that it is TPB constructs but not place attachment significantly predicting protesting behavior. Another two studies modelled place attachment on a more abstract dimension (referred to as a higher-order component) which mediates the influence from its more concrete sub-constructs (referred to as lower-order components) (e.g., place identity, place affect, place dependence). The two studies confirmed an indirect effect of place attachment on behavioral intentions via TPB constructs (Han, Kim, Lee, & Kim, 2019; Wan et al., 2021).

Yet this line of research merits more in-depth exploration before it can be considered conclusive. First, Anton and Lawrence (2016) did not investigate if place attachment could interact with the TPB and in turn predict behavior or intentions. Although the TPB is an empirically well-supported theoretical foundation to investigate a wide range of behaviors, meta-analyses conclude that TPB constructs only account for 39% of variance in intentions (Armitage & Conner, 2001; Rivis & Sheeran, 2003). Research suggest that individual differences could account for the unexplained variance and that might have a moderating effect on the TPB relationships (Ajzen, 2011; Rhodes, Courneya, & Hayduk, 2002). Meanwhile, place attachment is characterized as bonding between individuals and their important places (Low & Altman, 1992). The basis for the attachment is highly subjective to an individual and his/her personal experiences with the place (Lewicka, 2011; Raymond, Kyttä, & Stedman, 2017; Scannell & Gifford, 2010a). The portrait of place attachment suggests that it is a personal factor (Gifford & Nilsson, 2014) which there are differences among individuals. The factor therefore should not be excluded for its possible moderating effect on the TPB relationships.

Second, mechanisms of place attachment sub-constructs influencing environmental outcomes in the TPB framework are unclear. The study by Anton and Lawrence (2016) focused on direct impact of place attachment sub-constructs in parallel with the TPB on protesting behavior. Although recent studies have put forward by examining indirect effect of place attachment (e.g., Han et al., 2019; Wan et al., 2021) in the TPB framework, the place attachment sub-constructs had been conceptualized in a higher-order constructs (HOC) model. The practice has blurred the effects of specific place attachment sub-constructs because they had not been separately assessed. Notably, however, prior literature suggests that place attachment sub-constructs affect environmental actions in their own way (Ramkissoon, Smith, & Weiler, 2013). On the one hand, place dependence indirectly influences behaviors or intentions via place identity (Halpenny, 2010; Vaske & Kobrin, 2001). On the other hand, attachment feelings had been found to moderate the relationships between attitudinal constructs and behavior (De Dominicis, Fornara, Cancellieri, Twigger-Ross, & Bonaiuto, 2015; Kyle et al., 2003). Thus, timely research is needed to clarify if place attachment sub-constructs possessed a more complex effect in the TPB.

Against this background, this study aims to address the above research gaps by analyzing the impact of place attachment in conjunction with the TPB on recycling intention. It seeks to investigate whether place attachment would interact with TPB constructs to predict recycling intention. It will also examine mechanisms that the person-place bonding transforms into

environmental outcomes by separately considering the effects of place attachment sub-constructs (i.e., place dependence and place identity) in the TPB. To facilitate the study of the relationships between place attachment and the TPB, we choose recycling intention in Hong Kong for investigation. In 2019, a total of 5.67 million tonnes of municipal solid waste were generated and only 1.64 millon tonnes (29%) were recovered in Hong Kong (Environmental Protection Department, 2020). Fostering an interest in recycling in citizens has been a major task of the city. Early studies revealed that both the TPB and its extended model well explain Hong Kong citizens' recycling intention (Chan, 1998; Cheung, Chan, & Wong, 1999; Wan, Shen, & Choi, 2017). However, these studies did not place person-place bonding under the TPB framework for examination; even though recent scholarly work simultaneously examined the factor and the TPB, research gaps identified from preceding review imply that this area needs much more investigation.

The contribution of this research is threefold. First, it provides additional evidence on the interactive processes between place attachment and the TPB in predicting environmental outcomes. It addresses the knowledge gap that prior literature either did not explore the interactive possibility (Anton & Lawrence, 2016) or restricted the investigation to one type of interactive effects (mediating effect, Han et al., 2019; Wan et al., 2021) between place attachment and the TPB. Second, it goes beyond the current literature by considering distinctive pathways of place attachment sub-constructs that affect recycling intention in the TPB framework. In contrast to previous research which assumes place attachment sub-constructs share identical effect on environmental outcomes (direct effect, e.g., Anton & Lawrence, 2016; Cheng, Wu, & Huang, 2013; Scannell & Gifford, 2010b), this study recognizes and clarifies different mechanisms of place attachment sub-constructs in predicting recycling intention in the TPB framework. Third, this study would advance existing research concerned with improving the understanding of the relationships between place attachment and the TPB. The work together with previous studies provide a basis for comparison in the future research. It is especially useful for comparing explanatory power of different behavior models which integrate place attachment and variables from the TPB or other models such as value-belief-norm (VBN) model and norm activation model (NAM) (see also Raymond et al., 2011).

2. Literature review

2.1. The theory of planned behavior

The theory of planned behavior (TPB) (Ajzen, 1991) has been chosen to develop a theoretically grounded conceptual model for this study. The theory hypothesizes that behavioral intention is the proximal antecedent of behavior, and the intention is a function of attitude, subjective norm, and perceived behavioral control. *Attitude* toward behavior refers to an individual's overall evaluations of performing the behavior. *Subjective norm* is perceived social pressure from important others to perform or not to perform the behavior. *Perceived behavioral control* relates to an individual's perception of ability to carry out the behavior, that is, how difficult or easy that he/she would perceive the behavior is likely to be. The TPB has been widely applied to studying recycling behavior and it has shown good predictive validity (e.g., Chan, 1998; Cheung et al., 1999; Davis, Phillips, Read, & Iida, 2006; Knussen & Yule, 2008; Tonglet, Phillips, & Read, 2004; Wan et al., 2017).

