Tourists' visual attention and stress intensity under COVID-19 environmental stimuli: An eye-tracking study

Tourists' visual attention and stress intensity under COVID-19 environmental stimuli: An eye-tracking study

1. Introduction & Literature Review

Tourist' visual attention is critical for destination managers because the intangible travel experiences, the preferences for tourism activities and services, and the tourist-environment relationship can be manifested in tourists' visual attention and visual processing information (Scott, Zhang, Le, & Moyle, 2019; Wang & Sparks, 2014). Visual attention is a selectively cognitive process that elicits concentrating visual scenes and information (Jonides, 1983). Attention often involves two distinct modes, directed attention and effortless attention (Kaplan, 1995). Directed attention mode involves effortful control of attention and can eventually lead to attention fatigue (Basu, Duvall, & Kaplan, 2018; Ohly et al., 2016). Effortless attention mode, also referred as "fascination" mode, draws attention to fascinating stimuli without sustained control (Basu et al., 2018). Nature-based tourism destinations serve as ideal environment settings for attention restoration (Qiu, Jin, & Scott, 2021; Qiu, Sha, & Scott, 2021), because the natural environment has the capacity to draw attention without fully occupying mindsets (Kaplan, 1995; Ohly et al., 2016). However, limited studies have examined tourists' visual attention patterns in natural settings and how visual attention might influence tourists' stress and emotions in the tourism destinations.

Traveling and recreation activities provoke and mediate stress (Jordan, Spencer, & Prayag, 2019; Jordan & Vogt, 2017; Zhu, Gao, Zhang, & Jin, 2020). Positive travel experiences (e.g. visiting natural or cultural scenery and participating in desired activities with satisfactory experiences) can reduce tourists' stress (Jordan et al., 2019). On the contrary, negative or overwhelming travel experiences may provoke tourists' stress (Zhu et al., 2020). For example, crowding has been identified as one of the most commonly experienced stressors during the traveling process (Schuster, Hammitt, & Moore, 2006; Xiao, Gao, Lu, Li, & Zhang, 2021). According to the Equilibrium Model of Human Response to Crowding (Stokols, 1972), exposure to human crowds in natural settings may lead to the cognitive inconsistency of environment quality, and resulting in stress (Miller & McCool, 2003). Research has found that environmental conditions are antecedent factors in stress-related mechanisms (Berto, 2014; Schuster et al., 2006).

According to the transactional theory of stress, tourists' cognitive appraisals of environmental conditions involve complicated processes (Jordan et al., 2019; Schuster et al., 2006), and visual attention to environmental conditions may influence the intensity of stress and available coping strategies for the stressful conditions (Qiu, Jin, et al., 2021). However, research on visual attention to tourism-related environments is in a notably nascent stage, and the management of tourists stress from the perspective of visual attention is not commonplace (Wang & Sparks, 2014). During the COVID-19 pandemic, the increasing demand for nature-based tourism destinations has intensified the exposure to virus transmission risks (Hamidi & Zandiatashbar, 2021; Shoari, Ezzati, Baumgartner, Malacarne, & Fecht, 2020; Venter, Barton, Gundersen, Figari, & Nowell, 2020). Increasing levels of human crowds, inappropriate social distance, or inadequate implementation of preventive strategies may elicit more visual attention from tourists, which changes the cognitive appraisal processes of tourists in nature-based tourism destinations (Xiao et al., 2021). Understanding how tourists' visual attention and stress levels respond to different levels of crowding stimuli can provide guidance for nature-based tourism destinations to fascinate the attention restorative capacity and enhance tourists' quality of life as a long-term outcome.

Although a great deal of research has documented that natural environment can provide stimuli for attention restoration based on attention restoration theory (Basu et al., 2018; Kaplan, 1995; Ohly et al., 2016), the relationship between natural environment's attentional restorative capacity and stress mediation is still a vague picture. The natural environment provides multi-dimensional sensory stimuli for tourists, including visualscape, soundscape, smellscape, and etc., and these sensescapes provide multisensory connections between tourists and natural environments and might collectively influence tourists' attention restoration (Buzova, Sanz-Blas, & Cervera-Taulet, 2021; Qiu, Jin, et al., 2021). During the COVID-19 pandemic, social-distancing preventive measures (e.g., stay-at-home order, temporary close policy for indoor service and facilities, strict domestic and international travel policies, etc.) limited individuals' mobility for long-distance travel, making proximate natural tourism destinations hotspots for attention restoration (Hamidi & Zandiatashbar, 2021; Shoari et al., 2020; Venter et al., 2020). However, the factors impacting tourists' visual attention and stress appraisals in nature-based tourism destinations from the multisensory perspective were very limited in the current literature (Qiu, Jin, et al., 2021).

