Asia Pacific Journal of Tourism Research

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rapt20

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To cite this article: X. Chen & L. T. O. Cheung (27 Feb 2025): Balancing nature-based tourism and sustainable well-being: exploring aesthetic quality, environmental benefits, and pro-environmental behaviour, Asia Pacific Journal of Tourism Research, DOI: 10.1080/10941665.2025.2470639

To link to this article: https://doi.org/10.1080/10941665.2025.2470639

Published online: 27 Feb 2025.

ASIA PACIFIC JOURNAL OF TOURISM RESEARCH
https://doi.org/10.1080/10941665.2025.2470639

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Balancing nature-based tourism and sustainable well-being: exploring aesthetic quality, environmental benefits, and pro-environmental behaviour

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ABSTRACT

This study investigates the trade-offs between biodiverse aesthetic quality, environmental benefits and nature-based tourism, emphasising their impacts on tourist well-being, pro-environmental behaviour and satisfaction. Questionnaire survey was conducted to obtain the responses of 406 visitors in nature-based destinations in Hong Kong. The biodiverse aesthetic quality has been identified as a significant stimulus in predicting perceived benefits and satisfaction. Although anthropocentric benefits perceived by visitors cannot directly predict pro-environmental behaviour, tourist satisfaction contributes to hedonic and eudaimonic well-being, and pro-environmental behaviour. These findings highlight the need for destination managers to design nature-based tourism experiences that optimise both visitor satisfaction and sustainability goals. This study provides a new perspective on the growing discourse on sustainable tourism management, offering policy contributions for balancing tourist well-being and environmental conservation.

ARTICLE HISTORY
Received 3 December 2024
Accepted 18 February 2025

KEYWORDS
Nature-based tourism; biodiverse aesthetic quality; pro-environmental behaviour; well-being; social exchange theory; bottom-up spillover theory

Introduction

One of the main topics in human-environment interaction in environmental psychology is encouraging behaviour change, especially pro-environmental behaviour (De Groot, 2019). Exploring the ecological antecedents, especially the natural ones, that influence human behaviours and psychology is critical for environmental psychologists (Gifford et al., 2011). Thus, more research investigating the influence of natural environmental factors on human well-being and behaviour is needed (Hoyle et al., 2017; Siikamäki et al., 2015; Tribot et al., 2018). Among the environmental factors, the literature confirms the importance of the aesthetic quality of landscapes in enhancing tourists' experience, satisfaction, positive emotion, etc., especially in nature-based destinations (Kirillova & Lehto, 2015; Zhang & Xu, 2020). Biodiversity is an integral part of aesthetic quality, and its effects on human well-being and other experiences have gained attention from researchers (Tam et al., 2023). Even though previous studies outline that biodiversity is an integrated part of aesthetics and is one of the dimensions in the aesthetic judgment of the natural environment (Kirillova et al., 2014; Siikamäki et al., 2015), the effects of aesthetic quality with the focus on biodiversity (i.e. biodiverse aesthetic quality) on visitors' psychology and pro-environmental behaviour is still unknown. Specifically, the psychological mechanisms by which perceived biodiverse aesthetic quality influences well-being and pro-environmental behaviour are under-investigated, especially in nature-based destinations in Hong Kong.

As a place endowed with abundant natural tourism resources, there are 24 country parks and more than 250 islands in Hong Kong, enabling various species to survive and thrive (AFCD, 2023b). In 1976, the

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country park ordinance was enacted, covering 24 country parks and 22 special areas by legislative regulation (AFCD, 2023b). The Government of the Hong Kong Special Administrative Region (HKSAR) Government introduced the New Nature Conservation Policy (NNCP) in 2004 and the Biodiversity Strategy and Action Plan (BSAP) in 2016 to further conserve the rich biodiversity through policy efforts (AFCD, 2023a, 2023c). Around 12.7 million domestic and inbound visitors to the country parks and special areas in 2023, but approximately 2,700 tons of litter were collected in country park areas, with an increase of 600 tons of litter collected compared with the data in 2022 (AFCD, 2024b). Despite the considerable effort dedicated by the authority in advancing sustainability, there is still an urgent need for the initiative from the tourist side. Visitors' pro-environmental behaviour thus is of more importance for reducing negative environmental impacts, such as littering, trampling, and disturbance to wildlife in nature-based destinations (Cheung, 2013; Ma, Lam, et al., 2021).

As one of the widely used theories to investigate sustainable behaviour in destinations, most studies apply social exchange theory (SET) to investigate the supporting behaviours of residents (Han et al., 2023; Munanura et al., 2023; Tam et al., 2023). SET refers to a set of procedures in which an individual experiences a sense of obligation to reciprocate the benefits/rewards from others or objects (Homans, 1958). At the same time, there are two main approaches developed to explore environmental-related behaviours, namely, ecocentrism and anthropocentrism (Thompson & Barton, 1994), which are usually applied as values, attitudes, and motivations in tourism studies (Adongo et al., 2018; Burns et al., 2011; Ma et al., 2018). However, few studies extended the application of these two approaches as perceived benefits in the social exchange process. Additionally, previous studies mainly focus on the anthropocentric view of perceived benefits (e.g. economic benefits, community benefits) (e.g. Munanura et al., 2023) while neglecting the perceived eco-centric benefits from the tourists' perspective. In the present study, we argue that, for the individuals who hold ecocentrism and believe in the value of the existence of nature itself, benefiting nature could be regarded as a benefit to themselves, leading to the potential for well-being and pro-environmental behaviour. This study takes the initiative to examine the perceived benefits of two approaches (i.e. eco-centric and anthropocentric benefits) in the social exchange process.

The bottom-up spillover theory is a commonly used theory to explore the well-being at the destinations. It assumes that well-being in different life domains contributes to overall well-being (Ryff, 1989). If tourists are satisfied with their experience, such a positive effect may promote overall life satisfaction. The prior tourism research links the bottom-up spillover theory with the SET to explore the more comprehensive influence mechanism regarding perceptions and behaviours (Han et al., 2023). However, the research that considers the stimulating effects of perceived environmental factors (i.e. biodiverse aesthetic quality) on the bottom-up spillover process is limited.

This study draws from the stimuli-organism-response (S-O-R) theory to build a theoretical framework to narrow these research gaps. The three components of the S-O-R framework include stimuli (S), which generate effects on organism (O) and the internal state and then cause the response (R) on behaviour and psychology (Mehrabian & Russell, 1974). Biodiverse aesthetic quality is regarded as the stimulus, anthropocentric benefit, eco-centric benefit, and satisfaction as organisms, pro-environmental behaviour as the behavioural response, hedonic well-being, and eudaimonic well-being as psychological responses. The SET and bottom-up spillover theory were adopted to understand and quantify the relationships within the S-O-R framework. In addition, the current study adopts the SET at the organism stage to explain the effects of the stimuli on the premise that humans make decisions based on the cost–benefit evaluation. Meanwhile, we adopt the bottom-up spillover theory, mainly at the response stage, to explore the effects triggered by stimuli and organisms on the premise that satisfaction in visitor experience may spill over to general well-being.

The current investigation addresses the following research questions: (1) How does perceived biodiverse aesthetic quality impact perceived benefits and satisfaction? (2) what are the psychological mechanisms for perceived biodiverse aesthetic quality to influence well-being and pro-environmental behaviour? (3) how do the social exchange and bottom-up spillover processes jointly shape visitors' well-being and pro-environmental behaviour? This study highlights the novel contribution of integrating aesthetic quality and environmental benefits in nature-based tourism, which has been underexplored in previous studies, and explores how perceived environmental benefits influence tourist well-being and pro-environmental behaviour, which is bridging a gap between

nature-based tourism experiences and long-term sustainability goals. In addition, the findings can offer recommendations on tourism planning and visitor engagement strategies to help park management authorities design visitor experiences that enhance satisfaction and sustainability.