Despite the potent predictive power, a growing body of research has acknowledged the need of expanding original constructs of the TPB. Scholars have proposed that the attitude construct identified in the model should be represented by two components: experiential (emotional, affective) and instrumental (utility, cost-benefit) (Ajzen, 2002; Davies, Foxall, & Pallister, 2002). *Experiential attitude* captures the affective component of attitude, and it is usually represented by the original attitude measure of the TPB. *Instrumental attitude* refers to the functional dimension of attitude which focuses on individuals' knowledge of behavioral consequences and cost-benefit consideration of performing the behavior (Wan et al., 2017). Previous studies examining recycling behavior (e.g., Chen & Tung, 2010; Rhodes et al., 2014; Tonglet et al., 2004) have included the instrumental aspect of attitude and have established positive and significant results. The instrumental attitude in these studies has been measured as instrumental consequences of engaging in recycling behavior. In line with the past research, this study will expand the original attitude construct of the TPB as experiential and instrumental evaluations of a behavior in order to capture the multidimensional notion of attitude (Voss, Spangenberg, & Grohmann, 2003).

2.2. Place attachment

Place attachment is generally conceptualized as affective bonds between individuals and a place (Low & Altman, 1992). The concept is usually conceived as a multidimensional construct representing several dimensions such as place affect, place dependence, place identity, and social bonding (Ramkissoon, Weiler, & Smith, 2012). Nevertheless, no uniform definition of place attachment (Lewicka, 2011; Scannell & Gifford, 2010a) and clear consensus on place attachment scale (Anton & Lawrence, 2014; Daryanto & Song, 2021) has been reached, resulting in heterogeneity in construct evaluation and measurement procedures (Hernández, Hidalgo, & Ruiz, 2020). A common perspective across disciplines refers the concept as having a distinction between emotional-symbolic meanings and functional meanings (e.g., Anton & Lawrence, 2016; Bricker & Kerstetter, 2000; Moore & Graefe, 1994; Kyle et al., 2003; Vaske & Kobrin, 2001; see also Schreyer, Jacobs, & White, 1981). The emotional-symbolic meanings is termed place identity while the functional meanings is referred to place dependence (Williams & Roggenbuck, 1989).

Place dependence is defined as functional attachment to a place (Stokols & Shumaker, 1981); it captures behavioral aspects of humans' ties to the place (Williams & Roggenbuck, 1989). The functional connection to a place arises from an evaluation of that place on the basis that it provides individuals with resources and facilities that support for goal attainment (Stokols & Shumaker, 1981). It reflects the degree to which the physical environment provides conditions to support an individual's intended use (Raymond, Brown, & Weber, 2010). *Place identity* is an individual's personal identity defined in relation to a physical environment; it is a combination of ideas, beliefs, preferences, feelings, values, goals, and behavioral tendencies toward a physical setting (Proshansky, Fabian, & Kaminoff, 1983). Giuliani and Feldman (1993) considered the concept as a result of an individual psychologically invests in a place over time and assigns symbolic meanings to that place. This set of emotional and symbolic meanings about the physical setting forms a major part of an individual's self-concept (Jorgensen & Stedman, 2001, 2006; Pretty, Chipuer, & Bramston, 2003).

Studies using two-dimensional conceptualization (i.e., place dependence and place identity) found a positive association between place attachment and pro-environmental intentions (Walker & Chapman, 2003) and environmentally responsible behavior (Cheng et al., 2013). Place-dependent individuals were found to be more concerned with resource development and maintenance (Bricker & Kerstetter, 2000). Evidence suggested that place dependence is positively connected to the spending support for environmental education (Kyle et al., 2003), engagement in environmentally responsible behavior (Kuo, Su, Wang, Kiatsakared, & Chen, 2021; Vaske & Kobrin, 2001) and general pro-environmental behavior such as recycling and energy saving (Junot, Paquet, & Fenouillet, 2018). However unlike Vaske and Kobrin (2001) which reported direct and indirect effect of place dependence, Halpenny (2010) only found an indirect relationship between place dependence and pro-environmental intentions. By contrast, past research generally concluded that place identity plays a positive vital role of motivating environmentally responsible behavior (for exception, see Uzzell, Pol, & Badenas, 2002). Individuals with a higher level of place identity were more willing to take place-protective actions (Devine-Wright & Howes, 2010; Stedman, 2002) and pay higher conservation fees (Kyle et al., 2003). The factor also positively influenced environmentally responsible behavior such as recycling (Vaske & Kobrin, 2001) and park visitors' environmental intentions like picking up other people's litter (Walker & Chapman, 2003). Based on the above literature we proposed the following hypotheses:

Hypothesis 1a (H1a). *Place dependence has a positive relationship with recycling intention in the extended TPB framework.*

Hypothesis 1b (H1b). *Place identity has a positive relationship with recycling intention in the extended TPB framework.*

2.3. Indirect effect of place dependence

Mixed results concerning the direct impact of place dependence revealed from the preceding section has caused us to become questioning the possibility of indirect effect of place dependence on environmental outcomes in the TPB framework. In fact, previous literature from across disciplines suggested that place dependence positively contributes to place identity (Anton & Lawrence, 2014; Hailu, Boxall, & McFarlane, 2005; Moore & Graefe, 1994; Kuo et al., 2021). Researchers justified their viewpoint by arguing that extensive interaction with a place due to place dependence may lead to place identity (Moore & Graefe, 1994). For a place to be incorporated in individuals' self-identity structure and provides them with feelings of distinctiveness and belonging, the place should first provide conditions and features that meet individuals' needs (Anton & Lawrence, 2014). Once a place supports one's goals, people tend to stay in or have frequent visits to that place and become place dependent. The increased interaction and direct experience with the place may become an important part of place identity (Trąbka, 2019). Recreation studies also highlighted that place dependence does not directly predict visitor intentions due to an absence of variability in site-specific facilities and activities of the investigated sites (Hailu et al., 2005; Halpenny, 2010). Quantitative evidence by Vaske and Kobrin (2001) indicated that place identity mediates the relationship between place dependence and general environmentally responsible behavior. Later, Halpenny (2010) also found that the impact of dependence-affect on park visitors' pro-environmental intentions is

mediated by identity-affect. Based on the above discussion and evidence, this study takes a perspective that place dependence precedes place identity in influencing recycling intention. Place dependence is suggested to possess an indirect effect on recycling intention in the TPB framework, and place identity may serve as a mediator in between the relationship. Hence:

Hypothesis 2 (H2). *The impact of place dependence on recycling intention is mediated by place identity in the extended TPB framework.*

2.4. Place identity as a moderator of TPB relationships

While place dependence is suggested possessing an indirect effect on recycling intention in the TPB framework, another question arises as what kind of impact that place identity would have on recycling intention. A small number of studies have explored interaction effects between place attachment and attitudinal factors. For example, Kyle et al. (2003) examined interactions between place identity and attitude toward fee programs. De Dominicis et al. (2015) investigated the moderating role of place attachment on the relationship between environmental risk perception and preventive coping behavior. This research proposed that place identity may moderate the following TPB relationships.

