Sensescapes and attention restoration in nature-based tourism: Evidence from China and Australia

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ABSTRACT

Several prior single-location case studies have found that the sensescape of a natural environment contributes to visitors' attention restoration. This study tests the effects of a soundscape and a visualscape on attention restoration using data from two natural destinations, Purple Mountain in China and Burleigh Heads Beach in Australia. The results indicate that the characteristics of a soundscape significantly contribute to visitors' attention restoration and quality of life directly and through the mediation of visualscape. Natural environments relate to visitors' quality of life through its multimodal sensescape. Critically, the attention restoration model is found to be applicable in different natural contexts, revealing that the restorative value of a natural sensescape is not contextually bound. Nature-based tourism can be used to promote mental health in the post-COVID-19 period worldwide.

1. Introduction

Attention is an important mental process that enables people to prioritize stimuli from the environment, but this capacity to direct attention decreases over a period of hours as attention requires cognitive effort (Basu, Duvall, & Kaplan, 2019). Such attentional fatigue can lead to task errors, insensitivity, or emotional issues, so it is important to restore effective attention and thus increase subjective well-being (Cole & Hall, 2010). Attention restoration is the regeneration of a depleted capacity to direct attention (Van den Berg, Hartig, & Staats, 2007). Attention restoration theory (ART) is the main theoretical framework used to explain nature's restorative effects (Joye & Dewitte, 2018). ART highlights the cognitive benefits derived from interactions with nature (Kaplan & Berman, 2010). Natural settings have been found to generate larger attentional restoration effects than urban surroundings (Hartig, Evans, Jamner, Davis, & Gärling, 2003). Recent studies indicate that interaction with the natural environment may help address isolation and other negative mental effects as a consequence of the COVID 19 outbreak (Fiorillo & Gorwood, 2020).

Every year, over eight billion people visit nature reserves such as beaches, islands, mountains, and wilderness areas, generating an estimated revenue of $600 billion worldwide (UNWTO, 2019). Research has found that experiences of nature provide an escape from stress (Ziegler, 2006), release anxiety and tension (Adevi & Mårtensson, 2013), prevent mental fatigue (Sonntag-Öström et al., 2014), and can develop self-discipline and creativity (Wolf, Ainsworth, & Crowley, 2017). However, there few studies on how interaction with nature can lead to attentional restoration.

The theory of grounded cognition proposes that people perceive the world through their senses (Krishna & Schwarz, 2014). Therefore, the mental benefits of nature-oriented experiences are related to our sensory perceptions of the natural environment (Franco, Shanahan, & Fuller, 2017). Viewing a natural environment reduces stress faster than an urban environment (Ulrich et al., 1991) due to the aesthetic appeal of natural environment (Grinde & Patil, 2009). The sounds of a natural environment can provide an additional layer of restorative effects (Payne, 2013). Birds chirping can elicit positive emotional responses, even though they may not be visible (Little, 2013). A virtual reality experience of a forest with sounds improves stress recovery better than without sounds (Annerstedt et al., 2013). Natural sounds decrease perceived crowding and increase tolerance of interpersonal encounters in national parks. Although visitors' sensory experiences vary (Pan & Ryan, 2009), tourism research has mostly focused on the visual effects of natural environments and only a few studies incorporate other senses

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(Waitt & Duffy, 2010). Seeing appears to have gained prominence over hearing after the sixteenth century, and the study of sounds is marginalized in Western scholarship (Adler, 1989). As a result, most studies in tourism literature are vision-centric, and the restorative effect of natural environments has been primarily attributed to "seeing" (Gallagher, Kanngieser, & Prior, 2017).

Furthermore, it is generally considered that the complex relationship between visitors and their visited locality is place, time, and culture-specific and, as such, requires contextual interpretation (Buckley, Cater, Linsheng, & Chen, 2008; Xu, Cui, Sofield, & Li, 2014). Tourism researchers usually conduct individual case-based studies rather than comparative studies. Such individual case studies generate findings that lack generalizability due to their small sample size and narrow focus. Also, previous ART studies have not examined the influences of both seeing and hearing on visitors' restorative process. There is no generally accepted model for how a visitor's different senses promote attention restoration in a natural environment.

To address this gap, this study examines the influence of both soundscape and visualscape on visitors' restorative outcomes (attention restoration and quality of life) using a comparative study involving two distinct cases—one in China and one in Australia. The selection of Chinese and Australian cases aims to examine if the restorative effects of the natural environment are consistent. Findings from this comparative study will shed light on how visitor-nature interactions affect attention restoration, the extent to which the soundscape of a natural environment has a restorative value, and whether this effect is culturally or contextually bound. Practically, research on how a sensescape improves mental health and wellbeing may contribute to reducing stress, depression, and other mental disorders during and after the COVID-19 pandemic.

2. Literature review

2.1. Attention restoration and a perceived restorative environment

Attention Restoration Theory (ART) examines the effect of the natural environment on the restoration of a person's capacity to direct attention (Staats, Van Gemerden, & Hartig, 2010). ART proposes that an individual's attention fatigue is reduced and attention restored through 1) "being away" from daily routines, 2) exposure to natural stimuli characterized by "soft fascination", 3) experiencing a large "extent" with expansive spaces and contexts, and 4) engaging in environments that are "compatible" with their intrinsic motivations (Kaplan, 1995). The combination of these four components encourages the recovery of an individual's capacity to direct attention (Herzog, Maguire, & Nebel, 2003). A natural environment that promotes restoration is defined as a perceived restorative environment (Hartig, Mitchell, De Vries, & Frumkin, 2014). In tourism literature, ART is widely used to explain preference for natural environments. The logic of this explanation is that nature is sought out because it is associated with relaxation or escape (Pearce, 2012).

However, ART has been criticized for its theoretical concepts being vague and lacking operationalization (Joye & Dewitte, 2018). For example, the attributes of a "fascinating" stimulus needed to provoke a fully restorative experience have not been verified in ART (Basu et al., 2019). Previous studies have suggested that a natural area is typically multisensory (Agapito, Pinto, & Mendes, 2017). As the sensory elements of the body are automatic and instinctual, a visit to a natural area requires only effortless bottom-up attention, and therefore the effort to direct attention can be reduced (Lehto & Lehto, 2019). Given that the sensory elements of a natural area provide a positive visitor experience (Agapito, Valle, & Mendes, 2014; Dann & Jacobsen, 2003), this paper considers that natural environment's effect on attention restoration is linked to sensory stimuli as discussed below.

2.2. The perceived restorative environment from a grounded cognition perspective

The theory of grounded cognition explains the importance of multimodal sensations for producing a restorative effect from exposure to natural environments (Barsalou, 2008; Gallese & Lakoff, 2005), highlighting that the restorative process is grounded by a multi-sensory experience (Mahon & Caramazza, 2008; Papies, Best, Gelibter, & Barsalou, 2017). Sensations are the basis of an individual's perception of their surroundings (Zurawicki, 2011) and the formation of action, and introspection (Krishna & Schwarz, 2014). When a person is exposed to the sensory stimulation of a natural environment, signals (impulses) are sent to the brain where interpretation as visual images or sounds occur (Leitan & Murray, 2014). Grounded cognition challenges standard theories which overtly emphasize the role of visual stimuli in human action and perception (Wilson, 2002). From the perspective of grounded cognition theory, sensation and perception are two consecutive stages in processing environmental stimulus (Barsalou, 2008). Sensation is the initial stage of human-nature interaction, laying the foundation for transforming low-level stimuli into high-level information (e.g., extraction of shapes for object recognition). This is followed by perception, which integrates multimodal sensations previous experiences and memories. Accordingly, multisensory sensation is key to understanding, planning, and marketing a perceived restorative environment (Agapito et al., 2017).

