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Research Paper

Protected areas as a space for pandemic disease adaptation: A case of COVID-19 in Hong Kong

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HIGHLIGHTS
- Protected areas were studied as spaces for adaptation to COVID-19.
- The socio-psychological model of precautionary adaptation was employed.
- High perceived adaptation efficacy and low adaptation cost promoted adaptation.
- The ability of protected areas to assist in adaptation to pandemics was highlighted.

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ABSTRACT

As COVID-19 has swept across the world, governments have been prompted to order social distancing measures, from the closure of schools, restaurants and public facilities to quarantines and lockdowns. Access to and contact with nature have been suggested to help combat impacts associated with isolation measures, and a coincidental surge in the number of visitors to country parks in Hong Kong has recently been observed. The current study sought to explore the visitation of country parks as an adaptation to COVID-19 by employing the socio-psychological model of precautionary adaptation (SPMPA). Questionnaire surveys were administered in 12 country parks in Hong Kong, and a total of 600 samples were collected. A conceptual model based on the SPMPA was proposed and tested through multiple regression analysis. Significant associations between perceived severity, threat experience and adaptative behaviour were found, suggesting the possible risks of visiting country parks. However, the relationships among perceived adaptation efficacy, adaptation cost and reliance on public adaptation implied that the adaptative benefits of visiting country parks may outweigh the risks when proper visitor management measures are implemented. The findings highlighted the importance of providing accessible protected areas or other types of nature-based spaces to facilitate the adaptation of people to disease outbreaks in both the short and long run.

1. Introduction

The outbreak of COVID-19 was officially announced by the Chinese government in January 2020 (World Health Organization, 2020a, 2020b, 2020c), 17 years after the devastating SARS epidemic. Throughout the deadly outbreak of SARS in 2003, over 8000 people were infected in 26 countries across the globe, and among them, 10% were killed (World Health Organization, 2003). Hong Kong, as one of the cities with the most severe proliferations of SARS, had 1755 cases of infection and nearly 300 deaths (Yeung & Fung, 2007). Only in March 2020 did the WHO characterize COVID-19 as a pandemic (World Health Organization, 2020a, 2020b, 2020c). According to the latest statistics in April 2020, COVID-19 has spread from China to over 212 countries, territories and areas around the world (World Health Organization, 2020a, 2020b, 2020c). Among the world population, over 2.8 million people have been infected, and over 190,000 have died due to COVID-19 (World Health Organization, 2020a, 2020b, 2020c). Despite the mild impact in Hong Kong, the region still identified 1038 cases of infection and 4 deaths (The Government of the HKSAR, 2020a, 2020b, 2020c, 2020d, 2020e). The global impacts of COVID-19 have undoubtedly

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surpassed those of SARS, and an end to the pandemic is still unforeseen (Chung, Xu, & Zhang, 2020).

The unprecedented contagiousness and severity of COVID-19 have placed the public in a vulnerable position. Governments around the world have announced various social distancing measures in response to outbreaks, such as complete lockdowns, quarantines, the closure of various businesses and facilities and urging citizens to stay at home voluntarily (Samuelsson, Barthel, Colding, & Macassa, 2020). In many places, the COVID-19 induced risks and uncertainties perceived by people also led them to actively practice social distancing, e.g. to avoid gathering in public areas such as groceries, transits and workplaces (Huynh, 2020a, 2020b, 2020c). While such measures have been immensely effective (Gu, Jiang, & Zhao, 2020; Tian et al., 2020; Wilder-Smith, 2020), psychological drawbacks to the implementation of such isolation measures during the COVID-19 outbreak have been observed, causing symptoms of stress, anger, and confusion (Brooks et al., 2020). Isolation resulting from social distancing may also induce other negative consequences, such as anxiety, depression, and a feeling of loneliness (Cacioppo et al., 2006; Cacioppo, Hawkley, & Thisted, 2010; Hawkley & Cacioppo, 2010). Brooks et al. (2020) thus suggested that access to and engagement with nature play a critical role in relieving the stress and anxiety of people currently in isolation situations. Due to the more lenient social distancing measures implemented in Sweden, a growing number of citizens have been visiting natural areas (Samuelsson et al., 2020).

Notably, a similar phenomenon has recently been observed in Hong Kong. Country parks across Hong Kong were reported to be very crowded with visitors (Post, 2020). Like Sweden, Hong Kong has implemented relatively relaxed social distancing measures, with no restrictions on access to country parks or other countryside areas, except that some public facilities in those areas are temporarily closed (the Government of the HKSAR, 2020). A major surge in the number of visitors to country parks was also recorded during the SARS outbreak (Cheung & Jim, 2006; Marafa & Fung, 2004; Wong, 2004). Marafa and Fung (2004) studied visitors to country parks during the SARS outbreak and demonstrated how the disease may motivate citizens to visit country parks.

Grothmann and Reusswig (2006) hinted that psychological variables concerning hazard perception and coping provide the best explanation for individual adaptation behaviours in the context of hazard adjustment. The authors proposed the socio-psychological model of precautionary adaptation (SPMPA), featuring risk perception, perceived adaptive capacity, threat experience, and reliance on public adaptation as the major drivers of individual adaptation, which are applicable to the current study in investigating individual disease adaptation Figs. 1 and 2.

Through adopting the SPMPA, the current study seeks to examine individuals’ adaptation to COVID-19 by visiting country parks. The perception of risk, adaptive capacity, threat experience, and reliance on the public adaptation of individuals are first measured and described; this is followed by an analysis of the underlying relationship between the psychological variables and the patterns of visitation in country parks. Through demonstrating and understanding how country parks, as protected areas, may play a role in aiding adaptation to a disease outbreak, this study can highlight the value and importance of such spaces.

