

RESEARCH

Open Access



# Participatory intention and behavior in green cultural heritage conservation: an application of the extended theory of planned behavior

Jing Xie<sup>1</sup>, Hongyu Li<sup>1</sup>, Katsunori Furuya<sup>1</sup>, Jie Chen<sup>1</sup> and Shixian Luo<sup>2\*</sup>

## Abstract

Cultural heritage is an important contributor to sustainable urban development, and its conservation is considered a global task. Previous research has primarily focused on the conservation of heritage buildings within architectural contexts and world heritage sites within geographical contexts. However, there is a notable gap in conservation of green cultural heritage (GCH) within a landscape-based framework. This study used the extended theory of planned behavior to explore the factors and pathways that influence the public's behavioral intentions toward GCH conservation. Based on 1075 questionnaires collected in Tokyo, Japan, the hypotheses of the newly constructed theoretical model were tested using partial least squares structural equation modeling. The results show that perceived behavioral control has the greatest positive influence on citizens' GCH conservation intentions and behaviors, while social norms do not influence people's behavioral intention to conserve. In the extended factors, the environmental awareness which including heritage awareness and cultural attachment, significantly influences public attitudes towards conservation. Additionally, environmental perception, including perceived usefulness and perceived quality, significantly affects the public's conservation intentions and behaviors, respectively. Our findings have implications for local governments and policymakers to enhance public participation in GCH, as well as some several new theoretical interests for further studies.

**Keywords** Green cultural heritage, Theory of planned behavior, Tokyo citizens, Heritage protection, Participatory heritage management

## Introduction

### Cultural heritage and sustainable development

In recent years, cultural heritage has become increasingly popular in academia, as a multidimensional research theme covering history and archaeology [1, 2],

anthropology and sociology [3, 4], education and pedagogy [5, 6], art and architecture [7, 8], tourism and heritage management [9–11], landscape planning [12, 13], and disaster protection [14–16].

Cultural heritage is a resource for economic development and placemaking movements in urban areas worldwide and is considered an important factor for sustainable urban development [13, 17]. Therefore, encouraging cultural heritage preservation has become a central political issue in several international sustainability agendas and is considered a global task [18]. For example, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) is a vital contributor to

\*Correspondence:

Shixian Luo  
shixianluo@swjtu.edu.cn

<sup>1</sup> Graduate School of Horticulture, Chiba University, Chiba 271-8510, Japan

<sup>2</sup> School of Architecture, Southwest Jiaotong University, Chengdu 611756, China



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

the global cultural heritage agenda, having adopted the “Recommendation concerning the Protection at National Level, of the Cultural and Natural Heritage” in 1972, followed by the development and implementation of the World Heritage Convention. Among the 17 Sustainable Development Goals (SDGs), Goal 11 (sustainable cities and communities) aims to achieve the Millennium Development Goals (MDGs) through ten specific targets. Of these, target 11.4 calls for increased efforts to protect and preserve the world’s cultural and natural heritage. The International Council on Monuments and Sites (ICOMOS), a non-governmental organization dedicated to heritage preservation, recently launched a nature-culture thematic community to promote cross-sectoral learning and stimulate integrated heritage conservation and management for the sustainable development of diverse landscapes worldwide [19].

Besides, several countries have implemented effective strategies to protect and revitalize local cultural heritage sites, defining the uniqueness of cities and enhancing their sustainable competitiveness in an increasingly globalized world. For example, the United Kingdom’s conservation areas aim to safeguard the special architectural and historical interests of a place [20]. In Australia, the Protecting National Historic Sites program maintains, protects, and conserves places on Australia’s National Heritage List [21]. Singapore’s National Heritage Board preserves and celebrates the shared heritage of diverse communities [22]. Agency of Cultural Affairs, Government of Japan is developing measures to create a national brand to promote comprehensive cultural management, with the slogan “realizing a strong nation in culture and the arts” [23].

### **An emerging concept—green cultural heritage**

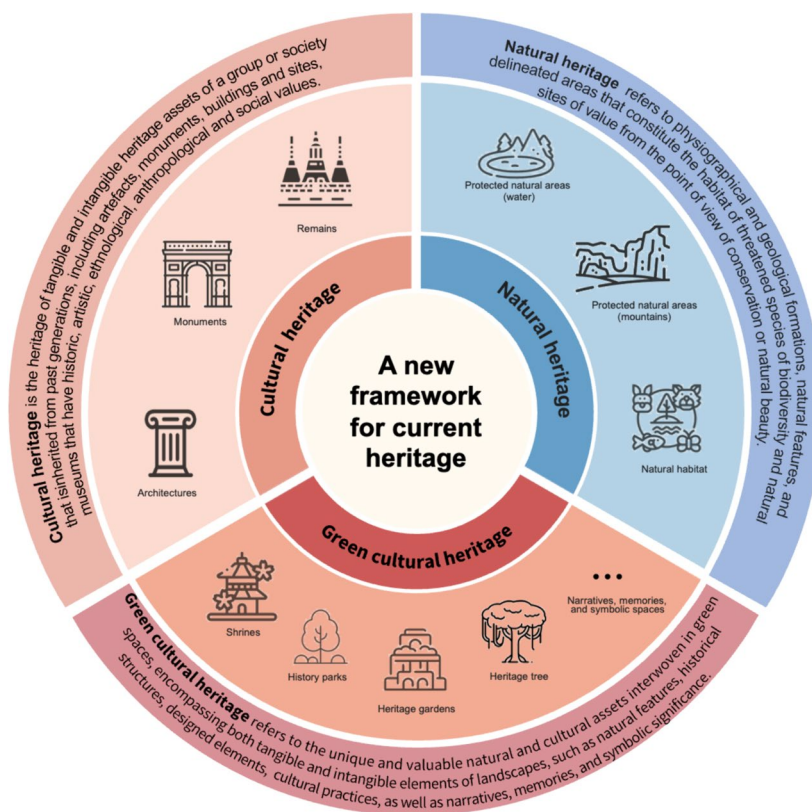
As a sub-concept of cultural heritage, green cultural heritage has been gaining attention and being discussed in recent years. As described by Bohnet et al. (2022) that active learning, reflection, and knowledge creation can generate valuable insights relevant to diverse cultures and contested landscapes [17]. In the twentieth century, the semantic expansion of heritage to include landscapes was introduced [24]. This gave rise to the concept of Green Cultural Heritage (GCH) based on a discussion of traditional heritage terminology, including cultural heritage, natural heritage, mixed heritage, green cultural heritage, and cultural landscape [25]. Of these heritage concepts discussed above which includes not only buildings and structures but also culturally significant landscapes and natural environments that are often overlooked by scholars. Unlike traditional cultural heritage preservation, which prioritizes historical edifices or natural heritage conservation and focuses on pristine landscapes, GCH

transcends architectural or natural confines. It embodies environments shaped by human ingenuity, blending natural green elements into a harmonious human-nature relationship [25].

Based on this, Bučas (2006) first proposed the concept of GCH, a type of heritage with the use of living natural materials (e.g., plants, flowers) rather than human-made materials, and created by modifying the green elements of nature according to human ideas [25]. Therefore, GCH can be considered as a special green space/element with cultural and heritage attributes. Some concrete examples, for example, historic gardens (as an example of human intentional creation and design of nature) [26], heritage trees (trees of heritage value growing on city public or private property) [27], as well as traditional gardens and landscapes (a historical site with a blend of natural and human atmosphere) [28] (Fig. 1).

It is essential to recognize that while UNESCO predominantly classifies green spaces and landscapes as natural heritage, there exist notable instances where these spaces are primarily acknowledged for their cultural significance. For example, the classical gardens of Suzhou, China, are designated as World Cultural Heritage sites due to their profound cultural, historical, and artistic values [29]. Similarly, Japanese traditional gardens, recognized as Important Cultural Properties [30], and heritage trees, such as those studied by Thaitutsa et al. (2008) [27] and Maleknia et al. (2024) [31], illustrate the importance of considering green spaces through a dual lens—both as cultural and natural heritage. Such an approach underscores the interplay between human cultural practices and natural environments, especially in urban contexts where these spaces play a crucial role in enhancing community well-being and preserving cultural identity. By integrating the concept of Green Cultural Heritage, we can better appreciate and manage these spaces, acknowledging their multifaceted contributions to both cultural and environmental sphere.

To date, although no country has officially used the term Green Cultural Heritage, GCH is increasingly becoming an important component and focus of attention in the heritage field. We conducted an extensive search using various keywords related to green cultural heritage, including “historic gardens,” “cultural landscapes,” “cultural heritage,” “heritage landscapes,” “traditional gardens,” “garden heritage,” “historic parks,” “park heritage,” and “botanical gardens.”, the aim was to include a wide range of examples from different cultural. Based on the results, we collected a number of representative country cases (Table 1). For example, Finland has established the National Board of Antiquities to preserve, collect, study, and present nationally important cultural heritage (including parks and gardens), and



**Fig. 1** The proposed new heritage definition framework for this study

municipalities are responsible for the local protection of GCH (culturally valuable gardens and parks) [32]. To date, France has inventoried more than 4700 information sheets on parks and gardens containing 2339 GCH sites [33], which have been arranged for the pre-inventories to be digitized [34]. France also developed a Heritage Code (Book VI, titles I and II) for GCH (immovable assets, parks, and gardens of historical, artistic, or architectural interest) [33]. The U.S. National Park Service was established in 1916, and the U.S. Congress passed the Organic Act to create the National Park Service within the Department of the Interior to protect and sustain cultural and natural resources in perpetuity [35]. It is noteworthy that in 1960, the Cultural Property Garden Preservation Council was established in Japan, which was designated as Cultural Property Designated Gardens and Parks under the Cultural Property Preservation Law [36].

**Sustainable utilization of cultural heritage and landscape-context conservation**

Heritage is associated with the existing culture that places it in context and is therefore shaped by social processes. However, it is not something permanent, but is continually produced and reproduced by society [12].

As Swensen & Jerpåsen (2008) argue [37], cultural heritage should be viewed as "the contemporary use of the past," i.e., it should be focused on satisfying current social needs [38]. Nevertheless, for World Heritage Sites, there is a current social need to find a balance between heritage conservation and heritage tourism [39], and cultural identity must be passed on to future generations by focusing on the conservation, restoration, and revitalization of heritage buildings [40].

The ongoing global environmental crisis requires urgent action to protect and restore natural and cultural assets, and landscape is an important perspective for sustainable development [41]. The concept of cultural landscape has emerged as a holistic approach to heritage conservation, acknowledging the inextricable relationship between nature and culture, and emphasizing the importance of preserving both [42]. In this context, the integration of heritage and landscape represents a practical approach to implementing sustainability principles [12].

GCH as a cultural heritage, provides several essential services for city dwellers, like fostering social memory and identity [12]. Besides, in an increasingly crowded city, it as a type of urban green space, meets various

**Table 1** Relevant names and policies of GCH in various countries

Country	Types/appellations	Institution in charge	Specific legislation	Relevant legislation
Croatia	Cultural-historical areas and cultural landscapes	Directorate for the protection of cultural Heritage Directorate for nature protection	Act on the protection and preservation of cultural property	Nature protection act
Czech Republic	Protected gardens	Institute of national heritage MCZK- Methodical center of garden culture in Kromeriz	Act n. 114/1992 Coll. about protection of the nature and landscape	Act n. 20/1987 Coll. about State Custody
Finland	Protected gardens and parks	Ministry of education and culture National board of antiquities Ministry of environment	The land use and building act	National land use guidelines Act on the protection of built Heritage
France	Parks and gardens which are of historical, artistic, or architectural interest	Ministry of culture and communication French national horticultural society (SNHF) French landscape federation (FFP)	Heritage code (book VI, titles I and II)	
Italy	Historic parks and gardens	Ministry for cultural heritage, cultural activities, and tourism The parks and gardens of Italy association (APGI)	The code of cultural heritage and landscape	
Netherlands	Gardens, parks, cemeteries	The cultural heritage agency of the Netherlands		Monumentenwet 1988
Slovak Republic	Historical parks and gardens	Ministry of culture of Slovak Republic Ministry of Environment of Slovak Republic		National cultural monuments under law on the protection of monuments and historic sites
Spain	Historic gardens	Ministry of education, culture and sports	The law of 16/1985, on Cultural and Historic Heritage	
England	Parks and Gardens of Special Historic Interest	Historic England		National Heritage Act 1983
Japan	Cultural Property Garden	Cultural property garden preservation council	Cultural property protection act	
P.R. China	Classical Gardens	No unified regulatory body for the time being		Cultural relics protection law of the People's Republic of China
Korea	Traditional garden	Cultural heritage administration	Basic planning for the conservation, management and utilization of traditional gardens	
South Africa	Cultural landscape	South African heritage resources agency		The National Heritage resources Act, Act No. 25 of 1999
Kenya	Museums, sites and monuments	National Museums of Kenya		National Museums and Heritage act 6 of 2006
The United States	Cultural landscapes, historic places	U.S. National Park Service		Management of cultural landscapes

The Specific Legislation indicates a direct correlation/reference to GCHs such as classical gardens and historic courtyards; The Relevant Legislation indicates no direct reference to GCH and is categorized at the author's discretion

social needs by combating urban ills and improving the quality of life [28], such as offering recreational opportunities, enhancing mental and physical well-being, supporting biodiversity, mitigates urban heat islands, and

improving air quality [12, 28]. These dual benefits create a complex relationship between conservation and urban development that must be addressed through interdisciplinary approaches in sustainable development [13].

