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Crowding and vaccination: Tourist’s two-sided perception on crowding and the moderating effect of vaccination status during COVID-19 pandemic

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1. Introduction

The COVID-19 pandemic has dealt a heavy blow to the tourism market and has profoundly reshaped the global tourism landscape. In the emerging industry discussion and research on tourism and COVID-19, there is a unanimous call to view and capitalize on the pandemic as a transformative opportunity (Mair, 2020; Sigala, 2020). For example, mass tourism destinations that had large volumes before the pandemic, the pandemic has brought a significant decrease in tourist arrivals. However, they should still treat the pandemic as a chance to mitigate the adverse effects of tourism crowding and promote sustainable practices (Jiricka-Pürrer, Brandenburg, & Probstl-Haider, 2020; Sigala, 2020), especially given that the current pandemic has magnified adverse responses to crowding (Osti & Naya, 2020; Park et al., 2021).

In tourism research, the negative effects of crowding have been widely discussed and confirmed. Various studies have shown that crowding negatively impacts tourists’ experience, satisfaction, and loyalty (Li, Zhang, Nian, & Zhang, 2017; Pikkemaat, Bichler, & Peters, 2020; Sharp, Sharp, & Miller, 2015; Yin, Cheng, Bi, & Ni, 2020; Yoon, Kyle, Hsu, & Absher, 2021). Since the outbreak of COVID-19, researchers have generally believed that these negative effects will be magnified. It is well known that COVID-19 is transmitted by aerosols, droplets, parasites, and feces, and crowded environments will increase exposure to SARS-CoV-2 and accelerate the spread of the virus (von Seidlein, Alabaster, Deen, & Knudsen, 2021). Given the dangers of transmission, tourists tend to increasingly avoid urban settings and popular destinations and choose non-crowded attractions (Chua, Al-Ansi, Lee, & Han, 2021; Park et al., 2021; Zenker & Kock, 2020).

However, large-scale vaccination has begun to address this worrisome trend. Despite the challenges of vaccine hesitation and low vaccine confidence (Barello, Palamenghi, & Graffigna, 2021; Chou & Budenz, 2020; Larson & Broniatowski, 2021), the benefits of vaccination for tourism remain clear. In the early pandemic, with no vaccine and limited medical capacity, non-pharmacological interventions (NPIs) such as unprecedented global travel bans, social distancing, and stay-at-home policies were the main strategy to contain the pandemic (Gössling, Scott, & Hall, 2020). However, it is argued that the hope of restarting international travel is now largely pinned on the COVID-19 vaccine. As a proactive and effective recovery strategy (Bernal et al., 2021), increasing vaccination rates could significantly impact the recovery of the hospitality and tourism industries (Gursoy, Can, Williams, & Ekinçi, 2021).

Thus, research on the impact of vaccination on tourism is needed. For destinations, vaccination could prevent the importation of vaccine-preventable diseases (Pavli & Maltezou, 2022); it is in this sense one of the most critical factors that can help restart travel and revive
domestic and international tourism (Moreno-González, León, & Fernández-Hernández, 2020; M. Wang et al., 2021). For tourists, COVID-19 vaccination can offset travel fears and anxieties caused by the pandemics (Boto-García & Francisco Baños Pino, 2022), reducing perceived health risks and increasing travel intentions (Gursoy et al., 2021). However, recent vaccine tourism impact studies have been conducted mainly on pre-travel aspects, such as the influence of vaccination on travel intention (Boto-García & Francisco Baños Pino, 2022) and factors that influence pre-travel vaccination intention (Ekinci, Gursoy, Can, & Williams, 2022; Kegsh, Can, Gursoy, Ekinci, & Aldawodi, 2022, p. 19; Suess et al., 2022; Williams et al., 2021; Zhu et al., 2022). Treatment of the direct impact of COVID-19 vaccination from the post-travel perspective is still lacking in the tourism literature, including aspects such as its influence on tourists’ experience, satisfaction, and loyalty. Undoubtedly, it is crucial to explore the pre-travel vaccination intention and its impact on travel intention. However, when facing challenges like the loyalty shift to mass tourism destinations (Osti & Nava, 2020; Park et al., 2021), exploring the impact of vaccination on tourists during and after their tours could more directly reflect the effect of vaccination on the destination management.

Moreover, while the pandemic has cast a shadow over the high-density tourism environment, its positive effects should not be ignored entirely. Many studies have shown that crowding is a necessary element in urban tourism, mass tourism, and outdoor activities, enhancing tourists’ experiences (Neut & Nijkamp, 2012; Popp, 2012; Wickham & Kerstetter, 2000). Milman, Tasci, and Wei’s (2020) research on theme parks indicates that popularity can be shown as the benefit of crowding and, in some environments, a certain degree of crowding is necessary for a positive travel experience. However, because these studies were conducted before the pandemic, it is doubtful whether they will be relevant now.

In summary, our research addresses the following two questions. First, the study explored whether the positive effects of crowding persist under the influence of the pandemic. Second, we explored differences among tourists with different vaccination statuses and willingness to vaccinate.