Theoretical background

Environmental aesthetics and S-O-R theory

S-O-R theory originated from environmental psychology and has been enriched by previous studies, with the stimuli including not only the external factors but also the perception of external/ situational factors, the organism state comprising but not limited to cognitive, affective, and interpersonal factors, and the response state incorporating both psychological and behavioural responses (Dashti et al., 2019; Gatautis et al., 2016; Ligaraba et al., 2023; McKinney, 2004; Mummalaneni, 2005; Prashar et al., 2017). As such, the S-O-R framework not only provides a general framework to guide the relationship construction of variables but also enables scholars to integrate different theories into the framework with flexibility (Li et al., 2024; Wong et al., 2023; Zhou et al., 2023). Many studies from the tourism field further extend the application of the S-O-R theory to explore the visitors' psychology and behaviour (Liu & Geng, 2023; Nian et al., 2023; Sthapit et al., 2024; Wang et al., 2024; Zhou et al., 2023). Explore the pro-environmental behaviour of visitors triggered by different stimuli and through various mechanisms (e.g. Liu & Geng, 2023). However, as dealing with environmental stimuli in the human brain is complex (Sohn et al., 2015), scholars have no consensus on the influence mechanisms activated by stimuli and the outcomes they trigger. Therefore, it is necessary to adopt different theories to explore the processing of stimuli and its outcomes.

The environment is essential in structuring aesthetic experience. Environmental aesthetics focuses on how people respond to the visual quality of the environment, including natural and built ones (Ataov, 1998). Beauty is the central theme in aesthetics, and it can be conceptualised in two ways: objectivist, which focuses on the physical attributes of the landscape, and subjectivist, which emphasises the observer's subjective assessment of the objective scenarios (Dickie, 1997). Although sensory stimulation of physical attributes influences aesthetic assessment (Le et al., 2019), scholars have argued that more attention should be paid to the subjective perceptual processing of the natural landscape (Zhang & Xu, 2020). This is because, compared with physical stimulation, subjective evaluation is more salient in producing aesthetic judgments, emotions, and experiences (Zhang & Xu, 2020). Therefore, the subjective view of aesthetic assessment has been regarded as the basis for the existence of beauty (Dickie, 1997).

Nature-based tourism relies heavily on natural environments and resources, with naturalness, facilities and open access to natural resources serving as integral attributes at nature-based destinations (Fredman et al., 2012). Increased nature-based tourism is led by a higher level of biodiversity in protected areas, and protected areas dedicated mainly to conserving biodiversity receive approximately 35% more visitors than those managed for mixed use (Chung et al., 2018). Furthermore, the diversity of natural environments supports various species and ecosystems to survive and thrive, inducing biodiverse areas with wildlife and natural beauty for leisure and recreational purposes (Fredman et al., 2012). The intercorrelations and synergy between biodiversity and aesthetic value have been underscored in prior literature (Hoyle et al., 2017; Tribot et al., 2018), evidencing that biodiverse aesthetic quality is a vital element in nature-based destinations (Siikamäki et al., 2015). However, the study examining the concept of biodiverse aesthetic quality is still limited. In the current study, we regard biodiverse aesthetic quality as the subjective perception of the aesthetic attributes of species diversity and landscape diversity in nature-based destinations.

Perceived benefits and social exchange theory

As there is an urgent need for more attention on environmental issues in environmental psychology, anthropocentrism and ecocentrism have been proposed as the reasons and motives for nature conservation (Thompson & Barton, 1994). Anthropocentric individuals express ecological concern and support for conservation based on the need for quality-of-life quality, welfare, and other benefits that nature can exploit for humans. Eco-centric individuals are concerned about nature conservation because of the intrinsic value of nature and the existence itself of nature, regardless of the extrinsic one (e.g. economic value) (Thompson & Barton, 1994). Compared with ecocentrism, many scholars criticise the

anthropocentric one in many ways. One of the most worth noting criticisms is that anthropocentrism is not enough to conserve nature and is environmentally ethically wrong because its nature is rooted in self-interest (i.e. conserving nature for human sake) and it is utilitarian (Katz, 2011). The evidence for this statement is the biodiversity loss and the distinction of keystone species that have not yet generated adverse effects or have little negative impact on humans (Washington & Ehrlich, 2013). It is concluded that anthropocentrism merely demonstrates its efforts on conservation when human well-being is threatened (Kopnina et al., 2018). However, both anthropocentrism and ecocentrism have been proven crucial in promoting sustainability in previous evidence (Bjerke & Kaltenborn, 1999; Patwary et al., 2023). Thus, more investigation is needed on how these two approaches generate their impacts. Scholars in the tourism field have introduced the concepts of anthropocentrism and ecocentrism to investigate the sustainable way of tourism development (Adongo et al., 2018; Burns et al., 2011; Patwary et al., 2023; Xu & Fox, 2014; Zhou et al., 2023). Based on the previous literature, this study explores anthropocentrism and ecocentrism through benefits perceived in destinations.

Social exchange theory aims to understand and explain human social behaviours, which are viewed as goods in the exchange process (Homans, 1958). The goods for exchange can be material and non-material, such as information, money, and services (Folger & Konovsky, 1989). It is highlighted that the transaction is not limited to economic and social ones; psychological transactions, which are inactive, also exist, such as the concept of psychological capital (Luthans et al., 2007). As continuous exchange processes occur, social exchange relationships can be built between the parties involved (Gouldner, 1960). As social exchange theory provides a rationale for the cost–benefit evaluations engaged in tourism, it has been adopted to explore residents' and tourists' perceptions, attitudes and behaviours (Munanura et al., 2023; Wong et al., 2023). Currently, mainstream research focuses on understanding the perceptions of residents toward tourists and the development of tourism, which subsequently influences the cost–benefit evaluation mechanisms and then impacts supporting behaviours (Gautam, 2023; Han et al., 2023; Tam et al., 2023). Limited research focuses on tourists' perspectives to investigate the cost–benefit evaluation mechanisms and behaviours (Kim et al., 2022; Wong et al., 2023). We adopt pro-environmental behaviour, defined as the action consciously seeking to minimise the negative impact of one's actions on the tourist destination (Kollmuss & Agyeman, 2002), as an essential step within the social exchange process by promoting the destination's sustainability. Previous studies have examined an array of internal and perceived external factors in driving pro-environmental behaviour, such as place attachment, environmental restorativeness and natural exposure in nature-based settings (Martin et al., 2020; Ramkissoon et al., 2013; Zhang et al., 2024; Zhou et al., 2023), illustrating the great potential to be further explored in terms of how environmental factors can activate it.

Positive benefit perceptions can cultivate a series of subsequent attitudinal and behavioural impacts directly and indirectly, with satisfaction being one of the most salient mediators (Han et al., 2023; Munanura et al., 2023). It is worth noting that prior research uses various approaches to construct the social exchange process in a way that social exchange theory explains the relationship between perceived benefits and reciprocal behaviours. In a nature-based destination, a socially built context, the intangible psychological transaction also exists when they perceive the benefits from the destination. As such, the current research posits that perceived benefits may either directly or indirectly activate the reciprocal behavioural response, by which satisfaction may serve as a pivotal construct that induces reciprocal behaviour.

Positive psychology and bottom-up spillover theory

Positive psychology is a psychological discipline that aims to understand humans' positive, emotional filling, and creative perspectives (Seligman et al., 2005). Positive psychology mainly contains two philosophies in well-being: hedonic well-being, which refers to the general feelings of satisfaction, happiness, and pleasure in life (Ryan & Deci, 2001), and eudaimonic well-being, which is focused on the general sense of self-development, self-actualisation, optimal functioning in life (Cloninger, 2004). Scholars in tourism have concentrated on the connection between tourism, satisfaction, and well-being because tourism is an industry that provides tourists with experiences that aim to meet expectations and bring positive outcomes (Gautam, 2023; Kim et al., 2021; Sthapit et al., 2019; Tam et al., 2023; Tsurumi & Managi, 2019; Vada et al., 2019b).

The bottom-up spillover theory assumes that the overall pleasant and positive experience in life comprises numerous happy moments in various aspects of life (Diener, 1984). In other words, overall life satisfaction is determined by the satisfaction in a set of life domains. Based on bottom-up spillover theory, scholars in tourism gain a better understanding of the effects of tourist experience on general well-being in life, with further investigation on the antecedents and outcomes of well-being (Gautam, 2023; Han et al., 2023; Kim et al., 2021; Sthapit et al., 2019; Tam et al., 2023; Vada et al., 2019b). Given the spillover effects of satisfaction within the leisure life domain, the satisfactory tourist experience may act as the connecting point for the bottom-up spillover process, possibly leading to a general life evaluation.