The study of perceived restorative environments is increasingly turning attention to soundscapes, smellscapes, tastescapes, and hapticscapes, in addition to visualscape (Dann & Jacobsen, 2003). Bunkše (2012) integrates all of these into the "sensescape", defining it as the multisensorial space which is distinguished, understood and valued by humans. A sensescape is where the environment and body meet (Rosen, 2018). The sensescape describes a multisensorial connection between the self, others, and the surrounding world, as a method of inhabiting and experiencing oneself and one's surroundings at the same moment (Jensen, Scarles, & Cohen, 2015). People experience the world with their sensations and cross-modal interactions across sensations results in faster reactions, timely recognition, and improved information processing (Laurienti, Burdette, Wallace, Yen, & Field, 2002). Thus, it is widely accepted that our understanding of a perceived restorative environment should be grounded in its sensescape (Grahn & Stigsdotter, 2010) and thus, a research on various sensescapes is crucial in the understanding of the perceived restorative environment.

2.3. Visualscape, soundscape and the perceived restorative environment

The literature of grounded cognition focuses on the effects of individual sensescape elements, particularly the visualscape—visual features of the environment that the body senses (Bagdare & Roy, 2016; Llobera, 2003). This is because the visual sense is often dominant compared to other stimuli (Ohly et al., 2016). Research has evaluated visual characteristics such as shape, colour, scale, texture, and topography that have influences on the perceived restorative environment (Grahn & Stigsdotter, 2010; Grinde & Patil, 2009; Li & Sullivan, 2016; Van den Berg, Hartig, & Staats, 2007). Natural environments viewed as green, open, and luminous with intermediate levels of visual complexity are considered ideal, as they attract indirect attention with a moderate, pleasant response (Galindo & Hidalgo, 2005). Therefore, we propose the following hypothesis:

H1. The visualscape characteristics (VC) directly affect the formation of the perceived restorative environment (PRE).

Soundscape is defined as a sonic environment sensed and understood by an individual or a society (Aletta, Kang, & Axelsson, 2016). Unlike the acoustic environment, a soundscape is a perceptual construct (Brown, 2012). Thus, a soundscape is not merely background to an environment but central to how space is perceived as interactive (Qiu,

Zhang, Zhang, & Zheng, 2018). Following this line, this study defines soundscape characteristics (SC) as the auditory features which the body senses and sends to the brain to interpret as a soundscape. Soundscape characteristics add credence to visual images of the natural environment, elicit emotions, and impact visitors' restoration (Schafer, 1993). Different soundscape characteristics have substantially divergent effects on the perceived restorative environment (Zhang, 2014). That is, a tranquil natural soundscapes leads to a higher evaluation of the restorative environment, compared to a complex soundscape requiring directed attention to resolve (Payne & Guastavino, 2018; Ratcliffe, Gatersleben, & Sowden, 2013). Therefore, this study considers that soundscape characteristics (SC) affect the evaluation of the restorative environment. We propose the following hypothesis:

H2. The soundscape characteristics (SC) directly affect the formation of the perceived restorative environment (PRE).

2.4. The interaction between the soundscape and visualscape

Seeing and hearing provide external environmental information that is synthesized in the brain (Liu, Kang, Behm, & Luo, 2014). This stimulates action and may be encoded in memory (Krishna & Schwarz, 2014). Therefore, understanding the relationship between the soundscape and visualscape is important. Soundscape characteristics affect the appraisal of a visualscape (Fuller, Axel, Tucker, & Gage, 2015; Sun et al., 2018). Images of destinations, for example, receive higher ratings on pleasure and relaxation when paired with sounds of nature, and urban sounds decrease the ratings of natural images (Jiang, Zhang, Zhang, & Yan, 2018). Furthermore, the absence of sounds may induce apprehension and fear of threats (Annerstedt et al., 2013). Bare ground, green plants, mountains, and the sky were found to be significant visualscape elements that are influenced by soundscape characteristics (Aletta et al., 2016). Therefore, this study proposes the following hypothesis:

H3. The soundscape characteristics (SC) directly affect the visualscape characteristics (SVC).

As the soundscape is more fluid and transitory, it is not always accurately identified in localization and orientation (Schafer, 1993). The meaning of soundscape may need to be clarified by visualscape (Carles, Bernáldez, & Lucio, 1992). Alvarsson, Wiens, and Nilsson (2010) found that the birdsongs enhanced the perceived pleasantness of rainforest images, contributing to visitors' experienced stress reduction. Qiu et al. (2018) pointed out that the natural environment is more restorative when the soundscape and visualscape contain consistent characteristics. Based on previous research, this study posits that the sensation of visualscape characteristics mediates the relationship between the soundscape characteristics and perceived restorative environment. Therefore, this study proposes the hypothesis:

H4. The soundscape characteristics (SC) indirectly affect the perceived restorative environment (PRE) through the mediating effects of the visualscape characteristics (VC).

2.5. The perceived restorative environment and visitors' quality of life

In the tourism literature, quality of life (QoL) is an indicator of human welfare, rather than an income or production indicator (Uysal, Sirgy, Woo, & Kim, 2016). For a visitor, QoL relates to an individual's evaluation of their tourism and leisure experiences (Andereck, Valentine, Vogt, & Knopf, 2007). Bottom-up spillover theory is the most utilized theory in QoL research, and considers QoL as a multidimensional concept (Sirgy, 2010). Overall QoL is at the top of a satisfaction hierarchy and affected by all life domains and sub-domains (Dolnicar, Lazarevski, & Yanamandram, 2013). For instance, a visitor' overall QoL is influenced by satisfaction with one's family, social life, leisure and recreation, health, work, finances, and travel (Uysal, Berbekova, & Kim, 2020).

Pleasurable trip experiences are an important domain of overall QoL (Neal, Sirgy, & Uysal, 1999). Quiet and green space appear to contribute to human enjoyment, positively influencing visitors' trip experiences (Watts, Pheasant, & Horoshenkov, 2011). In contrast, exposure to noise or a disordered visual environment has been linked to annoyance, insomnia, stress, and activity disturbance (Alvarsson et al., 2010). These responses are considered risk factors for cardiovascular diseases and mental pathologies, negatively impacting health related QoL (Shepherd, Welch, Dirks, & Mathews, 2010). High-quality acoustic and visual environments are associated with satisfaction in the security domain, contributing to overall QoL (Shepherd, Welch, Dirks, & McBride, 2013). Therefore, this study proposes the following hypotheses:

H5. The visualscape characteristics (VC) directly affect tourists' quality of life (QoL).

H6. The soundscape characteristics (SC) directly affect tourists' quality of life (QoL).

A perceived restorative environment provides visitors a place to reduce stress, evoke positive emotions, release negative emotions, and improve cognitive function (Finlay, Franke, McKay, & Sims-Gould, 2015; Nghiem et al., 2021). Additionally, a restorative environment may lead a visitor to become "someone" different and experience positive changes in attitude, performance, values, and spiritual engagement (Wolf et al., 2017). It not only brings visitors momentary pleasure but also has diverse long-term benefits to their overall quality of life, resulting in revisit and/or the recommendation of that environmental destination (Lehto & Lehto, 2019). The increased emotional, social, and spiritual satisfaction are significant predictors of overall life satisfaction (Pavot & Diener, 2008). Therefore, this study proposes the following hypothesis:

H7. The perceived restorative environment (PRE) directly affects visitors' quality of life (QoL).