To address these research gaps, this study aims to investigate three overarching research questions:

Research Question 1: What are the patterns of tourists' visual attention to different levels of crowding stimuli in nature-based tourism destinations during the COVID-19 pandemic?

Research Question 2: How will visual attention affect tourists' stress appraisal processes and stress levels?

Research Question 3: What situation factors (e.g. COVID-19 prevent measures, natural sounds, and human crowds) influence tourists' visual attention and stress levels in nature-based tourism destinations during the COVID-19 pandemic?

Answering these research questions will provide a better understanding of the theoretical linkages between visual attention and stress, and result in concrete evidence from which managers of natural resource based tourism sites can formulate policies to provide stress-free experiences for visitors.

2. Methods

To answer the study search questions, we utilize experimental design tracking the eye movement of research participants shown pictures of a natural area with differing conditions. Three phases of data collection were conducted to fulfill the study design, including real-time observation (Phase 1), eye-tracking experiments (Phase 2), and self-reported surveys (Phase 3). The following paragraphs contain full details about the study site selection, experimental design, and data analysis.

2.1 Data Collection

To investigate tourists' visual attention and cognitive appraisals of stress during the COVID-19 pandemic, our study selects the Leiqiong UNESCO Global Geological Park as the study site. Leiqiong Geological Park was chosen as a study site for its natural beauty and proximity to the research team, which was particularly important with the many travel restrictions present during the early stages of the COVID-19 pandemic

Phase 1: Real-time observation of density of use

First, we collected data in real-time observations of the study site by taking pictures every five minutes and recording People Per View (PPV) before and after the COVID-19 pandemic. We conducted the real-time observation on December 27th, 2019, and June 21st, 2020, respectively, and both of the days were on the weekend. The observation started at 10:00 am and ends at 4:00 pm each day. Through this approach, the different levels of density of use can be represented by the indicator of PPV. PPV is a widely-used indicator for the density of use in tourism destinations (Manning, 2011). We selected six images representing different levels (0-, 6-, 12-, 18-, 24-, 30-, 36-PPV) of the density of use in the eye-tracking study.

Phase 2 Eye-tracking experiment design and procedure

Experiment design: The experiment design involves tracking the eye movements of research participants who were shown photographs of the nature park with differing conditions. The full design was 6 (PPV densities) x 2 (mask or non-mask) x 2 (nature sound or no sound) design. In the first experiment, the six-images with different PPVs without masks (normal version) were displayed to participants in random order, and a follow-up group of the same images when tourists are wearing masks (environmental factor 1) were displayed to participants. In the second experiment, the image of 6-PPV (low density) without soundscape (normal version) was first displayed, and the same image with nature sound (environmental factor 2) was displayed to participants. In addition, the image of 18-PPV (medium density of use) without soundscape (normal version), and with natural sound (environmental factor 2) were displayed to participants with random order.

Participants: Tourists over 18-year old with normal (or corrected to normal) vision, and have visited Haikou Leiqiong Global Geological Park before were qualified to participate in this study. We distributed recruitment advertisements in several local communities surrounding a public university in Haikou through flyers and posters and recruited 50 participants in our study. More than half of the participants were females (54.9%), and 45.1% of the participants were males. The age of the participants ranged from 19 to 57, and more than one-third of the participants have a bachelor's degree or higher education background.

Apparatus: A Pupil Core eye tracker was used to collect eye movement data in this study. Pupil Core is a mobile eye-tracking headset with one scene camera and one infrared (IR) spectrum eye camera for dark pupil detection. The open-source software Pupil Capture can assist the eye-tracker to detect, record, and map real-time eye movements (Kassner, Patera, & Bulling, 2014). Pupil Capture is considered accurate and is capable to collect information every 4 milliseconds (Kassner et al., 2014).