However, the sole adoption of either social exchange theory or bottom-up spillover theory exhibits limitations in providing a more nuanced understanding of the interaction between tourism, local community and sustainability. Prior investigations have thus integrated social exchange theory and bottom-up spillover theory to outline the synergistic effects of such integration on residents' quality of life and sustainable behaviours (Gautam, 2023; Han et al., 2023). For example, Han et al. (2023) confirmed that, induced by perceived tourism impacts, there are spillover effects exist within the process of how residents' life domain satisfaction impacts support for tourism development. Following this logic, this study integrates pro-environmental behaviour into the bottom-up spillover process as a potential behavioural consequence of satisfaction with the tourist experience, benefit perceptions at destinations, and the possible antecedent of the overall evaluation of life. This integration is justified for two reasons: the behaviour conducted at the destinations also serves as a crucial component of the leisure life domain (Carr, 2002), possibly influencing the general well-being at a higher level from a bottom-up spillover perspective; pro-environmental behaviour serves as the subsequent response, aiming at reciprocating the positive impacts gained from the destination from a social exchange perspective. Even though eudaimonic well-being may be generated when tourists engage in volunteer or other altruistic activities that lead to self-development (Smith & Diekmann, 2017), the current literature has not reached an agreement on whether pro-environmental behaviour can contribute to eudaimonic well-being (Aviste & Niemiec, 2023; Venhoeven et al., 2013; Zawadzki et al., 2020). The key to pro-environmental behaviour to develop eudaimonic well-being relies on the meaningfulness it brings (Zawadzki et al., 2020). In the current context, the pro-environmental behaviour possesses reciprocality, in essence, to achieve the benefits exchange by mitigating environmental influences, which imparts meaning to it, we, therefore, argue that it may contribute to eudaimonic well-being.

Hypothesis development

We can outline the relationship between stimuli and organisms by employing the S-O-R framework. In the current study, biodiverse aesthetic quality is the perceived environmental stimuli that stimulate changes in the organism's state, including anthropocentric, eco-centric, and satisfaction. The anthropocentric benefit originates from the anthropocentric view toward nature-based destinations, emphasising the "pull factor" (i.e. the factors that make a destination attractive for visitors), such as the benefit of providing a place for bonding with friends and families (Chan et al., 2018). While the eco-centric benefit focuses on the intrinsic value of destinations (Fennell, 2013), such as the benefit of conserving nature itself. Together, these two benefits act as the beginning stage of activating the social exchange process, when visitors experience a cognitive appraisal for benefit evaluation.

Aesthetic quality is viewed as a perceptual processing of the natural landscape and is critical in shaping visitor satisfaction, destination selection, and revisit intention (Kirillova et al., 2014). Aesthetic quality in the current context reflects a subjective evaluation of objective stimulation. The aesthetic quality perceived in the nature-based destination has been found to affect aesthetic emotion, judgment, and loyalty positively (Zhang & Xu, 2020). In addition, aesthetic perception interacts with cognition, emotion, value systems, and sociocultural environment (Määttänen, 2017). The connection between increased visual quality and higher value perception has been indicated (Sevenant & Antrop, 2009). For example, functionality (e.g. attractive vegetation) is essential for the cognitive processing of aesthetics (Sevenant & Antrop, 2009). The aesthetic experience of biodiversity is conducive to value perceptions and positive psychological states. Specifically, the aesthetic landscape stimuli (e.g. vivid planting) promote the activated psychological state (e.g. excitement) (Hoyle

et al., 2017). Moreover, the awareness of the benefits of herbaceous planting to insects is positively associated with positive emotion (Hoyle et al., 2017). Spending time appreciating and interacting with biodiverse spaces increases psychological restoration and well-being and fosters a positive attitude toward nature (Carrus et al., 2015). Based on the above literature, we propose the following hypotheses:

Hypothesis 1: Biodiverse aesthetic quality positively influences the anthropocentric benefit.

Hypothesis 2: Biodiverse aesthetic quality positively influences eco-centric benefits.

Hypothesis 3: Biodiverse aesthetic quality positively influences satisfaction.

From the theoretical lens of social exchange, when visitors perceive the benefits from both anthropocentric and eco-centric aspects, they may either directly promote pro-environmental behaviours or indirectly influence them through satisfaction. This process is a "paying back" one to what they perceive positively from the destination, although the benefit provider is the destination rather than a specific person. In terms of anthropocentric benefit, satisfaction and pro-environmental behaviours are possibly brought by the extrinsic benefit of the destination. For eco-centric benefit, the influence mechanism may be more related to the psychological transaction with a focus on altruism (Ahmad et al., 2023) because of the perception that the destination in preserving the intrinsic value of the environment.

Previous studies have demonstrated the importance of cost–benefit evaluation in influencing psychological and behavioural factors (Chiu et al., 2014; Gautam, 2023; Han et al., 2023). Gautam (2023) found that, compared with the negative one (tourism-related stress), the positive evaluation (emotional closeness) is a significant predictor of residents' quality of life, then triggering their support for sustainability in tourism. Another research found that the perceived economic, sociocultural, and environmental effects significantly affect life satisfaction, ultimately promoting support for sustainable tourism (Han et al., 2023). In the same vein, an empirical study from Korea showed that the perceived values of the destination have positive effects on tourist satisfaction, which predicts the recommendation of the destination (Lee et al., 2007). The influence chain that tourists' experience quality positively affects satisfaction, then promotes behavioural intention has been evidenced (Chen & Chen, 2010). Further, the environmental restorative perception of visitors has been demonstrated as a predictor for pro-environmental behaviours in the forest park (Zhou et al., 2023). Thus, the following hypotheses are proposed:

Hypothesis 4: The anthropocentric benefit positively influences satisfaction.

Hypothesis 5: The eco-centric benefit positively influences satisfaction.

Hypothesis 6: The anthropocentric benefit positively influences pro-environmental behaviours.

Hypothesis 7: The eco-centric benefit positively influences pro-environmental behaviours.

Previous research has proved that satisfaction is a main determinant of a series of behavioural intentions and behaviours in tourism literature, including pro-environmental behaviours/ environmentally friendly behaviours (Cajiao et al., 2022; Lin et al., 2022; Ramkissoon et al., 2013). For instance, whether visitors are satisfied with the destination in the national park context determines whether they will behave sustainably, such as paying the increased park fee and reducing the visits to popular spots to minimise environmental damage (Ramkissoon et al., 2013). It is also reported that satisfaction, perceived value, and involvement in eco-trip experiences promote tourists' environmentally responsible behaviour (Chiu et al., 2014).

Hypothesis 8: Satisfaction positively influences pro-environmental behaviour.

The complexity of the tourist experience has been underlined that the happiness within the tourist life domain entails hedonic (e.g. positive affects) and eudaimonic aspects (e.g. meaning), and tourist hedonic experiences are necessary but not sufficient for eudaimonic experiences (Lee & Jeong, 2020). Scholars further found that hedonic and eudaimonic tourist happiness can be gained from hedonic tourism activities that reflect pleasure and detachment, and eudaimonic tourism activities that emphasise personal meaning and self-reflection, respectively (Park & Ahn, 2022). Both types of tourist happiness promote tourists' overall life satisfaction. Based on the theoretical notion of bottom-up spillover theory, it has been identified that the satisfaction of leisure life influences overall life satisfaction (Sirgy et al., 2011). Moreover, scholars noticed that positive evaluations of tourist experience lead to a complex set of

outcomes, including behavioural intentions toward the destination and hedonic and eudaimonic well-being (Saayman et al., 2018; Vada et al., 2019a). Given the tourist experience is a multi-faceted concept, comprising a series of elements such as enjoyment, personal growth and meaningfulness, current research adopted satisfaction toward tourist experience as a general evaluation of experience at the destinations, when visitors feel satisfied with the experience, the positive effects may spillover to overall life satisfaction, including hedonic and eudaimonic aspects. From the above discussion, the following hypotheses are formulated:

Hypothesis 9: Satisfaction positively influences hedonic well-being.

