Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Research Paper

Social carrying capacity and emotion dynamics in urban national parks during the COVID-19 pandemic

Xiao Xiao\textsuperscript{a,b}, Jie Gao\textsuperscript{c}, Junyu Lu\textsuperscript{a,b}, Peizhe Li\textsuperscript{a,b}, Yuling Zhang\textsuperscript{d,e,}\textsuperscript{*}

\textsuperscript{a} School of Community Resources and Development, Arizona State University, 411 N. Central Avenue, Suite 550, Phoenix, AZ, 85004, USA
\textsuperscript{b} The Hainan University-Arizona State University Joint International Tourism College, Hainan University, 58 Renmin Road, Haikou, Hainan Province, 570004, China
\textsuperscript{c} Department of Hospitality, Tourism and Event Management, San Jose State University, One Washington Square, San Jose, CA 95192, USA
\textsuperscript{d} Department of Tourism, Foshan university, No.18, Jiangwan 1st Road, Foshan City, Guangdong Province, 528225, China
\textsuperscript{e} Guangzhou Institute of Geography, Guangdong Academy of Sciences, 100 Central Xianlie Road, Guangzhou, Guangdong Province, 510070, China

\textbf{Keywords:} Emotion, Crowding, COVID-19, Natural landscape, Prevention strategies, Social carrying capacity

\textbf{A B S T R A C T}

The COVID-19 pandemic has changed the mobility, accessibility, and behaviors of visitors dramatically. Under the impact of COVID-19, the social carrying capacity and emotion dynamics in parks and recreation areas are expected to change due to the uncertainty of health risks associated with visitors’ behaviors. This study conducted an on-site visitor survey at Leiqiong Global Geological Park, a national park located in urban-proximate areas in Haikou, China. This study aims to examine factors impacting visitors’ perceived crowding and emotions under varying levels of visitor use in urban national parks in the context of COVID-19. Study results suggest that visitors have the highest level of motivation for scenery and culture viewing and are generally satisfied with the environmental quality and design and COVID-19 prevention strategies and implementation efforts within the park. Moreover, this study suggests that the level of crowding and COVID-19 prevention strategies and implementation can affect visitors’ emotions in urban national parks significantly. These findings highlight the importance of enforcing the social carrying capacity limits and COVID-19 prevention strategies for urban parks and protected areas to mitigate physical and mental health risks during the COVID-19 pandemic.

\textbf{Management implication:} This study is one of the pilot studies that examines the social carrying capacity and emotion dynamics in urban national parks under the impact of the COVID-19 pandemic. Study results identify the thresholds of social carrying capacity and visitors’ positive emotions based on the indicator of People Per View (PPV). Moreover, COVID-19 prevention strategies (e.g., mask-wearing and social distancing) can reduce visitors’ perceived crowding and enhance positive emotions. These findings suggest that urban national parks should monitor visitor use levels based on the social carrying capacity framework to reduce visitors’ perceived crowding and maintain positive emotions in the post-COVID-19 era.

1. Introduction

The COVID-19 pandemic has dramatically changed individuals’ mobility, accessibility in national parks (Gössling, Scott, & Hall, 2021; Kock, Norfelt, Josiassen, Assaf, & Tsionas, 2020) and significantly influenced human health. The stay-at-home-order reduces the long-distance travel demands to some extent while potentially increases the infectious risks of urban parks and green spaces due to the high visitation demands of residents living in park-proximate areas (Hamidi & Zandiatashbar, 2021; Shoari, Ezatti, Baumgartner, Malacarne, & Fecht, 2020). As one of the long-standing issues in parks and urban green spaces, crowding degrades visitors’ quality of recreation experiences (Manning, Freimund, Lime, & Pitt, 1996; Manning, Lime, Hof, & Freimund, 1995; Manning, Vali, & Hallo, 2010; Manning & Wang, 1998; Xiao, Lu, Manning, & Reigner, 2019) and can induce adverse psychological outcomes (Ditton, Fedler, & Graefe, 1983; Stokols, 1976). The uncertain health risks might lead to changes in the recreation demands and social carrying capacity of urban parks (Bae & Chang, 2020). In China, the COVID-19 pandemic was managed to be restrained since March 2020. Parks and recreation areas started to reopen with using some COVID-19 prevention strategies including social distancing, mask wearing, and temperature check; yet, little is known about how these prevention strategies influence visitors’ perception of crowding in parks and recreation areas (Gössling et al., 2021). Visitors’ perception of...
crowding may associate with different factors (e.g., visitors’ motivations, socio-demographic characteristics, characters of encounters, and situational factors) (Manning, 2011). Accounting for the impacts of the COVID-19 pandemic on the visitors’ perception of crowding can provide visitors with strategies to cope with perceived crowding. More importantly, it delivers critical information to tourism decision-makers and park planners about effective visitor management strategies and conservation practices under the challenges of the COVID-19 pandemic. However, few studies have documented the perception of crowding in parks and recreation areas during the COVID-19 pandemic (Santos-Roldán, Castillo Canalejo, Berbel-Pineda, & Palacios-Florencio, 2020; Shoari et al., 2020).

Recreation experiences involve person-environment interactions and can generate both positive and negative emotions. Emotions refer to short-lived, subjective feelings in the foreground of consciousness, demanding immediate attention and motivating behavior (Frijda, 2007). Emotions vary when unacceptable or unsatisfied visitation experiences happen in parks and recreation areas. When the relationship between the visitors and the environment is taxing or endangering the visitor’s well-being (Lazarus & Folkman, 1984), negative emotions may occur. Crowding, as one of the most critical issues that lead to cognitive inconsistency for environment design and quality (Manning, 2011; Manning, Valliere, Minteer, Wang, & Jacobi, 2000), may provoke emotional imbalance for visitors in parks and recreation areas (Mitas, Yarnal, Adams, & Ram, 2012; Stokols, 1972). Negative emotions can be produced by the goal interference attributed to other ones’ behaviors (Schneider & Hammitt, 1995) in parks and recreation areas. Research has conceptualized emotions as a transactional construct and suggested that negative emotions can be reappraised by employing emotional regulation strategies (Schuster, Hammitt, & Moore, 2006). During the COVID-19 pandemic, visitors’ emotions might be more complicated than the traditional transactional process: a series of concerns about health risks associated with crowding, the implementation of prevention policies, and encounters’ behaviors might affect the visitors’ emotions. However, very few studies have examined the factors impacting visitors’ emotions during the pandemic of COVID-19 and how visitors’ emotions may vary when responding to different levels of visitor use (Santos-Roldán et al., 2020; Venter, Barton, Gundersen, Figari, & Nowell, 2020).