Procedure: Before participating in the eye-tracking experiment, participants were informed that they would be viewing images representing different levels of density of use at Leiqiong Global Geological Park. No specific task was assigned to participates when they were viewing. Rather than viewing images on a computer monitor, our experiment displays all images on a large screen (144 cm * 81 cm). A calibration process was conducted before each eye-tracking experiment, and an offset of 5 degrees or lower could indicate successful calibration (Kassner et al., 2014). Each image was displaced for 10 seconds, and images were randomly presented to participants.

Phase 3 Self-reported Survey

After the eye-tracking experiments, the participates were asked to rate the perception of crowding and stress intensity for each viewed picture, respectively. The perceived crowding was measured by a 9-point scale, where "1" represented not crowded at all, and "9" represents extremely crowded (Manning, 2011). To make the measurement scale constant between perceived crowding and stress intensity, the 9-point scale was applied to measure the stress intensity by a separate question ("what is your stress intensity when you are viewing this image?"), where "1" represented "not stressful at all", and "9" represented "extremely stressful".

2.2 Data analysis

Eye movement data analysis

An open-source eye-tracking analysis software (Pupil Player) was used to export, code, and clean the eye-tracking data recorded from Pupil Capture. The fixation duration and dwell time of the eye-movement data were used for eye-tracking data analysis. We set the thresholds of the fixation as 100ms, which aligns with the threshold of clinical visual cognitive research (Manor & Gordon, 2003). After the exclusion of fixations that lower than 100ms, the fixation count and fixation duration of gazing positions of each image were extracted. Rather than traditional eye-tracking studies that directly compare the fixation durations among different images, we calculated the fixation durations of three objects: people, landscape, and mask by the ratio of total viewing time on the targeted object dividing the total viewing time on all objects. This approach excludes fixation durations of saccades (rapid eye movements that abruptly change the point of fixation) and fixation durations out of the Areas of Interest (designated areas for analysis) (Li, et al., 2016). The fixation duration ratios ranged from 0% to 100%. The dwell time was calculated as the sum of the fixation duration on each image, ranging from 0.70 second to 8.66 seconds.

Visual attention & survey data analysis

We used paired-sample t-tests to compare the perceived crowding and stress intensity by environmental factors (mask-wearing vs. non-mask wearing, natural sound vs. no sound). We used a multiple regression model to examine the effects of visual attention indicators, perceived crowding, and social demographic variables on stress intensity.

3. Results

3.1 Visual attention towards tourism images

3.1.1 Fixation durations

Crowding stimuli

In general, an increase in density of use yielded a higher proportion of fixation duration on people, whereas a lower proportion of fixation duration on natural landscape (Figure.1). In specific, at the low crowding level (PPV=6), the average ratios of fixation duration on people and natural landscape were 52.3% and 46.2%, respectively. The average ratio of fixation duration on people at medium crowding level (PPV=18) was 78.2%, which was significantly higher than the ratio of people viewing fixation duration at low crowding level. Similarly, at the high crowding level (PPV=36), the ratio of fixation duration on people increased to 87.0%, which was significantly higher than the ratio of people viewing fixation duration at low crowding level. Under the high crowding level, only 13% of fixation duration was viewing natural landscape, implying that a high level of crowding could yield a high proportion gazing duration on human crowds and low proportion gazing duration on natural landscape.