In sum, the proposal of GCH is vital for contemporary society to address the environmental crisis, preserve valuable green spaces and cultural landscapes, promote sustainable development, support tourism, and align with the international agenda.

### Public participation and the conservation of green cultural heritage

In the context stated above, GCH conservation is particularly important, and governments endeavor to protect and manage GCH at the national level. On the one hand, specialized governmental agencies and NGOs have been established to inventory GCH and to classify and code the levels of protection; on the other hand, relevant legislation and protection measures have been developed and considerable resources have been invested in the management and maintenance of GCH (Fig. 1).

While governments have important insights into the conservation of GCH, its sustainability has rarely been addressed comprehensively in existing studies, which tend to focus more on the top-down management and conservation of GCH and neglect bottom-up studies. Scholars have found that bottom-up public participation is an innovative solution to public governance problems in cities [43, 44], and is very effective in changing people's behavior towards the green environment. For example, in Japan, citizens participate in the assessment of designed green spaces in cities, which enables them to better utilize and even care for urban green spaces [45, 46]. In Finland, both green space planning authorities and participating citizens have found that participatory green space design methods have avoided conflicts in planning and increased residents' awareness of green space-related matters [47]. A study in Turkey also showed that effective collaboration between the government and other public institutions, universities, local civic groups, and non-governmental organizations (NGOs) can enhance the governance of urban forestry [48]. Besides, Chu et al. (2022) demonstrated that public participation improves environmental governance by adding a democratic element, allowing both government and business to benefit from it [49].

Consequently, such participation leads to better policy decisions with greater public support [50], as it allows local communities to participate more democratically in such heritage management thereby reducing potential conflicts of interest. Besides, it also allows for the measurement and understanding the extent of the actual behavior and willingness to participate of these publics who voluntarily engage in conservation behaviors, allowing for the dynamic application of promotional and ameliorative strategies. Therefore,

understanding the factors that influence public perceptions, motivations, and behaviors of bottom-up participation in governance can aid the development of targeted GCH conservation policies.

### Study aims

This study applies an extended research model of the Theory of Planned Behavior (TPB) to analyze the psychosocial factors influencing the decision to protect GCH by measuring the effects of environmental awareness (heritage awareness, cultural attachment) and environmental perception (perceived quality, perceived usefulness) on behavioral performance prerequisites (subjective norms, behavioral attitudes, and perceived behavioral control) and final behaviors (intentions, behaviors) respectively through a web-based questionnaire survey in the Tokyo metropolitan area, Japan.

The study aims to address the following research questions:

1. What are the key psychosocial factors that influence the decision to protect GCH among Tokyo metropolitan residents?
2. How do environmental awareness and perception affect the intentions and behaviors related to GCH conservation?
3. How can the findings inform the development of effective urban GCH preservation policies and regulations?

The results offer a holistic insight into citizens' awareness and behaviors regarding urban GCH conservation, particularly focusing on Tokyo Metropolitan residents' environmental awareness related to cultural attachment and heritage awareness, along with an evaluation of the environmental quality and benefits associated with GCH. Notably, this study marks the inaugural utilization of the extended TPB model in examining GCH conservation efforts. By understanding the influential factors that drive people's behavior in preserving GCH, this study is expected to enable policymakers to develop effective urban GCH preservation policies and regulations, incorporating systems that promote actual public participation in conservation efforts.

The rest of the paper is structured as follows: Sect. "Conceptual Framework of the Study" introduces the TPB and presents the hypotheses. Sect. "Methods" describes the case study city, Tokyo, and the research methodology in terms of the questionnaire design, survey, and data analysis. Sect. "Results" presents the study results. Sect. "Discussion" discusses the main findings and Sect. "Conclusion" concludes the study.

### Conceptual framework of the study

The TPB, first proposed by Ajzen (1991) [51], is a widely used theory in social science research and is applicable to studies aimed at understanding and influencing human behavior [52]. The TPB’s contribution to explaining behavior has been empirically tested in a wide range of fields, such as health sciences [53], environmental sciences [54, 55], business and management [56, 57], and educational research [58]. Specifically, in the realm of environmental psychology and sociology, TPB has been effectively employed to elucidate decision-making processes in urban environmental governance and residents’ behavioral patterns. For example, Tan et al. (2023) used TPB to reveal residents’ intentions and behaviors for green and low-carbon energy transition [59]. Some scholars used TPB to predict citizen participation behavior in urban green space governance [44] and management [60]. In order to exam the socio-psychological precursors of tree-planting behaviour, Ibrahim et al. (2022) explored the psychosocial predictors of tree-planting behavior among Nigerian civil servants using TPB [61]. Wan et al. (2018) explored citizens’ willingness to use urban green space [62]. Tang et al. (2022) revealed residents’ behavior to participate in neighborhood micro-renewal [63]. Du et al. (2023) identified factors influencing adolescents’ behavioral willingness to participate in climate change governance actions [54]. Additionally, Li et al. (2024) evaluated contribution intentions and behaviors of cultural heritage adaptive reuse projects using TPB [56]. Maleknia et al. (2024) focused on generational differences

in conservation intentions and behaviors for heritage trees by this theory [31].

Therefore, the TPB provides a robust framework for investigating the determinants of citizens’ intentions and behaviors, making it suitable for our examination of public attitudes and behaviors towards green cultural heritage (GCH) conservation.

### The theory of planned behavior

According to the TPB [51], subjective norms (SN), attitude towards the behavior (AB), and perceived behavioral control (PBC) influence deterministic behavioral intentions, whereas behavioral intentions and PBC are direct determinants of behavior (Fig. 2).

SN refer to the influence of an individual’s social environment (e.g., relatives, friends, neighbors, and companies) on their behavior, including how much they are approved of an individual’s behavior by others [57]. Greater perceived social pressure, which leads to a greater likelihood of such behavior. Recent studies have noted the importance of SN for urban green spaces and environmental governance behaviors highlighted in the studies [62]. Therefore, we hypothesize the following:

H1a: Subjective norms have a positive impact on citizens’ intentions to protect GCH.

AB is the result of an individual’s evaluation after weighing the pros and cons of a particular behavior, i.e., the extent to which the individual perceives the behavior as favorable or unfavorable [64, 65]. The more a person has a positive attitude, the more likely they

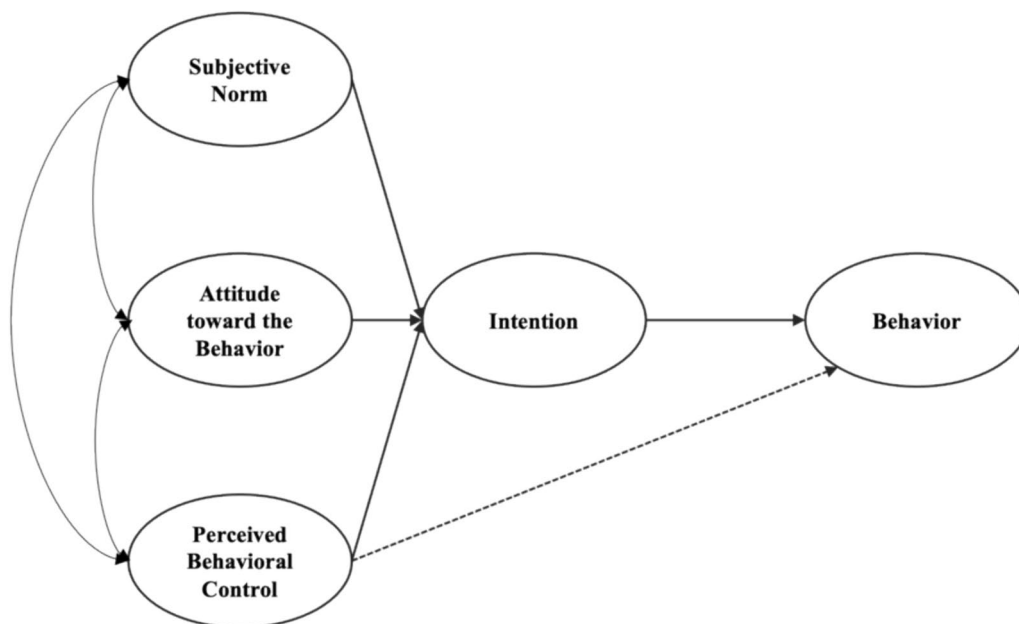


Fig. 2 Theory of planned behavior (Ajzen, 1991)

are to engage in such behaviors. Bonnes et al. (2011) conducted a study on attitudes and pro-environmental behavior in green spaces and confirmed the importance of attitudes toward environmental management behavior in green spaces [66]. Therefore, we hypothesize the following:

H1b: Attitude towards the behavior (AB) positively affect citizens' intentions to protect GCH.

PBC refers to the degree of self-perceived ease of performing a specific behavior [51]. Subsequently, Ajzen (2002) defined it as an individual's expectation of the degree of their ability to perform a particular behavior [70]. Huang et al. (2021) confirmed the importance of PBC for pro-environmental behavior and intention in green spaces [44]. Therefore, we hypothesize the following:

H1c: PBC positively affects citizens' intention to protect GCH.

H1d: PBC has a positive impact on citizens' GCH protection behavior.

Behavioral intention indicates the plan and determination to perform a target behavior [67, 68]. Ibrahim et al. (2022) argued that being subjected to the performance of any behavior is the result of the intention to perform such behavior; that is, the actual actions of people are explained through behavioral intention, which further explains the effect of intention on pro-environmental behavior [61]. Therefore, we hypothesize the following:

H1e: Citizens' intentions have a positive impact on their actual GCH protection behavior.

### The extended TPB

Although the TPB is widely used in the social sciences, its limitations have been criticized as an extension of the Theory of Reasoned Action (TRA), which proposes that humans rationally analyze their options and choose the most favorable course of action [69], with all its variables being rational predictor variables [70]. This causes it to focus on rational decision-making and ignore people's affect and emotions, demographic variables, individual personality factors, and past experiences [71]. The limits of predictive validity of TPB are also a point of controversy among scholars [53], and it was pointed that the traditional TPB has the limitation of not being able to predict many variances [72]. To address these limitations, scholars have proposed various extensions of the TPB, referred to as extended TPB models [73]. The extended TPB increases the percentage of intention and behavior explained by adding more predictor variables to the original TPB model (TPB-only), which has been applied in several fields and has been shown to possess high explanatory power [74, 75].

### Environmental awareness

Previous studies on environmental protection have incorporated environmental awareness into the TPB model to better explain behaviors such as waste management [75], general environmental behavior [76], and green space management [44, 61]. In line with these studies, our extended TPB model includes environmental awareness to enhance its explanatory power in the context of GCH conservation. Environmental awareness, which reflects people's concern and understanding of the environment, is often considered the first important step in solving environmental problems and a prerequisite for pro-environmental behaviors. It is widely believed that people with higher environmental awareness are more likely to engage in behaviors that are conducive to environmental sustainability [77].

Environmental awareness can be approached from two perspectives: general environmental awareness and specific environmental awareness [78]. Several studies have compared specific environmental awareness (awareness of partial or more specific environmental issues) to general environmental awareness [55, 76, 79]. General environmental awareness involves recognizing environmental issues and demonstrating concern for sustainability, encompassing concerns about global environmental issues, beliefs in harmonious coexistence between humans and the environment under sustainable development, and a sense of responsibility for environmental protection [80]. While specific environmental awareness pertains to individuals' awareness of their immediate environment, including their daily surroundings and interactive components [81, 82]. For this study, we adopt two specific dimensions of environmental awareness related to GCH: heritage awareness (HA) and cultural attachment (CA).

In the context of heritage places, Nyaupane and Timothy (2010) argue that heritage awareness (HA) constitutes a form of environmental awareness specific to heritage sites [78]. HA can be understood as the extent to which residents perceive heritage values and care about local heritage [56], which focuses on individuals' understanding of the significance, value, and historical context of heritage sites, and it has been shown to influence public attitudes towards heritage conservation [83]. Additionally, Xie et al. (2023) emphasized the identification of GCH as spaces of cultural value [28]. Cultural attachment (CA), as defined by Hong et al. (2013), refers to the emotional connection individuals form through interaction with their culture, encompassing a sense of belonging and trust in their cultural heritage [84]. This deep emotional connection to culture is considered another important aspect of environmental awareness [85, 86]. Therefore, within the framework of this study, we adopt

two specific dimensions of environmental awareness related to GCH: HA and CA.

According to previous studies, environmental awareness does not have a direct effect on environmentally friendly behavior, but has an indirect effect on environmentally friendly behavior through other factors [57, 87]. In order to construct a TPB model that can indirectly influence behavioral intention, this study aligns with Xu et al. (2020) and Wang et al. (2016) by using environmental awareness as a pre-variable for the three core TPB variables [76, 87]. Therefore, the hypotheses are as follows:

H2a: Heritage awareness positively impacts the intention to protect GCH through the mediating role of subjective norms.

H2b: Heritage awareness has a positive impact on the intention to protect GCH through the mediating role of attitudes towards behavior.

H2c: Heritage awareness has a positive impact on the intention to protect GCH through the mediating role of perceived behavioral control.

H3a: Cultural attachment positively impacts the intention to protect GCH through the mediating role of subjective norms.

H3b: Cultural attachment has a positive impact on the intention to protect GCH through the mediating role of attitude towards the behavior.