Given the uncertainty of COVID-19 related risks on visitors’ mental and physical health, the importance to gauge the factors contributing to social carrying capacity and emotions in parks and recreation areas, and the need to evaluate the tradeoffs among visitor use demand, perceived crowding, and emotions in urban parks and recreation areas, this study aims to examine factors impacting visitors’ perceived crowding and emotions under varying levels of use in urban national parks in the context of COVID-19. Findings from this study have important theoretical and practical implications for parks and recreation researchers, practitioners, and stakeholders. Theoretically, this study seeks to extend the normative theories by integrating emotions into the social carrying capacity framework. Understanding how visitors’ perceived crowding and emotions are affected by various factors will expand the knowledge about emotional responses towards the changing tourism environment, particularly under the challenges of the COVID-19 pandemic. For park and destination managers, investigating visitors’ acceptability of different levels of use and related emotions would help park and tourism managers and stakeholders develop appropriate thresholds of carrying capacity during the COVID-19 pandemic. In addition, understanding the factors associated with visitors’ emotions could help park managers and practitioners provide better service and minimize negative experience of visitors during the COVID-19 pandemic.

2. Literature review
2.1. Social carrying capacity framework and crowding
Crowding has received extensive attention in the context of parks and recreation areas since the 1960s. By adopting the concept of social carrying capacity, research on crowding has been conducted in different types of parks and recreation areas, including wilderness areas, nature-based parks, urban parks, and etc. (Shelby, Vaske, & Heberlein, 1989). The normative theory suggests that crowding has a psychological meaning, that is, crowding is a negative judgment of density of use in parks and recreation areas (Manning et al., 1996). The normative theory also suggests that crowding in parks and recreation areas is affected by a few factors, including characteristics of visitors, characteristics of encounters, and situation factors (Manning et al., 2000).

Research has found that the social carrying capacity of parks and recreation areas is associated with multiple factors, including visitors’ motivations, experience use history, and socio-demographic factors (Manning, 2011). Visitors’ motivation play an important role in the perception of crowding, that is, visitors with motivations of solitude and getting away from other people are significantly more likely to feel crowded than the visitors who are seeking opportunities to enhance social relationships (Bitton et al., 1983). By adopting the expectancy theory, Wickham and Kerstetter (2000) found that visitors who have motivations to participate in festivals and events were less sensitive to crowding than visitors who were seeking solitary experiences. The impacts of motivations on visitors’ perception of crowding were also manifested in the international scopes of tourism studies. For example, Luque-Gil, Gómez-Moreno, and Peláez-Fernández (2018) examined motivations and crowding perception in a nature-based tourism destination in Spain, and found that visitors who had the motivations of nature-based activities and sports were more likely to perceive crowding than visitors who had the motivations of learning. Besides motivations, visitor’s experience use history (EUH) was also found to influence the perception of crowding. Visitors with higher levels of EUH were more likely to perceive crowding in water-based recreation areas (Budruk et al., 2008) and urban national parks (Eder & Amberger, 2012) than visitors who had lower levels of EUH of these recreation areas.

Social carrying capacity is also influenced by the characteristics of encounters, including the similarity of activities, the behaviors of encounters, and the group size of encounters. Engaging in different types of activities in parks and recreation areas may lead to higher levels of perceived crowding. For example, the paddling canoeists were less tolerant of encountering motorized boats compared to encountering motorized canoes (Lucas, 1964). Also, when encounters’ behaviors did not resonate or align with one’s norms and attitudes, the level of perceived crowding tended to be higher and conflicts were more likely to occur (Lewis, Lime, & Anderson, 1996; Manning, 2011; Manning, Lawson, Newman, Laven, & Valliere, 2002). Moreover, the group size of the encounters can affect the visitors’ perception of crowding. Visitors might be more likely to perceive crowding when encountering large size of visitor groups (Manning & Anderson, 2012).

The third factor that influences the social carrying capacity is the situation factor (Manning et al., 1996). The types of recreation areas, locations within a recreation area (Manning and Anderson, 2012), and environmental quality and design (Li, Xiao, & Seekamp, 2022) are typical variables of situation factors associated with the perception of crowding (Lee & Graefe, 2003). For instance, the sensitivity to visitor use levels can be different between urban-oriented parks and nature-based parks (Amberger & Haider, 2007; Manning & Anderson, 2012). Visitors’ perception of crowding can also vary greatly at different spatial locations within the same park (Manning & Lawson, 2002). Besides, the design of low-density environmental elements can increase visitors’ acceptability of encounters in both indoor (Yıldırım & Akalin-Baskaya, 2007) and outdoor recreation areas (Bonnes, Bonaistu, & Ercolani, 1991).
Although the social carrying capacity framework has been applied to manage the recreation impacts and crowding issues in parks and recreation areas, the application of social carrying capacity framework in tourism destination management is in a relatively nascent stage. Savi- eriades (2000) defines tourism social carrying capacity as the maximum number of tourists that can be present without precluding tourists from enjoying the destination or making the impacts unacceptable by local residents. A recent study uses the social capacity framework to assess the maximum number of tourists that can be accepted in Pehuin Co Beach during the 2020 and 2021 summer seasons under the impacts of the COVID-19 pandemic (Bustos et al., 2021). Findings suggest that the carrying capacity for the coastal tourism destination is different between the high tide and low tide seasons. However, research indicates that tourism social carrying capacity needs to be extended by integrating novel methods (Tkarchuk, Gabriele, & Maurer, 2021), and diverse indicators of social carrying capacity might be considered for tourism destinations (e.g., quality of life, satisfaction, etc.).

2.2. Measurement of social carrying capacity

The studies of social carrying capacity and crowding have been conducted in different types of parks and recreation areas. A single item, 9-point measure scale representing “not crowded at all” to “extremely crowded” has been used to measure visitors’ perception of crowding in early empirical studies (Manning, 2011). Although the findings from these studies informed management of crowding in specific recreation areas, the single 9-point scale has limitations to measure crowding because crowding is a normative concept associated with many factors. A single measurement scale cannot inform the stakeholders at what use level visitors will feel crowded and managers should apply strategies to reduce the use level (Manning et al., 2000). Visitors have normative standards in different types of parks and recreation areas to define the perception of crowding. An indicator and standard of quality framework has been developed and used widely in parks and recreation management field. The indicator and standard of quality framework analyzes the levels of crowding and identifies the minimum acceptable conditions of indicators for visitor use (Lime & Stankey, 1971; Manning, 1999, 2011; Manning, Freimund, et al., 1996; Xiao et al., 2019). When the use level exceeds the standards of quality, the perception of crowding will occur, and management strategies and practices need to be made to maintain the quality of visitors’ experience.