The attachment people develop with the physical setting is likely to foster a positive attitude toward pro-environmental attitude and behavior (Brehm, Eisenhauer, & Stedman, 2013; Hernández, Martín, Ruiz, & Hidalgo, 2010; Stedman, 2002). Prosocial behavior is expected to benefit a place, which in turn, helps maintain a positive image of the place. People might hold favorable attitude toward recycling behavior that they deem compatible with their self-schemas because the behavior coincide with their value orientation (cf. Social Judgement Theory, Sherif & Hovland, 1961). Therefore, possessing higher levels of place identity may enhance an individual's positive evaluation of recycling behavior. The interaction between place identity and attitude toward behavior has been explored in one study. Kyle et al. (2003) confirmed that place identity is a significant moderator that magnifies the relationship between attitude toward fee programs and spending support in a recreation setting.

No previous research investigated interaction between place identity and instrumental attitude on recycling intention. Possessing higher levels of place attachment is generally considered as a pre-condition of developing awareness of consequences of taking pro-environmental behavior (e.g., Vorkinn & Riese, 2001; Williams, Patterson, & Roggenbuck, 1992; Zhang, Zhang, Zhang, & Cheng, 2014). Nevertheless, place attachment may weaken the association between instrumental attitude and recycling intention. Proshansky et al. (1983) proposed that defense is one of the core functions of place identity in response to environmental changes. A strong identification with a place may signal individuals the presence of threat and danger in physical settings; it may also imply responses tendencies enacted to cope with the risks (Peng, Strijker, & Wu, 2020). As a result, the predictive power of instrumental attitude toward recycling might reduce in a situation which people have deeply identified themselves with the place. In this connection, people are more likely to set recycling intention because of his/her internalized self-identification with the place and the associated tendencies to fight against environmental risks rather than being aware of the positive consequences of engaging in

recycling. Thus, we contended that place identity may weaken the strength between instrumental attitude and recycling intention.

There is a profound connection between attachment to a place and familiarity of the attached physical setting (Fullilove, 1996; Scannell & Gifford, 2010a). Fullilove (1996) considered familiarity as a cognitive component of attachment to a place. Scannell and Gifford (2010a) elaborated that to be attached to a place is to know the details of the environment. People who are strongly attached to a physical setting are assumed to acquire knowledge of that place through direct experience. One would exhibit higher tendencies of possessing more knowledge of recycling facilities, perceived opportunities of recycling, and perceived capability of recycling compared to an individual who has lower levels of place identity. Indeed, possessing place identity not only implies the desire to maintain personal distinctiveness or uniqueness but reflects a personal belief that one is capable of carrying out activities at a certain place as well (Twigger-Ross & Uzzell, 1996). Therefore, place identity may strengthen the relationship between perceived behavioral control and recycling intention. Three hypotheses were proposed based on the above literature:

Hypothesis 3a (H3a). *Place identity positively moderates the relationship between experiential attitude and recycling intention in the extended TPB framework.*

Hypothesis 3b (H3b). *Place identity negatively moderates the relationship between instrumental attitude and recycling intention in the extended TPB framework.*

Hypothesis 3c (H3c). *Place identity positively moderates the relationship between perceived behavioral control and recycling intention in the extended TPB framework.*