H3c: Cultural attachment positively impacts the intention to protect GCH through the mediating role of perceived behavioral control.

### **Environmental perception**

In the context of environmental governance of green space, studies have illustrated that if individuals are aware of the perceived benefits of pro-environmental behaviors, the likelihood of engaging in such behaviors increases [88]; besides, Wan et al. (2018) have included environmental perceived usefulness (PU) and perceived quality (PQ) as a prerequisite variable for intention in the TPB [62]. Considering this interpretation, we hypothesize the following:

H4a: Perceived usefulness have a positive impact on citizens' intentions to protect GCH.

H5a: Perceived quality have a positive impact on citizens' intentions to protect GCH.

Environmental quality has been identified as a factor influencing usage behavior as highlighted by Bonnes et al. (2011) [66]. Francis et al. (2012) demonstrated that perceived quality positively contributes to citizens' conservation behavior [89]. Moreover, according to Si et al. (2022), environment-specific quality conditions (e.g., residents' perceptions of habitat environmental quality) have a significant positive effect on pro-environmental behavior [90]. Therefore, we hypothesize the following:

H5b: Perceived quality of GCH has a positive impact on citizens' GCH protection behavior.

By incorporating these additional dimensions—environmental awareness and environmental perception—our extended TPB model aims to provide a more comprehensive understanding of the factors influencing GCH conservation behavior, thereby addressing the limitations of the traditional TPB. Taking above, the extended TPB model is shown in Fig. 3.

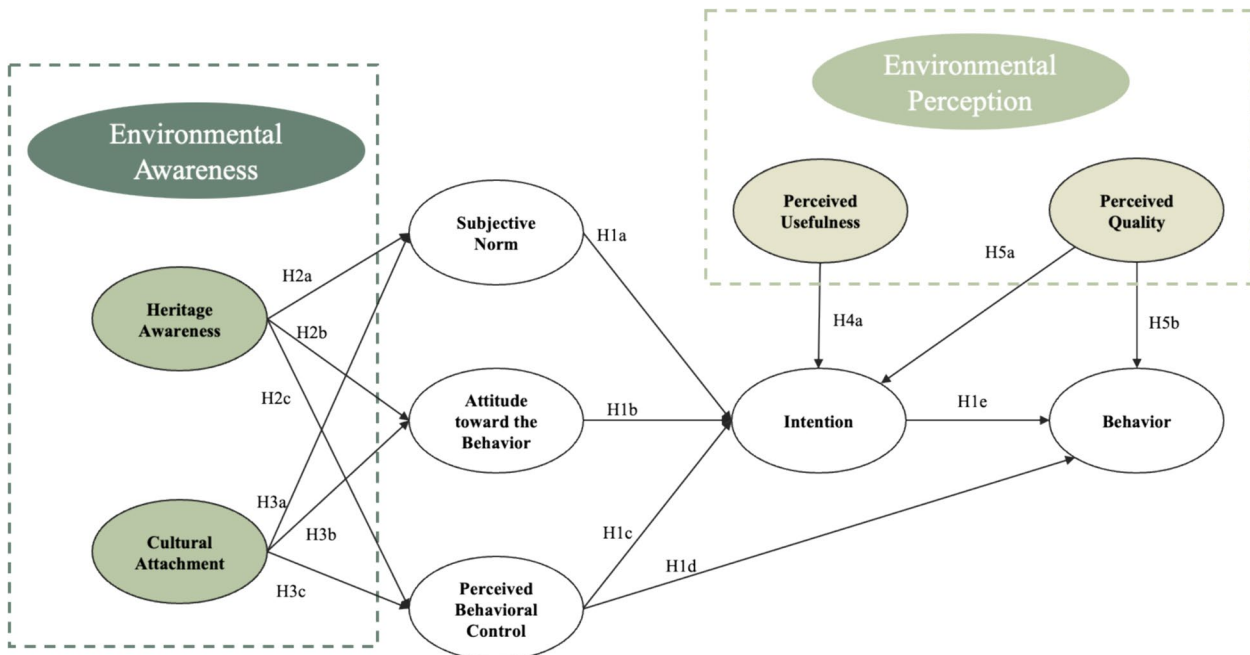
## **Methods**

### **Study area and background**

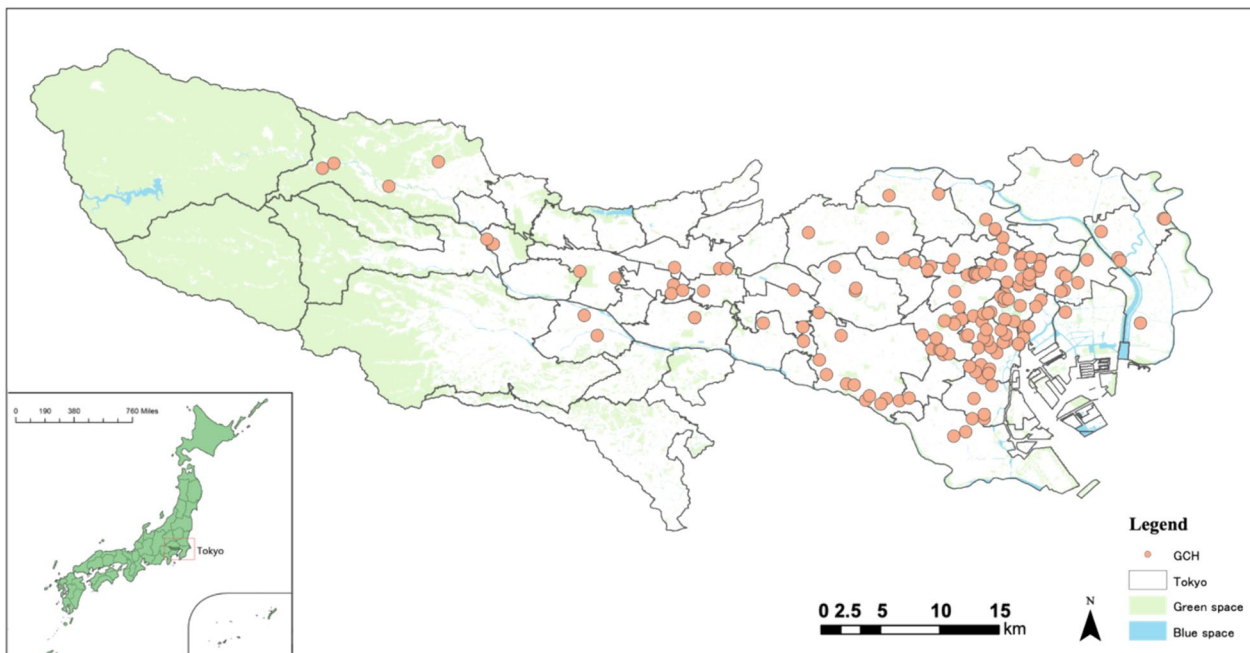
This cross-sectional survey was conducted in Tokyo, Japan. As a city that has undergone rapid modernization and urbanization, Tokyo has a relatively mature socioeconomic system, and the demand for a better quality of life among its citizens has increased [91]. GCH is increasingly seen as an important component of high-quality lifestyles and a valuable resource for regional development through cultural tourism and the creation of high value-added products [28]. Tokyo has a large variety of GCHs, including the National Garden established by the Ministry of the Environment (There are four in Japan: Shinjuku Gyoen National Garden, Chidorigafuchi National Cemetery, the Outer Garden of the Imperial Palace, and Kokyo Gaien National Garden, three of which are in Tokyo), and the Agency of Cultural Affairs, Government of Japan (<https://www.bunka.go.jp/english/index.html>), nationally and ward-level designated cultural properties by the Tokyo Metropolitan Government, Japanese historical parks (17 in Tokyo) designated by the Urban Park Law 50th Anniversary and Other Commemorative Projects Committee, and a number of other gardens and parks (Appendix A, Fig. 4).

The Japanese government has long been aware of the importance of preserving GCH sites. Legislation such as the City Park Law (Law No. 79 of Showa 31), the Landscape Act (Act No. 110 of 2004), and the Law for the Protection of Cultural Properties (Law No. 214 of 1950) establish legal frameworks for GCH conservation. Although these governments have important insights into the conservation of GCH, it is difficult for them to comprehensively address its sustainability. In addition, the Tokyo Metropolitan Bureau of Construction (2024) places significant emphasis on maintenance and disaster prevention measures for urban parks, including initiatives aimed at protecting GCH [92]. In its 2024 fiscal budget, priority projects for GCH preservation include the 'Development of unique urban parks' and the 'Rebirth of the World Garden,' among other initiatives [92]. It is important to note that although most of these GCHs are managed by the Tokyo Metropolitan Government or affiliated organizations, there are many opportunities





**Fig. 3** Research model of the extended TPB



**Fig. 4** Distribution of GCH in Tokyo

for bottom-up participation in governance. For example, community members are recruited to participate in volunteer activities such as providing tourism services to foreign tourists and handing out questionnaires at the

entrances and exits of the sites (<https://www.tokyo-park.or.jp/park/garden-volunteer/index.html>).

Therefore, for GCHs in Tokyo, bottom-up voices from citizens are vital in understanding public perception,

motivation, and behavior and to help to develop targeted GCH conservation policies.

### Measurements

This study examined citizens' environmental perceptions, awareness, and conservation behaviors toward GCH using a sample of Tokyo citizens. We designed a preliminary questionnaire based on the extended TPB in the literature and group discussions, and invited professors and doctors in landscape and planning to revise it. Specifically, the measures for the latent variables SN, AB, PBC, I, and B in the original model were constructed based on classical scales proposed by Taylor and Todd (1995) and supplemented by recent literature [44, 61–63, 65, 93]. Besides, the measurement items for extended variables HA, CA, PQ, and PU were adapted from relevant studies [28, 62, 78, 94–96]. The wording of these items was then adjusted, based on our research, to fit the specific context of public participation in green cultural heritage governance.

The final questionnaire was divided into four sections: demographic characteristics, the TPB measurement of GCH, environmental perception measurement, and environmental awareness measurement. The components about the TPB and sources of the scales are listed in Table 2, including AB, SN, PBC, I, B, HA, CA, PU and PQ. Followed Lee (2016), this study used a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) for participants' responses to each item [68].

### Data collection and characteristics of respondents

Data were obtained from a web-based questionnaire survey conducted using the Freeasy Questionnaire (<https://freeasy24.research-plus.net/>) in May 2023, which collected a sample of questionnaires from residents of the Tokyo metropolitan area. This platform is a professional online questionnaire service company with more than 13 million people from all regions of Japan. The Freeasy platform sent a questionnaire recruitment to the subjects who met our requirements—living in the Tokyo metropolitan area, aged 20 years or older—and set up the distribution of the specified sample area by gender and age as well as exact sample size of different age groups [97] (20–29 years old, 66 males and 63 females; 30–39 years old, 73 males and 70 females; 40–49 years old, 92 males and 90 females; 50–59 years old, 88 males and 87 females; over 60 years old, 198 men and 248 women), resulting in an sample size of 1,075 people. The decision to include only individuals aged 20 years or older was based on several considerations. Firstly, individuals in this age group are more likely to have formed stable opinions and attitudes towards green cultural heritage and conservation practices. Secondly, this age group encompasses a broad

range of adults, from young adults to senior citizens, providing a comprehensive understanding of public participation across different life stages. Additionally, individuals over the age of 20 are considered adults in Japan, so legal and ethical considerations for obtaining informed consent are more straightforward for adults, ensuring compliance with ethical research standards.

The minimum sample size required was calculated using the formula in Fecso et al. (1996) [98].

$$n = \frac{z^2(p)(1-p)}{c^2} \quad (1)$$

where:

n = sample size.

z = Z-value (e.g., 1.96 for 95% confidence level).

p = percentage of choosing an option; when p = 0.5, the sample size n is maximized.

c = confidence interval (also error tolerance), expressed as decimal (e.g., 0.05 = ± 5).

According to Eq. (1), the minimum sample size required is 385 when the confidence level is 95.0% (z = 1.96), p = 0.5, and c = 5%. Therefore, the sample size of 1075 used in this study was more than adequate.

All participants provided informed consent before completing the questionnaire online. Data-cleaning service was performed by the questionnaire company by collecting a larger sample than requested (about 20%) as a backup sample, which was subsequently cleaned by response time (excluding answers with unusually short response times), response content (excluding unnatural direct choices made in matrix questions or inappropriate answers filled in text boxes), respondents (excluding responses with the same IP), and finally by the author's manual check (no deleted samples). The demographic characteristics of the final sample are presented in Table 3. The Ethics Committee of the Graduate School of Horticulture, Chiba University waived the ethical approval as this study ensured online participant anonymity and no invasive experiments were conducted. All participants were aware of the purpose of the survey and agreed to participate.