2.6. Mediation effects of the perceived restorative environment

In addition to the direct pathway from visualscape, soundscape and perceived restorative environment to QoL, several researchers assume exposure to a natural soundscape or visualscape could lead to well-being via a restorative mechanism (Van Kamp, Klaeboe, Kruize, Brown, & Lercher, 2016). Studies have investigated the perceived restorative environment as a mediator between natural sensescapes and QoL. For example, Martínez-Soto, Lena, and Córdova (2014) found that visual contact with nature was positively correlated with a perceived restorative environment, which promotes improved emotional well-being. Jahncke, Eriksson, and Naula (2015) found that higher noise levels were associated with lower perceived restoration, resulting in less physical activity, low social cohesion, and poor mental health. Studies have also shown the effect of green views on quality of life is mediated by the perceived restoration (Marselle, Irvine, Lorenzo-Arribas, & Warber, 2016). However, no studies have combined both visualscape and soundscape in a model to investigate their direct impact on perceived restorative environment and on QoL mediated by perceived restorative environment. Therefore, this study posits that the perceived restorative environment mediates the relationship between the natural sensescape and perceived quality of life. We propose the following hypotheses:

H8. The perceived restorative environment (PRE) mediates the relationship between the visualscape characteristics (VC) and visitors' quality of life (QoL).

H9. The perceived restorative environment (PRE) mediates the relationship between the soundscape characteristics (SC) and visitors' quality of life (QoL).

2.7. The influence of context

Tourism theorists recognise that a visitors' restoration in nature requires contextual interpretation (Lehto, Kirillova, Li, & Wu, 2017). A visitor's personal experiences are unique and formed under the influence of physical, physiological, psychological, cultural, and other factors (Soldatenko & Backer, 2019). Studies indicate that natural experiences differ between Eastern and Western cultures due to subtle distinctions in attitude, easily masked by broad similarities (Buckley et al., 2008). Therefore, previous studies suggested that the restorative benefits of natural environments may not be at the same level or degree across cultural groups, socioeconomic groups, and geographical or landscape contexts (Chen, Huang, & Zhang, 2017; Lehto et al., 2017).

The Biophilia hypothesis asserts there is an inherent human need for attachment to nature as natural environments possess crucial survival importance (Kellert & Wilson, 1993). Regardless of the cultural or contextual bond, visitors will experience positive effect on their mental health and well-being when listening to natural sounds or viewing natural scenery (Chen, Tu, & Ho, 2013; Grinde & Patil, 2009). The influence of context is less understood as most existing restoration studies are case-based and lack cross-context comparisons. Hence, a multi-case study is necessary to assess if comparable effects are observed in different environments, populations, and cultural contexts (Hartig et al., 2014). This will improve the generalizability of the empirical findings, by assessing if the results differ between groups or contexts. Therefore, this study proposes the following hypothesis:

H10. Contextual factors moderate the model of tourists' attention restoration through audio-visual interaction.

3. Methods

3.1. Instrument development

Scale development for soundscape and visualscape is conducted via text mining user-generated content (UGC) in this study due to the absence of generally accepted measurement scale for the two constructs. Some 306 TripAdvisor posts about Purple Mountain and Burleigh Heads written from January 2010 to July 2018 were retrieved. These posts were deemed as authentic information provided by insiders as TripAdvisor is a leading traveler review site in both China and Australia (Goldsmith & Travel, 2016). These posts were analyzed using a combination of quantitative (word cloud and segmentation) and qualitative (text-mining) methods. Nvivo 12.0 Plus software was used in these analyses. Content analysis of the TripAdvisor posts revealed the soundscape and visualscape characteristics shared by the TripAdvisor users. Certain characteristic opposites emerged, such as "tranquility-noisy," "quiet-loud," and "eventful-monotonous" in the word cloud of soundscape and "bright-dull" and "open-closed" for visualscape. These words were used in the measurement scales. Additionally, the soundscape features described by Axelsson, Nilsson, and Berglund (2010) and Raimbault (2006) and the visualscape features depicted by Grahn and Stigsdotter (2010) and Van den Berg et al. (2007) were compared to complement the measurement items developed via the travel posts. The final list of items was reviewed by two experts in academia for face validity.

A ten item soundscape characteristic scale (SC) and a nine item visualscape characteristic scale (VC) were developed as a result. A principal component analysis (PCA), indicates SC contains two sub-constructs [acoustic factor (AF) and sonic emotion (SE)] while VC consists of visual information (VI) and spatiotemporal structure (STS). AF refers to the acoustic index of soundscapes, SE the subjective content contained in soundscapes, VI the perceived information delivered by visualscapes, and STS the temporal and spatial features of visualscape. The scale development process followed Churchill Jr (1979) guidelines in which scales were generated, tested, and re-tested via pilot and main

Table 1
Comparison between Chinese and Australian cases.

Characteristics	The Purple Mountain	The Burleigh Heads Beach
Location	E118°86' N32°08'	E153°46' S28°09'
Landform	Mountain	Coast
Weather	Subtropical humid climate	Subtropical monsoon climate
Vegetation	A mixed forest of evergreen broad-leaved and deciduous broad-leaved forests	Subtropical evergreen broad-leaved forest
Economic position	Developing country	Developed country
Tourism activities	Hiking, camping	Swimming, surfing, sunbathing
Culture traditions	The culture of Ming dynasty, Buddhist culture, Confucian and Taoist philosophies	Australian aboriginal culture, Culture of Marine exploration
Soundscape	Plant soundscape (rustle of leaves); Biological soundscape (birdsong, insect call)	Geological soundscape (sound of sea); artificial soundscape (mechanic sound, music)
Visualscape	Trees and plants, sandstones, creeks, birds, etc.	Sea, sand beach, rocks, sunshine, etc.

survey.

The original twelve items Perceived Restorativeness Scale (PRS-12) developed by Hartig et al. (1996) contains four dimensions, namely being away, fascination, extent, and compatibility. It has shown good reliability and validity in empirical research across different cultures and contexts (Han, 2018). Three studies investigating the perceived restorative environment of destinations adapted the perceived restorativeness scales (PRS-12) to a specific tourism situation (Chen et al., 2017; Lehto, 2013; Lehto et al., 2017). Although the items varied from study to study, the four components of the restorative quality were present in each of the studies (Han, 2018). Therefore, PRS-12 was employed in this study.

Visitors' QoL was measured using the overall QoL scale developed by Kim, Woo, and Uysal (2015). This scale contains six items and evaluates the entire life experience rather than a particular life domain. Participants were asked to predict the implication of a nature-based vacation on their future life, such as "Overall, I would feel happy upon my return from this trip", and "In the long run, this trip will enrich my life". In order to test participants' mental state before visiting the natural area, this study adopted the Perceived Stress Scale (PSS-10) developed by Cohen, Kamarck, and Mermelstein (1994), which has been confirmed and verified measuring stress levels in different countries (Mitchell, Crane, & Kim, 2008).

The questionnaire (see appendix) contains five parts: the demographic characteristics of respondents, their perceived stress level (PSS) before visiting the natural area, scales to measure soundscape characteristics (SC), visualscape characteristics (VC), perceived restorativeness scale (PRS) and visitors' quality of life scale (QoL). For PSS, participants rate the frequency from 1 (*never*) to 5 (*very often*) that they encountered stressful situations in the past month before they visited the natural environment. SC and VC are measured using a five-point semantic differential scale. The PRS and QoL are measured by a five-point ordinal scale (1 = *strongly disagree*, 5 = *strongly agree*).