2. Literature review

2.1. Adaptation measures in past pandemics

Adaptation is the adjustment of the behaviour of a system (e.g., a nation, community or individual) in response to actual or expected stimuli, with the aim of coping with external stress and reducing the vulnerability of the concerned system (Brooks, 2003; Füssel & Klein, 2006; Smith & Wandel, 2006).

Adaptation by the public or individuals to diseases has been widely documented during a number of past epidemic events, e.g., SARS and H5N1. The adaptation measures studied generally fall into a few areas, including precautionary hygienic practices (Cheng, 2004, 2006; Lee-Baggley et al., 2004; Puterman, Delongis, Lee-Baggley, & Greenglass, 2009), general public health practices (Cheng, 2004, 2006; Lee-Baggley et al., 2004; Puterman et al., 2009) and information-acquiring behaviour (Cheng, 2006).

While these hygienic and public health measures are of utmost importance in securing people’s health, other, softer strategies concerning a broader scope of everyday behaviours engaged in by individuals as adaptations should also be acknowledged. During the SARS outbreak, an increase in the practice of Qigong (a type of Chinese meditative and wellness exercise, which is also considered a form of health-enhancement practice and alternative medicine) was reported, and Qigong was suggested to be a health-enhancing behaviour that may help combat deadly diseases (Siu, Sung, & Lee, 2007). Visitations to country parks, as mentioned above, became another popular activity during the SARS outbreak, owing to the physical and mental health promotion functions of such visits (Marafa & Fung, 2004; Wong, 2004; Cheung, 2013).

2.2. Drivers of adaptation in past pandemics

A handful of studies, predominantly from the medical and public health fields, have investigated the influence of psychological attributes on the adaptation behaviours of individuals during the SARS and H5N1 outbreaks (Lau, Yang, Tsui, & Kim, 2003; Cheng, 2004; Gan & Liu, 2004; Lau, Kim, Tsui, & Griffiths, 2007; Siu et al., 2007). The determinants of adaptation studied have included the perception of risk and fear (Lau et al., 2003, 2007; Cheng, 2004), the perception of self-efficacy and response efficacy of hygienic and general health measures (Lau et al., 2003, 2007), past experience (Lau et al., 2007) and the appraisal of the threat and state anxiety (Puterman et al., 2009). With a particular focus on the use of the countryside, Marafa and Fung (2004) reported that the park visitation of 14% of surveyed country park users in Hong Kong during the time of the SARS outbreak was motivated by the fear of SARS, and up to 50% were driven by the urge to relieve stress brought about by the SARS outbreak with the companionship of family or friends. Despite recognizing the significance of the psychology of adaptation, these studies predominantly studied psychological constructs individually and lacked the application of a systematic framework or model, which may have failed to present a complete picture of individuals’ adaptations.
2.3. The socio-psychological model of precautionary adaptation

Grothmann and Reusswig (2006) proposed the SPMPA based on protection motivation theory (PMT), which allows a systematic analysis of the adaptation behaviour of individuals. The authors demonstrated the predictive power of the respective psychological constructs on individual adaptation measures developed in response to a hydrological hazard. The Health Belief Model (HBM), a traditionally adopted model of health-related behaviour, has described similar psychological and perceptual factors to PMT and the SPMPA, such as perceived severity, susceptibility, self-efficacy, and efficacy of the response (Lee-Bagley et al., 2004; Puterman et al., 2009). A distinction between the proposed model of Grothmann and Reusswig (2006) and the traditional model is the incorporation of past experience and reliance on public adaptation as the new dimensions, whereas health-related models rarely explore these variables. PMT is one of the most commonly adopted theories in research on health behaviours and threats, and its application has many benefits (Grothmann & Reusswig, 2006), making the following proposed model relevant and suitable for the current study on COVID-19 adaptation.

The SPMPA consists of four major perceptual processes and predictors: threat appraisal (risk perception), coping appraisal (perceived adaptative capacity), threat experience and reliance on public adaptation, which would be utilized in developing the proposed model and hypothesis of the current study. In particular, threat appraisal and coping appraisal originated from the PMT. The two processes are driven by the varying source of environmental and intrapersonal information and knowledge, e.g., the means of learning about the risk or personalities of a person (Floyd, Prentice-Dunn, & Rogers, 2000). The combined influence of threat appraisal and coping appraisal would drive adaptive behaviour with aggregative effects as suggested in PMT (Floyd et al., 2000). Threat experience and reliance on public adaptation which were newly developed by SPMPA provided more perspectives to analyse motivation and behaviour in adaptation, which would also differentiate the current model from traditional models such as PMT.

Threat appraisal, also known as risk perception, denotes an individual’s evaluation of two subcomponents, the perceived probability and perceived severity of a hazardous event. Perceived probability and severity capture, respectively, the expected exposure and the estimated level of harm to and consequences for an individual in facing a hazard. Prior studies on SARS have also attempted to assess, less specifically, the perception of risk as a single item (Lau et al., 2003; Cheng, 2004). For instance, Lau et al. (2003) assessed the perceived chance of SARS infection for people and their families, and individuals perceiving a higher chance of their family contracting the disease were associated with a higher frequency of handwashing as an adaptation behaviour. Likewise, Puterman et al. (2009) incorporated threat appraisal into their analysis of SARS and Yellow Nile outbreaks, with a particular focus on people’s emotions and feelings. Positive relationships between the perceived threat and adaptive behaviours were detected in both cases. Interestingly, an exception is recent research on mask use during COVID-19; the author suggested that risk perception has negatively driven the correct use of masks among Vietnam citizens (Huynh, 2020a, 2020b, 2020c). However, as in most cases, risk perception still produces positive effects on adaptive behaviour, the following hypothesis is proposed.