Hypothesis 10: Satisfaction positively influences eudaimonic well-being.

It has been underscored that engaging in pro-environmental behaviour is usually viewed as morally and ethically right, and believed to contribute to the greater good of sustainability. Therefore, performing pro-environmentally aligns with the universal values about sustainability and leads to a sense of fulfilment, purpose and self-actualisation (Venhoeven et al., 2013). Evidence also outlines that pro-environmental behaviour fosters a higher level of subjective well-being, given its inherent meaningfulness (Zawadzki et al., 2020). Interestingly, compared with eudaimonic well-being, it is stated that pro-environmental behaviours may lead to decreased hedonic well-being because such behaviour may be perceived as discomfort, inconvenience and unpleasant in theory as the possible extra time and effort paid in conducting it (Venhoeven et al., 2013). However, this statement does not hold true in all cases, pro-environmental behaviour can provide pleasure when hedonic elements are involved in such an act or/and when individuals believe that they are having a sustainable lifestyle by conducting pro-environmental behaviour (Venhoeven et al., 2013). Further, it has been proven that pro-environmental behaviour is related to not only a positive affective state (e.g. feeling good and happy) but also a sense of meaningfulness about conducting a behaviour (Lv et al., 2024; Zawadzki et al., 2020). In the current context, on the one hand, pro-environmental behaviour exhibits greater meaningfulness as it acts as the subsequent behavioural step for paying back to the satisfaction at destinations by performing sustainably to promote environmental integrity, which may further shape eudaimonic well-being at a higher level. On the other hand, visitors may conduct pro-environmental behaviour out of their satisfaction, a hedonic element, and view such behaviour in leisure life as a step toward a more sustainable life in general, thus gaining pleasure from this act and spillovers to hedonic well-being. Accordingly, the following hypotheses are established:

Hypothesis 11: Pro-environmental behaviours positively influence hedonic well-being.

Hypothesis 12: Pro-environmental behaviours positively influence eudaimonic well-being.

Methods

Study site

Hong Kong boasts a diverse landscape that encompasses rocky foreshores and sandy beach ranges ascending to around 1,000 metres, with open grassland covering woodlands and mountain ranges (AFCD, 2023b). Various responsibilities, such as tree planting, plantation enhancement, and park maintenance, are taken on by the Agriculture, Fisheries and Conservation Department (AFCD) to maintain the sustainability of country parks and special areas. Those areas cover 44,842 hectares, comprising woodlands, reservoirs, and coastlines (AFCD, 2023b). Approximately 13 million visitors were attracted to the nature-based areas in Hong Kong and engaged in various nature-based recreational activities (e.g. camping) (AFCD, 2023b) (Figure 1).

The survey sites for the current study cover several major nature-based destinations in the country parks of Hong Kong, such as Sai Kung East Country Park, Ma On Shan Country Park, Lung Fu Shan Country Park (as shown in Figure 2(a & b)). The selected destinations have been listed among "Recommended Nature-Based Destinations in Hong Kong" by major travel websites (e.g. Tripadvisor), with a multitude of tourists expressing admiration of the beauty of scenic spots (Tripadvisor, n.d.). The Hong Kong Tourism Board (HKTB) has developed viewing guidelines for those destinations (HKTB, 2025), further endorsing their significant aesthetic value. Usually, the visitors traverse the hills to reach its shores or arrive by sea to the beach, captivated by both terrestrial and seaside scenarios.

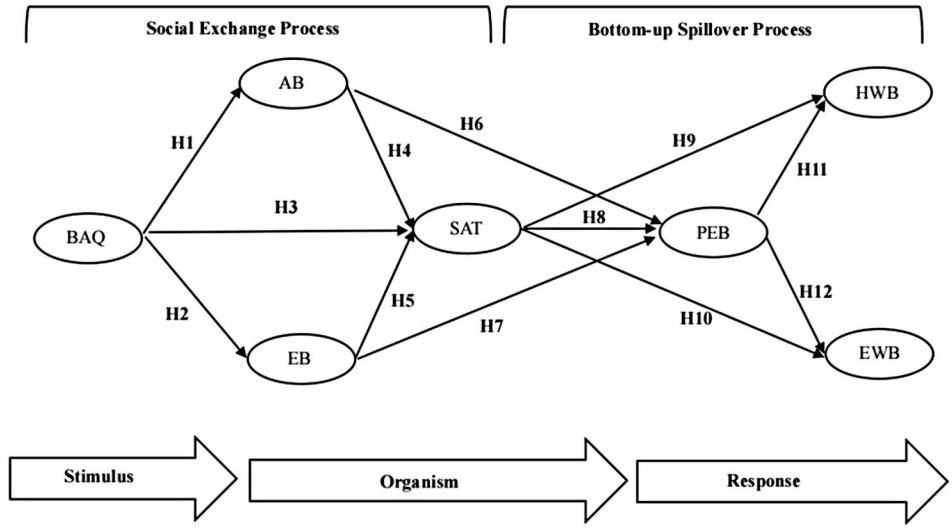

Figure 1. The conceptual framework of the current study.

Note: BAQ = Biodiverse Aesthetic Quality; AB = Anthropocentric Benefit; EB = Ecocentric Benefit; SAT = Satisfaction; PEB = Pro-environmental behaviours; HWB = Hedonic Well-being; EWB = Eudaimonic Well-being.

Measurements

The questionnaire includes 9 sections, with 8 sections containing measurement items for eight constructs and the last section collecting the demographic and visiting information from the respondents. The measurement items were adopted and modified from the previous literature (see **Appendix A**). Regarding the measurement of biodiverse aesthetic quality, the original aesthetic quality scale developed and validated from previous studies considered the aesthetic quality in both natural and urban settings (Kirillova et al., 2014; Kirillova & Lehto, 2015). To ensure the applicability of the original scale to the natural contexts, the prior investigation has further deleted items which were nonapplicable to the natural-based destination and modified the items based on the detailed description of the original measurement and the specific situation of the survey site, together with the item validity being confirmed (Zhang & Xu, 2020). In the current study,

Figure 2. (a & b). Scenic views of Sai Kung East Country Park. Source: the authors.

we follow the previous practice by adopting the items to ensure the relevance of items to nature-based destinations. Further, we take into consideration the descriptions of both original items on aesthetic quality and biodiversity (Kirillova et al., 2014; Siikamäki et al., 2015), alongside the situation of biodiversity in nature-based destinations in Hong Kong (AFCD, 2024a), rephasing the items to ensure the applicability to natural aesthetic appreciation in current survey sites. To ensure the visitors' understanding of items would not deviate from the original meaning, some descriptive examples were added. For example, the descriptive example, "bird", which is one of the representative species of biodiversity in Hong Kong and is commonly observed in survey sites, was added to facilitate the understanding.

Anthropocentric benefit was measured using 6 items described in prior studies (Chen & Jim, 2012; Croy et al., 2020; Han et al., 2023), while eco-centric benefit was measured by 6 items borrowed from previous research (Bjerke & Kaltenborn, 1999; Tsurumi & Managi, 2019). 5 items were adopted from prior studies to measure satisfaction (Kim et al., 2015; Lee et al., 2018). A 6-item scale was adopted to measure pro-environmental behaviour (Yan & Jia, 2021). These items were considered the general pro-environmental behaviour of visitors at the destinations. To measure hedonic well-being and eudaimonic well-being, 5 items for each construct were borrowed from previous studies (Lee et al., 2018; Vada et al., 2019a). All the measurement items adopted a 7-point Likert scale (7-point from "strongly disagree" = 1 to "strongly agree" = 7).