3.2. Pilot study

The pilot test was hosted on Qualtrics which is an Australian market research company. A total of 161 participants were recruited through convenience sampling. As a result, the potential issues in readability and logistics were identified. Then, the questionnaire was translated into Mandarin by three Chinese scholars in the tourism field. A convenience sample of 100 university students in China was used to conduct a pre-test. According to the comments provided by these participants, the Chinese version was amended and finalized.

Table 2
Profile of participants.

	Total (%)	Australia (%)	China (%)		Total (%)	Australia (%)	China (%)
Gender				**Age**			
Male	46.45%	41.87%	48.62%	20–30 years old	16.70%	17.36%	16.38%
Female	53.37%	57.58%	51.38%	31–40 years old	23.89%	22.59%	24.51%
other	0.18%	0.55%	0.00%	41–50 years old	19.89%	24.52%	17.69%
Marital status				51–60 years old	20.69%	15.98%	22.94%
Single	30.55%	22.87%	34.21%	61–70 years old	18.83%	14.05%	13.50%
Married	42.36%	43.80%	41.68%	Over 70 of age	5.15%	5.51%	4.98%
Partner	16.34%	19.83%	14.68%	**Origins**			
Divorced	7.90%	8.54%	7.60%	Local residents	29.75%	27.55%	30.80%
other	2.84%	4.96%	1.83%	Domestic tourists	46.89%	41.05%	49.67%
Level of education				Foreign tourists	23.36%	31.40%	19.53%
No formal education	2.84%	2.75%	2.88%	**Organization**			
Primary school	8.35%	5.79%	9.57%	Group	57.82%	28.10%	71.95%
Secondary school	18.29%	19.56%	17.69%	Individual	42.18%	71.90%	28.05%
Diploma and above	56.31%	62.81%	53.21%				
Other	14.21%	9.09%	16.64%				

Table 3
t-test of the two cases.

Construct	Mean value		Standard deviation		*t*	*p*
	Australia	China	Australia	China		
Soundscape Characteristics (SC)	3.77	4.3	1.31	1.28	2.05	0.021
Acoustic Factor (AF)	3.73	4.21	1.27	1.32	2.70	0.007
Sonic Emotion (SE)	3.80	4.38	1.25	1.28	3.05	0.001
Visualscape Characteristics (VC)	4.13	3.86	1.22	1.21	2.35	0.003
Visual Information (VI)	4.18	3.73	1.32	1.29	3.34	0.001
Spatio-Temporal structure (STS)	4.07	3.98	1.10	1.09	1.43	0.152
Perceived Restorative Environment (PRE)	4.26	4.48	1.33	1.25	2.83	0.002
Overall Quality of life (QoL)	4.23	4.25	1.05	1.21	1.07	0.253

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

Table 4
Perceived stress level before visiting the natural area.

Perceived stress scale (PSS)	Mean value		*t*
	Australia	China	
How often have you been upset because of something that happened unexpectedly?	3.81	4.41	3.57***
How often have you felt you were unable to control the important things in your life?	3.92	4.47	2.40**
How often have you felt nervous and stressed?	3.94	4.45	2.79**
How often have you felt confident about your ability to handle your personal problems?	3.79	3.82	1.34
How often you felt that things were going your way?	3.56	3.83	3.62***
How often have you found you could not cope with all the things that you had to do?	3.46	3.86	2.83**
How often have you been able to control irritations in your life?	3.56	3.76	1.92
How often have you felt that you were on top of things?	3.25	3.61	4.06***
How often have you been angered because of things that were outside of your control?	3.58	3.76	2.19**
How often have you felt difficulties piling up so high that you couldn't overcome them?	3.61	3.64	0.78

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

3.3. Study sites and participants

Since this study aims to validate the attention restoration model across cases, Chinese and Australian visitors in different natural environments were selected as the target population. Australia and China were selected as they differ in terms of economic level, political governance, tourism development, and cultural values. Chinese and Australian visitors have different attitudes to nature and demonstrate different levels of concern over environmental issues (Packer, Ballantyne, & Hughes, 2014). Western studies dominate research on nature's effect on attention restoration and a Chinese case study will extend knowledge to a new context. The differences between the two locations are summarised in Table 1.

The Chinese survey was conducted between September 21 and 27, 2018 in Purple Mountain, which is a famous 5A destination in east Nanjing, China (Fig. 2). Seven interviewers conducted the survey at the major attractions there. A total of 1000 questionnaires were distributed by convenience sampling, of which 763 were deemed usable. The Australian survey was conducted between January 10 and 20, 2019, when it is the corresponding autumn season. Four interviewers distributed questionnaires at Burleigh Heads Beach, Gold Coast, Queensland (Fig. 3). Some 450 questionnaires were completed, and 363 were usable. The demographic characteristics of Australian and Chinese samples are shown in Table 2. According to national tourism statistics, both

destinations are popular among residents and domestic tourists, but few foreign tourists visit. In both cases, the sample is representative of the normal visitor profile.

The *t*-test results (Table 3), indicate that, except for spatio-temporal structure, the two groups of respondents perceived Purple Mountain and Burleigh Heads as having different soundscape and visualscape characteristics. The stress level of the Chinese group was significantly higher than their Australian counterparts (Table 4). It indicates that most of the visitors at Purple Mountain were high-fatigue individuals, thus confirming the results of a study by Chen et al. (2017) that Chinese population are busier and more likely to experience fatigue as their public holidays and paid vacations are fewer than most western countries.

3.4. Partial least squares structural equation modelling

This study adopted partial least squares structural equation modelling (PLS-SEM) to test the predictive power of the conceptual model. As PLS-SEM explains the residual variance of each latent variables, it is widely used to predict the key constructs (Fornell & Larcker, 1981). This study investigates the influences of several soundscape and visualscape characteristics on the perceived restorative environment and tourists' quality of life. It focuses on the exploration of various predictive

Table 5

Individual item reliability and construct validity.