Based on the Stimulus-Organism-Response (SOR) framework (Mehrabian & Russell, 1974), this study was designed to identify the structural relationship between crowding perception, popular perception, and loyalty through the effects of destination attractiveness. We considered crowding perception and popular perception as environmental stimuli, destination attractiveness as the inner organism changes, and destination loyalty as the response. Finally, we measured whether vaccination, vaccination completeness (among vaccinated tourists), and vaccination intention (among unvaccinated tourists) could moderate the above pathways of influence.

It is hoped that the insights of this study will eventually benefit practitioners of the tourism industry and policymakers in facilitating the recovery of the tourism industry. On the one hand, a certain amount of tourist volume under prudent control retains its positive value for mass tourism destinations. On the other hand, our research proved that vaccination is beneficial for destination management. Despite being challenged by many anti-vaccine and vaccine hesitancy arguments, COVID-19 vaccination should firmly be promoted by stakeholders.

2. Literature review and theoretical framework

2.1. The stimulus-organism-response (SOR) model

The basic framework of this study was derived from the SOR model proposed by Mehrabian and Russell (1974). It posits that environmental stimuli (S) elicit an emotional reaction from an organism (O), and this emotional reaction triggers the corresponding behavior response (R). The SOR model has been widely employed in tourism literature (Hew, Leong, Tan, Lee, & Ooi, 2018; Kim, Lee, & Jung, 2020; Yin & Ni, 2021) and has been applied in studies of tourism crowding (Yin et al., 2020).

2.2. Crowding perception and popular perception

In tourism research, the term “crowding” emerged with the outdoor recreation boom in the 1950s (Manning, 1999). Researchers use the word “crowding perception” to describe tourists’ perceptions of the high-density environment of tourist attractions. In most relevant studies, researchers have used stimulus overload theory and social interference theory to discuss the psychological effects of crowding environment stimulus (Andereck & Becker, 1993; Schmidt & Keating, 1979; Stoklos, 1972). In these studies, crowding perception always leads to negative outcomes, such as making the destination less attractive, increasing personal stress, and negatively impacting tourist experience, satisfaction, and loyalty (Brown, Kappes, & Marks, 2013; Li et al., 2017; Pikkemaat et al., 2020; Yin et al., 2020).

However, some studies have shown that crowding may also be positive. Crowding is indispensable in social tourism activities, such as festivals, outdoor recreation, and urban tourism (Neuts & Nijkamp, 2012; Wickham & Kerstetter, 2000). Popp (2012) noted that “active” crowding is essential for the urban tourism experience. In these tourism activities, the high-density environment encourages interaction among tourists, who are more willing to join the crowd for exciting and novel experiences by sharing experiences, observing others, or participating in like-minded group activities (Amberger, Alkoh, Eder, Shoji, & Mieno, 2010; Hou & Zhang, 2021; Popp, 2012; Wickham & Kerstetter, 2000).

Popular perception offers a new perspective to explain this positive effect. Researchers often use geotagged data on the density of the physical environment of a scenic area to characterize the popularity of the area (Peng & Huang, 2017; Wibowo, Bustomi, & Sukamdi, 2019). Milman, Tasci, and Wei (2020) further clarified that crowding perception has a significant positive effect on popular perception. However, tourists seem to have become more resistant to crowding after the outbreak of the pandemic (Zenker & Kock, 2020), which has created uncertainty in this relationship.

To verify this, we made the following assumptions:

H1. Crowding perception positively affects popular perception.

2.3. Destination attractiveness and loyalty

In recent decades, the concept of destination attractiveness has received widespread attention (Formica & Uysal, 2006; Hong-bumm, 1998; Lee, Huang, & Yeh, 2010). Destination attractiveness refers to tourists’ perceptions about a destination and its ability to satisfy their needs (Reitsamer, Brunner-Sperdin, & Stokburger-Sauer, 2016). It corresponds to tourists’ comprehensive judgment of a destination from both cognitive and emotional perspectives (Yin et al., 2020), which matches the definition of the organization within the SOR model (Lin, Zhang, Gursoy, & Fu, 2019).

While it is proven that crowding perception has a significantly negative impact on destination attractiveness (Yin et al., 2020), for hotspot tourist destinations, high density is also one of the antecedents of destination attractiveness (Jacobsen, Iversen, & Hem, 2019). The positive emotion of perceived density, or popular perception, may positively affect destination attractiveness. Accordingly, H2 and H3 were proposed as follows:

H2. Crowding perception negatively affects destination attractiveness.

H3. Popular perception positively affects destination attractiveness.