**Hypothesis H1. a:** The level of perceived probability is positively associated with the visitation of country parks.

**Hypothesis H1. b:** The level of perceived severity is positively associated with the visitation of country parks.

Copied appraisal, or the perceived adaptative capacity, describes the assessment of the ability to adjust to and avert detrimental effects of a threat and the associated cost of the adjustment. Perceived adaptative capacity consists of three subcomponents, namely, perceived adaptation efficacy, perceived self-efficacy, and perceived adaptation costs. Perceived adaptation efficacy is the perceived effectiveness of the adaptive measure, perceived self-efficacy represents the perceived ability of an individual to implement a particular adaptation, and perceived adaptation cost is the cost of the adaptive behaviour in terms of money, time, and other potential effort factors. Lau et al. (2003) discussed the perceived effectiveness of SARS protective behaviours and concluded that people with a stronger belief that wearing masks could help avoid contracting SARS performed the adaptive measure more regularly. In a similar vein, Lau et al. (2007) again indicated that higher perceived efficacy in protective measures promoted the implementation
of precautionary measures in the case of the H5N1 outbreak. Evidence on the influences of self-efficacy and perceived adaptation cost is lacking in relevant studies, yet literature on hazard adaptation may provide clues on the relationship between the two predictors and adaptation behaviour (Lo & Cheung, 2016). In a study on climate change adaptation, Grothmann and Patt (2005) ascertained that self-efficacy and perceived adaptation cost are, respectively, positively and negatively associated with adaptive responses (Lo, Chow, Liu, & Cheung, 2019; Lo, Liu, Cheung, & Chan, 2020).

Hypothesis H2. a: The level of perceived adaptation efficacy is positively associated with the visitation of country parks.

Hypothesis H2. b: The level of perceived self-efficacy is positively associated with the visitation of country parks.

Hypothesis H2. c: The level of perceived adaptation cost is negatively associated with the visitation of country parks.

The first variable that differentiates the SPMPA from conventional health behaviour models, threat experience, describes the perceived severity of a threat experience in the past. Grothmann and Reusswig (2006) posited that this predictor would motivate adaptive behaviour, which was supported by previous studies on hazard adaptation (Urwin & Jordan, 2008; Zaalberg, Midden, Meijnders, & McCalley, 2009; Becker, Paton, Johnston, Ronan, & McClure, 2017). In Hong Kong, the magnitude of adaptation behaviours during the H5N1 outbreak was reported to have increased due to the effects of the experience with SARS a few years prior (Lau et al., 2007). The motivation to avoid uncertainty and tendency to prevent impacts of hazards by precautionary adaptive measures have also been proved to increase with the level of past experience in other contexts of hazards (Siegel, Shoaf, Afifi, & Bourque, 2003; Zaalberg et al., 2009). The literature discussing the influence of reliance on public adaptation on adaptive behaviour is sparse (Barnett & Breakwell, 2001; Grothmann & Reusswig, 2006). The determinant denotes the reluctance of individuals to perform adaptive measures when personal effort can be substituted with those of the public or institutions. For instance, in the event of flooding, the government’s effort to build effective public or administrative flooding protection facilities such as levies helps prevent potential damage to households, which results in a lower tendency of individuals to make adjustments themselves. As a result, a reliance on public adaptation can hinder the implementation of adaptive measures.

Hypothesis H3. a: The level of threat experience is positively associated with the visitation of country parks.

Hypothesis H3. b: The level of reliance on public adaptation is negatively associated with the visitation of country parks.

3. Methods

3.1. Study area

Since the enactment of the Country Park Ordinance in 1976, a total of 24 country parks have been designated in Hong Kong. As a major type of protected area, country parks in Hong Kong stretch across 44,300 ha of land, covering up to 40% of the total land area (Cheung & Fok, 2014). All country parks are managed by the Agriculture, Fisheries and Conservation Department (AFCD) of Hong Kong. A broad array of facilities is available in country parks, including over 10 education and visitor centres and numerous footpaths, hiking trails, campsites and barbecue sites. The AFCD reports leisure walks, fitness exercise, hiking, barbecuing, and camping to be the most popular activities in country parks (Agriculture, Fisheries and Conservation Department, 2020a, 2020b). The pristine environment and amenities in country parks have attracted visitors was documented (Agriculture, Fisheries and Conservation Department, 2020a, 2020b).

A total of 12 country parks across Hong Kong were selected as the questionnaire survey sites, including 2 on Hong Kong Island, 1 in Kowloon, 8 in the New Territories and 2 on Lantau Island. The 12 country parks were selected to cover all districts of Hong Kong (except 2 districts without country parks). This aims to capture a better representation of the population across Hong Kong.

3.2. Questionnaire design

A questionnaire was developed as the instrument for the current study with reference to SPMPA, existing studies employing SPMPA or related models or constructs were consulted before the design of the questionnaire items. The questionnaire was divided into four parts. All items in the first three parts were measures on a 5-point Likert scale. The lowest level of agreement with the questionnaire items was represented by 1 score and the highest level by 5 scores, a higher level of agreement with the items refers to a higher level of perception with the particular construct. For example, a score of 5 in RP item reflects a high level of perception of the risk of COVID-19. The first part consisted of 8 items, including items RP1 to RP4 and items RP5 to RP8, which measured the perceived severity and probability of COVID-19. Severity was indicated by, for example, the perceived fatality and contagiousness of COVID-19, and probability was represented by the perceived chance of individuals or their friends and family being impacted by or infected with COVID-19. The second part, with 9 items gauging the perceived adaptation efficacy (PAC1–PAC4), self-efficacy (PAC5–PAC7) and cost of adaptation (PAC8–PAC9), asked respondents to evaluate their ability and resource availability in adapting to COVID-19 and how effective country parks may be in facilitating their adaptation to COVID-19. The cost of adaptation was measured in both time and monetary terms. Items in the first two parts were designed with reference to studies on SARS, H5N1 and general hazards (Lau et al., 2003, 2007; Grothmann & Patt, 2005; Puterman et al., 2009; Le Dang, Li, Nuberg, & Bruwer, 2014). Threat experience and reliance on public adaptation were assessed in the third part by 8 items, including EXP1 to EXP4 and RA1 to RA4, respectively, in accordance with the study of Grothmann and Patt (2005). The items on experience were developed based on the context of SARS, which best represents the experience of Hong Kong people in a pandemic event, given the severity and extensive impacts caused by SARS. The reliance on public adaptation measured the confidence of people in the adaptation policies and effort of the government and the public.