Construct	Loading			Cronbach' α			CR			AVE		
	Overall	China	Australia	Overall	China	Australia	Overall	China	Australia	Overall	China	Australia
Perceived Restorative Environment (PRE)				0.81	0.79	0.85	0.93	0.9	0.94	0.76	0.7	0.81
Extent				0.82	0.88	0.81	0.92	0.87	0.94	0.79	0.69	0.84
extent1: there is a clear order in the physical arrangement of this place	0.89	0.83	0.91									
extent2: everything matches the overall environment	0.9	0.84	0.92									
extent3: this place seems limitless to allow exploration	0.88	0.81	0.92									
fascination				0.86	0.82	0.89	0.91	0.9	0.94	0.78	0.74	0.83
fascination1: this place make me wonder about things	0.89	0.87	0.92									
fascination2: there are many interesting things in this place that draw my attention	0.91	0.894	0.94									
fascination3: I am engrossed by this place	0.85	0.81	0.89									
being away				0.84	0.73	0.91	0.91	0.86	0.94	0.78	0.67	0.83
being away1: this place is different from where I usually live	0.89	0.82	0.92									
being away2: this place gives me a break	0.89	0.82	0.93									
being away3: this place is a refuge from unwanted distractions	0.86	0.83	0.9									
compatibility				0.82	0.78	0.85	0.87	0.85	0.9	0.69	0.65	0.75
compatibility1: this place suits my personality	0.85	0.77	0.91									
compatibility2: there are few boundaries to limit my possibility for moving about	0.81	0.81	0.81									
compatibility3: this place meets my expectations	0.86	0.84	0.87									
Soundscape Characteristics (SC)				0.79	0.81	0.77		0.71	0.80		0.63	0.70
Acoustic Factor (AF)				0.82	0.89	0.78		0.93	0.84		0.72	0.62
AF1: far-nearby	0.83	0.86	0.78									
AF2: organized-disorder	0.85	0.87	0.79									
AF3: steady-capricious	0.76	0.86	0.76									
AF4: dull-sharp	0.71	0.84	0.66									
AF5: quiet-loud	0.75	0.80	0.70									
Sonic emotion (SE)				0.83	0.84	0.82		0.81	0.85		0.54	0.67
SE1: pleasant-unpleasant	0.77	0.73	0.8									
SE2: appealing-boring	0.72	0.69	0.82									
SE3: natural-manmade	0.76	0.74	0.8									
SE4: eventful-monotonous	0.72	0.78	0.83									
SE5: tranquility-noisy	0.75	0.71	0.76									
Visualscape characteristics (VC)				0.85	0.84	0.87		0.75	0.75		0.7	0.61
Visual Information (VI)				0.86	0.88	0.82		0.92	0.92		0.79	0.78
VI1: historical-modern	0.88	0.88	0.91									
VI2: impressive-unimpressive	0.86	0.91	0.84									
VI3: rich in life-lifeless	0.89	0.88	0.9									
VI4: natural-manmade	0.79	0.76	0.87									
Spatio-temporal Structure (STS)				0.83	0.81	0.89		0.92	0.95		0.63	0.74
STS1: bright-dull	0.78	0.78	0.8									
STS2: opened-closed	0.85	0.79	0.91									
STS3: vast-narrow	0.8	0.79	0.83									
STS4: lasting-temporary	0.82	0.79	0.89									
STS5: tidy-untidy	0.85	0.81	0.88									
Tourists' quality of life (QoL)				0.91	0.89	0.93		0.93	0.9		0.61	0.62
QoL1: Overall, I felt happy from this trip.	0.74	0.80	0.78									
QoL2: My satisfaction with life, in general, increased shortly after the trip.	0.72	0.72	0.78									
QoL3: In the long run, this trip will enrich my life.	0.77	0.81	0.72									
QoL4: Although I have ups and downs, in general, I felt good after this trip	0.82	0.80	0.82									
QoL5: I believe I will have a good life in the future.	0.74	0.79	0.74									
QoL6: I am satisfied with my physical and mental body through this trip.	0.77	0.79	0.73									

relationships rather than theory confirmation (Sarstedt, Becker, Ringle, & Schwaiger, 2011). Therefore, PLS-SEM was an appropriate analytical technique in this study.

4. Results

4.1. Common method variance

Common Method Variance (CMV) refers to the presence of a spurious correlation between two variables caused by a common third variable

Table 6
Discriminate validity with HTMT.

	AF	being away	Compatibly	Extent	Fascination	PRE	QoL	SE	SC	STS	VC	VI
AF	0.803											
Being away	0.415	0.828										
Compatibility	0.399	0.714	0.788									
Extent	0.392	0.696	0.691	0.831								
Fascination	0.472	0.307	0.33	0.462	0.77							
PRE	0.444	0.876	0.771	0.805	0.442	0.83						
QoL	0.484	0.399	0.408	0.48	0.631	0.495	0.821					
SE	0.336	0.643	0.631	0.684	0.438	0.818	0.441	0.781				
SC	0.472	0.631	0.623	0.655	0.423	0.727	0.445	0.619	0.758			
STS	0.601	0.365	0.38	0.512	0.963	0.494	0.661	0.461	0.472	0.75		
VC	0.488	0.385	0.431	0.494	0.623	0.491	0.754	0.399	0.465	0.683	0.621	
VI	0.37	0.284	0.297	0.443	0.722	0.406	0.795	0.393	0.358	0.74	0.651	0.704

when they are measured by the same method (Hair, Sarstedt, Ringle, & Mena, 2012). It is a significant concern when questionnaires are distributed at the same time to similar respondents (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). To detect potential CMV, Harman's single-factor test was adopted to check whether variance in the data can be largely attributed to measurement method. As a result, only 17.6% of the total variance was explained by the first factor, revealing that this study was not pervasively affected by CMV.

4.2. The second-order constructs of SC and VC

In the conceptual model, the SC, VC, and PRE are posited as second-order constructs. The SC and VC contain two first-order constructs, auditory feature and sonic emotion, and spatiotemporal structure and visual information, respectively. The second-order construct of PRE is comprised of four dimensions: being away, fascination, extent, and compatibility. Following recommendations by Hair et al. (2012), the first- and second-order confirmatory factor analysis (CFA) are compared by the target coefficient (range from 0 to 1). The target coefficients in this study scaled from 0.83 to 0.92, revealing that 83% to 92% of the variation among the first-order constructs can be explained by the second-order CFA. Moreover, the large value of the target coefficient implies the data had a better fit index, promoting the conceptual model more precisely.

4.3. Measurement model

There are four main constructs in this study: SC, VC, PRE, and QoL. The loading of each indicator on its associated latent variables (LV) was higher than 0.60, proving the internal consistency reliability of the construct measures (Henseler, Hubona, & Ray, 2016). The composite reliability (CR) was a key coefficient to assess the construct reliability of the measurement model (Henseler, Ringle, & Sarstedt, 2015). Table 5 indicates that the CRs of all reflective LVs were higher than 0.8, which exceeds the threshold of 0.70. Thus, the measurement model established acceptable reliability. The average variance extracted (AVE) was evaluated to examine the convergent validity of the measurement model (Chin, 2010). The convergent validity was supported as all the AVE values for the first- and second-order constructs exceeded the required

threshold value of 0.50.

To demonstrate each LV is distinct from other constructs, discriminant validity was established (Hair et al., 2012). Based on the hetero-trait-mono-trait ratio of correlations (HTMT) approach, the conservative criterion for HTMT should be less than 0.85 to support discriminant validity (Henseler et al., 2015). The results in Table 6 show that all of the HTMT criteria were less than 0.85. The result supported that the measurement model had good fitness with the data, and the measurement model was reliable and valid.

4.4. Structural model

R^2 indicates the amount of variance explained by the exogenous variables (Kline, 2015). T Figure he model appears to have an appropriate predictive power, with R^2 exceeding the standard threshold of 0.10 (4). Moreover, the model had significant predictive relevance as the Q^2 values of all the endogenous constructs were above zero (Fornell & Larcker, 1981). To evaluate the significance of each path coefficient, a bootstrapping procedure was used (Hair et al., 2012). Previous studies suggested that when zero is outside the bootstrapped 95% confidence intervals, the hypotheses were supported. Fig. 4 shows the PLS results for all samples. It indicates that VC significantly influences PRE ($\beta_{total} = 0.54$, $\beta_{China} = 0.59$, $\beta_{Australia} = 0.65$, $p < 0.001$) and QoL ($\beta_{total} = 0.36$, $\beta_{China} = 0.25$, $\beta_{Australia} = 0.34$, $p < 0.001$), while SC has direct effects on PRE ($\beta_{total} = 0.47$, $\beta_{China} = 0.65$, $\beta_{Australia} = 0.48$, $p < 0.001$), VC ($\beta_{total} = 0.50$, $\beta_{China} = 0.58$, $\beta_{Australia} = 0.47$, $p < 0.001$) and QoL ($\beta_{total} = 0.10$, $\beta_{China} = 0.14$, $\beta_{Australia} = 0.11$, $p < 0.01$), and PRE also significantly influenced QoL ($\beta_{total} = 0.87$, $\beta_{China} = 0.85$, $\beta_{Australia} = 0.74$, $p < 0.001$). Thus, H1, H2, H3, H5, H6, and H7 are all supported.