Destination loyalty is often interpreted as a tourist’s willingness to revisit a destination, provide positive word-of-mouth and recommend it to others (Oppermann, 2000). Although loyalty has been widely explored in tourism literature, research on the role of antecedents in the formation of loyalty is still needed (Sumarjan et al., 2014). Various factors have been proved to affect tourist loyalty, including experience, satisfaction, perceptions, familiarity, sociodemographic characteristics, and others (Godovykh & Tasci, 2020). However, there is limited
research in tourism research investigating the direct impact of crowding perception on loyalty, although marketing research has widely explored it. Through a meta-analysis of 535 studies in retail research, Santini et al. (2020) discovered that crowding perception significantly negatively affects loyalty. In the context of tourism, Avila-Foucat, Vargas, Jordan, and Flores (2013) found that whale-watching tourists who have a crowding experience are less likely to revisit. Yin et al.’s (2020) study in China found that human crowding has a significant negative effect on loyalty. Therefore, it was assumed that crowding perception could significantly negatively affect loyalty in this study.

Compared to crowding perception, popular perception is more related to hedonism and enjoyment because it could bring the emotions of excitement and joy (Eroglu & Harrell, 1986; Thomas & Saenger, 2020), which could in turn influence their behavior at the destination. For example, among tourists to Disneyland, the longer the queue for popular rides, the more tourists are willing to wait and share their experience online (Ju et al., 2018). The positive emotions brought out by popular perception are also considered antecedents of loyalty (Godoykyh & Tasci, 2020). Prayag et al. (2017) found that emotional experience affects domestic tourists’ willingness to recommend destinations. Thus, it is reasonable to assume that popular perception could significantly, positively affect loyalty. Following Tasci’s (2011) suggestion, we adopt both behavior and attitudinal methods, and revisit intention and word-of-mouth (WOM) were used to construct destination loyalty. Hence, the following hypotheses were proposed:

H4. Crowding perception negatively affects loyalty.

H5. Popular perception positively affects loyalty.

Destination attractiveness is an important antecedent of loyalty. Um et al. (2006) discovered that the perceived attractiveness of a destination was the most influential and decisive antecedent of revisit intention for international tourists in Hong Kong. Chien (2016) found that destination attractiveness has a significant positive effect on tourists’ revisit intention for ecotourism. Vigolo (2015) found that destination attractiveness significantly predicted revisit intention and positive word-of-mouth in a survey of long-haul Italian tourists in South Africa. Nevertheless, it is also necessary to explore the relationship between destination attractiveness and loyalty in crowded destinations, as this can improve the generalizability of the results of these studies (Vigolo, 2015).

According to the paradigm of the SOR model, environmental stimuli could trigger emotional reflection in an organism, and that organism could then elicit a response. This chain might indicate the mediating role of the organism within the SOR model. Previous studies have shown that crowding perceptions positively affected popular perception (Milman et al., 2020). Yin et al. (2020) found that destination attractiveness could mediate the relationship between physical crowding and revisit intention. Hence, it is reasonable to assume that the chain between crowding perception, popular perception, destination attractiveness, and loyalty could be significant.

Therefore, we propose the following hypotheses:

H6. Destination attractiveness positively affects loyalty.

H7. Crowding perception positively affects loyalty via popular perception and destination attractiveness.

2.4. Vaccine and tourist behavior

Overcrowding threatens the safety of tourists (Li et al., 2017). Unfortunately, this trend is further aggravated by the impact of pathogens (Wang & Ackerman, 2018). In terms of the actual development of the COVID-19 outbreak, crowded spaces contributed to a rapid increase in the number of infected cases (Rader et al., 2020). Affected by this threat, travelers tended to avoid crowded destinations to guard against possible risks (OECD, 2020).

The rapid and widespread distribution of vaccines has become an essential anchor for the rapid recovery of the tourism industry (Cheer, Hall, & Saarinen, 2021). People began to look forward to returning to a normal life after mass vaccination (Li & Giabbanelli, 2021). The benefits of vaccination may be able to moderate tourists’ perception of risk (Mostafapour, Meyer, & Scholer, 2019), ease undesirable emotions (Thompson et al., 2012), and increase travel intention (Williams et al., 2021).

Vaccination can also contribute to the relationship between an organism and action response because it can reduce perceived travel risk. Perceived health risks and travel anxiety are critical determinants of short-term travel intentions (Reisinger & Mavondo, 2005). Boto-García and Francisco Banos Pino (2022) found that vaccination increases the probability of taking a holiday trip during the summer period by 8.3 percentage points among the general population and 11.3 percentage points among the vaccinated subsample. Gursoy et al. (2021)’s research indicates that vaccination was negatively correlated with travel intention in February 2021 and March 2021, but not with travel intention in April 2021 and May 2021. A large-scale vaccination program may further reduce the perceived health risks and travel anxiety of those who support vaccination (Gursoy et al., 2021).

Therefore, we believe that whether a person is vaccinated or not would be crucial. Hence:

H8a. Vaccination has a moderating effect on the relationship between crowding perception and destination attractiveness.

H8b. Vaccination has a moderating effect on the relationship between crowding perception and loyalty.

H8c. Vaccination has a moderating effect on the relationship between destination attractiveness and loyalty.

Different COVID-19 vaccines have different dose requirements, and there is a time gap between doses. Thus, it is possible for tourists to travel after completing part, but not all, of the vaccination process. Generally, three types of COVID-19 vaccines are administered in mainland China, each requiring one to three doses. The importance of complete vaccination has been widely emphasized at all levels of government in China, from central to local (CDC, 2020, p. 19). In order to improve the vaccination rate, before our research was conducted, many provincial governments set a new policy, which turned the health code for vaccination completers to gold (which is a popular color among Chinese people), representing free mobility rights (Fig. 1).