The last part of the questionnaire collected information on the respondents’ visitation patterns to country parks after the outbreak of COVID-19 in terms of frequency and duration, as this reflects their adaptation. The date of the COVID-19 outbreak here specifically refers to 25th January, which is when the Hong Kong government announced the activation of Emergency Response Level and the related responses and measures to tackle novel coronavirus infection (now known as COVID-19). This date was provided to respondents in the briefing as a reference. Basic demographic information about the respondents was also collected in this part.

3.3. Questionnaire survey

Face-to-face questionnaire surveys were delivered during April 2020 in the 12 selected country parks, and pilot tests were carried out earlier in March 2020. The surveys were conducted on both weekdays and weekends. Random sampling was adopted, where 1 in 4 visitors encountered would be invited to join the survey. Target respondents of the survey were Hong Kong residents aged 18 or above. Participation of all the respondents was voluntary, and a cash voucher was given to each participant upon the completion of the questionnaire as a reward. It took approximately 15 min to complete the whole questionnaire. A group of student assistants from a public university in Hong Kong was briefed and trained to carry out the questionnaire survey under the supervisor of the researchers. Student assistants were assigned to stations at the entrances...
of each of the country parks where the possibility of encountering visitors was the highest.

Several precautions were taken to prevent the disease during the administration of the questionnaire survey. According to the Hong Kong government’s Prevention and Control of Disease regulation, social distancing was required in the form that no citizen should stay in groups with more than 4 people. All student assistants were assigned to survey locations individually and did not stay in group. Aside from the requirements of the government, extra preventive measures were implemented. All student assistants were required to wear a face mask throughout the survey, and only visitors with face masks on were invited to join the survey (as most visitors did wear masks, it is unlikely that a biased population would be surveyed). Student assistants would first give participants a brief note and consent form, where participants would read, sign and indicate their willingness to join the survey. Student assistants would then pass participants a printed questionnaire, which participants would be asked to complete individually. Student assistants would stay at approximately 6 feet away from the participant during the process unless a question is raised. Alcohol-based disinfectants were distributed to each student helper and all materials handled by both the assistant and the participant were sanitized before and after the survey.

A respondents-driven pilot test approach was taken, where a small subsample of the sample population was recruited to complete a pilot questionnaire and provide feedback. Thirty respondents of varying demographic profiles with experience visiting country parks after the COVID-19 outbreak in HK were invited. Pilot test respondents were given a cash voucher as a reward similar to the actual survey. The procedures of the pilot survey mimicked those of the actual survey and respondents were asked to first complete the questionnaire and provide feedback afterwards. Upon completion, each respondent was debriefed individually to gather feedbacks on the survey items, design and process (DeMaio, Rothgeb, & Hess, 1998). The pilot survey aimed to test the ability of respondents to comprehend instructions, to assess the length and layout, the clarity of items, and the understanding of terms and language. A few modifications to the terms and language were made according to the feedback from the pilot survey participants to improve the readability and ease of understanding. Participants reflected that the acronyms of SARS and COVID-19 were easier to understand than the full term, so the full terms were given in the briefing only, while SARS and COVID-19 were used instead in the items. Technical terms, e.g. efficacy, were substituted by more layman terms. The section titles for constructs, e.g. risk perception and perceived adaptive capacity were removed as participants reported that they tended to assess the meaning of items from the title instead of reading only the item itself. The arrangement of items was amended to help improve the flow and understanding of participants. For instance, items on threat experience were rearranged and placed after risk perception items as the two constructs were more similar in nature and differed only in the context, so respondents would not need to spend extra effort in determining the meaning of items. A total of 967 visitors were approached, yielding 600 successful attempts and resulting in a response rate of 62.05%.

### 3.4. Data analysis

Cronbach’s alpha coefficients for all constructs were generated to confirm the reliability of the variables. The recommended coefficient levels summarized by Taber (2018) were used as references to evaluate the reliability of the constructs. Multiple linear regression analysis with entry method was employed to investigate the relationship between explanatory variables in the model and adaptive behaviours in terms of the frequency and duration of visits to country parks. As a recent study on COVID-19 indicated that there could be possible geographic effects on the risk perception and adaptation of people (Huynh, 2020a, 2020b, 2020c), the location of country parks was entered as a control variable in the analysis. All statistical tests were carried out with the statistical tool package SPSS 25.0.

### 4. Results

#### 4.1. Demographic characteristics of respondents

As shown in Table 1, the distribution of males (52.3%) and females (47.7%) was fairly even. The plurality of respondents were aged 18–30, comprising approximately one-third of the sample, and fewer respondents were 61 or above (11.2%). Respondents were generally well educated, as more than half had attained post-secondary or undergraduate levels of education. The majority of respondents were in lower income groups, earning 9999 or below (15.7%), 10,000–19,999 (19.0%) or 20,000–29,999 (19.5%) a month (HKD).