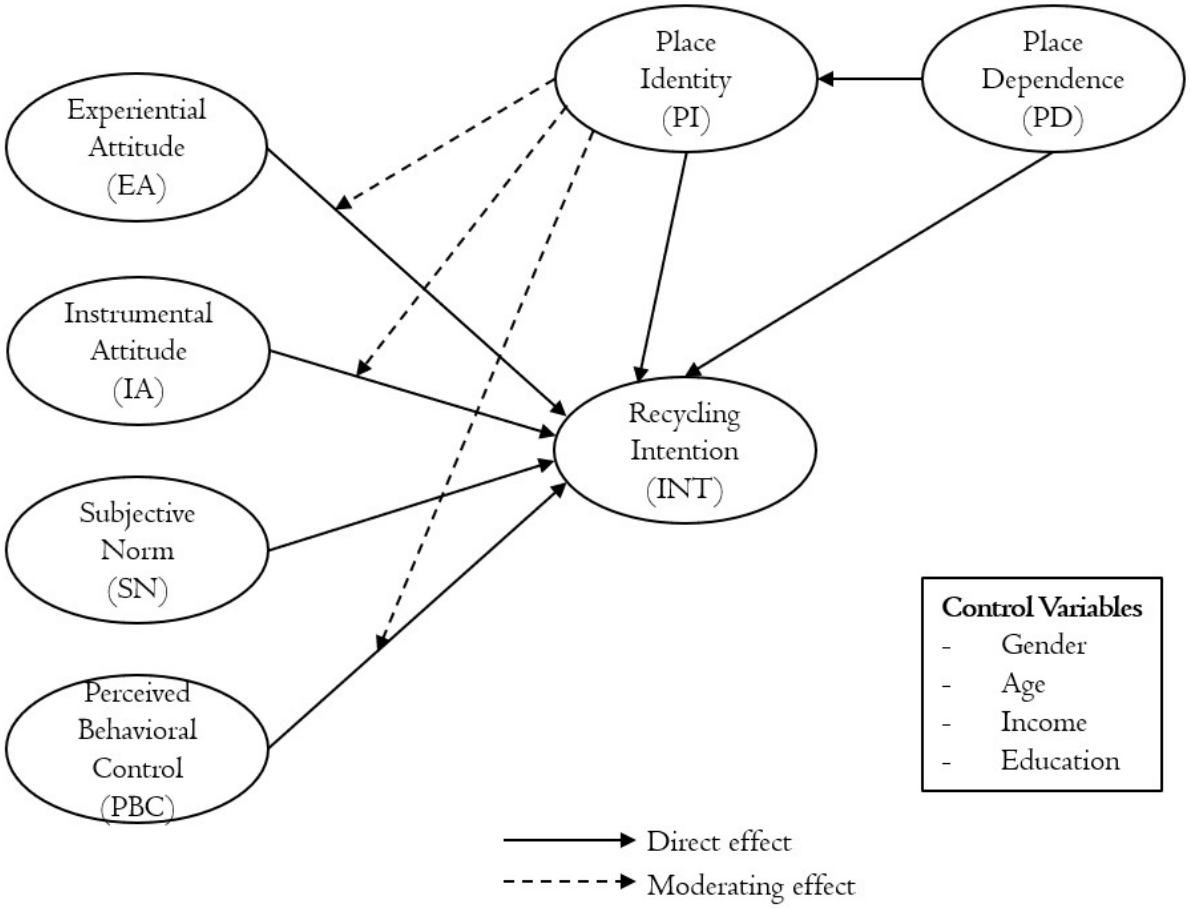

Figure 1. Proposed research model

3. Method

3.1. Participants and procedure

Data were collected using a random sampling online questionnaire survey. Ethical approval of the research project was obtained from authors' institutions. The survey was carried out in Hong Kong in November 2019. Target participants were Hong Kong residents aged 18 to 64. This age range was selected for two reasons. First, people from this age range are active age groups engaging in economic activities and thus likely to generate more waste. Second, people might not be able to comprehend the questionnaire if they are too young or too old. 6,658 invitation letters were sent to eligible panel members of a marketing research company via email. 1,614 invited participants have opened the survey link. 1,102 responses were collected. 31 participants aged 65 or older were excluded for analysis. A total of 1,071 responses were scrutinized as valid for data analysis.

To calculate the required sample size, we have performed a statistical power analysis based on significance level of hypothesis testing (α), effect size (f^2), and the number of paths directed at the dependent variable (np) (Akter, D'Ambra, & Ray, 2011; Cohen, 1988) using a software G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). The result indicated that the minimum sample size required for this study is 194 ($\alpha = 0.05$; $f^2 = 0.15$; np = 14). Therefore, 1,071 observations are statistically adequate.

Table 1 presents respondents' profiles. Nearly half of respondents are male (47.8%), reflecting a similar gender ratio of the city as of mid-2020 statistics. Young and middle-aged respondents represent the majority of the sample (24% from 18-24 years, 26.7% from 25-34 years, 23.7% from 35-44 years). The rest are aged 45 to 54 (17.9%) and 55 to 64 years old (7.7%). There are 2.3% of respondents with primary or below education level. One-third of respondents (30.2%) complete secondary education. Over two-third of respondents (67.5%) have received tertiary education. 15.3% respondents earn less than HKD9,999. People earning HKD10,000 to 19,999 constitute the largest income group (29.9%), followed by income group HKD20,000 to 29,999 (23.2%). Monthly income HKD30,000 to 39,999 account for 14.4%. The rest are respondents with monthly income HKD40,000 or above (17.3%).

Table 1. Profile of survey respondents (n = 1,071)

Demographic characteristics	Unweighted sample (%)	Weighted sample (%)	Hong Kong Census mid-2020 (%)
Gender			
Male	47.8%	48.2%	47.1%
Female	52.2%	51.8%	52.9%
Age (in years)			
18 to 24	24.0%	10.2%	10.2%
25 to 34	26.7%	19.4%	19.4%
35 to 44	23.7%	21.8%	21.8%
45 to 54	17.9%	22.9%	22.9%
55 to 64	7.7%	25.8%	25.8%
Monthly Income (HKD)			
≤ 9,999	15.3%	11.6%	13.6%
10,000-19,999	29.9%	28.6%	36.4%
20,000-29,999	23.2%	23.0%	20.3%
30,000-39,999	14.4%	16.4%	10.6%
≥ 40,000	17.3%	20.4%	19.2%
Education Level			
Primary or below	2.3%	1.9%	9.0%
Lower secondary	3.3%	3.2%	14.3%
Upper secondary	26.9%	32.6%	33.0%
Tertiary: non-degree course	20.1%	18.7%	11.0%
Tertiary: degree course	47.4%	43.6%	32.7%

3.2. Measures

Measures of this study were drawn reference to past studies (Knussen, Yule, MacKenzie, & Wells, 2004; Tonglet et al., 2004; Wan et al., 2017; Raymond et al., 2010). A seven-point Likert scale ranging from 1 (indicating strongly disagree) to 7 (indicating strongly agree) was used to measure all psychometric items. Demographic and socio-economic variables, including gender, age, personal monthly income, and education level were asked at the end of the questionnaire. Questionnaire items were translated into Traditional Chinese to facilitate the target audience. A pilot test was organized with 16 people answering the questions. Questionnaire was finalized after ambiguous or unclear wordings had been refined. Pilot test results were excluded from official data analysis.

Experiential attitude (Cronbach's α = 0.928) . The construct consists of five items tapping the experiential component of attitude taken from Tonglet et al. (2004): *"Recycling is good"*, *"Recycling is useful"*, *"Recycling is rewarding"*, *"Recycling is a responsible behavior"*, and *"Recycling is sensible"*.

Instrumental attitude (Cronbach's α = 0.898). It was measured with four items that closely follow the measurement of this construct used in the past studies (Tonglet et al., 2004; Wan et al., 2017). It taps instrumental component of attitude: *"Recycling helps to protect the environment"*, *"Recycling reduces wasteful use of landfills"*, and *"Recycling preserves natural resources"*, and *"Recycling improves environmental quality"*.

Subjective norm (Cronbach's α = 0.886). It was assessed with four items taken from previous research (Knussen et al., 2004; Wan et al., 2017). Participants were asked to evaluate the following statements: *"Most people who are important to me think I should recover recyclable waste"*, *"Most people who are important to me would approve of me recycling my recyclable waste"*, *"My family expects me to recycle household recyclable waste"*, and *"My friends expect me to recycle household recyclable waste"*.

Perceived behavioral control (Cronbach's α = 0.913). Participants were asked to rate the following statements adopted from Knussen et al. (2004) and Tonglet et al. (2004): *"I have plenty of opportunities to recycle recyclable materials"*, *"Doing recycling is an easy job"*, *"Doing recycling is convenient"*, *"I know how to recycle recyclable materials"*, *"There is enough time for me to do recycling practices"*, and *"There is enough space for me to do recycling practices"*.

Place dependence (Cronbach's α = 0.911). The measure consists of five items taken from a study by Raymond et al. (2010) with minor modification: *"I get more satisfaction out of living in Hong Kong than any other place"*, *"Hong Kong is the best place for the activities I like to do"*, *"Doing my activities in Hong Kong is more important to me than doing them in any other place"*, *"I would not substitute any other area for the activities I do in Hong Kong"*, and *"No other place can compare to Hong Kong"*.