Through the lens of the Health Belief Model (Champion & Skinner, 2008) and Protection Motivation Theory (Rogers, 1975), compared with...
tourists who have not completed the whole vaccination process, tourists who have completed the entire vaccination process have a stronger resistance to the pandemic and a more positive self-assessment of their health condition. Therefore, it can be argued that vaccination completeness might make them have lower pandemic-related risk perception and might then play a significant role in alleviating their negative emotions such as anxiety toward the destination. Because of the long time gap between doses, vaccine compliance is a significant challenge for realizing group immunity (Dror et al., 2020). Exploring the differences in emotions and behavior between tourists with different degrees of vaccination will contribute to the understanding of vaccine completeness and compliance from the perspective of the tourism market.

Based on the above discussion, it is reasonable to assume that vaccine completeness would act on the entire process from external stimuli to actual responses within the SOR framework. The hypothesis will help highlight the importance of completing the entire vaccination process, which is important for destination management but rarely investigated in recent vaccine impact tourism literature.

Therefore, the following hypotheses are proposed:

H9a. Vaccination completeness has a moderating effect on the relationship between crowding perception and destination attractiveness.

H9b. Vaccination completeness has a moderating effect on the relationship between crowding perception and loyalty.

H9c. Vaccination completeness has a moderating effect on the relationship between destination attractiveness and loyalty.

Vaccination willingness has been widely discussed, in particular since vaccine hesitation and anti-vaccines hinder the process of herd immunization (Latkin, Dayton, Yi, Colon, & Kong, 2021). Many studies have focused on the factors that affect tourists’ vaccination willingness at the pre-travel stage. Williams et al. (2021)’s research proved effectiveness and safety to be key predictors of vaccination intentions. Wang et al. (2021) developed a conceptual framework based on protection motivation theory, apart from safety and effectiveness, they considered time, cost, and autonomous concerns as potential obstacles to vaccination. Ekinci et al. (2022) highlighted the impact of travel desire, and their findings indicate that travel desire can encourage COVID-19 vaccination intentions.

Although the factors influencing tourists’ vaccination willingness have gained widespread attention, studies focusing on vaccination willingness’s impact on tourist behavior remain limited. Based on the above discussion, we could argue that tourists who are still not willing to be vaccinated after travel may have doubts about the effectiveness and safety of the vaccine (Williams et al., 2021), which might be a meaningful difference from tourists who are willing to be vaccinated in their inner emotion and cognition, as well as their actual behavior. Based on the SOR model, our study aims to address this gap for the first time by investigating the influence of vaccination willingness on tourists’ behavior from the post–travel perspective.

Therefore, we proposed the following hypotheses:

H10a. Vaccination willingness has a moderating effect on the relationship between crowding perception and destination attractiveness.

H10b. Vaccination willingness has a moderating effect on the relationship between crowding perception and loyalty.

H10c. Vaccination willingness has a moderating effect on the relationship between destination attractiveness and loyalty.

Thus, the conceptual framework of this study is shown in Fig. 2.

3. Research design and method

3.1. Study area

The Nanjing Confucian Temple, an iconic popular tourism attraction in Nanjing, China, was chosen for this study. It used to be a place to worship and consecrate Confucius, ancient philosopher and educator. The original building has been destroyed and rebuilt many times. In 1984, the Chinese government began repairing the damaged monuments and building large-scale pedestrian blocks of ancient buildings around it. In 2010, the Nanjing Confucian Temple was nominated as the first national 5A (top rank) free scenic spot in China. Since then, the temple has become one of the most popular and crowded tourist sites in China. During the International Labor Day holiday of 2021, it received more than 300,000 visitors per day (Fig. 3), an increase of 10.9% over the pre-COVID time, in 2019 (Nanjing Municipal Bureau of Culture and Tourism, 2021), ranking first among all attractions in Jiangsu province. The occupancy rate of the surrounding hotels peaked, and the queues for nearby popular restaurants necessitated more than 2 h of waiting time (Xu, 2021).

As mentioned before, another perception of a high-density environment is high popularity, and in fact, Chinese tourists have always loved the bustling, flourishing atmosphere of cultural attractions. During the holiday, the impact of COVID-19 tapered off, and the vaccine began to be administered in large numbers. In this context, tourists have complex psychology of both liking and disliking the high-density environment of
3.2. Measurement

Most constructs contained in the study were derived from previously validated and reliable research. The focus was on the following constructs: crowding perception, popular perception, destination attractiveness, loyalty and vaccination status (see Table 1). All items were scored on a five-point Likert scale with values ranging from ‘totally disagree’ to ‘totally agree.’