When compared to the most recent census statistics in Hong Kong, the gender of respondents in this study showed a similar distribution, where 54% and 46% of the Hong Kong population were female and male respectively. The youngest age group of 18–30 was slightly overrepresented and respondents aged 61 or above were not as frequently encountered than expected, where the two groups comprised a proportion of approximately 20% and 25.5% of the total population (of this age range) (Census and Statistics Department, 2016). Similarly, there were fewer respondents with primary and secondary-level education in this study than the actual population aged 15 or above (~20% and 47% respectively) (Census and Statistics Department, 2016). This is likely associated with the higher proportion of younger respondents who generally attain higher levels of education. As the census statistics show only household income, it is not comparable to the statistics of the current study. This discrepancy in the age distribution of the current study with the general population will be addressed later in the limitation section.

#### 4.2. Risk perception and perceived adaptive capacity

Among the risk perception items (Table 2), respondents were most concerned about the high probability of COVID-19 spreading in Hong Kong (mean = 4.59, S.D. = 0.580), followed by the risk of their family and friends being infected (mean = 4.53, S.D. = 0.613). In general, respondents demonstrated a rather high level of perceived risk, with mean scores of 4.37 and 4.25 for perceived probability and perceived severity, respectively.

Concerning the effectiveness of country parks in aiding adjustment, respondents strongly agreed that the environment provided by the parks was the highest.

### Table 1

Demographic characteristics of respondents.

| Gender          | n     | %   | Age groups       | n     | %   |
|-----------------|-------|-----|------------------|-------|-----|
| Female          | 314   | 52.3| 18-30            | 226   | 37.7|
| Male            | 286   | 47.7| 31-40            | 109   | 18.2|
|                 |       |     | 41-50            | 102   | 17.0|
|                 | Income (HKD) |     |                  |       |     |
|                 | 9,999 or below | 94  | 15.7 | 61 or above     | 67    | 11.2|
|                 | 10,000-19,999 | 114 | 19.0 |                  |       |     |
|                 | 20,000-29,999  | 117 | 19.5 | Education level  |       |     |
|                 | 30,000-39,999  | 72  | 12.0 | Primary level or lower | 44 | 7.3 |
|                 | 40,000-49,999  | 26  | 4.3  | Secondary level  | 208   | 34.7|
|                 | 50,000-59,999  | 14  | 2.3  | Post-secondary or undergraduate level | 306 | 51.0|
|                 | 60,000 or above | 19 | 3.2  | Master’s level or above | 42 | 7.0 |
| No income or retired | 114 | 24.0|                  |       |     |
| Total (N)       | 600   | 100.0|                  | 600   | 100.0|
Table 2
Questionnaire items on risk perception, perceived adaptive capacity, threat experience, reliance on public adaptation and adaptive behaviour (N = 600).

| Item | Strongly agree | Agree | Neutral | Disagree | Strongly disagree | Mean | S.D. | α |
|------|----------------|-------|---------|----------|-------------------|------|------|----|
| **Risk perception** | | | | | | | | |
| **Perceived probability** | | | | | | | | |
| RP1. The chance of me being infected with COVID-19 if I do not take any actions is high. | 40.2 | 49.2 | 8.8 | 1.8 | 0 | 4.28 | 0.698 | 0.766 |
| RP2. The chances of my family and friends being infected with COVID-19 if they do not take any actions are high. | 58.8 | 36.3 | 4.3 | 0.3 | 0 | 4.53 | 0.613 | |
| RP3. The chance of COVID-19 spreading widely in Hong Kong is high. | 63.0 | 33.0 | 3.7 | 0.3 | 0 | 4.59 | 0.580 | |
| RP4. The chance of COVID-19 lasting for a long period of time is high. | 34.3 | 45.2 | 14.0 | 6.3 | 0 | 4.07 | 0.865 | |
| **Perceived severity** | | | | | | | | |
| RP5. COVID-19 could be fatal. | 44.7 | 49.3 | 3.8 | 0.8 | 1 | 4.35 | 0.718 | |
| RP6. COVID-19 is highly contagious. | 45.7 | 49.3 | 3.5 | 0.5 | 1 | 4.38 | 0.676 | |
| RP7. The COVID-19 outbreak is a pandemic. | 28.0 | 52.5 | 14.8 | 4.5 | 0 | 4.04 | 0.798 | |
| RP8. COVID-19 is currently uncontrollable. | 32.8 | 59.0 | 6.5 | 1.5 | 0 | 4.23 | 0.646 | |
| **Perceived adaptive capacity** | | | | | | | | |
| **Perceived self-efficacy** | | | | | | | | |
| PAC1. Country parks provide an environment that helps to improve mental health by relieving my stress and anxiety brought about by the COVID-19 pandemic. | 22.2 | 56.2 | 18.3 | 3.2 | 0 | 3.97 | 0.739 | |
| PAC2. Country parks provide an environment for physical activities that effectively help improve physical health and prevent COVID-19 from spreading. | 20.5 | 50.7 | 22.0 | 6.7 | 0 | 3.85 | 0.827 | |
| PAC3. Country parks are not as crowded as the city, which effectively helps prevent the spreading of COVID-19. | 13.3 | 38.2 | 29.0 | 16.5 | 3 | 3.42 | 1.011 | |
| PAC4. Country parks are good destinations to retreat to during the time of the COVID-19 pandemic. | 6.2 | 28.3 | 37.0 | 21.5 | 7 | 3.05 | 1.012 | |
| **Perceived cost** | | | | | | | | |
| PAC5. I understand COVID-19 and its impacts. | 15.8 | 61.2 | 19.3 | 3.7 | 0 | 3.89 | 0.698 | |
| PAC6. There are many measures I can take to prevent COVID-19 and its impacts. | 13.3 | 63.3 | 21.0 | 2.3 | 0 | 3.88 | 0.650 | |
| PAC7. I have sufficient resources for preventing COVID-19 and its impacts. | 6.8 | 43.2 | 36.3 | 13.0 | 0.7 | 3.43 | 0.826 | |
| **Past experience with SARS** | | | | | | | | |
| EXP1. The outbreak of SARS in 2003 severely impacted my life at the time. | 16.8 | 41.5 | 32.0 | 7.5 | 2 | 3.63 | 0.922 | |
| EXP2. The outbreak of SARS in 2003 severely impacted the lives of my family and friends at the time. | 16.7 | 44.5 | 30.7 | 6.8 | 1 | 3.68 | 0.876 | |
| EXP3. The outbreak of SARS in 2003 severely impacted society at the time. | 29.7 | 51.5 | 15.7 | 2.3 | 0.8 | 4.07 | 0.786 | |
| EXP4. I have learnt lessons from the experience with SARS. | 28.3 | 52.2 | 15.5 | 3.2 | 0.8 | 4.04 | 0.800 | |
| **Reliance on governmental and public adaptation measures** | | | | | | | | |
| RA1. The government has provided adequate assistance to the citizens for the prevention of COVID-19. | 2.8 | 10.2 | 25.7 | 29.5 | 31.8 | 2.23 | 1.990 | |
| RA2. The government has made much effort to prevent and treat COVID-19. | 2.7 | 15.3 | 24.5 | 27.7 | 29.8 | 2.33 | 1.135 | |
| RA3. The Chinese government will assist the Hong Kong government and people in tackling COVID-19. | 1.8 | 15.3 | 19.8 | 23.8 | 39.2 | 2.17 | 1.159 | |
| RA4. As the general public will take preventive measures to avoid the spread of COVID-19, I do not need to take any. | 0.8 | 4.0 | 9.2 | 34.3 | 51.7 | 1.68 | 0.861 | |
| **Adaptive behaviour** | | | | | | | | |
| **Visitation frequency** | | | | | | | | |
| B1. How frequently have you visited country parks since the outbreak of COVID-19? | 0.8 | 9.8 | 26.2 | 29.3 | 33.8 | 2.15 | 1.024 | |
| **Visitation duration** | | | | | | | | |
| B2. How long do you stay in country parks during each visit since the outbreak of COVID-19? | 2.3 | 19.2 | 65.7 | 9.0 | 3.8 | 3.07 | 0.724 | |