Place identity (Cronbach's α = 0.937). The five-item construct was also drawn reference from the study by Raymond et al. (2010). Participants were asked to rate their agreement on the following statements: *"Hong Kong means a lot to me"*, *"I am very attached to Hong Kong"*, *"I have a lot of fond memories about Hong Kong"*, *"Hong Kong is very special to me"*, and *"I identify strongly with Hong Kong"*.

Recycling intention (Cronbach's α = 0.877). The construct was assessed by three items adopted from Wan et al. (2017). Participants were asked to rate the following statements: *"I intend to recycle my recyclables in the next four weeks"*, *"I will recycle my recyclables every time I have it for disposal"*, and *"I am willing to participate in recycling scheme in the future"*.

3.3. Common method variance

Common method variance may cause biased estimations since data used in this study were self-reported and collected using a questionnaire. We have taken feasible procedural remedies to minimize common method variance (MacKenzie & Podsakoff, 2012; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). First, respondents were told that this is an anonymous survey, and their identities will be kept private. Second, we have instructed respondents at the beginning of the survey that there are no right or wrong answers. Respondents were reminded to respond honestly and to the best of their knowledge.

If common method variance is a problem in the study, a single factor would emerge from the exploratory factor analysis or a factor accounts for a substantial amount of variance (Podsakoff & Organ, 1986). Harman's One-Factor Test indicates that all constructs in this study explained 69.9% of the total model variance. The largest factor accounts for 43.9% of it, below the criteria

for common method bias (50%) (Podsakoff & Organ, 1986). Thus, common method bias is not an issue in this study.

3.4. Statistical analysis

Partial least squares structural equation modelling (PLS-SEM) was employed for statistical analysis in this study. Structural equation modelling (SEM) measures relationships between unobserved constructs based on their assigned indicators (Chin, 1998). PLS-SEM is a prediction-oriented approach to SEM, and it has advantage over covariance-based SEM (CB-SEM) for handling complex structural models which contain many constructs and indicators (Hair, Ringle, & Sarstedt, 2011). Moreover, this research is an extension of an existing structural theory and aims to predict proposed key target constructs; thus, PLS-SEM is appropriate for this study. Data analysis was performed on statistical software SmartPLS version 3.3.3.

Sampling weight adjustments in PLS-SEM was applied following procedures stipulated by Cheah, Roldán, Ciavolino, Ting, and Ramayah (2020). Gender and age are commonly selected population characteristics for weighting (Biemer & Christ, 2008). Since gender in this study reflected a similar gender ratio of the city, only age was chosen as the auxiliary variable for data weight to align with the sample with benchmarks from the mid-2020 General Household Survey of the city (Table 1). The weighted numbers are reported and discussed in the remainder of the article.

Internal consistency (e.g., Cronbach's alpha), convergent validity (e.g., average variance extracted), and discriminant validity were assessed in the measurement model. Research hypotheses were tested in the structural model. Recycling intention was set as dependent variable. Independent variables were constructs of the extended TPB, place dependence, and place identity. Gender, age, income level, and education level were covariates of this study. A bootstrapping technique using 5,000 samples was performed to confirm the significance of pathways. The effect is considered significant if confidence intervals exclude zero. The mediating effect of place dependence on intention via place identity was tested with the bootstrapped confidence intervals of the indirect effect. Moderating effects of place identity on the TPB relationships were also assessed by referring to bootstrapped confidence intervals. Simple slope analysis was performed to interpret the moderating effects.

4. Results

4.1. Measurement model assessment

Internal reliability, convergent validity, and discriminant validity of construct measures were evaluated following the procedures outlined by Fornell and Larcker (1981). Internal reliability evaluates the consistency of results across each construct's measures. In order to confirm internal reliability, the values of composite reliability and Cronbach's Alpha should be greater than 0.60 and 0.70, respectively. Convergent validity is the degree to which a measure correlates positively with an alternative measure of the same construct. To provide support for convergent validity, factor loadings of a construct should be above 0.70 and the average

variance extracted (AVE) value of a construct should exceed 0.50. Consequently, all the constructs of this study are sufficiently valid and reliable (Table 2).

Table 2. Results summary of measurement model

Construct	Indicators	Factor loadings	Average variance extracted	Composite reliability	Cronbach's alpha
Experiential Attitude (EA)	EA1	0.873	0.776	0.945	0.928
	EA2	0.886			
	EA3	0.895			
	EA4	0.881			
	EA5	0.871			
Instrumental Attitude (IA)	IA1	0.902	0.766	0.929	0.898
	IA2	0.882			
	IA3	0.908			
	IA4	0.804			
Subjective Norm (SN)	SN1	0.866	0.743	0.921	0.886
	SN2	0.882			
	SN3	0.856			
	SN4	0.844			
Perceived Behavioral Control (PBC)	PBC1	0.790	0.697	0.932	0.913
	PBC2	0.865			
	PBC3	0.882			
	PBC4	0.796			
	PBC5	0.857			
	PBC6	0.815			
Place Dependence (PD)	PD1	0.856	0.738	0.934	0.911
	PD2	0.870			
	PD3	0.872			
	PD4	0.843			
	PD5	0.855			
Place Identity (PI)	PI1	0.903	0.800	0.952	0.937
	PI2	0.893			
	PI3	0.877			
	PI4	0.913			
	PI5	0.886			
Recycling Intention (INT)	INT1	0.874	0.803	0.924	0.877
	INT2	0.909			
	INT3	0.905			

Discriminant validity is assessed to ensure that every construct is unique and captures phenomena not represented by other constructs in the model (Hair, Hult, Ringle, & Sarstedt, 2013). This study used Fornell-Larcker criterion to assess discriminant validity. It compares the square root of the AVE with the correlations between the constructs. Table 3 shows that all constructs fulfil the requirement because the square root of each construct's AVE is larger than its correlation with other constructs. Alternatively, we examined Heterotrait-Monotrait ratio (HTMT) to consider the discriminant validity (Table 4). Henseler, Ringle, and Sarstedt (2015) suggested that HTMT ratio is a more reliable and an alternative index compared to Fornell-

Larcker criterion. All HTMT values in this study are lower than the threshold value of 0.85. As expected, discriminant validity of constructs was established.