Crowding perceptions were measured with three sub-dimensions: physical, personal, and social crowding. Physical crowding reflects the physical environment’s space limitations perceived by tourists (Graham & Burdge, 1984). Personal crowding refers to the conflict of interest caused by individual demand for space that exceeds space supply in tourist destinations (Machleit, Kellaris, & Eroglu, 1994). Differing from personal crowding, social crowding pays more attention to the loss of aesthetic enjoyment or attenuation of the meaning of the scene caused by being surrounded by too many people or inappropriate interaction with others (Li et al., 2017; Manning, 1999). All 12 items for crowding perception were adapted from previous research (Li et al., 2017; Yin et al., 2020). Three popular perception items were based on studies by Milman et al. (2020). The four items of destination attractiveness were adapted from Li et al. (2017) and revised from pre-researched tourist interviews. The five loyalty items, including word-of-mouth (WOM), were adapted from Wei, Qi, and Zhang (2019).

In the analysis of moderating variables, we grouped vaccination according to whether they were vaccinated, had completed the entire vaccination process (i.e., the total dose of vaccine), or were willing to be vaccinated in the next six months.

3.3. Data collection

Web-based questionnaires have been found to have ideal feasibility and equivalent validity and reliability compared to paper-based questionnaires in past research (Hung & Law, 2011; Yu & Yu, 2007; Zhang, Yang, Zheng, & Zhang, 2016). The combination of online and offline surveys is considered the most reliable data collection method (Dolnicar, Laesser, & Matus, 2009), and an ex-ante control procedure for controlling the common method variance (Zhang et al., 2016). In addition, during the pandemic, tourists prefer the contactless questionnaire collection method; the online survey could help obtain more samples in a contactless way.

A detailed survey was conducted around an official holiday in China (May 1–5, International Labor Day), from April 23 to May 9, 2021. Offline questionnaires were collected on April 23, April 24 (the busy weekend before the holiday), and on two days during the holiday (May 1 and May 3), and a semi-random sampling method was adopted. Two postgraduate students who had taken a course in research methods and had experience in data collection helped collect data. The online questionnaire was distributed by Tencent Questionnaire (https://wj.qq.com), and each interviewee was paid 2.5 CNY (About $0.4) after completing the questionnaire. Online questionnaire respondents were tourists who had visited Nanjing Confucian Temple during the International Workers’ Day holiday (May 1–5, 2021), and the data were collected from May 6 to May 9. A total of 680 questionnaires were

![Fig. 3. The crowded Nanjing Confucian Temple Scenic Area on International Workers’ Day.](image)
returned. After excluding the surveys with missing answers and inattentive answers, 535 valid questionnaires were finally collected. Of the valid questionnaires, 276 were completed online and 259 were completed offline.

Since we adopted both online and offline survey methods, a nonresponse analysis was needed to examine the sample data for evidence of no-response bias. We used the method recommended by Armstrong and Overton (1977). Chi-square tests using social demographic characteristics were used to examine the statistically significant differences between the online and offline samples. The results showed no significant differences between online and offline samples, meaning that the online and offline samples could be considered the same sample.

For the remaining 535 samples, partial least-squares structural equation modeling (PLS-SEM) was used to analyze the measurement model. Despite its short appearance, PLS-SEM is acknowledged for its ability to estimate under conditions of small samples and data nonnormality (Wong, 2010). Among the existing crowding studies, no study has yet analyzed the two-sided effect of crowding based on the SOR model or attempted an exploration of the impact of popularity perception on destination attractiveness and loyalty. Therefore, this study endeavored to identify the predictive power of a network of concepts instead of confirming well-accepted theoretical structures (Sarstedt, Ringle, & Hair, 2014). Hence, the PLS-SEM analysis technique was reasonable and adequate.

4. Results

4.1. Sociodemographic characteristics

As shown in Table 2, respondents were primarily between 18 and 45 years old, 47.30% female, and 52.70% male. More than 80% of the respondents had a junior college/university degree (including 8.20% of graduate students), and more than 40% earned a monthly income of at least 5000 CNY.

4.2. Common method bias

Common method bias could be a concern, since the same respondent answered all the self-administered survey question items. We followed the suggestion proposed by Podsakoff, MacKenzie, Lee, and Podsakoff (2003) to assess the common method variance. Harman’s single factor test was then used for exploratory factor analysis. The test returned a multi-factor solution, with the first factor explaining 25.2% of the total variance. The test results indicate that common method bias is not a serious problem and can be overlooked.

4.3. Measurement model

The evaluation of the measurement model usually consists of reliability and validity analysis. In this study, we used Smart PLS 3.3.3 to examine the reliability and validity of the measurement model. The results are shown in Table 3.

As shown in Table 3, all of the loadings of the first order are above 0.70, which means the indicators in the outer model reached an ideal reliability level. Cronbach’s a ranged from 0.775 to 0.893, all above the 0.70 level recommended by Anderson and Gerbing (1988). The consistency reliability (CR) values were higher than the required threshold of 0.70, indicating a high internal consistency and the reliability of the measurement model.