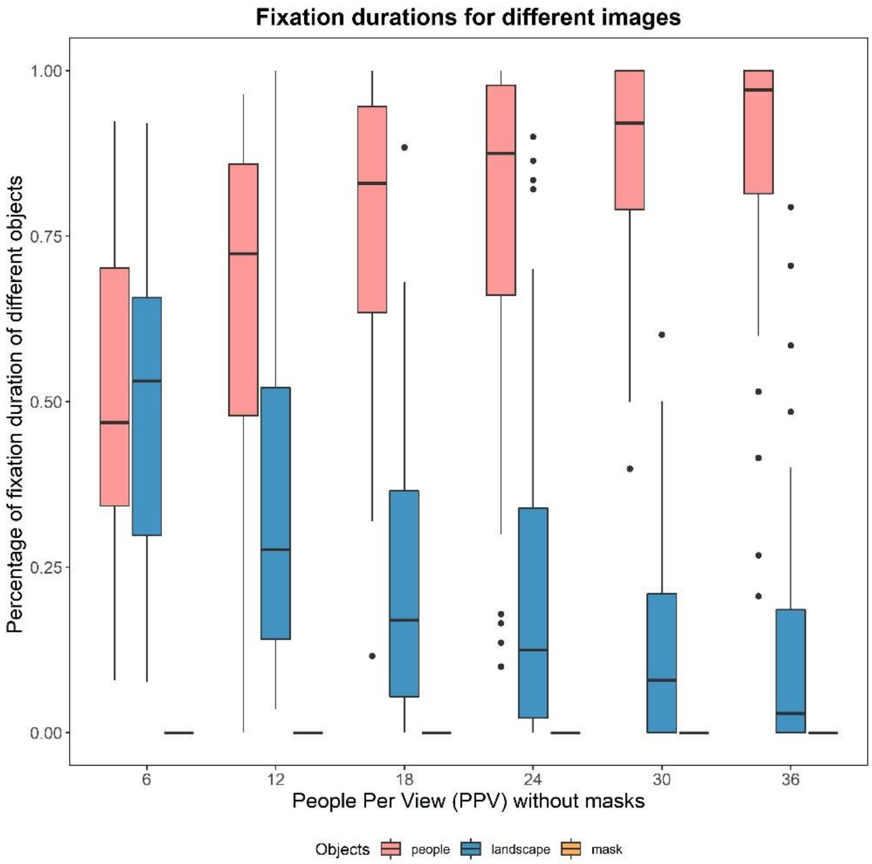

Figure 1 Fixation duration ratios under varying levels of crowding stimuli when tourists do not wear masks

Mask-wearing and non-mask-wearing comparisons

The fixation durations for the same group of images when tourists wore masks were calculated for three objects: people, natural landscape, and masks (Figure 2). Comparing to the images when all tourists did not wear masks, the fixation duration ratios of people viewing were significantly lower under a few conditions at 95 confidence level. In specific, in the medium crowding conditions (PPV=12 and PPV=18), people viewing fixation duration ratios were 52.6% and 54.1% when tourists were wearing masks, which were significantly lower than 62.1% ($p<0.001$) and 74.7% ($p<0.001$) when tourists were not wearing masks, respectively. In the high crowding conditions (PPVs=30 and 36), fixation duration ratios of people viewing when all tourists wore masks were significantly lower than the fixation duration ratios when all tourists did not wear masks ($p<0.001$ for both tests). Notably, in the extremely crowded condition, the fixation duration ratio on people was 65.4% compared to 87.0% when tourists did not wear masks, indicating the gazing attention on people was significantly reduced when COVID-19 preventive measures were implemented.

The fixation duration ratios of natural landscape viewing for the mask-wearing images did not heavily change compared to non-mask wearing images. The fixation duration ratios of masking viewing significantly increased from the low crowding condition (PPV=6) to the medium crowding condition (PPV=12), however, no significant differences in mask viewing fixation duration ratios were found between medium and high crowding conditions. These results implying that mask-wearing, as a preventive measure, could draw tourists' gazing intention at the low and medium crowding conditions, but the gazing intention on masks did not change heavily in the high crowding conditions.