Data collection and analysis

A non-probability sampling method, random selection, was used in the current study for data collection (Stone, 2009), and the visitors were randomly selected and approached at the survey sites. The questionnaire was distributed to visitors in nature-based destinations in Hong Kong, including Sai Kung East Country Park, Ma On Shan Country Park, Lung Fu Shan Country Park, Tai Mo Shan Country Park, and Shek O Country Park. The data collection period covered both weekends and weekdays between December 2023 and February 2024, and each sampling day lasted for 8 h from 10:00 am to 6:00 pm, ensuring the coverage of the main daytime period for visitation. The survey sites include the entrance, exit points, scenic viewpoints, trails, and rest areas, at which one of every five visitors was randomly approached to participate in the survey. Each response took the respondent around 20 min to complete. 430 responses were distributed, and 406 completed and valid questionnaires were collected and used for the subsequent analysis, with a valid response rate of 94.4%. Firstly, the skewness and kurtosis values were used to evaluate the normality. Then, to assess the reliability and validity, Cronbach's Alpha, Composite reliability (CR), average variance extracted (AVE) and factor loadings of items were tested. Structural Equation Modelling (SEM) was used to investigate the predictive and functional relationships between the variables and test the hypotheses (Kelloway, 1995). SPSS 27 was used to conduct the descriptive analysis and exploratory factor analysis (EFA), and AMOS 27 was used to perform the confirmatory factor analysis (CFA) and structural model analysis with the maximum likelihood estimation method.

Results

Sample profile

For the socio-demographic characteristics of the respondents (shown in Table 1), most of them are female (58.6%). A large proportion of the respondents attained an undergraduate/college degree or above (80.5%). More than half were aged between 18 and 45, whereas around one-fifth were above 56. Regarding individual monthly income, 28.6% of respondents had a monthly income below 9,999 HKD, which may be because most of them are students or retirees with no income, followed by a monthly income between 20,000 and 29,999 (18.7%). For travel characteristics, many respondents are first-time visitors (34.5%) and frequent visitors with more than five times visit experiences (32.8%). The proportions of respondents who travelled with family members and friends were 35.7% and 44,1%, respectively. Notably, the participant profile diverges from the demographic characteristics of the general population in Hong Kong regarding gender, educational level and income. These may be attributed to the higher preferences for nature-based destinations of certain demographic groups, such as females and individuals with a higher education level (Chiu et al., 2016; Ma, Ng, et al., 2021). The demographic characteristics of the current study also align with those of previous research

Table 1. Respondent sociodemographic profile ($N = 406$).

Variable	Category	N	Percentage (%)
Gender	Male	168	41.4
	Female	238	58.6
Educational level	Primary or lower	4	1.0
	Secondary	75	18.5
	Undergraduate/ College degree	236	58.1
	Graduate or above	91	22.4
Age	18–25	72	17.7
	26–35	93	22.9
	36–45	95	23.4
	46–55	56	13.8
	56–65	58	14.3
	65 or above	32	7.9
Individual monthly income (HKD)	≤9,999	116	28.6
	10,000–19,999	48	11.8
	20,000–29,999	76	18.7
	30,000–39,999	52	12.8
	40,000–49,999	32	7.9
	50,000–59,999	25	6.2
	60,000 or above	57	14.0
Visit frequency	First-visit	140	34.5
	2–3 times	93	22.9
	3–5 times	40	9.9
	More than 5 times	133	32.8
Companions	Traveling with partner	55	13.5
	Travelling alone	27	6.7
	Travelling with family members	145	35.7
	Travelling with friends	179	44.1

focusing on nature-based destinations in Hong Kong (Ma et al., 2024).

Measurement model

The values for skewness and kurtosis ranged between −1.767 and 0.713, 0.105 and 6.311, respectively (Table 2). The recommended threshold for the absolute value of skewness is 3, and the absolute value for kurtosis is 7; the absolute values exceeding these thresholds would be considered highly biased (Kline, 2023). Because the absolute values for skewness were less than 2 and the absolute values for kurtosis were less than 7, the normality for values for all measurements was met. Harman's single-factor test results show that 35.8% of the overall variance is explained by the first factor (Eco-centric Benefit), which is lower than 50% (Chang et al., 2020). The Common method bias (CMB) analysis indicated that no item was loaded exclusively on one construct, indicating that the problem of standard method bias was unlikely to be present.

EFA was then conducted to evaluate whether the observed variables (measurement items) that intended to measure a specific unobserved construct loaded together and on a predicted component. The principal component method and varimax rotation were used at this stage, and the minimum value for eigenvalue was set at 1. It is suggested that items in two scenarios in EFA need to be excluded: when the factor loading for the item is less than 0.4 and when the cross-loading for the item is larger than 0.4 (Therefore, 5 items were deleted in the current study at this stage. 3 items had a factor loading less than 0.4, which were BAQ1, BAQ6, and SAT4. 2 items had a cross-loading greater than 0.4, which were AB3 and PEB1, indicating they were not only measuring the construct they intended to measure but also the other irrelevant constructs. 44 items remained for the subsequent data analysis (Table 2). After removing the 5 items mentioned above, 8 constructs were extracted, each with an eigenvalue greater than 1. Kaiser-Meyer-Olkin (KMO) test and Bartlett's sphericity test would be used to conduct the principal factor analysis (Fabrigar & Wegener, 2011). The KMO can test whether the sampling is adequate, and the minimum threshold for KMO is 0.5 (Hair et al., 2013). The KMO value was 0.94, and Bartlett's test of sphericity was 10297.39 ($df = 703$, $p < 0.001$), which indicated the sampling adequacy and factorability.

CFA was conducted to validate the measurement model further based on the EFA results (Table 3). All the factor loadings exceeded the threshold of 0.5 and were significant, which was acceptable (Kline, 2023). In addition, Cronbach's alpha and CR after removing the items were shown; all of them were greater than 0.7, and the reliability of measurement was thus supported. The results indicated that the model fit for measurement model was good according to the recommended thresholds (Schumacker & Lomax, 2004): $\chi 2 / df = 1.928$, TLI = 0.926, CFI = 0.932, IFI = 0.932, RMSEA = 0.048.

For the further evaluation of convergent validity, the AVE values of all the constructs exceeded the 0.5 recommended level, except the AVE value for BAQ, which was 0.486. Although it is suggested that the AVE value near the level of 0.5 is acceptable (Hair et al., 2013), the current study removed BAQ7 to enhance the robustness of the construct. The main reasons were as follows: although removing an item with an AVE value close to the acceptable threshold is not very common in social science studies, there are previous studies that indicate the

Table 2. Results of exploratory factor analysis.

				Factor loadings						
	Observed variable	Skewness	Kurtosis	1	2	3	4	5	6	7
BAQ	BAQ2	−0.982	1.513	0.690						
	BAQ3	−1.214	2.256	0.653						
	BAQ4	−1.105	1.676	0.701						
	BAQ5	−0.73	0.852	0.697						
	BAQ7	−1.412	2.909	0.556						
	BAQ8	−1.392	3.329	0.682						
	BAQ9	−0.526	0.163	0.737						
	BAQ10	−0.566	0.105	0.663						
EB	EB1	−1.181	1.975		0.712					
	EB2	−1.151	1.911		0.776					
	EB3	−1.409	1.955		0.804					
	EB4	−1.486	3.073		0.796					
	EB5	−1.477	4.184		0.773					
	EB6	−1.767	5.766		0.689					
HWB	HWB1	−1.236	3.214			0.755				
	HWB2	−1.197	2.682			0.757				
	HWB3	−1.111	2.223			0.817				
	HWB4	−1.057	2.171			0.803				
	HWB5	−1.257	2.927			0.780				
EWB	EWB1	−0.995	1.421				0.713			
	EWB2	−0.835	1.122				0.685			
	EWB3	−1.008	1.865				0.747			
	EWB4	−1.076	2.224				0.749			
	EWB5	−0.963	2.474				0.703			
AB	AB1	−0.896	1.478					0.736		
	AB2	−1.094	2.31					0.676		
	AB4	−0.915	1.634					0.651		
	AB5	−0.791	0.787					0.683		
	AB6	−0.941	2.123					0.728		
PEB	PEB2	−1.677	4.089						0.705	
	PEB3	−1.232	1.907						0.659	
	PEB4	−1.447	5.254						0.727	
	PEB5	−0.409	1.029						0.599	
	PEB6	−1.078	1.542						0.670	
SAT	SAT1	−1.118	3.22							0.707
	SAT2	−0.726	1.087							0.736
	SAT3	−1.407	6.311							0.689
	SAT5	−0.889	1.898							0.627
Eigenvalue				14.273	3.554	2.365	1.804	1.433	1.199	1.076
% of Variance				37.561	9.352	6.224	4.748	3.772	3.156	2.830

0.5 level is a critical one (e.g. Ma et al., 2018), removal of some items to meet this criterion is conducive to enhance the quality of measurements; after removal of BAQ7, the remaining items for measuring the biodiverse aesthetic quality were 7, still meeting the minimum requirements of 3 items for measuring a construct in SEM (Kelloway, 1995); after removal of BAQ7, all the AVEs met the minimum threshold of 0.5, enhancing the validity of BAQ construct; the model fit statistics then improved after the removal, with $\chi 2$ /df = 1.933, TLI = 0.931, CFI = 0.936, IFI = 0.937, RMSEA = 0.048. Therefore, 43 items remained for further analysis.