### Statistical analyses

Structural equation modeling (SEM) is a common method for testing models with latent variables [99]. Based on similar previous studies [62], this study used partial least squares structural equation modeling (PLS-SEM) for statistical tests. The reasons for choosing PLS-SEM are as follows: first, PLS-SEM performs more robustly when dealing with models with complex structures [100]. Second, PLS-SEM does not strictly require that the data follow the normality assumption [101]. Third, in contrast to covariance-based structural

**Table 2** Constructs and measurement items

Constructs	Items	Measurement items	References
Subjective norm (SN)	SN1	My family thinks I should protect the green cultural heritage	[51, 62]
	SN2	My friends think I should protect the green cultural heritage	
	SN3	My neighbors think I should protect the green cultural heritage	
	SN4	My company think I should protect the green cultural heritage	
Attitude toward the behavior (AB)	AB1	I think it is important to preserve the green cultural heritage	[61, 62]
	AB2	I think it is worthwhile to preserve green cultural heritage for Tokyo	
	AB3	I think it is my social responsibility to preserve green cultural heritage	
	AB4	I am proud of the efforts made by the government to preserve green cultural heritage	
Perceived behavioral control (PBC)	PBC1	I can participate in activities to preserve green cultural heritage	[44, 62]
	PBC2	I have some opportunities to participate in activities to protect green cultural heritage	
	PBC3	I have enough time to participate in activities to preserve green cultural heritage	
	PBC4	Preserving local green cultural heritage is not a difficult task for me	
Intention (I)	I1	I would like to engage in activities to preserve Tokyo's green cultural heritage	[44, 51, 62, 65]
	I2	I would like to learn more about the preservation of green cultural heritage	
	I3	I would like to work for the preservation of local green cultural heritage	
	I4	I would like to assist government in managing and preserving green cultural heritage	
Behavior (B)	B1	I have participated in a clean-up activity or other activities in the green cultural heritage	[61]
	B2	I am a member of a cultural heritage related conservation organization	
	B3	I have filled out a questionnaire with suggestions in green cultural heritage	
Heritage awareness (HA)	HA1	I have the knowledge of the cultural value of green cultural heritage in the city	[78, 95]
	HA2	I have knowledge of the importance of green cultural heritage in the city	
	HA3	I have a knowledge of the historical background related to green cultural heritage	
	HA4	I am aware of the events that take place in the green cultural heritage at certain times	
Cultural attachment (CA)	CA1	I am proud of the history and culture of Tokyo's green cultural heritage	[78, 96]
	CA2	I have a strong sense of identity with the culture of Tokyo's green cultural heritage	
	CA3	I believe that my city's green cultural heritage is irreplaceable compared to other places	
Perceived usefulness (PU)	PU1	Green cultural heritage can promote socio-cultural activities	[28, 62, 63]
	PU2	Green cultural heritage can promote a sense of belonging and identity to the local area	
	PU3	Green cultural heritage enhances the understanding of history and culture	
	PU4	Green cultural heritage transmits traditional knowledge from generation to generation	
	PU5	Green cultural heritage enables experts and scholars to conduct some research	
	PU6	Green cultural heritage can contribute to the development of local tourism	
Perceived quality (PQ)	PQ1	I think there is enough green cultural heritage in Tokyo	[62]
	PQ2	I think there are enough facilities in the green cultural heritage in Tokyo	
	PQ3	I think the environment of the green cultural heritage in Tokyo is well-kept	

equation modeling, PLS-SEM is typically used in exploratory studies, which is consistent with this study's aim of hoping to predict the target structure of theoretical models and identify important drivers of GCH protection behavior. Microsoft Excel and SmartPLS 4 were used to compile and statistically analyze the questionnaire data, and the significance level was set at  $p < 0.05$ .

## Results

### Descriptive statistics results

According to respondents' perceptions, the deepest influence of SN was determined by family

(SN1 =  $3.207 \pm 1.069$ ), while the least influence was determined by neighbors (SN3 =  $3.047 \pm 1.016$ ). Overall, people had higher AB for GCH protection, with perceived importance of GCH protection (AB1 =  $3.935 \pm 0.823$ ) scoring the highest, followed by worthwhile (AB2 =  $3.689 \pm 0.889$ ), government protection status satisfaction (AB4 =  $3.481 \pm 0.919$ ), and social responsibility (AB3 =  $3.442 \pm 0.971$ ). In general, citizens had lower PBC than SN and AB, meaning that they had a relatively lower level of ability (PBC1 =  $2.856 \pm 0.984$ ), opportunity (PBC2 =  $2.581 \pm 0.949$ ), time (PBC3 =  $2.632 \pm 1.028$ ), and less difficulty (PBC4 =  $2.801 \pm 0.957$ ) for protecting CGH.

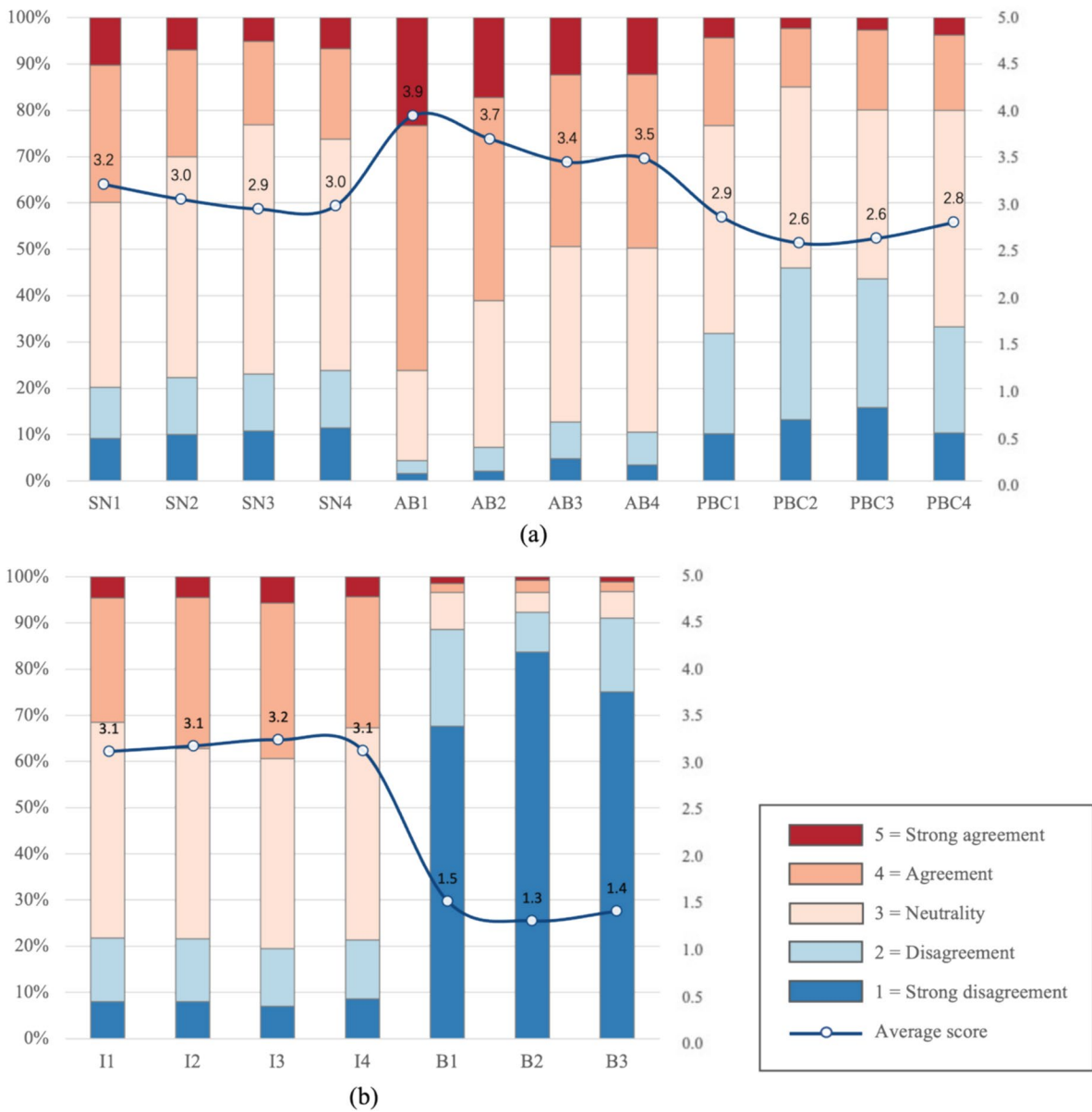
**Table 3** Basic characteristics of respondents (N= 1075)

Attributes	Category	Frequency	Percentage
Age	1=20~29	129	0.120
	2=30~39	143	0.133
	3=40~49	182	0.169
	4=50~59	175	0.163
	5=60~69	332	0.309
	6=70~79	95	0.088
	7=Over 79	19	0.018
Gender	1=Male	517	0.481
	2=Female	558	0.519
Occupation	1=Company employee	343	0.319
	2=Student	25	0.023
	3=Self-employed	52	0.048
	4=Physicians/medical personnel	11	0.010
	5=Manager/executive	25	0.023
	6=Part-time job	159	0.148
	7=Housewife	171	0.159
	8=Freelancer	28	0.026
	9=Company employee (temporary)	77	0.072
	10=Civil servants	27	0.025
	11=Unemployed	135	0.126
Marital Status	12=Other	22	0.020
	1=Married	622	0.579
Annual household income (JYP) 1 Million JYP $\approx$ 7300 USD	2=Unmarried	453	0.421
	1=Less than 1 million	80	0.074
	2=1 million to less than 2 million	66	0.061
	3=2 million to less than 3 million	103	0.096
	4=3 million to less than 4 million	140	0.130
	5=4 million to less than 5 million	128	0.119
	6=5 million to less than 6 million	104	0.097
	7=6 million to less than 7 million	81	0.075
	8=7 million to less than 8 million	59	0.055
	9=8 million to less than 9 million	61	0.057
	10=9 million to less than 10 million	68	0.063
	11=10 million to less than 12 million	68	0.063
	12=12 million to less than 15 million	63	0.059
	13=15 million to less than 18 million	12	0.011
	14=18 million to less than 20 million	7	0.007
15=Above 20 million	35	0.033	

Interestingly, citizens' intentions towards GCH conservation were high in terms of their willingness to participate ( $I1=3.063 \pm 0.952$ ), understand ( $I2=3.121 \pm 0.974$ ), work ( $I3=3.186 \pm 0.966$ ), and help the government ( $I4=3.072 \pm 0.960$ ) to protect GCH. However, over 80 percent of respondents rarely or never engaged in GCH conservation behaviors, as shown in Fig. 5, either in terms of doing voluntary work ( $B1=1.487 \pm 0.838$ ), membership

of environmental protection ( $B2=1.281 \pm 0.732$ ) and giving GCH advice ( $B3=1.382 \pm 0.783$ ).

Nevertheless, most Tokyo residents perceived the benefits that GCH brought to them (Fig. 6). Whether it is cultural activities ( $PU1=3.473 \pm 0.875$ ), sense of community belonging ( $PU2=3.348 \pm 0.874$ ), history and culture ( $PU3=3.436 \pm 0.872$ ), bequest value ( $PU4=3.411 \pm 0.875$ ), education and scientific research



**Fig. 5** SN, AB, and PBC of Tokyo citizens towards GCH (a) and their conservation intentions and behaviors (b)

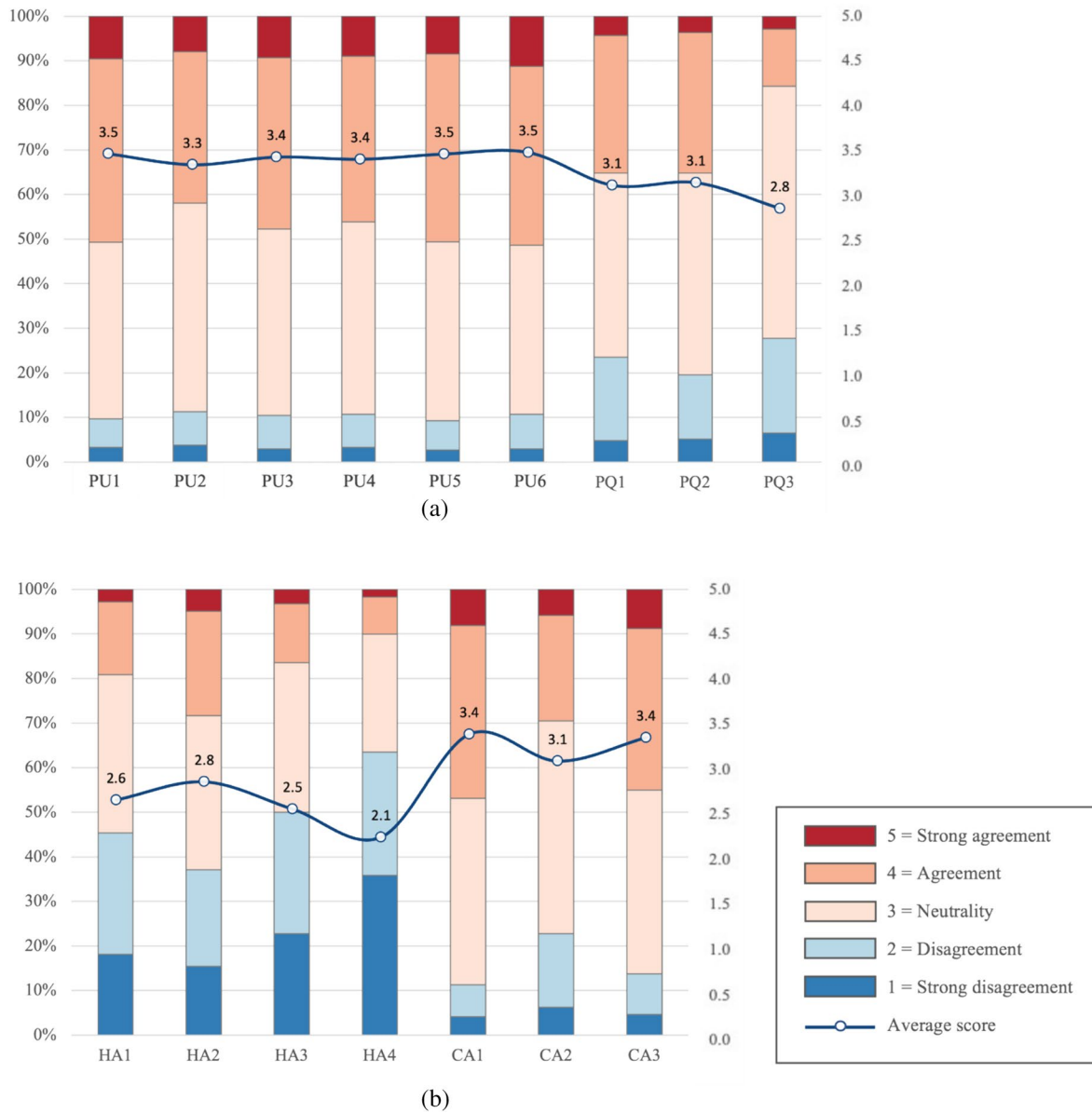
( $PU5=3.471 \pm 0.844$ ), or the perception of tourism ( $PU6=3.489 \pm 0.899$ ), all these PU received higher scores. Moreover, the scores for the perceived quality of GCH were high, including a sufficient number of GCH facilities ( $PQ1=3.111 \pm 0.921$ ) and abundant facilities ( $3.141 \pm 0.889$ ). Compared to the first two points, the quality of GCH protection ( $PQ3=2.844 \pm 0.832$ ) scored slightly lower but also received recognition from most citizens.