Items RP1–RP8, PAC1–PAC8, EXP1–EXP8 and RA1–RA4 were measured on a Likert scale ranging from 5 “Strongly agree” to 1 “Strongly disagree”.
Item B1 was measured on Likert scale ranging from 5 “Everyday” to 1 “Once a month”.
Item B2 was measured on Likert scale ranging from 5 “More than 5 h” to 1 “< 1 h”.

Notes:
- All scale items were measured on a Likert scale ranging from 5 “Strongly agree” to 1 “Strongly disagree”.
- All scale items were measured on a Likert scale ranging from 5 “Everyday” to 1 “Once a month”.
- All scale items were measured on a Likert scale ranging from 5 “More than 5 h” to 1 “< 1 h”.
- All scale items were measured on a Likert scale ranging from 5 “Strongly agree” to 1 “Strongly disagree”.
had learned a lesson from SARS (mean ± S.D. = 4.07, S.D. = 0.786). Respondents also agreed that they had learned a lesson from SARS (mean ± S.D. = 4.04, S.D. = 0.800) (Table 2).

A generally low level of public adaptation reliance was reported (mean ± 2.10). The respondents mostly did not agree that when the general public has taken preventive measures, they themselves do not need to. This may indicate that the respondents were cautious and responsible in adopting disease prevention measures. The majority of respondents expressed that the government did not provide adequate assistance to citizens (mean ± 2.23, S.D. = 1.090) and that it put forth limited effort to tackle COVID-19 (mean ± 2.33, S.D. = 1.135). At the same time, they generally did not believe that the Chinese government would provide assistance to Hong Kong (Mean ± 2.17, S.D. = 1.159).

The reliability of the two constructs was confirmed by the resulting Cronbach’s alpha values of 0.812 and 0.845, as it is suggested that a construct can be considered robust with an alpha coefficient over 0.8 (Taber, 2018).

### 4.5. Multiple regression analysis of SPMPA predictors with adaptive behaviours

Five of the seven paths in the proposed model showed significant results regarding the visitation frequency of country parks (Table 3). The respective positive (r = 0.324, p < 0.001) and negative (r = −0.201, p < 0.001) relationships of perceived adaptation efficacy and perceived cost with visitation frequency supported hypotheses H2a and H2c. On the other hand, perceived severity (r = −0.098, p < 0.05) and threat experience (r = −0.081, p < 0.05) were negatively associated with visitation frequency, and reliance on public adaptation positively predicted visitation frequency (r = 0.096, p < 0.05). These three significant paths rejected hypotheses H1b, H3a and H3b. No support was identified for hypotheses H1a and H2b.

Similarly, perceived severity (r = −0.127, p < 0.01) and perceived cost (r = −0.155, p < 0.001) negatively influenced visitation duration, and perceived adaptation efficacy was a positive predictor (r = 0.287, p < 0.001). These results again confirmed hypotheses H2a and H2c while rejecting hypothesis H1b.

All locations of country parks showed no significant influence on either adaptive behaviour, and the contribution of the variable to the total R² of both cases was negligible (<1%). Therefore, no geographic effects were identified. This is fairly reasonable considering the small geographical range of Hong Kong.