For discriminant validity, the square root of AVE values for each construct, shown on the diagonal, was more significant than the correlation between that construct and the others (Fornell & Larcker, 1981) (Table 4). In addition, Heterotrait-Monotrait (HTMT) ratio was evaluated (Table 5). All the HTMT values should not be greater than 0.85 to indicate that each construct has sufficient discriminant validity (Henseler et al., 2015). Thus, the discriminant validity was supported.

Structural model and hypothesis testing

For the structural equation model, the model fit indicators (i.e. $\chi 2$ /df = 2.226, TLI = 0.920, CFI = 0.926, IFI = 0.926, RMSEA = 0.055), indicated the good model fit. This showed that the proposed model satisfactorily fits the collected data from the real world. According to the results summarised in Table 6 and Figure 3, the

Table 3. Results of confirmatory factor analysis.

Construct	Item	Loading	Cronbach's alpha (after deletion)	Composite Reliability (CR) (after deletion)	AVE (after deletion)
BAQ	BAQ2	0.754***	0.874	0.876	0.502
	BAQ3	0.662***			
	BAQ4	0.696***			
	BAQ5	0.674***			
	BAQ8	0.726***			
	BAQ9	0.743***			
	BAQ10	0.702***			
AB	AB1	0.697***	0.841	0.841	0.515
	AB2	0.704***			
	AB4	0.733***			
	AB5	0.729***			
	AB6	0.723***			
EB	EB1	0.813***	0.923	0.925	0.673
	EB2	0.871***			
	EB3	0.854***			
	EB4	0.830***			
	EB5	0.796***			
	EB6	0.752***			
SAT	SAT1	0.792***	0.891	0.893	0.677
	SAT2	0.850***			
	SAT3	0.846***			
	SAT5	0.801***			
PEB	PEB3	0.835***	0.795	0.806	0.516
	PEB4	0.764***			
	PEB5	0.516***			
	PEB6	0.720***			
HWB	HWB1	0.865***	0.941	0.941	0.762
	HWB2	0.878***			
	HWB3	0.913***			
	HWB4	0.882***			
	HWB5	0.824***			
EWB	EWB1	0.794***	0.895	0.896	0.633
	EWB2	0.836***			
	EWB3	0.791***			
	EWB4	0.841***			
	EWB5	0.708***			

Note: *** $p<0.001$

biodiverse aesthetic quality had a positive influence on both anthropocentric benefit ($\beta = 0.651$, $p < 0.001$) and eco-centric benefit ($\beta = 0.590$, $p < 0.001$), supporting Hypothesis 1 and Hypothesis 2. The biodiverse aesthetic quality explained 65.1% of the variance of anthropocentric benefit ($R = 0.651$) and 34.9% of eco-centric benefit ($R = 0.349$). The result also found that biodiverse aesthetic quality positively influences the visitors' satisfaction directly ($\beta = 0.248$, $p < 0.001$). Hypothesis 3 was thus supported. Regarding the relationships within the organism state, it was shown that both anthropocentric benefit ($\beta = 0.330$, $p < 0.001$) and eco-centric benefit ($\beta = 0.361$, $p < 0.001$) had positive and significant impacts on satisfaction. Hypothesis 4 and Hypothesis 5 were supported. The biodiverse aesthetic quality, anthropocentric, and eco-centric benefits together explained 60.4% of visitors' satisfaction ($R = 0.604$). It was found that pro-

Table 4. Inter-construct correlations.

	BAQ	AB	EB	SAT	PEB	HWB	EWB
1. BAQ	**0.709**						
2. AB	0.529**	**0.717**					
3. EB	0.506**	0.549**	**0.820**				
4. SAT	0.554**	0.597**	0.628**	**0.823**			
5. PEB	0.430**	0.378**	0.554**	0.495**	**0.719**		
6. HWB	0.453**	0.382**	0.387**	0.512**	0.411**	**0.873**	
7. EWB	0.420**	0.393**	0.384**	0.483**	0.439**	0.723**	**0.795**

Table 5. The results of the Heterotrait-Monotrait ratio.

	BAQ	AB	EB	SAT	PEB	HWB	EWB
1. BAQ							
2. AB	0.620						
3. EB	0.560	0.624					
4. SAT	0.628	0.689	0.691				
5. PEB	0.518	0.463	0.648	0.590			
6. HWB	0.500	0.430	0.415	0.560	0.473		
7. EWB	0.476	0.452	0.422	0.543	0.509	0.787	

Table 6. Results summary for hypothesis testing.

Hypothesis	Std. Estimates	Standard error	T-value	Conclusion
H1: BAQ→AB	0.651***	0.058	9.946	Supported
H2: BAQ→EB	0.590***	0.066	9.813	Supported
H3: BAQ→SAT	0.248***	0.060	3.615	Supported
H4: AB→SAT	0.330***	0.061	5.328	Supported
H5: EB→SAT	0.361***	0.043	6.661	Supported
H6: AB→PEB	0.047 n.s.	0.091	0.702	Rejected
H7: EB→PEB	0.432***	0.073	6.416	Supported
H8: SAT→PEB	0.248*	0.113	3.005	Supported
H9: SAT→HWB	0.459***	0.080	7.524	Supported
H10: SAT→EWB	0.409***	0.066	6.402	Supported
H11: PEB→HWB	0.216***	0.057	3.627	Supported
H12: PEB→EWB	0.292***	0.047	4.635	Supported

Note: ***$p < 0.001$; *$p < 0.05$; n.s.: not significant

environmental behaviour was positively influenced by eco-centric benefit (β = 0.432, $p < 0.001$) and satisfaction (β = 248, $p < 0.05$), while anthropocentric benefit had no positive and significant influence on pro-environmental behaviour (β = 0.047, $p > 0.05$); thus, the Hypothesis 7 and Hypothesis 8 were supported, but Hypothesis 6 was rejected. The eco-centric benefit and satisfaction explained 41.7% of pro-environmental behaviour (R = 0.417). The results found that satisfaction positively and significantly affected hedonic well-being (β = 0.459, $p< 0.001$) and eudaimonic well-being (β = 409, $p < 0.001$), supporting Hypothesis 9 and Hypothesis 10. Turning to the relationships within the responses, the positive and significant effects of pro-environmental behaviour on hedonic well-being (β = 0.216, $p < 0.001$) and eudaimonic well-being (β = 0.292, $p < 0.001$) were confirmed, thus supporting Hypothesis 11 and Hypothesis 12. Satisfaction and pro-environmental behaviour explained 36.7% of hedonic well-being (R = 0.367) and 38.4% of eudaimonic well-being (R = 0.384).