In addition, people’s cultural attachment to GCH is high; they are proud of GCH in Tokyo ( $CA1=3.396 \pm 0.889$ ), carry a strong sense of identification ( $CA2=3.063 \pm 0.939$ ),

and believe that there is no substitute for GCH ( $CA3=3.353 \pm 0.930$ ). Unfortunately, our study found that they were not sufficiently aware of the heritage of GCH, including its significance for the city ( $HA1=2.584 \pm 1.050$ ), level of knowledge about GCH ( $HA2=2.807 \pm 1.109$ ), historical background of GCH ( $HA3=2.470 \pm 1.080$ ), or usual activities of GCH ( $HA4=2.125 \pm 1.046$ ).

**Measurement model**

The Tables 4 and 5 show that the measurement model fulfilled all the requirements of factor loadings, reliability (Cronbach’s Alpha and Composite Reliability), and



**Fig. 6** PU and PQ (a) & HA and CA (b) of Tokyo citizens for GCH

construct validity (Convergent Validity and Discriminant Validity).

As shown in Table 4, all the standard factor loadings, ranging from 0.817 to 0.936, are greater than the standard of 0.707; Cronbach's alphas of all constructs ranged between 0.843 and 0.936, exceeding the threshold of 0.7 for construct reliability. All composite reliabilities (CR) were greater than 0.7, ranging from 0.905 to 0.954, confirming good construct reliability. The average variance

extracted (AVE) ranging from 0.730 to 0.838 were above 0.500, suggesting that the measurement model ensured convergent validity [102]. Finally, discriminant validity was confirmed using the Fornell-Larcker criterion and heterotrait-monotrait (HTMT) ratio analysis. The square roots of AVE in the latent variables were higher than other correlation values of latent constructs (Table 5) and the HTMT ratios of the correlation values were all below 0.900 [94, 103].

**Table 4** The information of the measurement model

Latent variable	Observed variable	Factor loading	Cronbach's alpha	CR	AVE
Subjective norm (SN)	SN1	0.896	0.926	0.948	0.819
	SN2	0.936			
	SN3	0.919			
	SN4	0.867			
Attitude toward the behavior (AB)	AB1	0.851	0.877	0.915	0.730
	AB2	0.882			
	AB3	0.843			
	AB4	0.841			
Perceived behavioral control (PBC)	PBC1	0.888	0.878	0.916	0.732
	PBC2	0.858			
	PBC3	0.836			
	PBC4	0.839			
Intention(I)	I1	0.913	0.935	0.954	0.838
	I2	0.929			
	I3	0.917			
	I4	0.902			
Behavior (B)	B1	0.911	0.890	0.931	0.818
	B2	0.900			
	B3	0.902			
Heritage awareness (HA)	HA1	0.915	0.908	0.936	0.784
	HA2	0.892			
	HA3	0.907			
	HA4	0.825			
Cultural attachment (CA)	CA1	0.908	0.883	0.928	0.810
	CA2	0.896			
	CA3	0.897			
Perceived usefulness (PU)	PU1	0.882	0.936	0.949	0.757
	PU2	0.859			
	PU3	0.898			
	PU4	0.888			
	PU5	0.873			
	PU6	0.817			
Perceived quality (PQ)	PQ1	0.892	0.843	0.905	0.761
	PQ2	0.881			
	PQ3	0.844			

CR Composite reliability, AVE Average variance extracted

### Structural model

The TPB-only and the extended TPB model shown in Fig. 7. To evaluate the structural model (Table 6), first, the multicollinearity of all the predictor constructs was not problematic, meeting the criteria of VIF values < 3.3 or < 5 [100, 104]. Second, it was also shown that the predictive correlations of the models were not problematic, with all the  $Q^2$  values in the models being well above zero [100]. In addition, the coefficient of determination ( $R^2$ ) used to assess the predictive power of the models was > 0.10,  $R^2_{(SN)} = 0.305$ ,  $R^2_{(AB)} = 0.458$ ,  $R^2_{(PBC)} = 0.359$ ,  $R^2_{(I)} = 0.631$ ,  $R^2_{(B)} = 0.184$ , which is

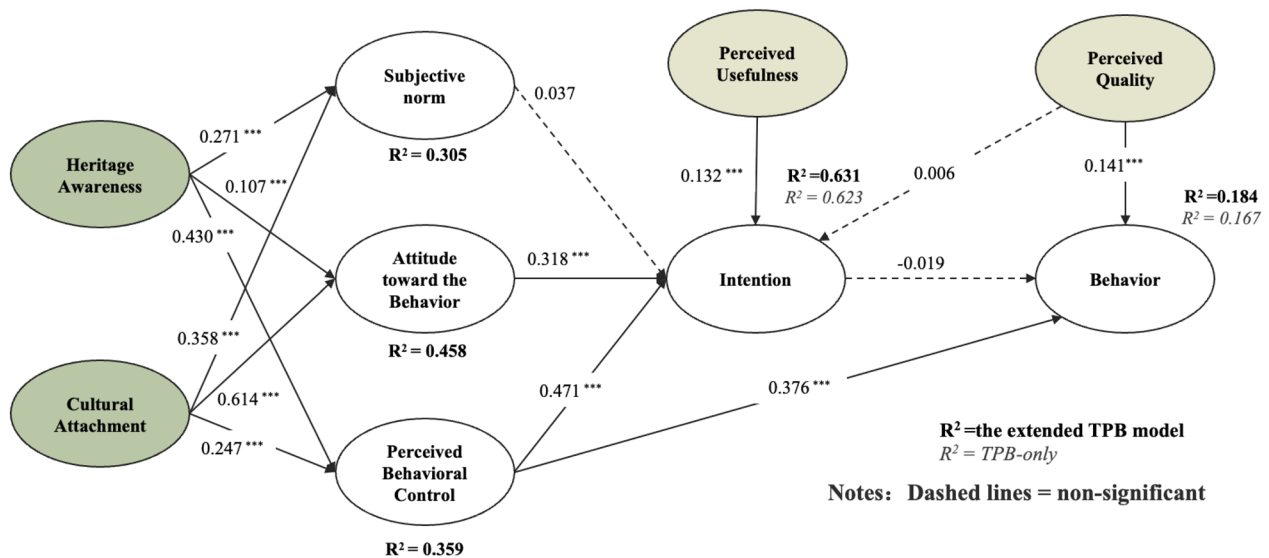
acceptable for behavioral and social science research [90]. Finally, the standardized root mean square residual (SRMR) value was less than 0.10, indicating that the model fit level was acceptable [94, 105].

The results in Table 6 indicate that all hypotheses are supported, except for hypotheses H1a, H1e and H5a. More specifically, as shown in Fig. 7, in terms of public intention and behavior, AB ( $\beta = 0.318$ ,  $p < 0.001$ ) and PBC ( $\beta = 0.471$ ,  $p < 0.001$ ) and PU ( $\beta = 0.132$ ,  $p < 0.001$ ) had a significant positive effect on I. Contrary to expectations, SN had no significant effect on I ( $\beta = 0.037$ ,  $p = 0.221$ ). In addition, the effect of the public's self-reported

**Table 5** Discriminant validity based on the Fornell-Larcker criterion and HTMT ratio

Fornell-Larcker criterion									
	SN	AB	PBC	I	B	HA	CA	PU	PQ
SN	<b>0.905</b>								
AB	0.563	<b>0.854</b>							
PBC	0.523	0.464	<b>0.855</b>						
IN	0.521	0.650	0.697	<b>0.915</b>					
B	0.269	0.095	0.408	0.295	<b>0.904</b>				
HA	0.461	0.433	0.561	0.552	0.473	<b>0.886</b>			
CA	0.502	0.671	0.475	0.603	0.215	0.531	<b>0.900</b>		
PU	0.431	0.682	0.432	0.571	0.137	0.454	0.750	<b>0.870</b>	
PQ	0.311	0.415	0.321	0.368	0.255	0.422	0.630	0.506	<b>0.872</b>
Heterotrait-Monotrait ratio (HTMT)									
SN	–								
AB	0.617								
PBC	0.574	0.518							
IN	0.556	0.716	0.758						
B	0.292	0.137	0.453	0.316					
HA	0.500	0.480	0.623	0.597	0.525				
CA	0.551	0.762	0.533	0.664	0.235	0.590			
PU	0.458	0.754	0.468	0.609	0.145	0.488	0.824		
PQ	0.349	0.483	0.369	0.412	0.291	0.481	0.731	0.569	–

Bold text represents the square root of AVE in the latent variable



**Fig. 7** Standardized coefficients of the TPB-only and the extended TPB model. \*\*\* $p < 0.001$

intentions on their actual behavior was not significant ( $\beta = -0.019, p = 0.556$ ). PBC ( $\beta = 0.376, p < 0.001$ ) and PQ ( $\beta = 0.141, p < 0.001$ ) significantly affected B. In terms of environmental awareness, HA positively and significantly affected public SN for GCH ( $\beta = 0.271, p < 0.001$ ), AB ( $\beta = 0.107, p < 0.001$ ), and PBC ( $\beta = 0.430, p < 0.001$ ).

Similar to HA, CA also significantly affected the public's SN for GCH ( $\beta = 0.358, p < 0.001$ ), AB ( $\beta = 0.614, p < 0.001$ ), and PBC ( $\beta = 0.247, p < 0.001$ ), with CA having the most significant AB for the public.

In addition, Fig. 7 shows that the extended TPB model, which includes environmental awareness and perception,



**Table 6** Hypothesis Results, determination coefficients ( $R^2$ ), and predictive relevance ( $Q^2$ ) of endogenous

Research hypothesis	Path coefficients	Standard deviation	T statistics	Confidence intervals		P values
				2.50%	97.50%	
H1a: SN → I	0.037	0.030	1.244	-0.022	0.097	0.221
H1b: AB → I	0.318***	0.031	10.355	0.256	0.378	< 0.001
H1c: PBC → I	0.471***	0.029	16.500	0.414	0.527	< 0.001
H1d: PBC → B	0.376***	0.032	11.887	0.315	0.439	< 0.001
H1e: I → B	-0.019	0.032	0.568	-0.083	0.043	0.556
H2a: HA → SN	0.271***	0.030	9.008	0.214	0.328	< 0.001
H2b: HA → AB	0.107***	0.028	3.884	0.052	0.160	< 0.001
H2c: HA → PBC	0.430***	0.033	13.059	0.365	0.494	< 0.001
H3a: CA → SN	0.358***	0.031	11.534	0.296	0.418	< 0.001
H3b: CA → AB	0.614***	0.027	22.943	0.561	0.664	< 0.001
H3c: CA → PBC	0.247***	0.034	7.316	0.181	0.311	< 0.001
H4a: PU → I	0.132***	0.029	4.626	0.072	0.191	< 0.001
H5a: PQ → I	0.006	0.031	16.696	-0.042	0.057	0.799
H5b: PQ → B	0.141***	0.028	4.891	0.086	0.194	< 0.001
	$R^2$	$Q^2$				
SN	0.305	0.301				
AB	0.458	0.455				
PBC	0.359	0.355				
I	0.631	0.449				
B	0.184	0.154				
SRMR	0.052					

Bold values represent significant results

\*\*\*  $p < 0.001$

explains more intentions and behaviors. In the TPB-only model,  $R^2_{(I)} = 0.623$  and  $R^2_{(B)} = 0.167$ , whereas they increase by 1.28% and 10.18% in the extended TPB model, respectively.