The normative approach of crowding and carrying capacity framework often use visual simulation surveys to collect the perceptions of visitor use (e.g., people per view, people at one time, etc.) simulated by digitizing photographs of recreation areas (Lawson et al., 2011; Manning, 1999, Freimund, et al., 1996). The digitizing photographs used in visual simulation surveys can be generated by monitoring the current use level of visitors and proposing a range of scenarios that higher or lower than the current use level (Pettengill et al., 2012; Xiao et al., 2019). The visual simulation surveys conceptualized by the normative theory have been used to manage crowding in both nature-based and culture-oriented parks in the western context, however, very little is known about the normative approach of crowding in the non-western context (Manning, 2011). This study aims to fill up this gap by examining the perception of crowding by applying the normative theory in a nature-based national park in China and how the perceptions of crowding and would affect visitors’ emotions during the COVID-19 pandemic.

2.3. Emotions

Given that emotions are direct, intense reactions to an event that happens in a person’s environment (Beedie, Terry, & Lane, 2005), researchers have begun studying its role in tourists’ experiences (Gao & Kerstetter, 2018; Lin, Kerstetter, Nawijn, & Mitas, 2014; Nawijn, Mitas, Lin, & Kerstetter, 2013) and found that emotions dramatically influence visitors’ thinking and behaviors, and thus leads to long-term consequences for quality of life (Fredrickson & Losada, 2005; Gao, Kerstetter, Mowen, & Hickerson, 2018). Nawijn and his colleagues (2010, 2012) were some of the first researchers to study emotion change throughout a vacation. Their perspective on emotions in a vacation context was different from previous researchers who treated emotions as static and an entire experience as a simple point in time (Mitas et al., 2012; Nawijn, 2011). For example, Nawijn (2010) proposed a holiday happiness curve based on data indicating that tourists felt relatively worse during the first couple of days of their holiday, best during 70% of the holiday time, and slightly worse and then more positive during the last part of the holiday. Later, in 2013, Nawijn and his colleagues tracked vacationers’ daily emotions during their vacation using a daily diary approach (Nawijn, Mitas, Lin, & Kerstetter, 2013). Their findings indicated that fluctuations in emotions are related to the length of vacation: vacationers on an 8- to 13-day trip experienced significant changes in the balance of their emotions over the course of their trip.

Visitors’ emotions in parks and recreation areas are not static. Both positive and negative emotions can occur under different visitation scenarios. Lin et al. (2014) examined changes in specific positive and negative emotions during a vacation, as well as their interactions with personality. They found that travelers were high in both positivity and arousal, which was exhibited through an inverted U-shape curve. They also found that travelers reported feeling more positive at the front end of their vacation rather than at the end of their vacation. When visitors experience negative emotions or stresses, cognitive reappraisal processes may be activated, and coping strategies may be applied to respond to negative emotions (Jordan & Prayag, 2021; Zhu, Gao, Zhang, & Jin, 2020).

2.4. COVID-19 impacts on visitors’ behaviors

The COVID-19 pandemic has raised concerns for health risks associated with travel (Gössling et al., 2021; Tremblay-Huet, 2020). Recent research has found that visitors exposed to a high flow of tourism are more vulnerable to the risks of COVID-19 (Farzanegan, Gholipour, Feizi, Nunkoo, & Andargoli, 2020). The risk perception of visitors consists of two dimensions: cognitive and affective. The cognitive perception of risks refers to visitors’ perceived susceptibility and severity of risks associated with travel. The affective perception of risks, on the other hand, refers to visitors’ anxiety or worries about their exposure to risks (Sjöberg, 1998). Both cognitive and affective perceptions of risks can influence visitors’ intention to travel during COVID-19 (Bae & Chang, 2020; Wang, Jin, Fan, Ju, & Xiao, 2020). Moreover, preventive behaviors such as social distancing, mask-wearing, and frequent hand-washing have been found to positively influence on South Koren visitors’ intentions to travel (Bae & Chang, 2020). The perception of risks has also changed the behavior intention of parks and recreation areas: visitors are more likely to prefer to visit remote and rural parks than urban-oriented parks during the COVID-19 pandemic (Zhu & Deng, 2020). Although research has begun to document how the COVID-19 would influence the perception of risk and travel intention, few studies have examined how COVID-19 would influence on-site visitors’ behaviors and the effects of prevention strategies on the perception of crowding and emotions in parks and recreation areas (Lu et al., 2021; Sujood, Hamid, & Bano, 2021). This study aims to fill this research gap and provide insights for park managers and landscape planners to mitigate crowding impacts and negative emotions during the COVID-19 pandemic.

3. Methods

3.1. Study site

Leiqiong UNESCO Global Geopark is located at the southern margin of China. The geology is characterized by the Leiqiong Rift Volcanic Belt and holds records of the origin of the Leiqiong Rift and the spreading of
the South China Sea Basin. The Geopark is extremely rich in volcanic landscapes and lava structures, such as different kinds of lava flows and tunnels, which is a natural, open-air exhibition of volcanism. Leiqiong UNESCO Global Geopark consists of two parks, the north rim is located in Zhanjiang City, Guangzhou Province. The south rim is located in Haikou city, Hainan Province. The Haikou Leiqiong UNESCO Global Geopark is one of the most iconic nature-based parks in Haikou and has an average annual visit of 365,000 visitors before the COVID-19 pandemic. During the pandemic period, the Ministry of Culture and Tourism of China has made the prevention policy that the daily visit cannot exceed 30% of the carrying capacity of each park in China before July 14th, 2020. After July 14th, the limit of daily visitor number has been uplifted to 50% of the carrying capacity of each park.

3.2. Data collection

We conducted an onsite visitor survey at Haikou Leiqiong UNESCO Global Geopark from June 15–June 22, 2020. A group of trained survey administrators were stationed at the exit of the park and approached park visitors. Given the social distancing policy that only 30% of the maximum carrying capacity of visitors were allowed to enter the park during the data collection period, the survey used the convenient sampling method to collect questionnaires. To ensure the representativeness of the samples, only one member of a group was invited to complete the questionnaire for their group. In order to minimize the contact between survey administrators and visitors, a poster describing the purpose of the questionnaire for their group. In order to minimize the contact between survey administrators and visitors, a poster describing the purpose of the survey and the QR code of the link of the survey was placed next to the survey station. Visitors can complete the survey through mobile devices. To help ensure the representativeness of surveys, the sampling process included both weekdays and weekends. A total of 550 questionnaires were distributed, and 461 completed samples were collected, yielding a response rate of 83.6%. After eliminating the invalid samples (e.g. invalid age, same answers for multiple batteries of questions, etc.), 443 valid responses were retained for final analysis.

Five batteries of questions were asked in the questions. The first battery of questions was about visitors’ motivations to visit the Haikou Leiqiong UNESCO Global Geopark. Seventeen motivations were listed in the questionnaire and the study used the 5-point Likert scale, where “1” represents strongly disagree and “5” represents strongly agree.