Discussion and conclusions

Discussion

Biodiverse aesthetic quality is a positive determinant of perceived benefits and satisfaction. Indeed, previous studies have denoted the importance of biodiversity in enhancing the attractiveness of nature-based destinations and influencing visitors'

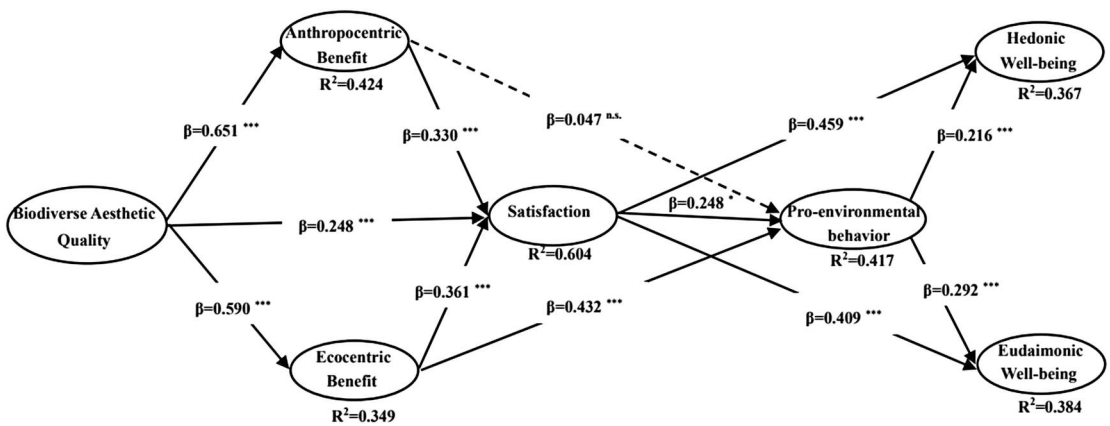

Figure 3. Results summary for structural model.

cognitions, affects, and conservation behaviours (Ribet & Brander, 2020; Samus et al., 2022; Siikamäki et al., 2015; Walpole & Leader-Williams, 2002). It is indicated that the integrated concept of biodiverse aesthetic quality is essential for shaping visitors' psychological mechanisms and behaviours. From the anthropocentric benefit aspects, the results from the current study are, to some extent, in line with the prior studies (Hoyle et al., 2017; Ribet & Brander, 2020). This implies that the potential motivation for conservation is derived from both the use and non-use value of biodiversity, from an instrumental view that humans can exploit nature. In addition, the findings indicate that the biodiverse aesthetic quality enhances the evaluation of intrinsic values (e.g. welfare of the habitats in destinations), which is a non-humanistic and altruistic value orientation. It emphasises that life forms should be preserved as they go through thousands and millions of years of ecological evolution (Alho, 2008). In other words, biodiverse aesthetic quality promotes the perceived benefit related to humans and the existence of nature and itself.

The positive effects of biodiverse aesthetic quality on perceived benefits shown in the current inquiry may help explain the weak association between the positive value assigned by visitors to biodiversity and actual biodiversity (Tolvanen et al., 2020). Some places with a high level of biodiversity may possess a different level of aesthetic quality. Still, the aesthetic factors in destinations can positively direct the evaluation of the benefits of the visitors' destinations. Therefore, aesthetic quality might be the extra determinant that influences visitors' value assessment. This is also consistent with previous literature that underscores the significance of visitors' aesthetic assessment on aesthetic judgment, satisfaction, and behavioural intention in nature-based destinations (Breiby & Slåtten, 2018; Le et al., 2019; Zhang & Xu, 2020). The finding from the current study also demonstrates the positive effects of biodiverse aesthetic quality on satisfaction, which is also similar to the prior studies that evidence the role of perception in nature-based areas in enhancing satisfaction and other positive effects (Samus et al., 2022; Zhang & Xu, 2020). For example, through the connection with nature, whether nature would be perceived as wild is critical to developing nature connectedness, thus promoting positive outcomes (Samus et al., 2022).

The positive associations between the two types of benefits and satisfaction are also similar to prior studies, which confirmed that favourable evaluation is an essential component for triggering positive attitudes, satisfaction, and decisions to support sustainable tourism development based on the social exchange theory (Han et al., 2023; Lin et al., 2017; Munanura et al., 2023). Such a process relies on the benefit evaluation and satisfaction mechanism, laying the solid foundation for "paying back" actions to the destinations through pro-environmental behaviour. This study subsequently confirms that visitors' satisfaction is positively related to pro-environmental behaviour, consistent with the widely accepted notion in the academic community (Cajiao et al., 2022; Ramkissoon et al., 2013).

We found that eco-centric benefit predicts pro-environmental behaviour directly, while anthropocentric benefit has no significant effect. Interestingly, both anthropocentric and eco-centric views are believed to promote pro-environmental behaviour conventionally (Bjerke & Kaltenborn, 1999; Patwary et al., 2023). One plausible explanation for these findings is underpinned by self-determination theory (Deci & Ryan, 2008), which refers to the categorisation of aspirations/motivations into intrinsic and extrinsic ones. Intrinsic motivation is associated with a high level of value internalisation, which is driven by internal forces (e.g. personal satisfaction) rather than external consequences, while extrinsic motivation emphasises external gains (e.g. money, fame) and is prompted by extrinsic forces (Deci & Ryan, 2008, 2013; Ma et al., 2018). In the current study, the eco-centric benefit focuses more on the inherent worth of nature and the existence of nature itself. Individuals with highly perceived eco-centric benefit may be more inclined to internalise the value of nature, and thus recognise the innate motivation to perform pro-environmentally, leading to the alignment between intrinsic value of nature and internal forces to motivate pro environmental behaviour. In contrast, the anthropocentric benefit is primarily associated with extrinsic value (i.e. instrumental value) of nature, highlighting the human's superior right to exploit natural resources (Aviste & Niemiec, 2023). In other words, anthropocentric benefit represents the notion that nature is valuable because it can be utilised by humans, corresponding to extrinsic forces to drive pro-environmental behaviour, such as protecting nature for further exploration of recreational resources. Although a stream of studies found both intrinsic and extrinsic motivations contribute to visitors' environmentally responsible attitudes and behaviours (Cheung & Fok,

2014; Ma et al., 2018), current findings support the notion that, compared with extrinsic forces, intrinsic ones are more effective in predicting pro-environmental behaviour (Aviste & Niemiec, 2023; Schultz & Zelezny, 1999; Xu & Fox, 2014).

The current study provides empirical evidence from nature-based destinations in Hong Kong to support the bottom-up spillover theory. It shows that a satisfactory leisure life in nature-based destinations is integral to the overall evaluation of life satisfaction, pointing out the existence of spillover effects from satisfaction developed at the destinations to both hedonic and eudaimonic well-being as a whole. Besides, satisfaction plays an important role in building the linkage between benefit perceptions and spillover effects, showcasing a satisfactory evaluation of the tourist experience could be strengthened by the perceived benefits of nature for both sides and activates the subsequent behavioural and psychological responses. The positive effect of satisfaction on pro-environmental behaviour reinforces the robustness of previous attempts to integrate bottom-up spillover theory with social exchange theory to demonstrate how sustainable practices can be activated (Gautam, 2023; Han et al., 2023). Moreover, the findings about pro-environmental behaviour is a positive determinant of hedonic well-being and eudaimonic well-being reveal that a positive spillover effect could also be formed by a reciprocal sustainable behaviour conducted in the leisure life domain, further contributing to life satisfaction and gaining support from sustainability and tourism literature (Lv et al., 2024; Zawadzki et al., 2020). The pro-environmental establishes a connection between the satisfaction of visitors from the leisure life domain and general life satisfaction, this illustrates a positive loop in which not only the environment itself but also visitors can also reap potential positive effects from sustainable practices. In general, these findings are also congruent with tourism and well-being literature that annotates visitors' satisfaction can lead to leisure life satisfaction, improved quality of life, revisit intention, environmentally responsible behaviour, and subjective well-being (Kim et al., 2015; Kim et al., 2016; Su et al., 2018; Vada et al., 2019b).

Theoretical implications

This study fills the first research gap by exploring the effects of biodiverse aesthetic quality on the psychological mechanism and the responses. This study shows the potential of a different pathway in the human-nature relationship (i.e. from biodiverse aesthetic quality to pro-environmental behaviours). From the theoretical tenet of social exchange theory, this study highlights the role of biodiverse aesthetic quality in stimulating the social exchange process. This process either indirectly contributes to satisfaction through two types of benefits (i.e. anthropocentric and eco-centric benefits) or directly contributes to satisfaction. We then have positive effects on pro-environmental behaviours and reciprocal behaviours.