**The results of the mediation effect for structural model**

In addition, while testing the significance of each path coefficient, it is also necessary to evaluate the mediating effect through a specific algorithm, to determine

whether SN, AB, PBC are effective mediating variables. The SmartPLS software was used to generate the values of the specific mediation effect. From Table 7, we could see neither HA nor CA can influence I through SN. However, the mediating role of the variables AB and PBC was significant. Of these, HA had the largest indirect effect on I through PBC ( $\beta = 0.203$ ,  $p < 0.001$ ); whereas the indirect effect on I through AB was highly significant, but the coefficient was not high ( $\beta = 0.034$ ,

**Table 7** Mediation effect test results

	Path Coefficients	Standard deviation	T statistics	Confidence intervals		P values
				2.50%	97.50%	
HA → SN → I	0.010	0.008	1.198	-0.006	0.027	0.231
HA → AB → I	0.034***	0.009	3.718	0.016	0.053	< 0.001
HA → PBC → I	0.203***	0.021	9.535	0.122	0.203	< 0.001
CA → SN → I	0.013	0.011	1.211	-0.008	0.035	0.226
CA → AB → I	0.195***	0.022	9.031	0.155	0.239	< 0.001
CA → PBC → I	0.116***	0.016	7.050	0.084	0.149	< 0.001

Bold values represent significant results

\*\*\*  $p < 0.001$

$p < 0.001$ ). The indirect effect of CA on I via AB ( $\beta = 0.195$ ,  $p < 0.001$ ) and PBC ( $\beta = 0.116$ ,  $p < 0.001$ ) were both significant.

## Discussion

### The predictors of protection intention and behavior

Contrary to our hypothesis, the results suggest that the effect of SN on citizens' willingness to protect GCH was not significant. This finding is puzzling, but interesting to interpret. Similar results were found in previous studies by Gao et al. (2017) and Liao et al. (2018), who interpreted them as indicating subjective norms were not sufficiently established to provide significant social pressure [74, 75]. One possible explanation for our findings is that, given the cultural and normative nature of Japanese society, individuals may believe that they will not cause trouble for others and may be uncomfortable expressing the idea that they want another person to do something. Therefore, it is reasonable to suggest that the role of subjective norms may have cultural contextual differences, and the influence of different national contexts should be considered in future studies.

Furthermore, our results found (Fig. 7) that individuals have stronger willingness if they have positive behavioral attitudes toward their local GCH. This is consistent with previous findings, residents are more likely to participate in environmental governance when the public has a positive opinion of urban green space [44]; residents' intention to recycle household waste would significantly depend on their attitudes [106]; and attitude is also one of the determining factors affecting intention in discussions of residents' behavioral intention to participate in neighborhood micro-renewal [107]. Therefore, following the meaning of attitude in the TPB framework, in our study, when Tokyo residents perceive this behavior as beneficial and important (e.g., AB1 and AB2), it elicits their willingness to protect GCH (e.g., I1 and I4). Thus, educational and awareness campaigns that highlight the benefits and importance of GCH can foster more favorable attitudes and increase engagement.

Among all TPB constructs, PBC is the most important predictor of intention and behavior [62], which is consistent with TPB theory [51]. PBC refers to the degree of self-perceived ease of performing a specific behavior [51], which indicated that when individuals perceive themselves as having a higher likelihood of performing, actual behavior is also higher. Tokyo residents reported lower PBC compared to SN and AB, with more than 30% reporting that they are constrained by time and resources to conserve GCH. This illustrates that citizens in the Tokyo metropolitan area are still poorly informed about the opportunities for GCH governance and conservation, leading to a majority not engaging in GCH conservation

(very low self-report scores on actual behaviors). Tokyo is one of the most crowded and busiest cities in the world, and rapid urbanization has led to an accelerated pace of life for urban residents [108, 109], making it difficult to devote sufficient time and resources to actively participating in the conservation of GCH. However, the significance of PBC indicates that, for residents of Tokyo, this is a major issue in their intention and behavior toward GCH conservation. To address this, the government should increase its efforts to promote visits "Let's go to the gardens" (<https://www.tokyo-park.or.jp/teien/en/>), "Let's go to the parks" ([https://www.tokyo-park.or.jp/#googtrans\(en\)](https://www.tokyo-park.or.jp/#googtrans(en))), and other existing GCH participation and conservation programs. Specific measures may include negotiating with relevant management departments to incentivize pro-environmental behavior through convenient individual or family conservation activities in exchange for admission and facility service discounts, among other incentives.

However, it is worth noting that despite over 80 percent of Tokyo residents in our sample expressing positive attitudes to conserve GCH, over 80 percent engaged in little to no GCH conservation behavior (Fig. 5), and the current results show no significant correlation between intentions and reported behaviors ( $\beta = -0.019$ ,  $p = 0.556$ ). In TPB, intentions are usually positively correlated with behavior, as the actual behavior of individuals is perceived to be controlled and influenced by intentions [51]. Nevertheless, as research has progressed, some recent studies have found that people's intentions do not necessarily lead to behavior [110, 111], a situation attributed to external conditions and/or endogenous factors, where external conditions indicate that individuals may have to implement the social and physical opportunities provided by their environment [112]. Consistent with these findings, our study revealed that 30 percent of respondents reported being constrained by time and resources to protect GCH (Fig. 5). This illustrates that citizens in the Tokyo metropolitan area are still poorly informed about the opportunities for GCH governance and conservation, leading to a majority not engaging in GCH conservation. In addition, a review by Conner & Norman (2022) concluded that moderators such as sociodemographic factors (age, gender, income), personality, or past behaviors/habits may also potentially influence the relationship between intentions and behaviors [113]. Understanding the intention-behavior gap is one of the important future research directions. Future research on the intention-behavior gap would benefit from a more systematic consideration of the wide range of moderators of the intention-behavior relationship, either individually or in combination.

### The importance of environmental awareness and perception

Our study demonstrates the importance of heritage awareness on perceived behavioral control in the conservation of GCH. As Nyaupane and Timothy (2010) [78], Lim et al. (2018) [95], and Shankar and Swamy (2013) have found, heritage awareness plays a non-negligible role in heritage conservation and public participation [114]. However, our survey of urban residents in Tokyo revealed (Fig. 6) a lack in GCH heritage awareness, especially in terms of the historical background of GCH and the activities usually carried out by it. Approximately 50 percent of citizens were aware of the historical background of GCH, while more than 60 percent were not aware of the activities carried out by GCH. This suggests a need for local governments to raise public awareness of heritage in practical ways, such as conducting heritage festivals, educational events such as heritage walks, heritage newspapers, and online information campaigns [86].

Additionally, our study provides further evidence of the substantial impact of cultural attachment on SN, AB, and PBC, with a particularly strong influence observed on attitudes towards behavior. This finding aligns with previous research by Cheng and Chen (2021), which highlighted the pivotal role of cultural attachment in promoting the sustainable development of cultural heritage sites [96]. Cultural attachment serves as a significant emotional catalyst, reflecting residents' sense of pride and connection to their local GCH. Such emotional ties play a crucial role in shaping individuals' perceptions, attitudes, and behaviors towards the conservation and utilization of GCH assets. Thus, these findings emphasize the potential benefits of the Tokyo authorities' popularizing the cultural and historical significance of each GCH to residents. Specifically, in addition to fostering public appreciation of the cultures of GCH, education and promotion efforts for the understanding of these cultures can allow residents to form cultural bonds with GCH. When local communities feel that their GCH are valued and respected, they are more likely to actively participate in efforts to protect them.

For environmental perception, the significant role of PU in influencing intentions, as observed in Wan et al. (2018) [62]. Our study reaffirms this trend, demonstrating that citizens' willingness to protect GCH will be shaped by their usefulness perception of GCH. Thus, as described in the questionnaire item on the usefulness of GCH, it becomes imperative to bolster public engagement in social and cultural activities pertaining to GCH, fostering a deeper sense of belonging and historical understanding among communities. Moreover, efforts to expand knowledge dissemination and scientific research

opportunities in GCH, as well as to promote tourism associated with GCH could offer tangible demonstrations of the practical benefits and utility of these heritage sites for the local community.

Additionally, as with Wan et al. (2018) [62], the relationship between PQ and intentions was non-significant, suggesting that PQ is not necessarily a predictor of intentions, as PQ may only be associated with high levels of intentions [115]. In the current study, although the majority of residents reported positive protection intentions, however, the trend was slight, which could be a potential reason for this result. On the other hand, unlike Wan et al. (2018), who only considered intentions, our results also emphasized the important influence of PQ on residents' actual protective behaviors [62]. The significance of this finding lies in the fact that in situations where intentions cannot significantly influence behavior (as in this case), some extrinsic environmental factors may directly encourage residents to engage more in protective behaviors. In addition, based on the low level of PQ and the low level of B in the statistical results, we can infer that if the residents believe that the local government does not manage the GCHs well (e.g., insufficient facilities, insufficient maintenance), then it will greatly weaken their willingness to participate in the actual protection because they may believe that the authorities do not pay attention to these GCHs, and therefore they do not need to put in the actual effort to pay for the government's responsibility. Therefore, this finding suggests that local governments should prioritize investments in improving the environmental quality of GCHs, including infrastructure and maintenance, in order to encourage residents to become more involved in protection behaviors.

The mediation analysis presented in Table 7 offers valuable insights into the underlying mechanisms through which environmental awareness influences behavioral intentions in the context of GCH conservation. Specifically, the significant mediating effects of AB and PBC highlight the pivotal role of these psychological constructs in shaping individuals' intentions to engage in conservation efforts. However, SN don't seem to play a significant role in influencing intentions in our study, unlike in previous research [80]. AB reflects individuals' evaluations or affective responses toward participating in GCH conservation efforts. In our study, AB serves as a mediator between environmental awareness and intentions, suggesting that indicates that positive personal attitudes towards GCH conservation help to reinforce the influence of environmental awareness on conservation intentions. This finding underscores again the importance of fostering favorable attitudes and perceptions toward GCH conservation through education, awareness

campaigns, and community engagement initiatives. PBC refers to individuals' perceptions of the ease or difficulty of performing a behavior, taking into account internal and external factors that may facilitate or hinder their ability to act. As a mediator in the relationship between environmental awareness and intentions, PBC highlights the critical role of perceived self-efficacy and perceived control over GCH conservation intentions. Individuals with higher levels of environmental awareness may feel more empowered and confident in their ability to contribute to GCH conservation, leading to stronger intentions to engage in conservation efforts. Enhancing individual's perceived behavioral control through skills training, capacity-building initiatives, and providing opportunities for bottom-up participation can empower them to overcome barriers and obstacles to GCH conservation, thereby facilitating the translation of environmental awareness into concrete actions.

### Study implications

Overall, the results of this study have multiple implications for the development and implementation of policies and plans to promote public participation in the environmental governance behaviors of GCH. The contribution of this work is mainly in both theoretical and practical aspects.

For practical aspect, it highlights the importance and research value of GCH, and proposes a participatory heritage management approach to enhance the voice of the landscape in heritage conservation. Local governments can enhance public participation in green cultural heritage management through three measures: (1) raising citizens' awareness of heritage and cultural identity through education and publicity; (2) increasing the publicity of green cultural heritage participation and conservation programs, while providing citizens with more opportunities for GCH conservation and governance; and (3) emphasizing bottom-up public participation in GCH governance and conservation to improve the overall environmental quality of GCH. For example, participatory heritage management, which involves local communities, stakeholders, and individuals in decision-making and implementation [56, 116]. In particular, so far, there is still a lack of systematic, institutionalized platforms for public participation in GCH in various countries. Lian et al. (2024) have recognized that the conservation of historic garden needs to be rooted in a bottom-up approach through an efficient communication network between multiple stakeholders (knowledgeable gardeners, civil society organizations, environmentally conscious residents, relevant institutions and local authorities) [26]. This highlights a crucial area which is raised by current study for improvement and underscores the need for

the establishment of such platforms to enhance public engagement, and ensure the sustainable preservation of GCH. In short, it is undisputed that public participation in environmental governance can bring many benefits, such as giving citizens the opportunity to voice their opinions and needs, gain a sense of control and empowerment, and strengthen their sense of residency and willingness to participate again [45, 117].

For theoretical aspect, firstly, this study applies the extended TPB model for the first time in the study of green cultural heritage conservation, and the TPB model was reasonably extended by integrating two factors—environmental awareness and perception—to predict citizens' attitudes, intentions, and behaviors toward environmental protection. Second, the inclusion of both environmental awareness and environmental perception variables in the extended TPB model led to an increase in the explained variance in both intention and behavior compared with the TPB alone. In detail, the explained variances in intention and behavior in the original model were 62.3% and 16.7%, respectively, whereas the extended model explained 63.1% and 18.4% of the information, respectively. This represents an increase of 1.28% and 10.18% in the explained variance for intention and behavior. These findings support the predictive validity of the extended TPB model and emphasizing the important role of including environmental awareness and environmental perception dimensions in the overall model. In the future, more expansion variables could be considered for inclusion in the TPB model to deepen the understanding of utilizing the TPB to investigate bottom-up GCH conservation. These findings enrich the theoretical system of participation in heritage management and provide scientific references for policymakers to develop effective and targeted public participation policies for the conservation of urban GCH. Moreover, heritage trees, historical gardens, and other forms of green cultural heritage have often been overlooked in cultural heritage discourse. The current study, by recognizing the intrinsic value of cultural and historic elements within green spaces, green cultural heritage represents a significant advancement in heritage studies, filling a gap that has long existed in research on green spaces and cultural landscapes. This study serves as a call to action, encouraging scholars to delve deeper into the study of these neglected green cultural spaces. Its findings hold particular significance for scholars in landscape and related fields, offering inspiration to explore and investigate the rich complexities of green cultural heritage. By shedding light on these overlooked aspects of our cultural and natural heritage, this research can inspire scholars worldwide to broaden their perspectives and deepen their understanding of landscape dynamics.