The second battery of questions asked the visitors to report their experiences with encounters within the park. The questions were primarily about the behaviors of encounters in the park and the measurement items were adopted from Neuts and Nijkamp (2012). In addition, we added a few questions about the encounters’ prevention behaviors, including mask wearing and 1-m social distancing to consider the impacts of COVID-19 on visitors’ perception of other encounters in the study location.

The third battery of questions measured the situation factors. The situation factors measured in this study include the authenticity of the landscape, and the design of the environment. Moreover, we added measurement items related to COVID-19 prevention strategy implementation within the park, including the sanitary condition, the information about COVID-19 prevention (social distancing), mask-wearing requirement, and body temperature check.

The fourth battery of questions measured visitors’ perception of crowding and emotions. Visitors were shown a series of visual simulations depicting a range of visitor use scenarios in the study location (0-visitor, 6-visitor, 12-visitor, 18-visitor, 24-visitor, 30-visitor, and 36-visitor), and they were asked to rate the acceptability of each condition using a scale that ranged from −4 (“very unacceptable”) to +4 (“very acceptable”) (Fig. 1). The visitors were also asked to rate three groups of emotions for each photo: (joy to anger, relaxation to tension, and excitement to depression) where −4 represented extremely negative emotions, and +4 represented extremely positive emotions. To compare the perception of crowding and emotions between visitor use scenarios with and without COVID-19 prevention strategies, the survey also asked respondents to rate their acceptability and emotions for the same scenarios (0-visitor, 6-visitor, 12-visitor, 18-visitor, 24-visitor, 30-visitor, and 36-visitor) where all visitors wear masks. The digitalization images that visually simulate visitor use scenarios have been widely used in managing social carrying capacity in parks and recreation areas (Hallo & Manning, 2010; Pettengill, Manning, Anderson, Valliere, & Reigner, 2012), and we adopted this approach to simulate the mask-wearing and non-mask-wearing scenarios. We used the same images representing varying people per views (PPVs) and manually added the masks to the

Fig. 1. Visual Simulation Survey of People Per View (PPV) in the Study Site without/with COVID-19 Prevention Strategy (wearing masks).
images to ensure mask-wearing was the only changing variable between mask-wearing and non-mask-wearing scenarios. The respondents were also reminded by the question statements that all visitors presented in the images were wearing masks in the mask-wearing scenarios.

The last group of questions were about respondents’ socio-demographic characteristics, including gender, age, group size, and education background.

4. Results

4.1. Socio-demographic characteristics of respondents

Respondents were almost evenly split between male (51%) and females respondents (49%). The majority of respondents were middle-aged, that more than 50% of respondents were between 24 and 45 years old. About 46% of respondents reported obtaining a bachelor’s degree or higher. More than one-third of the respondents were visiting the park with a child. More than half of the respondents have visited the Haikou Leiqiong UNESCO Global Geopark before.

4.2. Factor analysis for visitors’ motivations, encounters’ characters, and situation variables

A series of exploratory factor analyses (EFA) was performed to identify the dimensions of visitors’ motivations, encounters’ characters, and situation variables. The Varimax Rotation approach was used for the EFA process and a factor loading of 0.40 was set as the benchmark to include items in a factor. The KMO and Bartlett’s Test of Sphericity was performed to the reliability of EFA. The EFA extracted three main factors for visitors’ motivations (Table 1): scenery & culture, activity & enjoyment, and social relationship & safety. The three extracted factors explained 65.6% of the variances of items. The means for environment quality and design for the Leiqiong Geological Park as well as the COVID-19 prevention strategies implementation (Table 3). The factor loadings ranged from 0.629 to 0.825, and the two primary factors explained 84.7% of the variances of items. The means for environment quality & design and COVID-19 prevention strategies & implementation were 4.055 and 3.930, respectively. In general, most visitors rated positive perception of the environment quality and design for the Leiqiong Geological Park as well as the COVID-19 prevention strategies and implementation.

4.3. Visitor perception of crowding and emotions

The indicator for crowding and emotions used in this study is PPV in the Leiqiong Volcano Geological Park. The norms of visitors’ acceptability and emotions for a range of PPVs are shown in Fig. 2a. In general,

Table 1

| Factors                          | Factor loading | Explained variance | Composite mean |
|----------------------------------|----------------|--------------------|----------------|
| Scenery & Culture                |                |                    |                |
| Outstanding scenery              | 0.811          | 33.8%              | 4.233          |
| Mountainous area                 | 0.806          |                    |                |
| Different culture                | 0.774          |                    |                |
| Visiting a new place             | 0.771          |                    |                |
| Activity & Enjoyment             |                |                    |                |
| Opportunities for physical activities | 0.827     | 18.1%              | 4.008          |
| Variety of recreation activities | 0.794          |                    |                |
| Fun and enjoyment                | 0.716          |                    |                |
| Social Relationship & Safety     |                |                    |                |
| Visiting a place with friends    | 0.725          | 13.8%              | 4.137          |
| Feeling safe and secure          | 0.475          |                    |                |
| Having a restful and relaxing trip | 0.574      |                    |                |
| Snack at home too long during the pandemic | 0.824 | | 65.6% |

Table 2

| Factors                          | Factor loading | Explained variance | Composite mean |
|----------------------------------|----------------|--------------------|----------------|
| Encounters’ depreciative behaviors |                |                    |                |
| Other visitors are smoking within the park | 0.844  |                    |                |
| Other visitors are noisy and disturbing the tranquility | 0.825 | | |
| Other visitors are standing in the way when taking pictures | 0.804 | | |
| Other visitors bump into you     | 0.795          |                    |                |
| Other visitors throw litter on the trails | 0.793 | | |
| Other visitors did not follow the 1-m social distance guidance | 0.785 | | |
| Other visitors did not wear masks | 0.755          |                    |                |
| Other visitors have cultural conflicts with me | 0.734 | | |
| Other visitor groups have more than 5 people with a group | 0.722 | | |

for the items (KMO = 0.916). Overall, visitors’ perceptions of encounters’ depreciative behaviors were relatively low (M = 2.626), indicating that most visitors did not perceive other encounters’ behaviors having conflicts or potential risks with their own behaviors.

For the situation factors, the EFA extracted two primary factors: environment quality & design and COVID-19 prevention strategies & implementation (Table 3). The factor loadings ranged from 0.629 to 0.896 (KMO = 0.876), and the two primary factors explained 84.7% of the variances of items. The means for environment quality & design and COVID-19 prevention strategies & implementation were 4.055 and 3.930, respectively. In general, most visitors rated positive perception of the environment quality and design for the Leiqiong Geological Park as well as the COVID-19 prevention strategies and implementation.