Convergent validity was measured using the average variance extracted (AVE). The AVE was higher than 0.50 for all but one construct (0.467), demonstrating partial support for convergent validity (Nunnally & Bernstein, 1994). Discriminant validity was first examined using the Fornell–Larcker criterion (Fornell & Larcker, 1981), which requires all constructs’ AVE to be higher than the square of inter-construct correlations. All constructs used in this study met this requirement. However, the PLS-SEM method often overestimates the factor loadings and underestimates the structural model relationships so that the Fornell-Larcker criterion can be easily satisfied. The HTMT (heterotrait-monotrait ratio) method proposed by Henseler, Ringle, and Sarstedt (2015) can solve this shortcoming. They suggested that the HTMT conservative criterion should be less than 0.85 to assess discriminant validity. The results in Table 4 show that none of the HTMT criteria was larger than 0.85.

We also tested the reliability and validity of the second-order construct. Crowding perception. The coefficients of its first-order constructs were higher than the criterion of 0.6. The second-order variables’ AVE and consistency reliability (CR) meet the corresponding criteria. In conclusion, these results demonstrate that the measurement model fits the data well.

4.4. SEM results

The significance of the path coefficient of the structural equation was tested using the bootstrapping program in Smart PLS 3.3.3 (with 5000 bootstrapped, others are default). Table 5 and Fig. 4 show the test results.

R² reflects the predictive effect of the structural model. Fig. 4 shows that the explanatory power of the entire model for loyalty is 32.3%, which is above the 20% threshold. The results show that H1, H3, H4, H5, H6 and H7 were accepted, while H2 was rejected. H1 verifies the effect of crowding perception on popular perception, and the results show that crowding perception has a significantly positive impact on popular perception.

H2 predicts the positive relationship between crowding perception and destination attractiveness, and it was rejected because the t value is insignificant.

H3 and H6, which indicate the positive relationship between popular perception, destination attractiveness, and loyalty, were fully supported. H4 and H5 were about the impact that perception would have on loyalty. The signs of these two path coefficients revealed that the effects of crowding and popular perceptions on loyalty were opposite. While crowding perception has a negative impact on loyalty, popular perception shows a positive trend.

According to the measurement of indirect effects (Hayes & Preacher, 2014; Montoya & Hayes, 2017), crowding perception has a significant positive indirect impact on loyalty via popular perception and destination attractiveness, supporting H7.
4.5. Moderate effect of vaccination status

Vaccination, vaccination completeness and vaccination willingness were analyzed as moderate variables to test the potential moderating effects of the model.

In this study, we analyzed the moderating effect of vaccination on loyalty using a multiple group analysis (MGA). The sample was first divided into two groups according to whether they were vaccinated: VCC and non-VCC. We further divided the people who had been vaccinated into two groups: the end of vaccination (VCC-finished) and the unfinished vaccination (VCC-unfinished). According to their willingness to be vaccinated in the next six months, unvaccinated tourists were divided into willing (non-VCC-willing) and unwilling (non-VCC-unwilling). The classification criteria are presented in Table 6.

The samples were substituted into the original structural model for testing using SmartPLS 3.3.3, and the results are shown in Table 7. As shown in Table 7, in comparing the VCC and non-VCC groups, only the path coefficient from destination attractiveness to loyalty was significant. For the VCC-finished and VCC-unfinished groups, the path coefficient from crowding perception to loyalty was significant. Third, for the non-VCC-willing and non-VCC-unwilling groups, the path coefficient from crowding perception to destination was significant. A comparison of the specific path coefficients is shown in Fig. 5.

Fig. 5 shows the differences in the path coefficients for the three comparison groups. Comparison 1 shows that, whether vaccinated or not, the effect of destination attractiveness on loyalty is positive. Still, it was evident that the VCC group was significantly more substantial than the non-VCC group.

Moreover, there was also a significant difference based on whether the entire inoculation process was completed. In the path of crowding perception on loyalty, a significant negative effect was observed for tourists who did not complete the entire vaccination process. In contrast, a slightly positive but not significant effect was observed for those who completed the entire vaccination process. However, since the VCC-finished group failed to pass the t-test, the difference is still meaningless.

Further, we find that there were also significant differences in path coefficients for willingness to be vaccinated in the next six months, unvaccinated tourists were divided into willing (non-VCC-willing) and unwilling (non-VCC-unwilling). The classification criteria are presented in Table 6.

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Table 3
Assessment of the measurement model.