In addition, even though this is only a study in Japan, scholars in other countries can still benefit. As Table 1 demonstrates, although no country has yet formally used the term Green Cultural Heritage, GCH is increasingly becoming an important part of the World Heritage field and a focus of attention. Therefore, we believe that this study can stimulate transnational dialogues among scholars from different cultural backgrounds to enrich and complete the existing theoretical framework. Furthermore, scholars from other countries can incorporate local policies or other forms of public participation in governance theory to construct local frameworks for GCH conservation.

### Limitations and future study

Unlike previous studies that have focused on cultural heritage and green spaces, this study makes a significant contribution to the literature because it purposefully presents the concept of GCH in a landscape-based context and examines bottom-up heritage conservation. However, our study has some limitations. First, this study was a cross-sectional survey, not a longitudinal study. In the future, more studies need to examine the changes in GCH conservation intentions and behaviors of Tokyo metropolitan residents before and after changes in public awareness of heritage and cultural attachment will complement the cross-sectional findings.

Second, in our study, we just focused on the cognitive dimensions of the TPB—attitudes, subjective norms, and perceived behavioral control—providing a structured framework for understanding psychological predictors of behavior. However, this approach may not fully capture the complexity of environmental and socio-economic influences. Future research should integrate geographic information systems (GIS) data on green space accessibility with the TPB framework. This integration would include contextual variables such as physical and perceived accessibility to green spaces, socio-economic status, and geographic factors specific to Tokyo's 23 wards, offering a more comprehensive understanding of conservation behavior.

Third, we did not separately classify or analyze different types of green cultural heritage. We acknowledge that public attitudes towards various types of green cultural heritage, such as different kinds of gardens or green cultural properties, may vary significantly. Future studies should aim to separately classify and analyze different types of green cultural heritage to provide a more detailed understanding of public attitudes and behaviors towards each specific category.

Finally, while the extended TPB model provides a valuable framework for understanding GCH conservation behavior, it has inherent limitations. The TPB assumes

that individuals make rational decisions based on available information. However, environmental behaviors, including conservation efforts, are often influenced by habitual, emotional, and unconscious factors that are not fully captured by this model. Future research should consider exploring methods that capture habitual, emotional, and unconscious influences on behavior, as well as the complexity of social influences, will be essential for identifying effective strategies to promote GCH conservation. To address this limitation, future research should integrate the TPB with other theoretical perspectives that account for these non-rational influences. Employing methods that capture the emotional habitual dimensions and unconscious factors of behavior, such as ecological momentary assessment or emotional tracking or electroencephalogram measurement, could provide a more nuanced understanding of conservation behaviors. By adopting a more holistic approach, researchers can develop strategies that better address the multifaceted nature of environmental behaviors and enhance the effectiveness of conservation initiatives.

Furthermore, although government initiatives towards GCH protection advancement are generally considered effective, our current data still show very low levels of self-reported behavior (Fig. 5b). Therefore, it is necessary to consider some other forms of efforts in the future, such as empowering local communities to play a more active role in decision-making processes related to GCH conservation, to understand the social networks, community engagement, and cultural norms of local residents; collaborating with educational institutions to foster cultural attachment and identification with local GCH in the next generation; and identifying and addressing barriers to public participation in GCH conservation, such as a lack of information, limited resources, socioeconomic disparities, and institutional constraints; Adopt inclusive and equitable measures to ensure that diverse voices and perspectives are heard and valued.

### Conclusion

Based on the theory of planned behavior, this study explored people's conservation intentions and behaviors toward GCH and the psychosocial factors that influence decisions regarding GCH conservation. by using a population sample consistent with the demographic characteristics of Tokyo and an extended TPB model.

The study supported most of our hypotheses, while three of these hypotheses were rejected. The data showed no significant effect of SN on intention (H1a:  $SN \rightarrow I$ ), intention on behavior (H1e:  $I \rightarrow B$ ), and PQ on intention (H5a:  $PQ \rightarrow I$ ). Thus, the results of this study identified influential factors that affect Tokyo residents' conservation intentions and behaviors toward local GCH,

emphasizing the important role of PBC in this regard. In terms of environmental awareness, heritage awareness has the most significant effect on PBC, which has a non-negligible role in heritage conservation and public participation, and CA has an important effect on AB. Regarding environmental perception, perceived benefits can directly affect citizens' GCH conservation intentions, and the significant relationship between perceived quality and behavior suggests that perceived environmental quality is also a necessary predictor of GCH conservation behavior.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s40494-024-01407-x>.

Additional file 1.

## Acknowledgements

We would like to thank all anonymous participants for their precious time in this study. Besides, we would like to thank Editage ([www.editage.com](http://www.editage.com)) for English language editing.

## Author contributions

Jing Xie and Shixian Luo developed the study, analyzed the data and wrote the main manuscript text. Jing Xie and Jie Chen are involved in the visualization. All authors were involved in data engagement and reviewed the manuscript.

## Funding

This work was supported by JST SPRING [Grant No. JPMJSP2109].

## Availability of data and materials

No datasets were generated or analysed during the current study.

## Declarations

## Competing interests

The authors declare no competing interests.

Received: 15 May 2024 Accepted: 8 August 2024

Published online: 19 August 2024

## References

- Smith L. ? Doing Archaeology?: cultural heritage management and its role in identifying the link between archaeological practice and theory. *Int J Herit Stud.* 2000;6(4):309–16.
- Ross A, Prangnell J, Coghill B. Archaeology, cultural landscapes, and Indigenous knowledge in Australian cultural heritage management legislation and practice. *Heritage Manage.* 2010;3(1):73–96.
- Zhang J. New functionalism: rejuvenating historical and cultural heritage through urban revival. *Int J Anthropol Ethnol.* 2019;3(1):1–14.
- Eklund L, Sjöblom B, Prax P. Lost in translation: video games becoming cultural heritage? *Cult Sociol.* 2019;13(4):444–60.
- Ott M, Pozzi F. Towards a new era for cultural heritage education: discussing the role of ICT. *Comput Hum Behav.* 2011;27(4):1365–71.
- Giménez JE, Ruiz RMÁ, Listán MF. Primary and secondary teachers' conceptions about heritage and heritage education: a comparative analysis. *Teach Teach Educ.* 2008;24(8):2095–107.
- Kaya DI, Dane G, Pintossi N, Koot CA. Subjective circularity performance analysis of adaptive heritage reuse practices in the Netherlands. *Sustain Cities Soc.* 2021;70: 102869.
- Della Torre S. Italian perspective on the planned preventive conservation of architectural heritage. *Front Architect Res.* 2021;10(1):108–16.
- Li J, Stoffelen A, Meijles E, Vanclay F. Local people's sense of place in heavily touristed protected areas: contested place meanings around the Wulingyuan World Heritage Site. *China Landscape Urban Plan.* 2023;237: 104792.
- Millar S. Heritage management for heritage tourism. *Tour Manage.* 1989;10(1):9–14.
- McKercher B, Ho PS, Du Cros H. Relationship between tourism and cultural heritage management: evidence from Hong Kong. *Tour Manage.* 2005;26(4):539–48.
- Sánchez ML, Cabrera AT, Del Pulgar MLG. Guidelines from the heritage field for the integration of landscape and heritage planning: a systematic literature review. *Landscape Urban Plan.* 2020;204: 103931.
- Seyedashrafi B, Ravankhah M, Weidner S, Schmidt M. Applying heritage impact assessment to urban development: world heritage property of Masjed-e Jame of Isfahan in Iran. *Sustain Cities Soc.* 2017;31:213–24.
- Gandini A, Garmendia L, Prieto I, Álvarez I, San-José JT. A holistic and multi-stakeholder methodology for vulnerability assessment of cities to flooding and extreme precipitation events. *Sustain Cities Soc.* 2020;63: 102437.
- Miranda FN, Ferreira TM. A simplified approach for flood vulnerability assessment of historic sites. *Nat Hazards.* 2019;96:713–30.
- Holtorf C. Embracing change: how cultural resilience is increased through cultural heritage. *World Archaeol.* 2018;50(4):639–50.
- Bohnet IC, Molnarova KJ, van den Brink A, Beilin R, Sklenicka P. How cultural heritage can support sustainable landscape development: the case of Treboň Basin. *Czech Republic Landscape Urban Planning.* 2022;226: 104492.
- Jagielska-Burduk A, Pszczyński M, Stec P. Cultural heritage education in UNESCO cultural conventions. *Sustainability.* 2021;13(6):3548.
- ICOMOS, 2020. Share Your Practices of Linking Nature and Culture for Conservation. <https://www.icomos.org/en/what-we-do/image-what-we-do/679-focus/nature-culture/81326-share-your-practices-of-linking-nature-and-culture-for-conservation>. Accessed 31 May 2023.
- Historic England, 2023. What Is a Conservation Area?. <https://historicengland.org.uk/listing/what-is-designation/local/conservation-areas/>. Accessed 1 June 2023.
- Department of Climate Change, Energy, the Environment and Water, 2021. Protecting National Historic Sites. <https://www.dcceew.gov.au/parks-heritage/heritage/grants-and-funding/protecting-national-historic-sites>. Accessed 1 June 2023.
- Government of Singapore, 2023. Pride In Our Past Legacy For Our Future. <https://www.nhb.gov.sg/>. Accessed 1 June 2023.
- Agency of Cultural Affairs, 2024. Cultural Policy in Japan. [https://www.bunka.go.jp/tokei\\_hakusho\\_shuppan/hakusho\\_nenjihokokusho/r01\\_bunka\\_seisaku/index.html](https://www.bunka.go.jp/tokei_hakusho_shuppan/hakusho_nenjihokokusho/r01_bunka_seisaku/index.html). Accessed 25 March 2024.
- Choay F, OConnell LM. The invention of the historic monument. 2001.
- Bučas J. Problem of green cultural heritage. *J Archit Urban.* 2006;30(1):19–29.
- Lian J, Nijhuis S, Bracken G, Wu X, Wu X, Chen D. Conservation and development of the historic garden in a landscape context: a systematic literature review. *Landscape Urban Plan.* 2024;246: 105027.
- Thaiutsa B, Puangchit L, Kjelgren R, Arunparatur W. Urban green space, street tree and heritage large tree assessment in Bangkok. *Thailand Urban Forestry Urban Greening.* 2008;7(1):219–29.
- Xie J, Luo S, Furuya K, Wang H, Zhang J, Wang Q, Chen J. The restorative potential of green cultural heritage: exploring cultural ecosystem services' impact on stress reduction and attention restoration. *Forests.* 2023;14(11):2191.
- UNESCO World Heritage Centre. (n.d.). Classical gardens of Suzhou. <https://whc.unesco.org/en/list/813>. Accessed 7 July 2024
- Oniwa Garden. (n.d.). *A garden designated as a national important cultural property.* <https://oniwagarden/tag/%E5%9B%BD%E6%8C%87%E5%AE%9A%E9%87%8D%E8%A6%81%E6%96%87%E5%8C%96%E8%B2%A1/>. 7 July 2024
- Maleknia R, Heindorf C, Rahimian M, Saadatmanesh R. Do generational differences determine the conservation intention and behavior towards sacred trees? *Trees, Forests and People.* 2024;16: 100591.