### 5. Discussion and implications

This study drew on the SPMPA to investigate the potential of country parks as spaces for adjusting to the outbreak of COVID-19. A total of five constructs within the regression analysis of visitation frequency and three constructs for that of visitation duration were shown to be significant predictors of adaptive behaviour. From a theoretical point of view, good levels of internal consistency between items of the model constructs and significant correlations were identified between the proposed predictors and adaptive behaviours, indicating the relevance of the model and the associated constructs in studying individual adaptations, albeit with the identification of a few contrasting findings relative to past studies. The resulted adjusted total variance explained by the model variables for visitation frequency and visitation duration were 16.7% and 10.5% respectively. Visitation frequency is arguably a better representation of adaptive behaviour than visitation duration, given the higher variance yielded; hence, the following discussion is primarily based on the adaptive behaviour reflected by visitation frequency. Three hypotheses, H1b, H3a and H3b, were rejected, as the relationships found were opposed to the predictions of past studies, which may actually provide new insights into the use of protected areas for disease adaptation. This also added onto the previous finding of travel motivation of citizens to country parks during SARS by the adoption of a more comprehensive framework (Marafa & Fung, 2004).

### Table 3
Multiple regression analysis of the proposed model variables (N = 600).

| Adaptive behaviour                                      | Visitation frequency | Visitation duration |
|----------------------------------------------------------|----------------------|---------------------|
|                                                           | Standardized coefficient | Standard error | Significance | Standardized coefficient | Standard error | Significance |
| (Constant)                                                | 0.481                | 0.000              |             | 0.137                 | 0.000          |             |
| Risk perception                                           |                      |                    |             |                      |                |             |
| Perceived probability                                    | 0.003                | 0.087              | 0.942       | −0.011                | 0.064          | 0.823       |
| Perceived severity                                       | −0.098               | 0.087              | 0.032       | −0.127                | 0.064          | 0.007       |
| Perceived adaptive capacity                              |                      |                    |             |                      |                |             |
| Perceived adaptation efficacy                            | 0.324                | 0.061              | 0.000       | 0.287                 | 0.044          | 0.000       |
| Perceived self-efficacy                                  | −0.064               | 0.076              | 0.128       | 0.019                 | 0.056          | 0.666       |
| Perceived adaptation cost                                | −0.201               | 0.052              | 0.000       | −0.155                | 0.038          | 0.000       |
| Threat experience                                        | −0.081               | 0.055              | 0.043       | 0.010                 | 0.040          | 0.805       |
| Reliance on public adaptation                            | 0.096                | 0.049              | 0.023       | −0.077                | 0.036          | 0.081       |
| R²                                                       | 0.192                |                    |             | 0.131                 |                |             |
| Adj. R²                                                  | 0.167                |                    |             | 0.105                 |                |             |
| F-statistic                                             | 7.657                | 4.885              |             | 0.935                 | 0.685          |             |

Note: Only regression results of the pathways in the proposed model are shown. The control variable of Country Park locations all showed no significant relationships and contributed to <1% of the adj. R² in both visitation frequency and visitation duration.
The relationship of perceived adaptation cost with adaptive behaviours was consistent with the prediction by the proposed model. This indicated that the lower the cost is to an individual in terms of time and money, the more motivated that individual is to travel to country parks as part of the adaptation to the outbreak. This result highlights the importance of providing accessible protected areas or other nature-based spaces, e.g., urban green space, in or around cities (Ma, Chow, Cheung, & Liu, 2018; Chow, Cheng, & Cheung, 2019; Cheung et al., 2020). Visiting accessible locations reduces the travelling cost and time for people and subsequently facilitates adaptation. The wide coverage and high accessibility of country parks in Hong Kong may therefore be one explanation for the recent crowding.

The three rejected hypotheses, H1b, H3a, H3b, might have opened up a fresh perspective for understanding the adaptation of individuals during this pandemic. The higher perceived severity and threat experience during the SARS outbreak discouraged visits to country parks. Visiting country parks as an adaptive measure inherently and inevitably involves some level of contact with the outside environment and the public (World Health Organization, 2020a, 2020b, 2020c). People’s increased exposure necessarily raised their vulnerability, as well as that of other people, to the disease (World Health Organization, 2020a, 2020b, 2020c), where vulnerability is the function of exposure, adaptive capacity and the sensitivity of a system during a hazardous event (Adger, 2006; Lo & Cheung, 2016; Lo, Cheung, Lee, & Xu, 2016). Subsequently, the increased vulnerability implies a higher risk and impact of infection. This differentiates such adaptive measures from other hygienic or public health measures that decrease the risk of exposure, e.g., quarantine or handwashing. This may explain why people who had greater experience with SARS and perceived higher severity of the situation still refrained from visiting country parks, as doing so best minimized their odds of catching the disease.

Alternatively, individuals with a greater reliance on public adaptation were more inclined towards visitation, which contradicts the proposed negative relationship in the model. As government-initiated measures focused predominately on the public health aspect, attention on psychological adaptation was scarce. People’s trust and confidence in the effectiveness of government efforts to control and treat COVID-19 may make them feel safer when travelling to country parks, thus prompting their visitation. At the same time, as psychological adaptation has not been addressed by public adaptation, the proposed phenomenon of individuals being reluctant to adjust may not completely apply.

The fact that visiting country parks exposes people to the disease, yet people still choose to travel to such places, may seem irrational and perhaps intelligent. From an individual perspective, disease adaptation may not only help prevent the contraction of the disease from a physical aspect but also help individuals cope with anxiety, pressure or other psychological effects brought about by the pandemic. The positive relationship between perceived adaptation efficacy and adaptive behaviour may support this argument. This outcome implied that the overall advantages (in all aspects, including, e.g., mental and physical health enhancement functions) of country parks in adaptation outweighed the added risk of exposure on certain occasions, which made visitation an effective measure in this case. In particular, among the items in adaptation efficacy, the mental health enhancement country parks provide by relieving stress and anxiety brought about by COVID-19 was rated as the most important factor, reconfirming the need to address the mental impact brought about by COVID-19 (Brooks et al., 2020). Country parks may, therefore, be perceived as venues that provide maximum benefits with relatively minimal risks. This phenomenon may also concern measures ordered by the government in tackling COVID-19 in Hong Kong. Although no strict lockdown or curfew were implemented, a number of public leisure facilities such as sports grounds, libraries and community halls have been closed intermittently as required by the government (the Government of the HKSAR, 2020). The operation of some premises, such as karaoke, fitness centres and beauty parlours have also been suspended from time to time during peaks of infection (The Government of the HKSAR, 2020), which further limited the leisure and recreational opportunities of citizens and subsequently their chances to relieve and adapt mentally. Instead of motivating citizens to just stay at home, these measures might have further pushed citizens to explore some much needed relaxing yet relatively safe recreational opportunities, including visiting country parks.