| Construct                  | First order          | Items | Coefficients | Loading | Cronbach’s α | AVE | CR |
|----------------------------|----------------------|-------|--------------|---------|--------------|-----|----|
| Crowding perception (CP)   |                      |       |              |         |              |     |    |
| Physical crowding (PC)     |                      |       |              |         |              |     |    |
| PC1                        | 0.639                | 0.893 | 0.893        | 0.675   | 0.467        | 0.912 | 0.87|
| PC2                        | 0.839                | 0.867 | 0.691        | 0.87    |              |     |    |
| PC3                        | 0.785                |       |              |         |              |     |    |
| Personal crowding (PEC)    |                      |       |              |         |              |     |    |
| PEC1                       | 0.926                | 0.856 | 0.636        | 0.897   |              |     |    |
| PEC2                       | 0.768                | 0.687 | 0.857        | 0.898   |              |     |    |
| PEC3                       | 0.804                | 0.73  | 0.804        | 0.897   |              |     |    |
| PEC4                       |                      | 0.822 |              |         |              |     |    |
| PEC5                       |                      |       |              |         |              |     |    |
| Social crowding (SC)       |                      |       |              |         |              |     |    |
| SC1                        | 0.845                | 0.867 | 0.715        | 0.909   |              |     |    |
| SC2                        | 0.841                | 0.687 | 0.882        | 0.909   |              |     |    |
| SC3                        | 0.858                | 0.800 |              |         |              |     |    |
| SC4                        | 0.812                |       |              |         |              |     |    |
| Popular perception (PP)    |                      |       |              |         |              |     |    |
| PP1                        | 0.845                | 0.852 | 0.773        | 0.911   |              |     |    |
| PP2                        | 0.851                | 0.838 |              |         |              |     |    |
| PP3                        | 0.914                | 0.884 |              |         |              |     |    |
| Destination attractiveness (DA) |              |       |              |         |              |     |    |
| DA1                        | 0.851                | 0.851 | 0.692        | 0.9     |              |     |    |
| DA2                        | 0.834                | 0.834 |              |         |              |     |    |
| DA3                        | 0.867                | 0.867 |              |         |              |     |    |
| DA4                        | 0.800                | 0.800 |              |         |              |     |    |
| Loyalty (LOY)              |                      |       |              |         |              |     |    |
| LOY1                       | 0.890                | 0.890 | 0.693        | 0.919   |              |     |    |
| LOY2                       | 0.812                | 0.812 |              |         |              |     |    |
| LOY3                       | 0.839                | 0.839 |              |         |              |     |    |
| LOY4                       | 0.880                | 0.880 |              |         |              |     |    |
| LOY5                       | 0.820                |       |              |         |              |     |    |

Table 4
Discriminant validity with HTMT.

| Construct | DA | LOY | PC | PEC | SC |
|-----------|----|-----|----|-----|----|
| LOY       | 0.604 |     |    |     |    |
| PC        | 0.251 | 0.081 |    |     |    |
| PEC       | 0.07  | 0.149 | 0.604 |     |    |
| SC        | 0.072 | 0.085 | 0.364 | 0.772 |    |
| PP        | 0.557 | 0.426 | 0.259 | 0.137 | 0.047 |

Table 5
Hypothesis testing results.

| Hypothesis | Path | Path coefficients | t value | Supported? | Results |
|------------|------|-------------------|---------|------------|---------|
| H1         | CP → PP | 0.113***         | 2.718   | ✓          | Accepted |
| H2         | CP → DA | 0.048             | 1.343   | ×          | Rejected |
| H3         | PP → DA | 0.469***          | 9.638   | ✓          | Accepted |
| H4         | CP → LOY | –0.144***         | 3.900   | ✓          | Accepted |
| H5         | PP → LOY | 0.172***          | 3.542   | ✓          | Accepted |
| H6         | DA → LOY | 0.464***          | 10.419  | ✓          | Accepted |
| H7         | CP → PP | 0.025**           | 2.419   | ✓          | Accepted |

*p < 0.1; **p < 0.05; ***p < 0.01.
5. Discussion and implications

This study provides empirical results on crowding perception, popular perception, destination attractiveness, vaccination, vaccination completeness, and vaccination willingness related to loyalty. The results show that destination loyalty can be reasonably explained using the SOR model proposed by Mehrabian and Russell (1974). As two kinds of environmental stimuli in a high-density environment, both crowding perception and popular perception significantly affect loyalty, but with opposite signs. The result also shows that crowding perception and destination attractiveness are unrelated, while popular perception significantly impacts destination attractiveness. A further mediation test shows the chain mediation effect of crowding perception, popular perception, destination attractiveness, and loyalty is significant.

By investigating the moderating effects of vaccination status (vaccination, vaccination completeness, and vaccination willingness), interesting results were found. Vaccination was found to significantly moderate the relationship between destination attractiveness and loyalty significantly. Moreover, the result highlighted the importance of vaccination completeness. For tourists who had not completed the vaccination process, crowding perception significantly negatively affected loyalty ($\beta = -0.245, p < 0.001$), while the path coefficient was insignificant and close to zero ($\beta = 0.005, p = 0.949$) among tourists who had complete the entire vaccination process.

5.1. Theoretical implication

Our study provides several theoretical contributions to the literature. First, we provide empirical evidence of the two-sided effect of tourism crowding by simultaneously testing the impact of crowding perception, and that of popular perception on destination attractiveness and loyalty within one model. In general, the empirical finding of crowding in one single study is always rather homogeneous. Generally, there are three opinions on tourism crowding in past studies: negative (Pikkemaat et al., 2020; Yin et al., 2020), positive (Kim, Lee, & Sirgy, 2016), and neutral (Hou & Zhang, 2021). To this end, we introduce the construct of popular perception first proposed by Milman et al. (2020) to explore the positive effect of tourism crowding; it provides a new theoretical perspective to better understand the complex role of tourism crowding. Since the outbreak of COVID-19, many scholars have expressed concerns about tourism crowding, with some pointing out that tourists’ concerns about crowded destinations are magnified (Zenker & Kock, 2020), so it is debatable whether the two-sided effect of crowding still exists (Milman et al., 2020). This result also shows that even under the COVID-19 pandemic, the positive and negative effects of tourism crowding in popular destination still coexist.