Table 3

| Factors                          | Factor loading | Explained variance | Composite mean |
|----------------------------------|----------------|--------------------|----------------|
| Environment Quality & Design     |                |                    |                |
| The landscape of Leiqiong Geological Park is authentic | 0.896 | | 43.7% 4.055 |
| The landscape of Leiqiong Geological Park coordinates with the surrounding environment | 0.877 | | |
| COVID-19 Prevention Strategies & Implementation | | | |
| The sanitary condition of Leiqiong Geological Park is meeting the government requirement for COVID-19 response guide | 0.629 | | 41.1% 3.930 |
| The information and direction signs of Leiqiong Geological Park have illustrated the risks of COVID-19 and prevention approaches | 0.710 | | |
| The Leiqiong Geological Park has required every visitor to wear masks | 0.888 | | |
| The Leiqiong Geological Park has done a good job for COVID-19 inspection (e.g. testing body temperature, inspecting personal health code) | 0.856 | | |
visitors’ acceptability of PPVs and positive emotions decline with the increasing number of PPVs. When the number of encounters is greater than 24, visitors cannot accept the scenario and the emotions transit from positive to negative. When there is no encounter, visitors reported very high acceptability of visitor use and high levels of positive emotions, including joy, relaxation, and excitement. The norms of acceptability for PPV and emotions also show that when PPV is 18, visitors can accept the PPV (do not feel crowded), however, the emotions change to negative.

In order to identify the impact of COVID-19 prevention strategies and policies, the study asked the visitors to report their acceptability and emotions for the same PPVs when all encounters wear masks. The norms of visitors’ acceptability and emotion are shown in Fig. 2b. Under the scenarios that all visitors are wearing masks, visitors report a higher tolerance level of PPVs, that visitor use is unacceptable when the PPV is higher than 35. Similarly, visitors’ emotions are more positive when other encounters are wearing masks. For instance, all three emotion variables are positive for PPVs of 18 and 24 when encounters wear masks comparing to neutral and negative when encounters do not wear masks.

4.4. Measurement model for crowding and emotions

To analyze the multivariate relationship between perceived crowding, emotions and their associated factors, a structural equation model (SEM) was tested. Before conducting the SEM test, a confirmatory factor analysis (CFA) of the hypothesized model for crowding and emotions has been tested. Research indicated that a CFA test should be performed before the structural equation model to test the validity of each construct.

The CFA test excluded the items with a coefficient alpha below 0.40 (Table 4). The motivation of activity & fun and the situation factor of

Fig. 2. Perceived crowding and emotions for different PPVs without/with COVID-19 prevention action.
environmental quality & design were removed from the model due to the low loading factors. Moreover, research has indicated that three to four exogenous variables for each construct of the latent variable can improve the validity and reliability of the SEM model, therefore, four of the items with the highest loadings for the factor of encounters’ characters were included in the hypothesized model. In sum, 22 indicators were identified after the CFA test, including 4 indicators for the motivation of scenery & culture, and 4 indicators for the motivation of social relationship & safety, 4 indicators for encounters’ characters, 4 indicators for COVID-19 prevention strategies & implementation, 3 indicators for the acceptability of visitor use, and 3 indicators for emotions. All three types of goodness of fit indices indicated that the overall measurement model was acceptable in the proposed model among the collected data with a sample size of 443 (Chi-square (36) = 2.84, p < 0.001, goodness-of-fit index (GFI) = 0.95, root mean square residual (RMSR) = 0.058).

4.5. Structural equation model for perceived crowding and emotion

After the CFA test, an initial hypothesized model was examined by the structural equation model (SEM). The Comparative Fit Index (CFI), RMSEA, Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) were used to verify the overall goodness-of-fit of the model (Table 5). The RMSEA of the initial model was higher than 0.05, therefore, a model medication process was performed. By examining the modification indices, a direct path from COVID-19 prevention strategies & implementation was identified and added to the model to test whether or not the revised model fits the observed data.

Table 4
Confirmatory factor analysis for variables in the hypothesis model.

| Constructs & Indicators | Standardized Loading | Z-value | p-value |
|-------------------------|----------------------|--------|--------|
| Scenery & Culture       |                      |        |        |
| SCI                     | 0.558                | 11.276 | <0.001 |
| SC2                     | 0.607                | 11.297 | <0.001 |
| SC3                     | 0.562                | 12.346 | <0.001 |
| SC4                     | 0.569                | 12.413 | <0.001 |
| Social Relationship & Safety |                  |        |        |
| SRS1                    | 0.544                | 12.977 | <0.001 |
| SRS2                    | 0.554                | 13.271 | <0.001 |
| SRS3                    | 0.485                | 13.425 | <0.001 |
| SRS4                    | 0.545                | 12.936 | <0.001 |
| Encounters’ Depreciative Behaviors | |        |        |
| EBD1                    | 0.917                | 11.078 | <0.001 |
| EBD2                    | 0.924                | 10.384 | <0.001 |
| EBD3                    | 0.860                | 9.110  | <0.001 |
| EBD4                    | 0.809                | 11.638 | <0.001 |
| The COVID-19 Prevention Strategies & Implementation | |        |        |
| CPSI1                   | 0.741                | 10.611 | <0.001 |
| CPSI2                   | 0.720                | 9.785  | <0.001 |
| CPSI3                   | 0.758                | 12.215 | <0.001 |
| CPSI4                   | 0.731                | 11.747 | <0.001 |
| Acceptability of Visitor Use |                  |        |        |
| AVU1                    | 0.961                | 8.213  | <0.001 |
| AVU2                    | 0.896                | 12.172 | <0.001 |
| AVU3                    | 0.929                | 11.002 | <0.001 |
| Positive Emotion        |                      |        |        |
| PE1                     | 0.964                | 9.411  | <0.001 |
| PE2                     | 0.955                | 10.416 | <0.001 |
| PE3                     | 0.957                | 10.209 | <0.001 |

In the revised model, the results of the goodness of fit indices exhibited a similar pattern to those of the initial theoretical model, as well as indicated better fits for all measures (CFI = 0.980, RMSR = 0.042, TLI = 0.976, SRMR = 0.040). The coefficients of the SEM (Fig. 3) suggest that the motivation for scenery and culture has a negatively significant impact on the acceptability of visitor use, whereas the motivation of social relationship and safety has a positive impact on the acceptability of visitor use. Moreover, encounters’ depreciate behavior has a significant impact on the acceptability of visitor use. As for visitors’ emotions, the acceptability of visitor use has a direct impact on visitors’ emotions. Notably, the COVID-19 prevention strategies and implementation has a significant impact on visitors’ positive emotions.

5. Discussion and limitations

5.1. Discussion

This study examines visitors’ perceptions of crowding and emotion dynamics to various visitor use scenarios during the COVID-19 pandemic. It identifies factors affecting the perceived crowding and emotions in an urban national park. Study results provide insights for visitor use management under the impact of the COVID-19 pandemic and identify effective strategies to enhance visitors’ positive emotions in urban parks.