Secondly, this study fills the research gap of the limited application of anthropocentrism and eco-centrism as benefits. This adds to the existing literature by indicating that only considering the extrinsic value of the destinations from an anthropocentric view is limited in portraying a holistic picture in predicting visitors' satisfaction and environmental endeavours. The intrinsic value of the destinations to nature (i.e. eco-centric benefit) is also an integral part of the cognitive evaluation mechanism. On the one hand, this finding enriches the S-O-R framework by explaining the relationship between the perceived benefits and satisfaction within the organism state. It shows that satisfaction can be improved by a higher level of both anthropocentric and eco-centric benefits of destinations. On the other hand, by juxtaposing the eco-centric benefit with the anthropocentric one, the current study moves beyond the standard application of social exchange theory from the residents' perspective (Munanura et al., 2023). Extending the application of social exchange theory to tourists' perspectives in nature-based tourism acknowledges a dual mechanism in the social exchange process rather than merely focusing on anthropocentrism.

Surprisingly, we noticed that the anthropocentric benefit has no significant influence on pro-environmental behaviour compared with the eco-centric one. The insignificant path from anthropocentric benefit to pro-environmental behaviour highlights the importance of activating the whole social exchange process, i.e. from benefit evaluation to satisfaction, then contributing to pro-environmental behaviour, additionally, by integrating the concept of well-being within the S-O-R framework through the bottom-up spillover process. The finding suggests that the bottom-up spillover process is activated by satisfaction, which contributes to general well-being directly or indirectly through pro-environmental behaviours. Thus, an integrative framework from

perceived environmental stimuli to a bottom-up spillover process is outlined.

Managerial implications

Regarding nature-based tourism destinations, how to leverage their biodiverse aesthetic quality is the key to stride for the sustainability of destinations and visitors' well-being. This is because such an environmental factor is pivotal in initiating a set of positive outcomes for visitors, such as pro-environmental behaviour. Therefore, for online (e.g. website) or offline (e.g. visitor centre) promotion of country parks, particular areas, geoparks, marine parks, and marine reserves, more focus can be put on depicting the aesthetics derived from the natural biodiversity of the destinations by using different techniques (e.g. 360-degree videos), which may help to produce positive attitudes towards destinations before the actual visit (Rahimizhian et al., 2020).

In general, Hong Kong is a city endowed with abundant diverse natural environments and resources, maintaining an equilibrium between biodiversity conservation and aesthetic quality is increasingly crucial for the Agriculture, Fisheries and Conservation Department (AFCD) when developing proposals and planning strategies for local nature-based destinations. The balance between biodiversity and aesthetics should be maintained for planting and vegetation management, recreational facilities building and management, and wildlife management. For example, the proposed plan to change the vegetation of a specific area to increase the aesthetic quality might lead to changes in wildlife habitat and micro-ecosystems, possibly influencing local biodiversity. In addition, the proposed plans regarding the modifications of plants, vegetation, and facilities should involve a higher level of public engagement to ensure the public's perception of the proposed plan is positive and satisfactory because the aesthetic criteria are subjective.

Moreover, the finding shows that satisfaction predicts pro-environmental behaviour directly. Thus, one of the most straightforward ways to encourage pro-environmental behaviour is to improve visitor satisfaction. The potential practices can include expert guided tours, crowd management at specific sightseeing points, and interactive online sharing activities about the destinations via mobile apps. The finding that eco-centric benefits can promote pro-environmental behaviour provides a new focus for communication techniques for nongovernmental organisations (NGOs) and destination marketing organisations (DMOs) to encourage visitors to behave sustainably. For example, the online episodes named "Hiking Etiquette", pamphlets and posters, and newsletters provided to the public can emphasise the ecological process of plants and wildlife during evolutionary history, publicising that nature is valuable merely because of its existence. Moreover, as pro-environmental behaviour can improve well-being, more volunteer programmes about environmental protection (e.g. beach cleaning) can be encouraged. By performing sustainably, those programmes may help promote participants' life satisfaction and personal growth.

Limitations and future research

As the data collection in this study was conducted in nature-based destinations in Hong Kong, there is no fixed number of samples collected from each destination, leading to the variation of respondent numbers from different destinations. The current study can portray a general picture of the visitors' perceptions, psychological mechanisms, and behaviour in Hong Kong. However, it cannot delve into the situation in a specific destination; geographical variation may exist. Given the complexity of measuring the subjective aesthetic quality in natural contexts about biodiversity, such as rare species that may not be observed by most visitors and landscapes that are specific in some locations, current research may exhibit limitations in capturing perceived biodiverse aesthetic quality more comprehensively and accurately. Therefore, future research is encouraged to adopt qualitative and eye-tracking experiments to further enrich the understanding and measurement of this concept in existing literature. Further, the current study targeted the respondents in Hong Kong without including the respondents from other areas or countries, leading to limited generalizability in the survey region and respondents. More research is encouraged to investigate the destinations in other places, especially the destinations at different stages of tourism development and respondents from various countries. This study used quantitative research to explore and provide empirical evidence for the proposed hypothesis. Future research can adopt qualitative or mixed methods to understand the visitors' perceptions of situational, psychological, and behavioural factors from a different point of view, such as the social

normative influence. Besides, this study did not collect data from various trip stages (pre-trip, during, and post-trip). It is possible that the well-being would fade after a certain period (Kwon & Lee, 2020). Therefore, a longitudinal study is needed in future research to investigate the changes in well-being gained from the trip. Moreover, the anthropocentric benefit is found to have no significant influence on pro-environmental behaviour; the reasons may be rooted in motivational factors and the fulfilment of psychological needs; future research can delve into the ways that how intrinsic and extrinsic motivations shape the psychological-behavioural mechanism.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix A

Item	Description
BAQ1	The species of plants and animals (e.g. trees, bushes, birds, insects) are rich.
BAQ2	The plants and animals (e.g. trees, bushes, birds, insects) are abundant.
BAQ3	The plants and animals (e.g. trees, bushes, birds, insects) are authentic, rather than artificial.
BAQ4	Different types of plants and animals (e.g. trees, bushes, birds, insects) are cohesive.
BAQ5	The combination of different types of plants and animals (e.g. trees, bushes, birds, insects) is novel.
BAQ6	The categories of landscapes (e.g. forested, water, mire, rocky areas) are diverse.
BAQ7	The combination of landscape is authentic, rather than artificial.
BAQ8	The combination of landscape (e.g. forested, water, mire, rocky areas) is cohesive.
BAQ9	The combination of landscape (e.g. forested, water, mire, rocky areas) is novel.
BAQ10	The combination of landscape (e.g. forested, water, mire, rocky areas) is unique.
AB1	Provides a place for outdoor recreation activities.
AB2	Provides a place to socialise with friends and family.
AB3	Bring business and job opportunities through tourism development.
AB4	Contributes to the pleasure and welfare of humans.
AB5	Protects the environment for the needs of future generations.
AB6	Provides an opportunity to experience and learn more about nature.
EB1	Provides benefits for species conservation.
EB2	Protects ecosystem integrity.
EB3	Protects the welfare and natural habitats of animals.
EB4	Prevents natural areas from being destroyed.
EB5	Protects the valuable being of nature.
EB6	Protects nature for its own sake.
SAT1	Overall, I am satisfied with my tourist experience.
SAT2	My overall evaluation of this tourism experience is favourable.
SAT3	My overall evaluation of this tourism experience is positive.
SAT4	It is rewarding to me in many ways during this tourist experience.
SAT5	I am pleased with this tourism experience.
PEB1	I try not to disrupt the fauna and flora during my travel.
PEB2	I sort my garbage during my travel.
PEB3	I help to maintain local environmental quality.
PEB4	I comply with relevant rules and regulations in order not to destroy the destination's environment.
PEB5	I learn more about the state of the environment and how to help solve environmental problems in the future for the destination.
PEB6	I try to convince others to protect the natural environment at the destination.
HWB1	I feel my life is happy.
HWB2	I feel my life is in good spirits.
HWB3	I feel my life is cheerful.
HWB4	I am satisfied with my life.
HWB5	Although I have my ups and downs, I can feel good about my life.
EWB1	I feel like I have a sense of direction and purpose in life.
EWB2	My social relationships are supportive and rewarding.
EWB3	I enjoy making plans for the future and working to make them a reality.
EWB4	I actively contribute to the happiness and well-being of others.
EWB5	I am competent and capable of doing the activities that are important to me.