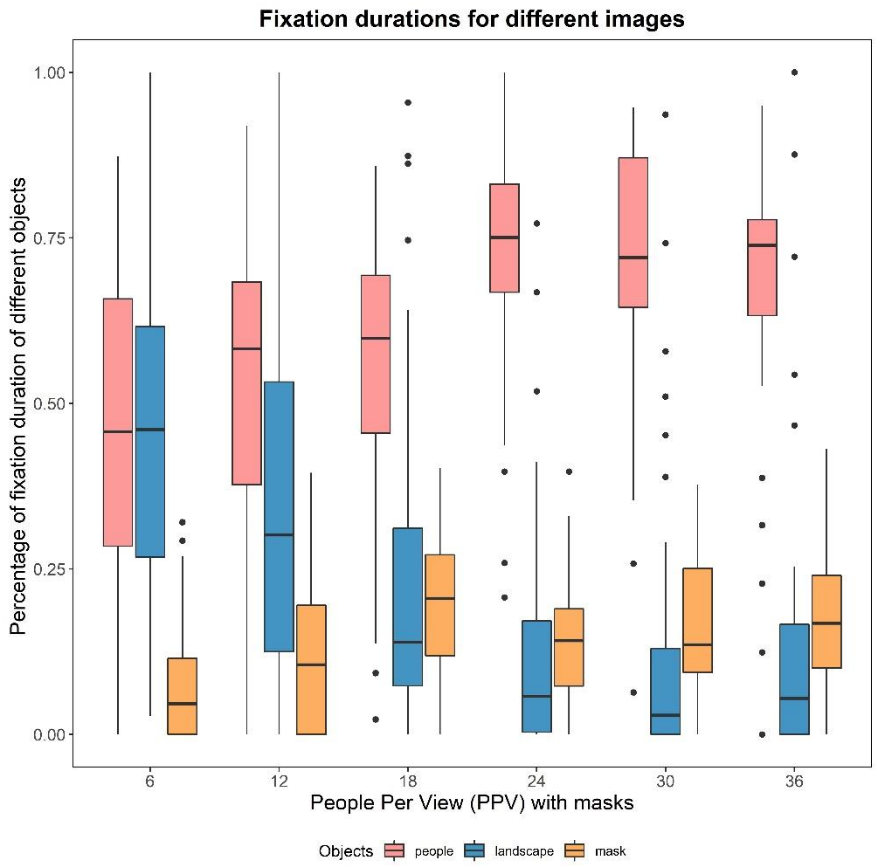

Figure 2 Fixation duration ratios under varying levels of crowding stimuli when tourists wear masks

Natural sound effect

The fixation duration ratios of people and landscape viewing between normal images and natural sound embedded images were compared in the low and medium crowding conditions (Figure 3). Notably, natural sound plays a significant impact on reducing the gazing duration on people and increasing the gazing duration on the scenic landscape. With the embedded natural soundscape in the low crowding condition, the fixation duration ratio on people reduced from 49.2% to 33.9% ($p=0.020$). Similarly, the embedded natural sound in the medium crowding condition reduced the ratio of people viewing duration, that 57.2% of fixation duration was targeted on people, compared to 74.7% in the same image without natural sound ($p=0.001$).