The mediation effects of VC and PRE were further examined in this study. The significance of indirect effects is the prerequisite to establish the mediating effect (Sobel, 1982). According to the rule of z statistic, there is a mediating effect when the z-value is higher than 1.96 ($p < 0.05$). The variance accounted for (VAF) value represents the ratio of per indirect effect on total effects. VAF can have a value less than 20% (no mediation) to very large outcomes of above 80% (full mediation). VAF from 20% to 80% can be characterized as partial mediation (Hair et al., 2012). As shown in Table 7, the study concludes that for the entire group, the Chinese group, and the Australian group, VC plays a partial

Table 7
The examination of mediating effects.

	SC - > VC - > PRE			VC - > PRE - > QoL			SC - > PRE - > QoL		
	Overall	China	Australia	Overall	China	Australia	Overall	China	Australia
Indirect effect	0.27	0.34	0.29	0.47	0.53	0.46	0.41	0.58	0.36
Total effect	0.74	0.99	0.77	0.83	0.78	0.8	0.51	0.72	0.47
Sobel z test	7.18	6.52	11.42	9.59	18.35	6.58	32.08	33.5	28.62
VAF	36.49%	34.34%	37.66%	56.63%	67.95%	57.50%	80.39%	80.56%	76.60%
Support	Partial mediation	Partial mediation	Partial mediation	Partial mediation	Partial mediation	Partial mediation	Full mediation	Full mediation	Partial mediation

Table 8
Results of invariance measurement testing using permutation.

Constructs	Configure invariance	Compositional invariance		Partial measurement invariance established	Equal mean variance		Equal mean value		Full measurement invariance established
		c-Value (c = 1)	95% CIs		Differences	95% CIs	Differences	95% CIs	
SC	Yes	0.925	[0.900,1.000]	Yes	−0.167	[−0.171,0.171]	−0.005	[−0.254,0.237]	Yes
VC	Yes	0.997	[0.995,1.000]	Yes	−0.013	[−0.020,0.032]	0.004	[−0.251,0.256]	Yes
PRE	Yes	0.918	[0.910,1.000]	Yes	−0.111	[−0.136,0.152]	0.000	[−0.126,0.128]	Yes
QoL	Yes	0.929	[0.925,1.000]	Yes	−0.086	[−0.216,0.024]	−0.002	[−0.129,0.127]	Yes

Table 9
Results of multi-group analysis.

Relationships	Path Coefficients	Path Coefficients	CIs	CIs	Path coefficient	P-value	P-value	Supported
	China	Australia	(Bias corrected)	(Bias corrected)	differences	Henseler's MGA	Permutation test	
			China	Australia				
H1: VC - >PRE	0.59	0.62	[0.23, 0.57]	[0.35, 0.68]	−0.03	0.11	0.21	×
H2: SC - >PRE	0.65	0.48	[0.47, 0.71]	[0.32, 0.53]	0.2	0.00***	0.00***	√
H3: SC - >VC	0.58	0.47	[0.25, 0.59]	[0.26, 0.47]	0.11	0.00***	0.00***	√
H5: VC - > QoL	0.25	0.34	[0.11, 0.21]	[0.22, 0.31]	−0.09	0.06	0.08	×
H6: SC - > QoL	0.14	0.11	[0.15, 0.20]	[0.27, 0.36]	0.03	0.13	0.3	×
H7: PRE- > QoL	0.89	0.74	[0.83, 0.86]	[0.67, 0.83]	0.15	0.01***	0.01***	√

$*p < 0.1$, $**p < 0.05$, $***p < 0.01$.

mediator role between SC and PRE while PRE partially mediated the relationship between VC and QoL. However, PRE fully mediated the relationship between SC and QoL in both the entire group and the Chinese group.

4.5. Multi-group analysis

The multi-group analysis (MGA) was conducted to compare the path coefficients between the Chinese and Australian groups to test the influence of context on the model. Henseler et al. (2016) recommended the measurement invariance of the composites method (MICOM) to examine the measurement invariance. It includes the assessment of configural invariance, compositional invariance assessment, and equal mean values, and variances. This is a requirement for comparing and interpreting the MGA's group-specific differences in PLS-SEM results. As shown in Table 8, the measurement invariance is supported as the three types of invariance are confirmed in this study. Therefore, MGA is possible.

Table 9 shows the results of MGA generated by two different methods: Henseler's bootstrap-based MGA and the permutation test (Chin, 2010). In Henseler's MGA, a *p*-value of differences between path coefficients higher than 0.95 or smaller than 0.05 implied the significance of specific path coefficients across the two groups at the 5% level. The permutation test indicated significant differences between path coefficients only when the *p*-value is lower than 0.05 (Sarstedt et al., 2011).

The MGA's result revealed significant differences between the Chinese and Australian groups regarding the effects of SC on PRE (β_{China} = 0.65, $\beta_{Australia}$ = 0.48, $p = 0.00***$), SC on VC (β_{China} = 0.58, $\beta_{Australia}$ = 0.47, $p = 0.00***$) as well as PRE on QoL (β_{China} = 0.89, $\beta_{Australia}$ = 0.74, $p = 0.00***$). However, the difference did not vary significantly between the Chinese and Australian groups regarding the effects of VC on PRE (β_{China} = 0.59, $\beta_{Australia}$ = 0.62, $p = 0.21$), VC on QoL (β_{China} = 0.25, $\beta_{Australia}$ = 0.34, $p = 0.08$) and SC on QoL (β_{China} = 0.14, $\beta_{Australia}$ = 0.11, $p = 0.30$). Both methods of MGA analysis confirm that SC has larger effects on PRE and VC in the Chinese group than their Australian counterparts with a p-value lower than 0.05. PRE has smaller effects on QoL in the Australian group. Moreover, the results indicated a non-moderating role of VC on PRE and QoL across both groups.

5. Discussion and implications

A visit to a natural setting involves experiencing a sensescape. Few tourism studies have investigated how these sensescapes influence health and well-being. To fill this gap, this study examined the relationship among visitors' sensation of sensescapes, perceived restorative environment, and quality of life, based on the framework of grounded cognition. Therefore, this research attributes attention restoration to the interaction of visitors' multiple senses with the natural environment.

Findings supported the hypotheses that a sensescape influences visitors' perceived restoration and quality of life. A perceived restorative environment is conceptualized as having multisensory components (Liu et al., 2013). However, there is a dearth of empirical research assessing the extent to which the soundscape and visualscape of a nature-based leisure environment affects human health and well-being (Agapito et al., 2017). This study filled this gap, revealing that VC and SC are foundational to the formation of attention restoration. Both VC and SC kept visitors from getting bored (fascination), allowed them to feel removed from their daily routine (being away), engaged them in exploration (extent), and thus be one with nature (compatibility). Overall, VC and SC stimulated mental rejuvenation through a perceived restorative environment separately and jointly (H1, H2, H3 and H4). Therefore, these attributes may foster a better functioning individual (H5, H6, and H7), including immediate sensory pleasure and quality of life improvement.