32. Council of Europe, 2023a. Garden policy: FINLAND. <https://www.coe.int/en/web/herein-system/finland-garden-policy>. Accessed 1 June 2023.
33. Council of Europe, 2023b. Garden policy: FRANCE. <https://www.coe.int/en/web/herein-system/france-garden-policy>. Accessed 1 June 2023.
34. Ministère de la Culture, 2023. POP: la plateforme ouverte du patrimoine. <https://www.pop.culture.gouv.fr/>. Accessed 1 June 2023.
35. National Park Service, 2024. Cultural Landscapes, An Agency Takes Shape: 1906–1929. <https://www.nps.gov/subjects/culturallandscapes/clitime2.htm>. Accessed 25 March 2024.
36. Cultural Property Garden Preservation Council, 2023. Summary. <https://meien.gr.jp/gaiyou/>. Accessed 1 June 2023.
37. Swensen G, Jerpåsen GB. Cultural heritage in suburban landscape planning: a case study in Southern Norway. *Landsc Urban Plan.* 2008;87(4):289–300.
38. Graham B, Ashworth G, Tunbridge J. *A geography of heritage*. Routledge; 2016.
39. Tan SK, Tan SH, Kok YS, Choon SW. Sense of place and sustainability of intangible cultural heritage—the case of George town and Melaka. *Tour Manage.* 2018;67:376–87.
40. Mısırlısoy D, Günçen K. Adaptive reuse strategies for heritage buildings: a holistic approach. *Sustain Cities Soc.* 2016;26:91–8.
41. Agnoletti M. Rural landscape, nature conservation and culture: some notes on research trends and management approaches from a (southern) European perspective. *Landsc Urban Plan.* 2014;126:66–73.
42. Rösslér M. World Heritage cultural landscapes: a UNESCO flagship programme 1992–2006. *Landsc Res.* 2006;31(4):333–53.
43. Thompson CW. Urban open space in the 21st century. *Landsc Urban Plan.* 2002;60(2):59–72.
44. Huang Y, Aguilar F, Yang J, Qin Y, Wen Y. Predicting citizens' participatory behavior in urban green space governance: Application of the extended theory of planned behavior. *Urban Forestry Urban Greening.* 2021;61: 127110.
45. Kobori H, Primack RB. Participatory conservation approaches for satoyama the traditional forest and agricultural landscape of Japan. *AMBIO A J Human Environ.* 2003;32(4):307–11.
46. Sakurai R, Kobori H, Nakamura M, Kikuchi T. Factors influencing public participation in conservation activities in urban areas: a case study in Yokohama, Japan. *Biol Cons.* 2015;184:424–30.
47. Sipilä M, Tyrväinen L. Evaluation of collaborative urban forest planning in Helsinki. *Finland Urban Forestry Urban Greening.* 2005;4(1):1–12.
48. Atmis E. Development of urban forest governance in Turkey. *Urban Urban Greening.* 2016;19(1):158–66.
49. Chu Z, Bian C, Yang J. How can public participation improve environmental governance in China? a public simulation approach with multi-player evolutionary game. *Environ Impact Assess Rev.* 2022;95: 106782.
50. Karlsson F, Holgersson J, Söderström E, Hedström K. Exploring user participation approaches in public e-service development. *Gov Inf Q.* 2012;29(2):158–68.
51. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process.* 1991;50(2):179–211.
52. St John FA, Edwards-Jones G, Jones JP. Conservation and human behaviour: lessons from social psychology. *Wildl Res.* 2010;37(8):658–67.
53. Ajzen I. The theory of planned behaviour: reactions and reflections. *Psychol Health.* 2011;26(9):1113–27.
54. Du M, Chai CS, Di W, Wang X. What affects adolescents' willingness to maintain climate change action participation: an extended theory of planned behavior to explore the evidence from China. *J Clean Prod.* 2023;422: 138589.
55. Shen J, Saijo T. Reexamining the relations between socio-demographic characteristics and individual environmental concern: evidence from Shanghai data. *J Environ Psychol.* 2008;28(1):42–50.
56. Li H, Kinoshita T, Chen J, Xie J, Luo S, Su D. What promotes residents' donation behavior for adaptive reuse of cultural heritage projects? an application of the extended theory of planned behavior. *Sustain Cities Soc.* 2024;102: 105213.
57. Chen MF, Tung PJ. Developing an extended theory of planned behavior model to predict consumers' intention to visit green hotels. *Int J Hosp Manag.* 2014;36:221–30.
58. Bosnjak M, Ajzen I, Schmidt P. The theory of planned behavior: selected recent advances and applications. *Eur J Psychol.* 2020;16(3):352.
59. Tan Y, Ying X, Gao W, Wang S, Liu Z. Applying an extended theory of planned behavior to predict willingness to pay for green and low-carbon energy transition. *J Clean Prod.* 2023;387: 135893.
60. Maleknia R, ChamCham J. Participatory intention and behavior towards riparian peri-urban forests management; an extended theory of planned behavior application. *Front Psychol.* 2024;15:1372354.
61. Ibrahim FM, Aderonmu AF, Akintola OO. Examining the socio-psychological predictors of tree-planting behaviour using the theory of planned behaviour: a study of a cohort of Nigerian urban workers. *Urban Forestry Urban Greening.* 2022;69: 127509.
62. Wan C, Shen GQ, Choi S. The moderating effect of subjective norm in predicting intention to use urban green spaces: a study of Hong Kong. *Sustain Cities Soc.* 2018;37:288–97.
63. Tang D, Gong X, Liu M. Residents' behavioral intention to participate in neighborhood micro-renewal based on an extended theory of planned behavior: a case study in Shanghai. *China Habitat Int.* 2022;129: 102672.
64. Fishbein M, Ajzen I. *Belief, attitude, intention, and behavior: An introduction to theory and research.* 1977
65. de Jong MD, Neulen S, Jansma SR. Citizens' intentions to participate in governmental co-creation initiatives: comparing three co-creation configurations. *Gov Inf Q.* 2019;36(3):490–500.
66. Bonnes M, Passafaro P, Carrus G. The ambivalence of attitudes toward urban green areas: between proenvironmental worldviews and daily residential experience. *Environ Behav.* 2011;43(2):207–32.
67. Ajzen I. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior 1. *J Appl Soc Psychol.* 2002;32(4):665–83.
68. Lee HS. Examining neighborhood influences on leisure-time walking in older Korean adults using an extended theory of planned behavior. *Landsc Urban Plan.* 2016;148:51–60.
69. Ajzen I. *From intentions to actions: a theory of planned behavior.* Berlin Heidelberg: Springer; 1985. p. 11–39.
70. Bertoldo R, Castro P. The outer influence inside us: exploring the relation between social and personal norms. *Resour Conserv Recycl.* 2016;112:45–53.
71. Ajzen I 2017. Theory of planned behavior with background factors. Retrieved November, 24, 2020
72. Conner M, Armitage CJ. Extending the theory of planned behavior: a review and avenues for further research. *J Appl Soc Psychol.* 1998;28(15):1429–64.
73. Rhodes RE, Courneya KS. Relationships between personality, an extended theory of planned behaviour model and exercise behaviour. *Br J Health Psychol.* 2003;8(1):19–36.
74. Gao L, Wang S, Li J, Li H. Application of the extended theory of planned behavior to understand individual's energy saving behavior in workplaces. *Resour Conserv Recycl.* 2017;127:107–13.
75. Liao C, Zhao D, Zhang S. Psychological and conditional factors influencing staff's takeaway waste separation intention: an application of the extended theory of planned behavior. *Sustain Cities Soc.* 2018;41:186–94.
76. Fu L, Sun Z, Zha L, Liu F, He L, Sun X, Jing X. Environmental awareness and pro-environmental behavior within China's road freight transportation industry: moderating role of perceived policy effectiveness. *J Clean Prod.* 2020;252: 119796.
77. Sekhokoane L, Qie N, Rau PLP. Do consumption values and environmental awareness impact on green consumption in China? cross-cultural design: 9th international conference, CCD 2017 held as part of HCI international 2017, vancouver, BC, Canada, July 9–14, 2017 proceedings 9. New York: Springer International Publishing; 2017.
78. Nyaupane GP, Timothy DJ. Heritage awareness and appreciation among community residents: perspectives from Arizona, USA. *Int J Herit Stud.* 2010;16(3):225–39.
79. Mobley C, Vagias WM, DeWard SL. Exploring additional determinants of environmentally responsible behavior: the influence of environmental literature and environmental attitudes. *Environ Behav.* 2010;42(4):420–47.
80. Xu X, Wang S, Yu Y. Consumer's intention to purchase green furniture: do health consciousness and environmental awareness matter? *Sci Total Environ.* 2020;704: 135275.
81. Grob A. A structural model of environmental attitudes and behaviour. *J Environ Psychol.* 1995;15(3):209–20.

82. Heiskanen E. The performative nature of consumer research: consumers' environmental awareness as an example. *J Consum Policy*. 2005;28(2):179–201.
83. Carter G. Heritage interpretation and environmental education. *Manual Heritage Manage*. 1994;3:359–64.
84. Hong YY, Fang Y, Yang Y, Phua DY. Cultural attachment: a new theory and method to understand cross-cultural competence. *J Cross Cult Psychol*. 2013;44(6):1024–44.
85. McKercher B, Du Cros H. Culture, heritage and visiting attractions. *Tourism Business Frontiers*: Elsevier; 2006. p. 211–9.
86. Shimray, S. R. (2019). Ways to create awareness on cultural heritage: An overview. *Library Philosophy and Practice*, 2577.
87. Wang S, Fan J, Zhao D, Yang S, Fu Y. Predicting consumers' intention to adopt hybrid electric vehicles: using an extended version of the theory of planned behavior model. *Transportation*. 2016;43:123–43.
88. Davies J, Foxall GR, Pallister J. Beyond the intention-behaviour mythology: an integrated model of recycling. *Mark Theory*. 2002;2(1):29–113.
89. Francis J, Giles-Corti B, Wood L, Knuiam M. Creating sense of community: the role of public space. *J Environ Psychol*. 2012;32(4):401–9.
90. Si W, Jiang C, Meng L. The relationship between environmental awareness, habitat quality, and community residents' pro-environmental behavior—mediated effects model analysis based on social capital. *Int J Environ Res Public Health*. 2022;19(20):13253.
91. Jain V, Okazawa Y. Case Study on Tokyo Metropolitan Region, Japan. World Bank: Washington, D.C; 2019.
92. Tokyo Metropolitan Government Bureau of Construction, 2024. About budget and settlement of accounts. [https://www.kensetsu.metro.tokyo.lg.jp/about/yosan\\_kessan/index.html](https://www.kensetsu.metro.tokyo.lg.jp/about/yosan_kessan/index.html). Accessed 24 March 2024.
93. Taylor S, Todd PA. Understanding information technology usage: a test of competing models. *Inf Syst Res*. 1995;6(2):144–76.
94. Wang C, Yao X, Sinha PN, Su H, Lee YK. Why do government policy and environmental awareness matter in predicting NEVs purchase intention? Moderating Role Education Level Cities. 2022;131: 103904.
95. Lim V, Frangakis N, Tanco LM, Picinali L. PLUGGY: A pluggable social platform for cultural heritage awareness and participation advances in digital cultural heritage: international workshop, Funchal, Madeira, Portugal, June 28, 2017, Revised selected papers. New York: Springer International Publishing; 2018. p. 117–29.
96. Cheng Z, Chen X. The effect of tourism experience on tourists' environmentally responsible behavior at cultural heritage sites: the mediating role of cultural attachment. *Sustainability*. 2022;14(1):565.
97. e-Stat. (n.d.). Population by sex and age (cross tabulation). [https://www.e-stat.go.jp/dbview?sid=0003448228\[116\]](https://www.e-stat.go.jp/dbview?sid=0003448228[116]). 4 July 2024
98. Fecso RS, Kalsbeek WD, Lohr SL, Scheaffer RL, Scheuren FJ, Stasny EA. Teaching survey sampling. *Am Stat*. 1996;50:328–40.
99. Chin WW. The partial least squares approach to structural equation modeling. *Modern Methods Busi Res*. 1998;295(2):295–336.
100. Hair JF Jr, Sarstedt M, Ringle CM, Gudergan SP. Advanced issues in partial least squares structural equation modeling. London: Sage publications; 2017.
101. Tenenhaus M, Vinzi VE, Chatelin YM, Lauro C. PLS path modeling. *Comput Stat Data Anal*. 2005;48(1):159–205.
102. Al-Jundi SA, Ali M, Latan H, Al-Janabi HA. The effect of poverty on street vending through sequential mediations of education, immigration, and unemployment. *Sustain Cities Soc*. 2020;62: 102316.
103. Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. *J Mark Res*. 1981;18(1):39–50.
104. Latan H. PLS path modeling in hospitality and tourism research: the golden age and days of future past. In: Mostafa R, Cihan C, Faizan Ali S, editors. *Applying partial least squares in tourism and hospitality research*. England: Emerald Publishing Limited; 2018. p. 53–83.
105. Lopes JM, Suchek N, Gomes S. The antecedents of sustainability-oriented entrepreneurial intentions: an exploratory study of Angolan higher education students. *J Clean Prod*. 2023;391: 136236.
106. Knussen C, Yule F, MacKenzie J, Wells M. An analysis of intentions to recycle household waste: the roles of past behaviour, perceived habit, and perceived lack of facilities. *J Environ Psychol*. 2004;24(2):237–46.
107. Ma J, Hipel KW, Hanson ML, Cai X, Liu Y. An analysis of influencing factors on municipal solid waste source-separated collection behavior in Guilin, China by Using the theory of planned behavior. *Sustain Cities Soc*. 2018;37:336–43.
108. Waley P. Pencilling Tokyo into the map of neoliberal urbanism. *Cities*. 2013;32:43–50.
109. Chen H, Luo H, Song J. Population distribution and industrial evolution of the Tokyo Metropolitan Area. *Prog Geogr*. 2020;39:1498–511.
110. Rhodes RE, Dickau L. Experimental evidence for the intention-behavior relationship in the physical activity domain: a meta-analysis. *Health Psychol*. 2012;31(6):724.
111. Rhodes RE, de Bruijn GJ. How big is the physical activity intention-behaviour gap? a meta-analysis using the action control framework. *Br J Health Psychol*. 2013;18(2):296–309.
112. Rhodes RE, Yao CA. Models accounting for intention-behavior discordance in the physical activity domain: a user's guide, content overview, and review of current evidence. *Int J Behav Nutr Phys Act*. 2015;12(1):1–14.
113. Conner M, Norman P. Understanding the intention-behavior gap: the role of intention strength. *Front Psychol*. 2022;13: 923464.
114. Shankar B, Swamy C. Creating awareness for heritage conservation in the city of Mysore: issues and policies. *Int J Modern Eng Res*. 2013;3(2):698–703.
115. Rhodes RE, Courneya KS. Threshold assessment of attitude, subjective norm, and perceived behavioral control for predicting exercise intention and behavior. *Psychol Sport Exerc*. 2005;6(3):349–61.
116. Aykan B. How participatory is participatory heritage management? the politics of safeguarding the Alevi Semah ritual as intangible heritage. *Int J Cult Prop*. 2013;20(4):381–405.
117. Shan XZ. Attitude and willingness toward participation in decision-making of urban green spaces in China. *Urban Forestry Urban Greening*. 2012;11(2):211–7.

## Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.