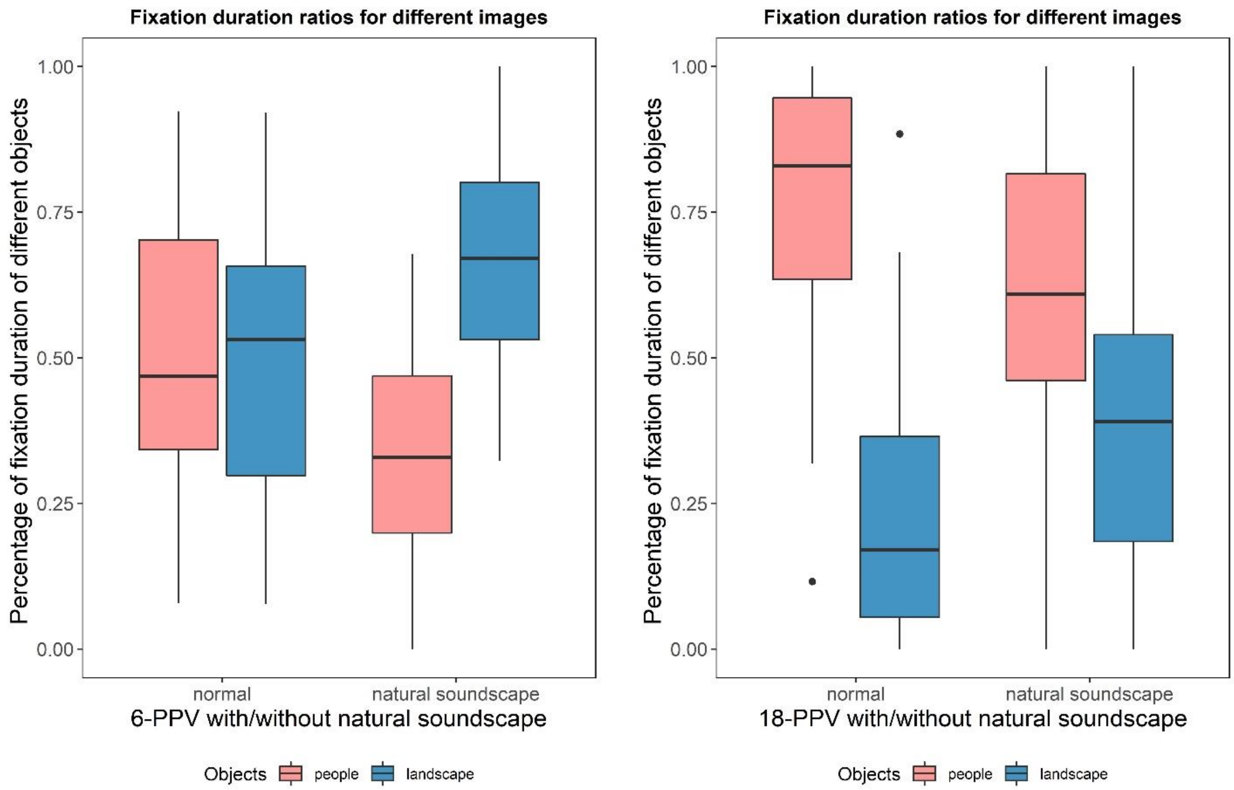

Figure 3 Fixation duration ratios of images with/without natural sound embedded

3.1.2 Dwell Time

We compared the dwelling time on images representing different crowding conditions as well as non-mask-wearing vs. masking-wearing conditions. The results indicated that the dwell time on the images of different PPVs has no significant differences. In general, the dwell time on the images of (6, 12, 18, 24, 30, and 36) ranged from 4.97s to 5.38s. Moreover, when comparing the dwell time on the images of mask-wearing and non-mask-wearing conditions, no significant difference was found for the six pairs of images representing different PPVs.

In terms of dwell time on images with and without natural sound embedded, the paired t-tests indicate the dwell time on the images with natural sound was significantly higher than the images without natural sound. In specific, under the low crowding condition (6-PPV), the average dwell time on the image with natural sound was 6.63s, which was significantly longer than the dwell time (M=5.07s) on the image without natural sound ($p<0.001$). Similarly, the average dwelling time on the image of medium crowding with natural sound was 5.64s, which was significantly longer than the dwell time (M=4.97s) on the image without natural sound ($p=0.040$).

3.2 Effects of visual attention on stress intensity

We compared the perceived crowding and stress intensity under the non-mask-wearing conditions and mask-wearing conditions (Table 1). No significant differences were found among all tested conditions except the condition of 12-PPV, indicating that masking-wearing has minimal impacts on reducing participants' perceived crowding and stress levels (Table 1). In terms of natural sound's effects on perceived crowding and stress levels, the ANOVA tests indicated that natural sound has significant impacts on reducing perceived crowding and stress levels under both 6-PPV and 18-PPV conditions ($p<0.001$ for both two tests).

Table 1 Paired sample t-tests for crowding and stress level by situation factors

Factors*	**Crowding**		**Stress**	
Comparison Groups	Base group	Treatment	Base group	Treatment
6-PPV × mask	2.81	2.52	2.62	2.48
12PPV× mask	5.40	4.76**	5.31	4.74**
18-PPV × mask	6.98	6.62	7.02	6.62
24-PPV × mask	8.43	8.64	8.43	8.60
30-PPV × mask	8.93	8.88	8.62	8.52
36-PPV × mask	9.00	9.00	8.90	8.70
6-PPV × natural sound	2.81	1.76***	2.62	1.64***
18-PPV × natural sound	6.98	4.29***	7.02	3.86**

*Asterisks indicate *significant at 0.05, **significant at 0.01, and ***significant at 0.001.

To identify the impacts of visual attention indicators on stress level, a multiple regression model was conducted (Table 2). Results indicate that the fixation duration ratio of natural landscape viewing has a significantly negative impact on stress ($p=0.009$). Moreover, the fixation count ratio of natural landscape viewing has a significantly negative impact on stress ($p=0.020$). Crowding has a significantly positive impact on stress levels. The socio-demographic factors, including gender, age, education had no significant impact on stress levels.