Our result indicate that the three dimensions of motivations for visiting Leiqiong Geological Park is 1) scenery and culture, 2) activity and enjoyment, and 3) social relationship and safety. Notably, the long stay-at-home order was rated as an important motivation to visit parks. This finding echoes the findings from the COVID-19 related research that visiting local parks is a demanding coping strategy to mitigate the mental and psychological challenges during the COVID-19 stay-at-home order (Hamidi & Zandiatashbar, 2021). However, the high levels recreation visit demands increase visitors’ exposure to the COVID-19. These results highlight the challenges for parks and recreation areas to balance visitors’ access and the risks of the COVID-19 transmissions (Shoari et al., 2020). Also, visitors rate a very positive perception of the situation variables for the Leiqiong Geological Park, including environmental quality and design and the COVID-19 prevention strategies and implementations. These results suggest that most visitors were supportive of the current COVID-19 prevention strategies and implementation efforts of the park.

Our study is one of the earlier studies that define and quantify the indicators and standards of crowding and emotions in an urban park in the context of COVID-19. Informed by the normative theory and social carrying capacity framework, the threshold of perceived crowding was identified as 24-PPV. An increasing number of encounters would decrease visitors’ acceptability of use level and the positive emotions (e. g., joy, relaxation, and excitement). Rather than preferring a low density of encounters in parks (Manning, 2011; Pettengill, et al., 2012; Xiao et al., 2019), visitors in this study prefer no encounter during the COVID-19 pandemic. The scenario of 0-PPV was identified as a preferable condition of visitor use during the COVID-19 pandemic. The COVID-19-related risks are still threatening the health of visitors and might be the driving factor that impairs the quality of visitors’ experiences in nature-based parks. Moreover, the social norms of visitor use scenarios suggest that visitors had a higher tolerance level for crowding when other encounters are wearing masks. The threshold of perceived crowding was lifted as 32 PPV when all encounters wear masks, which suggests that visitors had a higher tolerance level for crowding when other encounters are wearing masks. These results suggest that the social carrying capacity norm can serve as an important management tool for parks and nature-based parks to make management strategies of visitor use (e.g., the maximum number of visitor/day) to maintain high quality of visitors’ experiences and positive emotions.
during the COVID-19 pandemic.

Study results also found that perceived crowding was significantly associated with the motivations of scenery and culture, social relationship and safety, and encounters’ deprecative behaviors. The SEM results indicate that visitors who have higher motivations of scenery and culture viewing have significantly lower tolerance levels for the number of encounters. In contrast, visitors who have higher social relationships and safety motivations have significantly higher tolerance levels for the number of encounters. These results echo the normative theories of crowding that motivations are essential for perceived crowding, but the effects vary among different motivations. Moreover, visitors’ deprecative behaviors (e.g., littering, smoking, do not wear masks, and do not keep the 1-m social distance) are significant predictors of perceived crowding in the context of COVID-19. Combining with the fact that visitors are favorable with the scenario with no encounters, providing the information about appropriate behaviors and prevention strategies in parks and recreation areas is essential to mitigate visitors’ perception of crowding during the COVID-19 pandemic.

Finally, study results confirm that perceived crowding and COVID-19 prevention strategies and implementation efforts can affect visitors’ emotions significantly. When visitors’ acceptability for PPVs decreases, visitors’ emotions tend to be more negative. The high level of visitor use exceeding the standards of quality might cause unpleasant appraisals from visitors, and negative emotions (e.g., anger, tension, and depression) arise. More importantly, visitors are more vulnerable to contagious diseases through social interactions during the COVID-19 pandemic; the perception of crowding can be a predominant factor for emotions in parks and recreation areas. The SEM results also suggest that COVID-19 prevention strategies and implementation efforts significantly impact visitors’ emotions. The multi-layer COVID-19 prevention strategies (e.g., good sanitary condition, mask-wearing policy, and social distancing) and implementation efforts (e.g., well-illustration of information and direction signs of COVID-19 risks, COVID-19 inspection, enforcement of mask-wearing and social distancing for all visitors) will enhance visitors’ positive emotions. These results highlight the importance of carrying capacity management and COVID-19 prevention strategies and implementation on visitors’ emotions and provide insights for managers and decision-makers to balance the demands of visitation and the risks of visitors’ physical and mental health in the post-COVID-19 pandemic era.

Findings from this study have theoretical implications for tourism and recreation researchers as well as practical implications for tourism destinations. Theoretically, this study integrates multiple emotion variables into the social carrying capacity framework under the guidance of normative theory, which provides the theoretical basis for including diverse indicators to tourism social carrying capacity rather than the single-indicator (maximum number of tourists that can be acceptable by the destinations). This approach extends the normative theory to measure visitors’ emotions, which is particularly important under the impacts of the COVID-19 pandemic because the health uncertainty needed to be heavily weighted when defining the social carrying capacity of tourism destinations. For park and tourism destination managers, our study findings provide implications to implement effective preventive strategies to reduce the impacts of perceived crowding and negative emotions. These effective strategies (masking-wearing and the thresholds of crowding and negative emotions) can aid tourism destinations to enhance the quality of visitors’ experiences under the challenges of the public health crisis event. More importantly, the SEM results quantify the effects of factors impacting visitors’ perceived crowding and emotions, which help park and tourism destination managers elicit the appropriate strategies to reduce perceived crowding and negative psychological outcomes for targeted visitor groups in the context of COVID-19.
5.2. Limitations

This study examines visitors’ perceptions of crowding and emotions among different levels of visitor use scenarios and identifies factors affecting visitors’ perceptions of crowding and emotions during the COVID-19 pandemic. However, this study has a few limitations and can be examined in future studies. First, the respondents of this study were primary Chinese visitors to Leiqiong Geological Park, and the perception of crowding and emotions of visitors in other countries were not able to be included in this study. Future studies can extend this research to a cross-culture context to compare the perception of crowding and emotions of visitors from different countries during the COVID-19 pandemic. From the geographical perspective, future studies may extend this research to compare the differences in perceived crowding and emotions between local and non-local visitors. Finally, it is important to note that the data of this study were collected during the COVID-19 pandemic period, which might not fully represent visitors’ perceived crowding and emotions under the normal visitation conditions without COVID-19 associated health risks.

6. Conclusion

This study examines social carrying capacity and emotion dynamics, as well as factors associated with social carrying capacity and emotions in an urban national park during the COVID-19 pandemic. Results suggest that visitors had the highest level of motivation for scenery and culture viewing and were generally satisfied with the environmental quality and design as well as COVID-19 prevention strategies and implementation efforts within the park. Study results identify the thresholds of perceived crowding and positive emotions based on the indicator of PPV under the scenarios with and without COVID-19 prevention strategies and suggest that mask-wearing can reduce visitors’ perception of crowding and enhance visitors’ positive emotions. These findings indicate that urban parks and recreation areas should monitor visitor use levels based on the social carrying capacity framework to reduce crowding and maintain positive emotions in the post-COVID-19 era. Moreover, this study suggests that the level of crowding and COVID-19 prevention strategies and implementation can affect visitors’ emotions in urban national parks significantly. Findings of this study extend the normative theory by integrating multiple emotion variables to the social carrying capacity framework, and highlight the importance of COVID-19 prevention strategies implementation in parks and recreation areas to provide desirable experiences and mitigate physical and mental health risks of targeted visitor groups.