Table 3. Discriminant validity using Fornell-Larcker criterion

Construct	EA	IA	SN	PBC	PD	PI	INT	*M*	*SD*
EA	**0.881**							6.118	0.847
IA	0.713	**0.875**						5.990	0.890
SN	0.491	0.398	**0.862**					5.270	1.038
PBC	0.499	0.501	0.601	**0.835**				5.318	1.005
PD	0.346	0.379	0.404	0.466	**0.859**			5.413	1.127
PI	0.515	0.500	0.424	0.452	0.761	**0.894**		5.881	1.018
INT	0.580	0.585	0.459	0.548	0.372	0.491	**0.896**	5.779	0.960

Note. EA = Experiential Attitude; IA = Instrumental Attitude; SN = Subjective Norm; PBC = Perceived Behavioral Control; PD = Place Dependence; PI = Place Identity; INT = Recycling Intention. Figure in bolded diagonal are values of the square root of the AVE.

Table 4. Discriminant validity using HTMT criterion

Construct	EA	IA	SN	PBC	PD	PI	INT
EA							
IA	0.779						
SN	0.532	0.442					
PBC	0.537	0.550	0.666				
PD	0.374	0.418	0.447	0.510			
PI	0.553	0.546	0.461	0.485	0.820		
INT	0.641	0.657	0.511	0.649	0.412	0.542	

Note. EA = Experiential Attitude; IA = Instrumental Attitude; SN = Subjective Norm; PBC = Perceived Behavioral Control; PD = Place Dependence; PI = Place Identity; INT = Recycling Intention.

4.2. Structural model assessment

Table 5 shows the results of the structural model test, with variance explained in recycling intention and path coefficients. The R^2 value for recycling intention is moderate for all models (Hair et al., 2013), ranging from 0.488 to 0.520. Q^2 value was also assessed to evaluate the predictive power of the structural model. Q^2 value from all models (from 0.384 to 0.406) larger than zero indicates good predictive relevance.

Table 5. Structural model results

Independent variables	Model 1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI
Demographic						
Gender	0.008	[-0.042, 0.058]	0.010	[-0.040, 0.060]	0.006	[-0.044, 0.055]
Age	-0.006	[-0.062, 0.047]	-0.006	[-0.064, 0.048]	-0.020	[-0.073, 0.030]
Income	0.037	[-0.019, 0.095]	0.037	[-0.018, 0.095]	0.048	[-0.006, 0.104]
Education	0.052	[-0.006, 0.108]	0.053	[-0.008, 0.109]	0.038	[-0.024, 0.096]
Extended TPB						
EA	0.200***	[0.111, 0.289]	0.158**	[0.062, 0.254]	0.132*	[0.032, 0.246]
IA	0.257***	[0.172, 0.343]	0.229***	[0.134, 0.326]	0.198***	[0.110, 0.296]
SN	0.067	[-0.027, 0.166]	0.053	[-0.035, 0.155]	0.066	[-0.017, 0.162]
PBC	0.321***	[0.218, 0.417]	0.314***	[0.208, 0.408]	0.303***	[0.205, 0.390]
Place attachment						
H1a: PD			-0.080	[-0.171, 0.019]	-0.066	[-0.150, 0.028]
H1b: PI			0.195**	[0.046, 0.332]	0.207**	[0.081, 0.316]
Mediation						
H2: PD → PI → INT					0.157**	[0.063, 0.239]
Moderation						
H3a: EA×PI					-0.012	[-0.090, 0.066]
H3b: IA×PI					-0.123*	[-0.217, -0.025]
H3c: PBC×PI					0.111**	[0.025, 0.184]
R^2	0.488		0.503		0.520	
Q^2	0.384		0.394		0.406	

Note. EA = Experiential Attitude; IA = Instrumental Attitude; SN = Subjective Norm; PBC = Perceived Behavioral Control; PD = Place Dependence; PI = Place Identity; INT = Recycling Intention. Two-tailed test of significance was used. *$p < .05$; **$p < .01$; ***$p < .001$.

4.2.1. Direct effects

In line of prior literature the extended TPB (Model 1) showed the goodness of prediction of recycling intention, with experiential attitude (β = 0.200, $p < .001$, 95% CI = [0.111, 0.289]), instrumental attitude (β = 0.257, $p < .001$, 95% CI = [0.172, 0.343]), and perceived behavioral control (β = 0.321, $p < .001$, 95% CI = [0.218, 0.417]) significantly predicting recycling intention. However, subjective norm had an insignificant relationship with recycling intention (β = 0.067, $p = .173$, 95% CI = [-0.027, 0.166]). Model 2 tested if place dependence and place identity fit within the extended TPB framework. The extended TPB constructs retained their significance in Model 2 as they were in Model 1. H1a was not supported as place dependence was not associated with recycling intention (β = -0.080, $p = .101$, 95% CI = [-0.171, 0.019]). In accordance with H1b, place identity was a significant predictor of intention (β = 0.195, $p < .01$, 95% CI = [0.046, 0.332]).

4.2.2. Mediating effect

A mediation analysis was conducted to assess the indirect impact of place dependence on recycling intention via place identity (Model 3). Following Zhao, Lynch, and Chen's (2010) mediation analysis procedures, the indirect effect was first determined for its significance. Results demonstrated that the tested indirect effect was significant (H2: β = 0.157, $p < .01$).

The significance via confidence intervals based on 5,000 sample bootstrapping procedure indicated that confidence intervals at the 95% level did not include zero (95% CI = [0.063, 0.239]). Next, we determined the significance of the direct effect of place dependence on recycling intention after controlling the mediator place identity. The direct effect of place dependence on recycling intention is non-significant (β = -0.066, p = 0.148, 95% CI = [-0.150, 0.028]). According to Zhao et al. (2010), the findings suggested that there is indirect-only mediation effect between place dependence and recycling intention.

4.2.3. Moderating effects

With respect to the moderating effect of place identity (Model 3), there is no moderating effect of place identity on the relationship between experiential attitude and recycling intention (H3a: β = -0.012, p = 0.773, 95% CI = [-0.090, 0.066]). Interaction of place identity and instrumental attitude is negatively and significantly associated with recycling intention (H3b: β = -0.123, p < .05, 95% CI = [-0.217, -0.025]). Moreover, the product term of place identity and perceived behavioral control positively and significantly contributes to recycling intention (H3c: β = 0.111, p < .01, 95% CI = [0.025, 0.184]). The f^2 effect size of the tow interaction terms is 0.018 (place identity and instrumental attitude) and 0.021 (place identity and perceived behavioral control), implying a medium effect (Kenny, 2018).