5.1. Theoretical implications

This research represented the first step in understanding the interaction of VC and SC in constructing PRE as well as identifying why the interpretation of soundscape elements is integral to this process. Recent discussion of sensescapes in restoration research has focused implicitly on the visual senses. Studies have found that 80% of the total information from a perceived restorative environment is afforded by the visualscape (Liu et al., 2014). However, the examination of the mediation effects in this study indicated that interactivity (congruence) between soundscape and visualscape has a greater restorative effect than a visualscape alone (H4). If a visitor perceived congruent VC and SC, s/he is more likely to perceive the surroundings as a restorative environment,
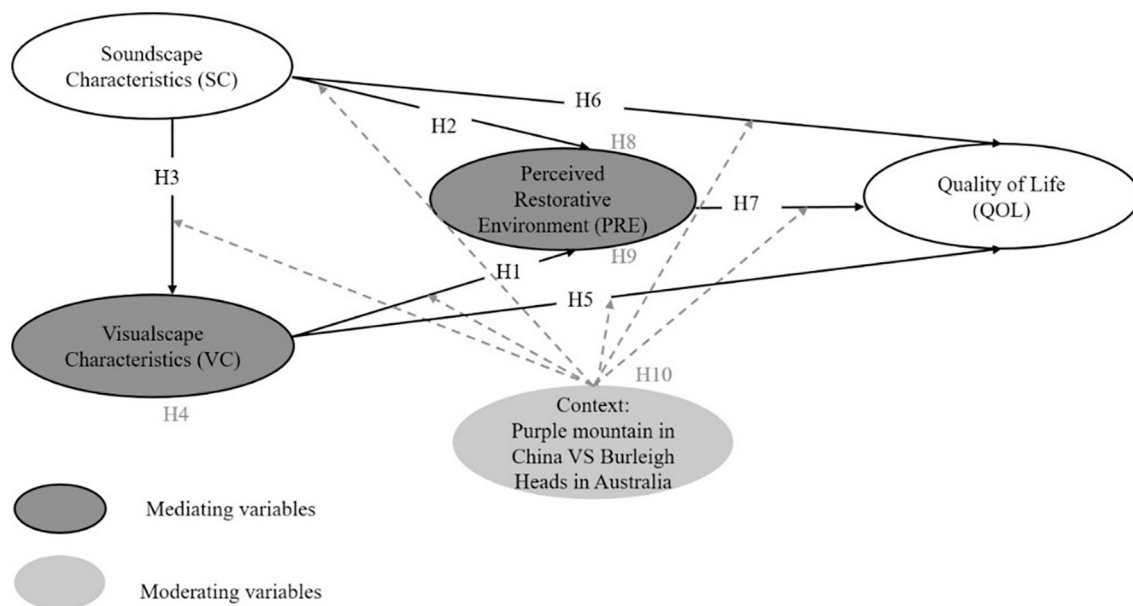
Fig. 1. The conceptual framework of visitors' attention restoration through audio-visual interactions.

leading to an improved evaluation of QoL. More importantly, a difference existed in the effects created by pathways of VC and SC. As indicated in Fig. 4, the spatio-temporal structure (STS) affected the relationship between VC and PRE whereas sonic emotion was more important for the SC and PRE relationship. The distinct effect of SE on SC is consistent with Schafer (1993), in that a soundscape can provide an immersive experience as it contains more emotional elements compared to a natural visualscape. This finding challenges the "tyranny of the visual" found in previous studies which place an overwhelming emphasis on the role of visualscape in attention restoration (Waitt & Duffy, 2010). It sheds light on the therapeutic efficacy of the soundscape in natural environments and indicates the importance of recognizing the effect of soundscape in PRE.

Previous studies stated that preference for nature is an innate part of being human, but there is little knowledge on how and why human-nature interaction could promote positive health outcomes (Dopko, Zelenski, & Nisbet, 2014). Results of this study showed that PRE mediates the relationships between SC and VC on QoL (H8 and H9). These findings can be explained by the framework of grounded cognition (Barsalou, 2008). Visitor exposure to soundscape and visualscape stimuli starts when the sensescape impinges upon the receptor. Then, visitors feel restored when their brain recognizes these sensations and attributes them to the four characteristics of restorative environments.

Afterward, the perceived restorative capacity of the environment improves visitors' evaluation toward quality of life. A significant finding was that visitors do not really tune out various soundscapes in the natural environment. Only when a soundscape and visualscape are perceived (embodied) as restorative (being away, fascination, extent, and compatibility) can it contribute to personal wellbeing. Especially the full mediating role of PRE between SC and QoL indicated that positive QoL outcomes from SC were dependent on PRE. Without selecting, interpreting, and connecting multimodal sensation to restorative perception, the sensations will not contribute to visitors' quality of life.

The result indicated that all direct and indirect relationships among VC, SC, PRE and QoL were consistent in both the Chinese and Australian contexts. As stated earlier, Burleigh Heads and Purple Mountain have different natural and cultural features. Yet, the conceptual model of visitors' attention restoration in nature was supported in these different contexts. This indicates that the ability of humans to adapt to an environment and benefit from nature seems to be a universal human feature rather than culturally or context dominated (Irons, 1998). The stability of the conceptual model also suggested that visiting a natural environment can be regarded as a public wellness product, regardless of cultural or geographical restrictions.

The multi-group analysis (MGA) showed that the path coefficients of SC to PRE, SC to VC, and PRE to QoL varied between the Chinese and
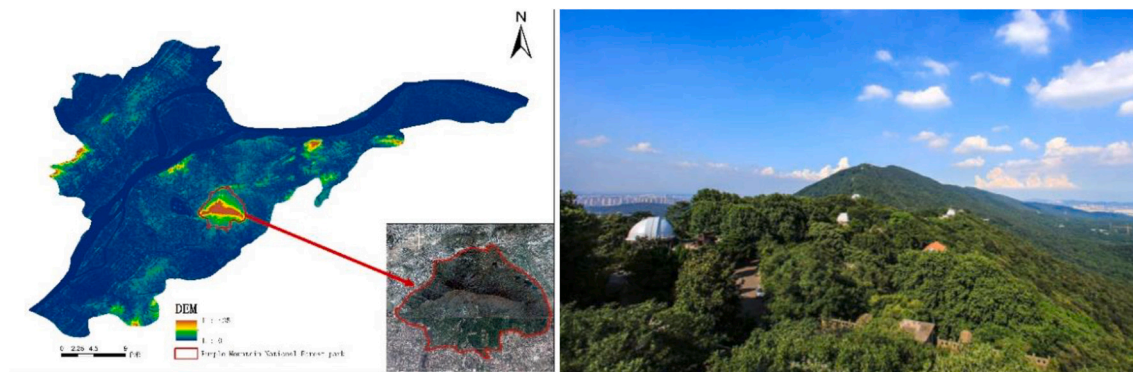