Table 2 Multiple regression model for stress

Variables	**Unstandardized Coefficient**	**Standardized Coefficient**	**p-value**
Fixation duration ratio of people viewing	1.510	0.159	0.009**
Fixation count ratio of people viewing	1.385	0.144	0.020*
Crowding	1.011	0.983	<0.001***
Gender	0.089	0.018	0.074
Age	-0.050	-0.021	0.085
Education	-0.062	-0.022	0.092
Constant	-0.064		0.765

*Asterisks indicate *significant at 0.05, **significant at 0.01, and ***significant at 0.001.

4. Discussion and conclusions

In this study, we examined tourists' visual attention and perceived stress from tourism environmental stimuli in a nature-based tourism destination during the COVID-19 pandemic. Study findings contribute to the transactional theory of stress from two perspectives. First, environmental factors are affecting the cognitive appraisal of stress through the transactional processes, which involve visual attention to different types of environmental stimuli. Our study findings show that the fixation duration ratio of human crowds viewing is significantly associated with stress intensity. These results highlight the fact that tourists' cognitive inconsistency under crowding stimuli is not an instant perception, rather, it is a visual information evaluation process of environmental stimuli that challenges the cognitive equilibrium. These results highlight the important role of visual attention on the cognitive appraisal of stress, that is, visual attention on different environmental elements (human crowds vs. natural landscape) can affect the perceived stress levels through the transactional process (Lazarus & Folkman, 1984). Second, the cognitive appraisals of stress in nature-based tourism destinations are collectively affected by attention restoration capacity and environmental factors (e.g., COVID preventive strategies and natural sound). Higher levels of attention on natural landscape initiate the attention restoration, which can reduce tourists’ stress levels as a positive outcome from natural landscape viewing (Grahn & Stigsdotter, 2010). These findings suggest that attention restoration is an essential antecedent process of cognitive appraisal, and the personal-environment transactions can be partially explained by the visual attention patterns under varying environmental stimuli. Study results also provide theoretical supports for the role of natural landscape in tourists’ stress mitigation and extend the application of the attention restoration theory to tourists’ transactional stress appraisal process.

This study also reveals the effects of the multi-sensory stimuli of natural environment on tourists’ visual attention and stress levels. Results from this study suggest that the natural sound embedded images draw more attention to natural landscape and facilitate stress mitigation compared to normal images. As manifested in higher ratios of fixation duration and fixation counts on natural landscape viewing, as well as longer dwell time on the natural sound embedded images under the low and medium crowding conditions, this study highlights natural environment's attention restorativeness capacity by multisensory stimuli. These findings provide empirical evidence to support the attention restoration theory, and soundscape embedded in natural environment, can serve as a complementary stimulus of visualscape to initiate “soft fascination” for tourists and reduce stress in nature-based tourism destinations (Basu et al., 2018). The effect of single-stimulus on attention restoration from natural environment, predominantly embedded in visualscape, has not been fully verified in previous studies (Qiu, Jin, et al., 2021). The visual attention and stress appraisal for multi-stimuli tourism images in this study advance the attention restoration theory, and highlight the need for future tourism research to include the multi-scape (sensescape) since tourists’ behaviors are often influenced by multi-types of stimuli in nature-based tourism destinations.

Methodologically, this study employed a mixed-method design and advances analysis analytics to extend the innovations of the eye-tracking research approach. This study is one of the first studies that uses real-time observation images of tourism conditions among the existing eye-tracking tourism research. The real-time observation image can reflect the realistic tourists’ experiences, and can overcome limitations of earlier tourism eye-tracking studies that use the materials, text, pictures are designed artificially (Li, Huang, & Christianson, 2016). Through this approach, the environmental stimuli can be reflected in realistic conditions, and empirical tourism destination management implications can be generated. Second, the images with COVID-19 preventive measure manipulation is an innovative approach to visualize the impact of preventive measures on tourists’ attention and stress appraisals. Although tourism destinations have implemented various types of COVID-19 preventive management policies, how do tourists perceive these strategies are still a vague picture in the literature (Xiao et al., 2021). The comparison of visual attention patterns between the mask-wearing and non-mask-wearing conditions provides a foundation for subsequent research related to tourists’ stress appraisal and coping strategies under the impacts of public health crisis events.