Two statistically significant interaction terms were visualized to better comprehend how place identity interacts with instrumental attitude and perceived behavioral control. Figure 2a suggests that the effect of instrumental attitude on recycling intention decreases as place identity increases, that is, a negative interaction. Higher levels of place identity entail a weaker relationship between instrumental attitude and recycling intention, while low levels of place identity led to a stronger relationship. In Figure 2b, the relationship between perceived behavioral control and recycling intention becomes stronger with higher levels of place identity, as indicated in the high moderator line which slope is steeper. By contrast, the slope is flatter for low levels of place identity, implying that the relationship between perceived behavioral control and recycling intention becomes weaker.

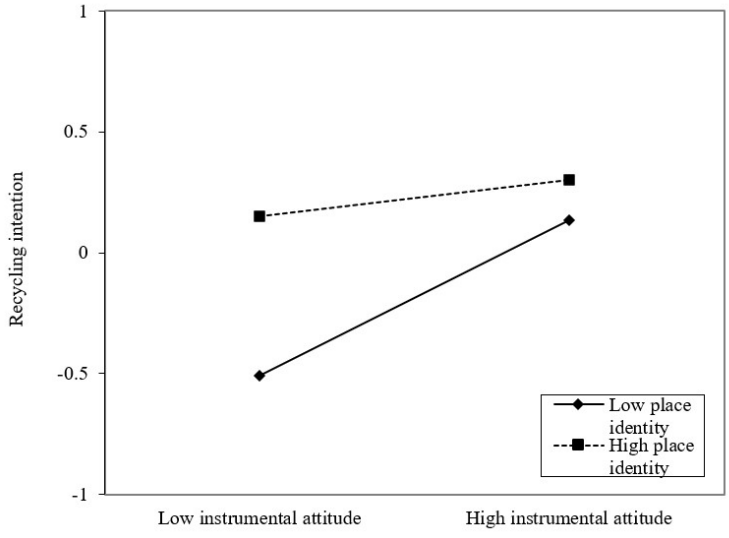

Figure 2a. Instrumental attitude by place identity interaction on recycling intention

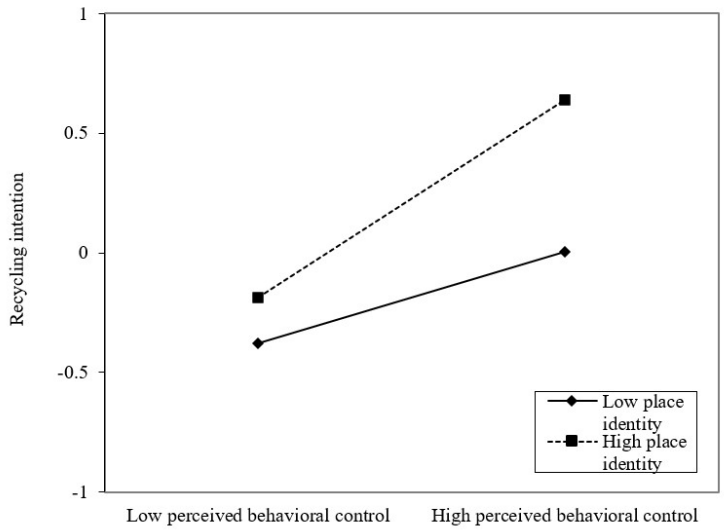

Figure 2b. Perceived behavioral control by place identity interaction on recycling intention

5. Discussion

The objective of this paper was integrating the concept of place attachment into the TPB. It explored the impact and pathways of place attachment sub-constructs influencing recycling intention. The rest of this section discusses results of hypothesis testing and associated theoretical implications. Practical meanings on environmental policy will be followed.

5.1. Integrating place attachment sub-constructs into the TPB

We did not find support for Hypothesis 1a that place dependence has a significant direct impact on recycling intention in the extended TPB framework. One possible explanation is that place dependence possesses an indirect effect on recycling intention instead. The results of mediation test, which would be discussed in the next section, gave support to the explanation. Regarding place identity, it was an immediate predictor of recycling intention (Hypothesis 1b). Consistent with previous research (e.g., Vaske & Kobrin, 2001; Walker & Chapman, 2003), the more individuals identified with a place, the more likely they will set environmentally friendly intentions. Our results indicated that place identity has similar connection to recycling intention compared with those significant TPB constructs. This implies that a personal identification with a place is an important predictor of environmental concern and behavior (Gifford & Nilsson, 2014). This may be especially true for that many environmental behaviors are context-specific and being conducted locally; variations in person-place bonding deserves a place in explaining individuals' responses to environmental problems (Clayton et al., 2016; Devine-Wright & Clayton, 2010).

5.2. An indirect effect of place dependence in the TPB

Statistical results supported Hypothesis 2 regarding the indirect effect of place dependence on recycling intention via place identity in the TPB model. The supported hypothesis may also explain why place dependence did not show significant direct influence on recycling intention. Anton and Lawrence (2016) found that place dependence was highly correlated with place

identity while the two sub-constructs were associated with TPB constructs; however, only TPB constructs significantly predicted place protective behaviors, leaving questions unanswered regarding the underlying relationships between place attachment and the TPB model. This study went farther by showing that place dependence is indirect linked to recycling intention in the extended TPB model through place identity. Providing opportunity to meet the individual's needs is one of the emphasized aspects for creating emotional and symbolic bonds between a person and particular places (Williams et al., 1992). Stronger bonds with the place is more likely on the basis of place dependence and becomes a part of one's identity (Anton & Lawrence, 2014; Moore & Graefe, 1994; Trąbka, 2019; Vaske & Kobrin, 2001). Hence, place dependence is the fundamental building block of place identity. The investigation allowed us to describe relationship between place attachment sub-constructs and the TPB with greater detail than previous studies (Anton & Lawrence, 2016; Wan et al., 2021). Our results showed that even in the TPB model the functional value of the place relies on identity structure to transform its impact on recycling intention, and place attachment sub-constructs may have differential effects and directions on environmental outcomes. Although prior studies have already shown an indirect effect of place dependence on environmental behaviors via place identity (e.g., Halpenny, 2010; Vaske & Kobrin, 2001), simultaneously analyzing both place attachment sub-constructs and the TPB model provides future studies with a basis for comparing our results.