Second, we examined the moderating effect of vaccination from the post-travel perspective, which addressed a gap in recent COVID-19 vaccine impact literature. Unlike previous studies that focused on the
effect of vaccination on travel intentions (Gursoy et al., 2021; Suess, Maddock, Dogru, Mody, & Lee, 2022), this study focuses on the effect of vaccination on tourists’ behavior after they arrive their destination. The result found that vaccination could moderate the path between destination attractiveness and loyalty in tourism. In the paradigm of SOR theory, this suggests that, given the same cognitive and emotional condition, vaccinated tourists have more confidence to respond accordingly.

Thirdly, by investigating the moderating role of vaccination completeness, our study generates new insights into whether vaccination completeness can help eliminate the negative effect of crowding perception. We found that for fully-vaccinated tourists, crowding perception did not reduce their loyalty. In the medical research on COVID-19, the importance of completing the entire vaccination process to achieve the desired vaccine efficacy against SARS-CoV-2 cannot be overemphasized (Sadarangani et al., 2021). In tourism research, Gursoy et al.’s (2021) study indicates that the greater the number of people who complete the entire vaccination process, the lower the travel health risk perception and travel intention for the individual. Our study shows that vaccination completeness also brings differences to tourists’ responses to environmental stimuli. This finding broadens the understanding of the impact of vaccination on tourists’ behavior from the post-travel stage, providing a new perspective to explore tourists evolving psyche during the COVID-19 pandemic (Kock, Nørfelt, Josiassen, Assaf, & Tzionas, 2020).

5.2. Managerial implications

This study offers several practical and managerial implications. First, tourism destination managers and marketers need to be aware that tourism crowding is still a double-edged sword even under COVID-19. On the one hand, they need to deal with the negative effects of tourism crowding, on the other hand, it is also important to note that the positive effects of crowding still exist and to use them in a prudent manner. Thus, how to provide a popular atmosphere for tourists while prudently controlling the tourist volume will be crucial to achieving a sustainable recovery process (UNWTO, 2020). Mass tourism destinations generally have a large amount of built and under-construction infrastructure, and both government and destination investors have invested much money in them. Therefore, they need to develop precise crowd management strategies to better recover from the shadow of the pandemic. One such strategy would be to perform partition management under overall volume control. For example, the density limits should differ between wide-open and well-ventilated plazas with narrow passes. Also, since there are differences in preferences regarding crowding among tourists, another strategy would be to offer timely information about crowding on the entrance of the destination, as well as official website and social media (Park et al., 2021).

Second, our study addressed the importance of vaccination in the post-travel stage, which offered a new perspective compared to previous studies that emphasized the positive effects of vaccination on pre-departure travel intentions (Gursoy et al., 2021; Williams et al., 2021). In this study, we found that the negative effect of crowding perception on loyalty has vanished among fully-vaccinated tourists. For destination marketers, loyalty management is vital during the pandemic, since the extent of loyalty could be changed at any time depending on respiratory disease-related risk perception (Osti & Nava, 2020). Thus, it is argued that vaccination is crucial for destination loyalty management during the pandemic, especially for those hotspot attractions.

Third, our exploration of the impact of vaccination also attempts to illustrate that promoting vaccination, and improving vaccine adherence, is not just a matter for the public health sector. For example, the Serbian government’s decision to offer free COVID-19 vaccines to the citizens of its neighbors who travel to Serbia led to a short-term boost in tourist arrivals and overnight stays (Mladenović, Rustremi, & Mogaji, 2021), which also relies on a strategic shift of all stakeholders. Thus, as UNWTO (2020) recommended, all sectors should have stronger ties to design a flexible and active resilience strategy. All stakeholders should value the importance of vaccination for the industry’s recovery, and actively promote vaccination. Anti-vaccine and vaccine hesitation behaviors need to be countered scientifically to increase vaccination rates and achieve herd immunity as soon as possible, working together to shape a more sustainable tourism industry.

5.3. Limitations and further research

This study has limitations that can help improve future research. First, our study chose a single destination and lacked comparisons between multiple destinations. A single destination may be influenced by the presence or absence of an outbreak in cities surrounding that destination and lacks a global and systematic approach. Therefore, multiple destinations can be selected for a comprehensive comparison in future studies.

Second, our data collection period mainly focused on the International Labor Day festival, which was insufficient for a comprehensive analysis. However, universal vaccination rates will continue to increase.
over time for vaccine impact studies, and there will be significant changes in tourists’ psychology (Gursoy et al., 2021), especially their perception of the high-density environment and travel risk. In future studies, the duration of data collection could be extended to detect changes in vaccine effects over time (Ram et al., 2022).

Declaration of interest

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