A dilemma then arises when infection control and measures are prioritized, as the consequences of such measures cannot be neglected. Implementing softer social distancing regulations in nature-based destinations, coupled with the use of well-designed crowd and visitor management measures in country parks, may provide a solution to the problematic situation. Without proper management in such spaces, overcrowding and the potentially irresponsible behaviour of visitors may render such coping strategies maladaptive. Maladaptation is an adaptive measure carried out by a system (in this case, an individual) increasing the vulnerability of the target group or other players or systems in the same or a different domain during current or future adaptation efforts (Juhola, Glaas, Linner, & Neset, 2016). In the current case, the adaptation of visiting country parks may be effective in enhancing mental and physical health; however, from a public health perspective, the risk of exposure and vulnerability of not only the individual but also other visitors is increased, and this can potentially exacerbate an outbreak, thus becoming a maladaptation. In a recent publication, Samuelsson et al. (2020) also stated that “whether cities can simultaneously promote nature contact and social distancing is a matter of how they are spatially organized”, again confirming the function of nature in disease adaptation and the associated management needs. Nevertheless, the more open environment of country parks than that of the compact city of Hong Kong or other cities around the world may provide great opportunities for measures such as social distancing, which was also generally agreed with by respondents in this study. Taking Hong Kong as an example, the campsite and barbecue sites in country parks have been closed to avoid the gathering of crowds, while other types of activities such as hiking have still been allowed. At the same time, conventional public health measures, e.g., social distancing and wearing face masks, should not be abandoned when travelling in country parks. In fact, the Hong Kong government has extended the regulation on mandatory mask wearing in general public space (e.g., in transit stations) to country parks at the 3rd local outbreak during July, which was abandoned after the eventual decline of cases by the end of August (the Government of the HKSAR, 2020). This demonstrated that another measure might help to build a safer country park environment without compromising the opportunity of citizens to visit nature. The appropriate and careful management of visitors and advocacy of responsible behaviour can make visiting country parks a physically, hygienically and psychologically viable option for disease adaptation. For instance, in managing visitors, advocating the visitation of less popular country parks or hiking routes could be a solution to reduce the chances of crowding. In the short run, such results suggest that allowing the visitation of protected areas or other types of nature-based spaces should be considered an alternative by countries or cities that are implementing strict lockdown or quarantine measures. In the long run, the findings illustrate that it is pivotal to provide accessible nature-based spaces of various forms to build resilience among cities and their residents in future pandemic events.

6. Limitations, recommendations for future studies and conclusions

The slight discrepancy in the age distribution of respondents to the general population may imply a limitation of this study. The older population that is more vulnerable to COVID-19 (U.S. Department of Health, Human Services, 2020), is also the group that is more likely to be experienced with SARS that occurred 17 years ago. Age, in this case, may influence the experience and adaptation perceptions on COVID-19. However, this group might have avoided public spaces in the first place,
causing them to be underrepresented. Future studies may need to take alternative survey approaches and interview a wider population than Country Park users to capture a better picture for the whole population and to take into account the impacts of socio-demographics factors on the psychological and perceptual variables for a more comprehensive investigation. The fact that current study was unable to capture the visitation rate change from the pre-outbreak to post-outbreak of COVID-19 could be another limitation. By capturing the change in rate, an even better representation of adaptation may be reflected.

Upon discussing how the psychological and physical needs of individuals may play a role in shaping the perceived adaptation efficacy of visiting country parks during a pandemic and how the benefits of such visits may outweigh the efforts of increased exposure, future studies may further examine the actual needs of people and how such needs directly influence perceived efficacy and, subsequently, adaptive behaviour. The unique landscape and setting of Hong Kong enable the high proximity of urban areas to country parks; hence, protected areas have become a salient space for adaptation in Hong Kong. Nonetheless, protected areas in other parts of the world are usually situated farther from residential areas; therefore, the results here may not be completely applicable and generalizable to other countries or places. However, this does hint that nature-based spaces of some kind would very likely serve a similar purpose Future research may also explore the ability of other types of nature-based spaces within accessible distances to local residents, e.g., the countryside or urban green space, to facilitate adaptation.

In conclusion, given the significant paths detected, this study successfully predicted adaptive behaviour in response to COVID-19 in terms of visitation frequency and duration by the proposed model based on the SPMPA. The respective positive and negative influences of perceived adaptation efficacy and adaptation cost on adaptive behaviour were consistent with findings in the past. Alternatively, associations between visitation frequency and perceived severity, threat experience and reliance on public adaptation revealed that individuals may be discouraged from visiting country parks, as doing so is not completely risk-free. These findings imply the need to acknowledge the psychological and physical needs of people during the COVID-19 pandemic. To make visits to country parks a more reliable adaptive behaviour, proper visitation management measures should be implemented to optimize the benefits of visiting country parks relative to the associated risk.

CRediT authorship contribution statement

Anson T.H. Ma: Conceptualization, Methodology, Data curation, Writing - original draft, Visualization, Investigation. Theresa W.L. Lam: Data curation, Writing - original draft, Visualization, Investigation.

Lewis T.O. Cheung: Conceptualization, Methodology, Data curation, Writing - original draft, Supervision, Validation, Writing - review & editing.

Lincoln Fok: Supervision, Validation, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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