5.3. Moderating effect of place identity in the TPB

The moderating test of place identity sheds light on when do the TPB constructs encourage or discourage pro-environmental intentions by taking the psychological connection between individuals and place into consideration.

Place identity negatively moderated the relationship between instrumental attitude and recycling intention (Hypothesis 3b). Although instrumental attitude is a direct predictor of recycling intention (e.g., Wan et al., 2017; Tonglet et al., 2004), we argued that it would become less significant to people who define themselves as highly attached to the place where they are living in. It is because there is an automatic defensive mechanism if an individual possessed higher levels of place identity (Peng et al., 2020; Proshansky et al., 1983; Sherman & Cohen, 2006; see also De Dominicis et al., 2015). In such a scenario, individuals may adopt pro-environmental responses for the purpose of keeping environmental features that are associated with place identity (Twigger-Ross & Uzzell, 1996; Uzzell et al., 2002) and they tend to invest considerable resources to protect the place that is important to them. By contrast, people who possess low levels of place identity are less likely to trigger the defensive mechanism; in this case, place-related self-schemas may have little or no impact on their behavioral intentions. Rather, they may accord more attention to the instrumental outcomes of engaging in behavior that benefits the environment. Instrumental attitude toward recycling is the functional beliefs of performing recycling behavior. Drawing from the findings it could be concluded that place identity overtakes the rational justification of engaging in environmental behavior and attenuates the influence of instrumental attitude on recycling intention.

We also found that place identity positively moderates the impact of perceived behavioral control such that it was a stronger predictor of recycling intention at higher levels of place

identity than at low levels (Hypothesis 3c). It explains why individuals with higher levels of place identity are presumed to be capable of carrying out activities in a place (Twigger-Ross & Uzzell, 1996). The findings confirm our proposition inferred from the argument by previous studies (e.g., Fullilove, 1996; Scannell & Gifford, 2010a) that familiarity of the place resulted from the identification of self to a place is likely to equip individuals with knowledge of that place, for example, knowledge of local's recycling sorting system, information facilitating the allocation of recycling facilities, and promotional events held in the community. All the knowledge depends partly on the degree of familiarity of the place which would contribute to the perceived capability of engaging in recycling behavior.

We did not find support for that place identity moderates the relationship between experiential attitude and recycling intention (Hypothesis 3a). This is somehow puzzling as empirical research by Kyle et al. (2003) has provided evidence that the attitude-behavior relationship is stronger for people with higher levels of place identity. Previous studies also highlighted a stronger effect of pro-environmental attitude on behavior given a stronger sense of place identity (Hernández et al., 2010). One possible explanation is that experiential attitude toward recycling behavior among Hong Kong respondents is stable enough that it persists over time and resists to change (Petty & Krosnick, 1995). As a result, place identity is unlikely to be significantly magnifying the attitude-intention relationship in a situation where people have already held a strong and stable experiential attitude toward recycling behavior. Ongoing effort is required to better understand relationships between place identity, strong and weak experiential attitude, and behavioral intentions in the future.

5.4. Recommendations for environmental campaigns

Marketers wishing to employ communications based on people's levels of place attachment should consider the implications of this research. Even though both place dependence and place identity are place-based psychological bonding, they did not share identical impact on pro-environmental behavioral intentions. Since the effect of place dependence on recycling intention is fully mediated by place identity, highlighting a place as an essential for supporting daily activities to people is not an effective strategy of boosting recycling intention. Instead, communication campaigns should be developed by fostering place identity among citizens to stimulate recycling intention. For instance, campaigns might be designed by engaging people in activities that help individuals develop and foster their sense of identity of the place, which in turn, drives higher levels of recycling intention.

Besides, policy managers should formulate waste management strategies carefully if place-based psychological meanings such as place identity were used. For example, place identity should be aligned with the concept of perceived behavioral control when designing environmental messages and promotional campaigns. Conversely, it is unlikely to be effective if the strategies were designed by simultaneously drawing reference to the ideas of instrumental attitude and place identity. It is because the latter might undermine the effect of instrumental attitude in promoting recycling intention according to findings of this study. In brief, the role of place attachment should be carefully considered when pairing it with other antecedents of behavioral intentions. Otherwise, place attachment variables may weaken the effectiveness of other factors in promoting pro-environmental behavior.

6. Limitations and future research

The current study is not without limitations. First, this study measured recycling intention but not actual behavior. Our primary interest is to understand the theoretical mechanisms of place attachment that drive recycling rather than in the behavior itself. In this case, measuring actual behavioral is not always necessary (Hulland & Houston, 2021). Meta-analyses of correlational studies generally reported that intentions imply a reliable association with behavior (e.g., Ajzen, 2020; Armitage & Conner, 2001; Hausenblas, Caron, & Mack, 1997; Sheeran, 2002; see also Webb & Sheeran, 2006). However, the intention-behavior gap should be acknowledged not only because correlational studies may preclude causal inferences (Webb & Sheeran, 2006), but also that measurement artifacts and other factors such as personality and cognitive variables may contribute to the discrepancies between intentions and behavior (Sheeran, 2002). We recommend an investigation of both intentions and actual behavior in the future.

Second, the participants of this study are predominantly young and middle-aged people; we have data weighted to ensure the sample is representative of the population of interest. Thus, readers should interpret the results with cautions. We understand that the ideal practice is collecting a statistical sample that is as similar to the population as possible. However, there is difficulty for reaching certain types of participants, such as elderly and those who do not have internet access, when using online surveys for data collection. Still, we are confident that this work can serve as a starting point for scholars who intend to improve understanding of the influence of place attachment on pro-environmental behavior.

Third, another limitation which could constitute an interesting avenue for future studies concerns the multidimensional of place attachment. This study operationalized place attachment as place dependence and place identity. However, increasing studies have included other dimensions in addition to these two sub-constructs, for example, place affect (Halpenny, 2010; Ramkissoon & Mavondo, 2015) and place social bonding (Kyle, Graefe, & Manning, 2005; Raymond et al., 2010). Future studies are recommended to investigate the contribution of other sub-constructs and the relationships with established frameworks to predict behavior and intentions.

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