CRediT authorship contribution statement

Xiao Xiao: Conceptualization, investigation, methodology, data analysis, writing – original draft. Jie Gao: Investigation, writing – review & editing, validation. Junyu Lu: Software, visualization, methodology. Peizhe Li: Data collection, writing – review & editing. Yuling Zhang: Funding acquisition, project administration.

Acknowledgment

This study is supported by Hainan Provincial Natural Science Foundation of China (Grant ID: 420QN218) and National Natural Science Foundation of China (Grant IDs: 42171242 & 41801144).

References

Amberger, A., & Haider, W. (2007). A comparison of global and actual measures of perceived crowding of urban forest visitors. Journal of Leisure Research, 39(4), 668-685.

Bae, S. Y., & Chang, P. J. (2020). The effect of coronavirus disease-19 (COVID-19) risk perception on behavioural intention towards ‘insect’ tourism in South Korea during the first wave of the pandemic (March 2020). Current Issues in Tourism, 1–19.

Beedie, C., Terry, P., & Lane, A. (2005). Distinctions between emotion and mood. Cognition & Emotion, 19(6), 847-878.

Bonifazi, M., Bonaiuto, M., & Ercolani, A. P. (1991). Crowding and residential satisfaction in the urban environment: A contextual approach. Environment and Behavior, 23(5), 531-552.

Bodurk, M., Wilhem Statin, S. A., Schneider, I. E., & Heisey, J. J. (2008). Crowding and experience use history: A study of the moderating effect of place attachment among water-based recreationalists. Environmental Management, 41(4), 528-537.

Busto, M. L., Zilio, M. I., Ferrelli, F., Piccolo, M. C., Perillo, G. M. E., Van Waarde, G., et al. (2021). Tourism in the COVID-19 context in medesital beaches: Carrying capacity for the 2020/2021 summer season in Pebatu Co, Argentina. Ocean & Coastal Management, 206.

Dittos, R. B., Fedeler, A. J., & Graefe, A. R. (1983). Factors contributing to perceptions of recreational crowding. Leisure Sciences, 5(4), 279-288.

Eder, R., & Amberger, A. (2012). The influence of place attachment and experience use history on perceived depreciable visitor behavior and crowding in an urban National Park. Environmental Management, 50(4), 566-580.

Fang, M., Tepanos, Y., & Uysal, M. (2008). Measuring tourist satisfaction by attribute and motivation: The case of a nature-based resort. Journal of Vacation Marketing, 14(1), 41-56.

Farzanehgan, M. R., Gholiipour, H. F., Feizi, M., Nunkoo, R., & Andargoli, A. E. (2020). International tourism and outbreak of coronavirus (COVID-19): A cross-country analysis. Journal of Travel Research, Article 00472877520931593.

Fredrickson, B. L., & Losada, M. F. (2005). Positive affect and the complex dynamics of human flourishing. American Psychologist, 60(7), 678-686.

Frijda, N. (2007). What might emotions be? Comments on the Comments. Social Science Information, 46(3), 433-443.

Gao, J., & Kerstetter, D. L. (2018). From sad to happy to happier: Emotion regulation strategies used during a vacation. Annals of Tourism Research, 69, 1–14.

Gao, J., Kerstetter, D. L., Mowen, A. J., & Hickerson, B. (2018). Changes in tourists’ perception of well-being based on their use of emotion regulation strategies during vacation. Journal of Travel & Tourism Marketing, 35(5), 567-582.

Gosling, S., Scott, D., & Hall, C. M. (2021). Pandemics, tourism and global change: A social assessment of COVID-19. Journal of Sustainable Tourism, 29(1), 1–20.

Hall, J. C., & Manning, R. E. (2010). Analysis of the social carrying capacity of a national park scenic road. International Journal of Sustainable Transportation, 4(2), 1-14.

Hamidi, S., & Zandianashbar, A. (2021). Compact development and adherence to stay-at-home order during the COVID-19 pandemic: A longitudinal investigation in the United States. Landscape and Urban Planning, 205, Article 103952.

Jordan, E. J., & Prayag, G. (2021). Residents’ cognitive appraisals, emotions, and coping strategies at local dark tourism sites. Journal of Travel Research, Article 00472877521004761.

Koch, F., Neefelt, A., Josiassen, A., Assal, A. G., & Tisonas, M. G. (2020). Understanding the COVID-19 tourist psyche: The evolutionary tourism paradigm. Annals of Tourism Research, 85, Article 103053.

Lawson, S., Chamberlin, R., Choi, J., Swanson, B., Kiser, B., Newman, P., & Gamble, L. (2011). Modeling the effects of shuttle service on transportation system performance and quality of visitor experience in Rocky Mountain National Park. Transportation Research Record, (2244), 97–106.

Lazarus, R., & Folkman, S. (1984). Stress, Appraisal, and Coping. New York, NY: Springer Publishing Company, Inc.

Lee, H., & Graefe, A. R. (2003). Crowding at an arts festival: Extending crowding models to the frontcountry. Tourism Management, 24(1), 1–11.

Lewis, M. S., Lime, D. W., & Anderson, D. H. (1996). Paddle canoeists’ encounter norms in Minnesota’s boundary waters canoe area wilderness. Leisure Sciences, 18(2), 145–160.

Li, P., Xiao, X., & Seekamp, E. (2022). Climate adaptation planning for cultural heritages in coastal tourism destinations: A multi-objective optimization approach. Tourism Management, 88, 104380. https://doi.org/10.1016/j.tourman.2021.104380

Lime, D. W., & Stanley, G. H. (1971). Carrying capacity: Maintaining outdoor recreation quality. Paper presented at the Recreation Symposium Proceedings.

Lin, Y., Kerstetter, D., Nawijn, J., & Mitas, O. (2014). Changes in emotions and their interactions with personality in a vacation context. Tourism Management, 40, 416–424.

Lucas, R. C. (1964). Wilderness perception and use: The example of the boundary waters canoe area wilderness. Natural Resources Journal, 3(3), 394–411.

Luo, C. G., & Pelaez-Fernandez, M. A. (2018). Starting to enjoy nature in Mediterranean mountains: Crowding perception and satisfaction. Tourism Management Perspectives, 25, 93–103.

Lu, J., Xiao, X., Xu, Z., Wang, C., Zhang, M., & Zhou, Y. (2021). The potential of virtual tourism in the recovery of tourism industry during the COVID-19 pandemic. Current Issues in Tourism, 1–17.