References

Basu, A., Duvall, J., & Kaplan, R. (2018). Attention Restoration Theory: Exploring the Role of Soft Fascination and Mental Bandwidth. *Environment and Behavior, 51*(9-10), 1055-1081.

Berto, R. (2014). The Role of Nature in Coping with Psycho-Physiological Stress: A Literature Review on Restorativeness. *Behavioral Sciences, 4*(4), 394-409.

Buzova, D., Sanz-Blas, S., & Cervera-Taulet, A. (2021). "Sensing" the destination: Development of the destination sensescape index. *Tourism Management, 87*, 104362.

Grahn, P., & Stigsdotter, U. K. (2010). The relation between perceived sensory dimensions of urban green space and stress restoration. *Landscape and Urban Planning, 94*(3-4), 264-275.

Hamidi, S., & Zandiatashbar, 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*, 103952.

Jonides, J. (1983). Further toward a model of the Mind's eye's movement. *Bulletin of the Psychonomic Society, 21*(4), 247-250.

Jordan, E. J., Spencer, D. M., & Prayag, G. (2019). Tourism impacts, emotions and stress. *Annals of Tourism Research, 75*, 213-226.

Jordan, E. J., & Vogt, C. A. (2017). Appraisal and coping responses to tourism development-related stress. *Tourism Analysis, 22*(1), 1-18.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15*(3), 169-182.

Kassner, M., Patera, W., & Bulling, A. (2014). *Pupil: an open source platform for pervasive eye tracking and mobile gaze-based interaction*. Paper presented at the Proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct Publication, Seattle, Washington. https://doi.org/10.1145/2638728.2641695

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*: Springer publishing company.

Li, M., Chen, Y., Wang, J., & Liu, T. (2020). Children's attention toward cartoon executed photos. *Annals of Tourism Research, 80*.

Li, Q., Huang, Z. J., & Christianson, K. (2016). Visual attention toward tourism photographs with text: An eye-tracking study. *Tourism Management, 54*, 243-258.

Manning, R. (2011). *Studies in Outdoor Recreation*. Corvallis OR: Oregon State University Press.

Miller, T. A., & McCool, S. F. (2003). Coping with Stress in Outdoor Recreational Settings: An Application of Transactional Stress Theory. *Leisure Sciences, 25*(2-3), 257-275.

Ohly, H., White, M. P., Wheeler, B. W., Bethel, A., Ukoumunne, O. C., Nikolaou, V., & Garside, R. (2016). Attention Restoration Theory: A systematic review of the attention restoration potential of exposure to natural environments. *Journal of Toxicology and Environmental Health, Part B, 19*(7), 305-343.

Qiu, M., Jin, X., & Scott, N. (2021). Sensescapes and attention restoration in nature-based tourism: Evidence from China and Australia. *Tourism Management Perspectives, 39*, 100855.

Qiu, M., Sha, J., & Scott, N. (2021). Restoration of Visitors through Nature-Based Tourism: A Systematic Review, Conceptual Framework, and Future Research Directions. *International Journal of Environmental Research and Public Health, 18*(5), 2299.

Schneider, I. E., & Hammitt, W. E. (1995). Visitor response to outdoor recreation conflict: A conceptual approach. *Leisure Sciences, 17*(3), 223-234.

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.

Scott, N., Zhang, R., Le, D., & Moyle, B. (2019). A review of eye-tracking research in tourism. *Current Issues in Tourism, 22*(10), 1244-1261.

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), e0241102.

Stokols, D. (1972). A Social-Psychological Model of Human Crowding Phenomena. *Journal of the American Institute of Planners*, *38*(2), 72-83.

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).

Wang, Y., & Sparks, B. A. (2014). An Eye-Tracking Study of Tourism Photo Stimuli: Image Characteristics and Ethnicity. *Journal of Travel Research, 55*(5), 588-602.

Xiao, X., Gao, J., Lu, J., Li, P., & Zhang, Y. (2021). Social carrying capacity and emotion dynamics in urban national parks during the COVID-19 pandemic. *Journal of Outdoor Recreation and Tourism*, 100451.

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