Fig. 2. The purple mountain in Nanjing, China. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
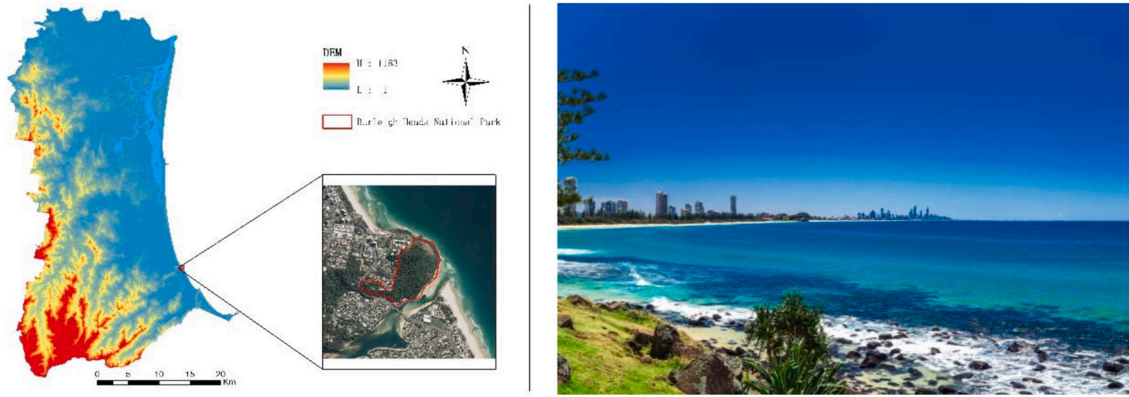
Fig. 3. The Burleigh heads beach in Gold Coast, Australia. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Note: The digital evaluation maps in Figs. 2 and 3 are used for illustrative purposes only.
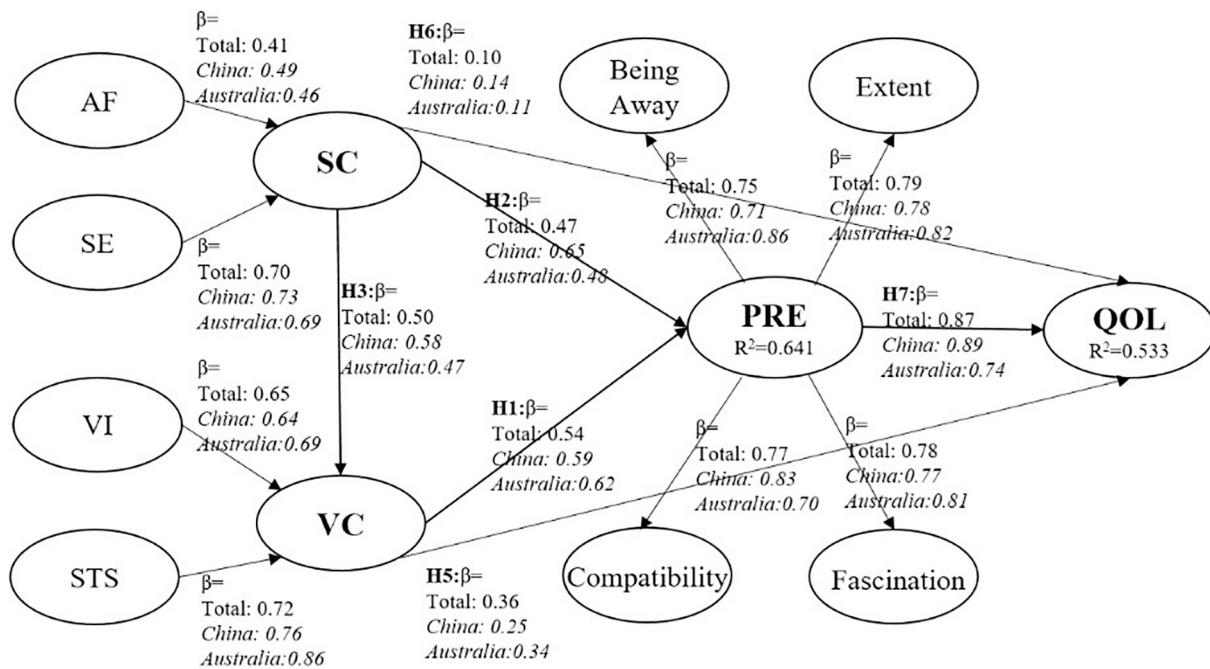

Fig. 4. The results of the structural model.

Australian samples. As shown in Table 5, the restorative effects of the visualscape did not always dominate the soundscape, which may have higher effect sizes in certain situations. Extent studies only refer to un-differentiated "total" visitors to natural environments, and few compare the results of different social cohorts in different parts of the world (Kabisch and Haase, 2014). It remains uncertain whether it is contextual or cultural factors that influence differences in the two samples. More-over, the pre-measured stress level of participants demonstrated that Chinese samples were more stressed than their Australian counterparts before they visited the natural area (Table 4). Therefore, the variations in the path coefficient might relate to participants' stress levels. As the high stressed group was more sensitive to multimodal sensescapes in nature, the pathway from SC to PRE held more significance, and pro-moted greater improvement in QoL. This finding concurred with pre-vious conclusions that the higher the stress, the stronger the restorative effects visitors receive from natural environments (Lehto & Lehto, 2019). Therefore, differences in the path coefficients of both cases confirmed that restoration from multimodal sensescapes in the natural

environment was a form of evolutionary adaptation, and the conceptual model of visitors' attention restoration was stable and reliable (Fig. 1).

5.2. Practical implications

The practical implications of the proposed restorative mechanism through audio-visual interaction should be noted for destination plan-ning and marketing. The results indicate that nature is a public health resource and the traditional vision-centric concept for a national park should be changed to recognise the natural soundscape as an important wellness resource. The indicators of SC which are distinctive with VC could serve as design parameters to optimally foster efficient rejuvena-tion. Park management should focus on protecting, designing, and advertising natural soundscape resources to visitors. For example, parks or attraction management parties could use conventional techniques (e. g., signage and an interpretation center) or start-of-art technology (e.g., augmented reality and virtual reality) to facilitate visitors' absorption of SC (or other sensual modules). These techniques may promote enhanced

soundscape stimuli in the natural environment, thus solving the problem of "hearing but not listening." Moreover, the similarities and differences between the two cases identified in this study offer insights on ways to target different visitors to improve engagement and interaction levels with nature more effectively.

The practical applications of this study become more prominent in the context of the current global health crisis. The widespread fear and anxiety following the COVID-19 outbreak resulted in erratic mental states and mental fatigue. The effects of PRE should be highlighted by DMOs to motivate potential visitors who want to reduce mental stress. Restoration in a natural environment could become an effective antidote to overcome global challenges.

6. Conclusions

This study improved the current understanding of visitors' restorative mechanisms through audio-visual interactions in natural environments. A model was proposed to investigate the relevant relationships among tourists' sensation of soundscape, visualscape, perceived restorative environment, and quality of life. The Purple Mountain in Nanjing, China, and the Burleigh Heads Beach in Gold Coast, Australia, were chosen as locations for a multi-case survey. The soundscape and visualscape characteristics of the case sites were foundational in constructing a perceived restorative environment. This research provides strong support for a multisensorial connection between visitors and nature. Results suggest that marketing strategies should use sensescapes to evoke a perceived restorative environment. Critically, the findings of a case comparison reveal that natural environments have restorative value and this effect is not culturally or contextually bond. Overall, this study provides the first comparative study on how visitors' exposure to natural sensescapes contributes to mental restoration. It illuminates the therapeutic efficiency of nature-based tourism in overcoming negative health outcomes.

Several limitations provide potential avenues for future research. The data collection was limited to pre-COVID-19 samples and therefore may not adequately predict changes in visitors' experience post-COVID-19. Longitudinal studies would assist in investigating the follow-up impacts of the perceived restorative capacity of environments on more domains of visitors' overall QoL. This study focuses on the role of visualscape and soundscape which are the two established primary elements of sensescapes in the natural environment. However, nature is characteristically multisensory, the smellscapes, tastescapes, and hapticscapes can also be salutogenic resources. This contribution of non-visual sensescapes to wellbeing and quality of life should be further explored by examining more sensescape types in future research. The present study should also be expanded to other natural environments (e.g., lakeside destinations, ski resort destinations, and national parks) and other cultural contexts to examine the cross-cultural validity and reliability of visitors' attention restoration model to provide a further understanding of nature-based tourism as a public health resource.

Acknowledgement

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tmp.2021.100855.
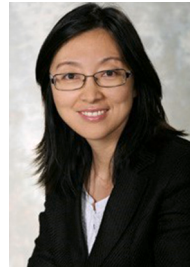
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