Manning, R. (1999). Crowding and carrying capacity in outdoor recreation: From normative standards to standards of quality. In Leisure studies: Prospects for the twenty-first century. State College, PA: Venture Publishing.

Manning, R. (2011). Studies in outdoor recreation. Oregon State University Press Corvallis, OR.

Manning, R., & Anderson, L. E. (2012). Managing outdoor recreation: Case studies in the national parks. Cambridge, MA: CAB International.

Manning, R., Freimund, W. A., Lime, D. W., & Pitt, D. G. (1996). Crowding norms at frontcountry sites: A visual approach to setting standards of quality. Leisure Sciences, 18(1), 39–59.

Manning, R., & Lawson, S. R. (2002). Carrying capacity as “informed judgment”: The values of science and the science of values. Environmental Management, 30(2), 157–168.
Manning, R., Lawson, S., Newman, P., Laven, D., & Valliere, W. (2002). Methodological issues in measuring crowding-related norms in outdoor recreation. Leisure Sciences, 24(3–4), 339–346.

Manning, R., Lime, D., Freimund, W., & Pitt, D. (1996). Crowding norms at frontcountry sites: A visual approach to setting standards of quality. Leisure Sciences, 18(39–59).

Manning, R., Lime, D., Hof, M., & Freimund, W. (1995). The visitor experience and resource protection (VERP) process: The application of carrying capacity to arches national park. Paper presented at the The George Wright Forum.

Manning, R., Valliere, W., & Hallo, J. (2010). Recreational carrying capacity of lake umbagog national wildlife refuge. Journal of Fish and Wildlife Management, 1(2), 175–182.

Manning, R., Valliere, W., Minteer, B., Wang, B., & Jacobi, C. (2000). Crowding in parks and outdoor recreation: A theoretical, empirical, and managerial analysis. Journal of Park and Recreation Administration, 18(4), 57–72.

Manning, R., & Wang, B. (1998). Social science in the national park system: An assessment of visitor information. Park Science, 18(1), 16–17.

Mitas, O., Yarmal, C., Adams, R., & Ram, N. (2012). Taking a “peak” at leisure travelers’ positive emotions. Leisure Sciences, 34(2), 115–135.

Navijn, J. (2010). The holiday happiness curve: A preliminary investigation into mood during a holiday abroad. International Journal of Tourism Research, 12(3), 281–290.

Navijn, J. (2011). Determinants of daily happiness on vacation. Journal of Travel Research, 50(5), 559–566.

Navijn, J., Mitas, O., Lin, Y., & Kerstetter, D. (2013). How do we feel on vacation? A closer look at how emotions change over the course of a trip. Journal of Travel Research, 52(2), 265–274.

Neuts, B., & Nijkamp, P. (2012). Tourist crowding perception and acceptability in cities: An applied modelling study on bruges. Annals of Tourism Research, 39(4), 2133–2153.

Pettengill, P., Lee, B., & Manning, R. (2012). Traveler perspectives of greenway quality in northern new england. Transportation Research Record: Journal of the Transportation Research Board, 2314(1), 31–40.

Pettengill, P., Manning, R., Anderson, L. E., Valliere, W., & Reigner, N. (2012). Measuring and managing the quality of transportation at acadia national park. Journal of Park and Recreation Administration, 30(1), 68–84.

Santos-Roldán, L., Castillo Canalejo, A. M., Berbel-Pineda, J. M., & Palacios-Floresco, B. (2020). Sustainable tourism as a source of healthy tourism. International Journal of Environmental Research and Public Health, 17(15), 5353.

Saverisades, A. (2000). Establishing the social tourism carrying capacity for the tourist resorts of the east coast of the Republic of Cyprus. Tourism Management, 21(2), 147–156.

Schuster, R., Hammitt, W. E., & Moore, D. (2006). Stress appraisal and coping response to hassles experienced in outdoor recreation settings. Leisure Sciences, 28(2), 97–113.

Shelby, B., Vanke, J., & Heberlein, T. (1989). Comparative analysis of crowding in multiple locations: Results from fifteen years of research. Leisure Sciences, 11(4), 269–291.

Shoari, N., Ezzati, M., Baumgartner, J., Malacarne, D., & Fecht, D. (2020). Accessibility and allocation of public parks and gardens in england and wales: A COVID-19 social distancing perspective. PLoS One, 15(10), Article e0241102.

Sjoberg, L. (1998). Worry and risk perception. Risk Analysis, 18(1), 85–93.

Stokols, D. (1972). A social-psychological model of human crowding phenomena. Journal of the American Institute of Planners, 38(2), 72–82.

Stokols, D. (1976). The experience of crowding in primary and secondary environments. Environment and Behavior, 8(1), 49–86.

Sujood, Hamid, S., & Bano, N. (2021). Behavioral intention of traveling in the period of COVID-19: An application of the theory of planned behavior (TPB) and perceived risk. International Journal of Tourism Cities, ahead-of-print(ahead-of-print).

Tokarchuk, O., Gabriele, R., & Mauer, O. (2021). Estimating tourism social carrying capacity. Annals of Tourism Research, 86, Article 102971.

Tremblay-Huet, S. (2020). COVID-19 leads to a new context for the “right to tourism”: A reset of tourists’ perspectives on space appropriation is needed. Tourism Geographies, 22(3), 720–723.

Venter, Z. S., Barton, D. N., Gundersen, V., Figari, H., & Nowell, M. (2020). Urban nature in a time of crisis: Recreational use of green space increases during the COVID-19 outbreak in oslo, Norway. Environmental Research Letters, 15(10), Article 104075.

Wang, M., Jin, Z., Fan, S., Ju, X., & Xiao, X. (2020). Chinese residents’ preferences and consuming intentions for hotels after COVID-19 pandemic: A theory of planned behaviour approach. Annals, 32(1), 132–135.

Wickham, T. D., & Kerstetter, D. L. (2000). The relationship between place attachment and crowding in an event setting. Event Management, 6(3), 167–174.

Xiao, X., Lu, J., Manning, R., & Reigner, N. (2019). Defining and monitoring the quality of shared-use transportation facilities in parks and recreation areas. International Journal of Sustainable Transportation, 13(9), 692–702.

Yildirim, K., & Akin-Akonsaleya, A. (2007). Perceived crowding in a cafe/restaurant with different seating densities. Building and Environment, 42(9), 3410–3417.

Zhu, H., & Deng, F. (2020). How to influence rural tourism intention by risk knowledge during COVID-19 containment in China: Mediating role of risk perception and attitude. International Journal of Environmental Research and Public Health, 17(10), 3514.

Zhu, M., Gao, J., Zhang, L., & Jin, S. (2020). Exploring tourists’ stress and coping strategies in leisure travel. Tourism Management, 81, Article 104167.