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Personality and travel intentions during and after the COVID-19 pandemic: An artificial neural network (ANN) approach

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ABSTRACT

The tourism sector has been deeply ravaged by the COVID-19 pandemic as many individuals abstained entirely from travel. Thus, before contemplating the trajectory of the sector's recovery, it is essential to understand individuals' travel intentions both during and after the pandemic. The present study contributes in this regard by examining the impact of individuals' personality traits categorised by the five-factor model, or the Big Five, on their leisure travel intentions during and after the pandemic. To this end, we utilised an artificial neural network (ANN) approach to analyse 500 responses from individuals residing in Japan. The results reveal that extraversion has the strongest relative influence on intentions to travel during the pandemic, whereas openness to experience has the strongest influence on travel intentions after the pandemic. This study is the first of its kind to examine the influence of the Big Five personality traits on travel intentions in the context of a pandemic.

1. Introduction

Due to the COVID-19 pandemic, which refuses to abate, the world is facing unprecedented times. The severity of the pandemic's impact is underscored by recent statistics released by the World Health Organisation (WHO), indicating 175,987,176 confirmed cases of COVID-19 infection and 3,811,561 deaths worldwide as of 15 June 2021. The scale of the pandemic has changed people's daily lives in myriad ways, particularly because lockdowns, which were imposed as preventive measures for controlling the spread of COVID-19, required individuals to perform all personal and professional obligations from the confines of their homes (Tu et al., 2021). As a result of these measures, working from remote locations, teaching and learning online and other relatively novel experiences have become the norm (Wang et al., 2020).

The restrictions imposed on movement for personal and professional purposes have also seriously impacted the performance of various sectors, including finance, aviation, agriculture and tourism. (Xiong et al., 2020). Sectors requiring people's physical presence (e.g. hospitality and

entertainment) have witnessed an extremely high increase in unemployment because the demand for such services has plummeted to almost zero. From this perspective, the tourism sector has borne the brunt of the COVID-19 pandemic (Donthu & Gustafsson, 2020). The ravaging effects of the pandemic on the tourism sector have continued unabated in 2021, with recent reports indicating a nearly 87% decrease in international tourist arrivals in January 2021 compared to figures from the same month in 2020 (UNWTO, 2021). Infections have, moreover, continued to swell in wave after wave, which has exacerbated individuals' feelings of fear and thus caused panic, anxiety and stress (Fitzpatrick et al., 2020). These circumstances have raised valid concerns about the future of the tourism sector, with a great deal of speculation and, in fact, pessimism about the recovery of travel and tourism activity. The general consensus of these discussions is that travellers' characteristics and behaviours will play a significant role in the evolving landscape of travel and tourism (De Vos, 2020).

It is, therefore, not at all surprising that scholars have urgently called for research on the tourism sector to explore the ways in which learning

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during the pandemic can be used to advance the sector's crisis-enabled transformation (Sigala, 2020). An important aim of such studies must be to understand changing consumer behaviour in the face of crises. Responding to such calls, recent studies related to the pandemic have examined consumer-related issues, such as the mental health of tourists (Zheng et al., 2020), new travel approaches post-pandemic or travel-related consumption behaviour (Kock et al., 2020; Wen et al., 2020). To elaborate, Zheng et al. (2020) observed that tourists' ability to establish a positive connection with others may be adversely affected if they do not feel warmly welcomed while visiting a foreign country for leisure, resulting in a persistent reduction of self-acceptance and self-esteem and a persistent increase in bleakness or vulnerability. In a similar vein, Kock et al. (2020) developed an evolutionary tourism paradigm to address key concerns in tourism research after the onset of the pandemic, revealing the association of perceived infectability with psychological concepts such as ethnocentrism and xenophobia. In addition, Wen et al. (2020) predicted that the pandemic is likely to affect Chinese individuals' consumption patterns related to free and independent travel, wellness tourism and luxury trips, among others. Furthermore, Zheng et al. (2021) argued that threat severity and susceptibility could cause 'travel fear' in China, which may lead to protection motivation and protective travel behaviours in the face of crises. The results also underscored that 'travel fear' can induce varied coping strategies, which may increase individuals' psychological resilience and adherence to cautious travel behaviours. Individuals may also differ in their response to the crisis. Past studies have noted that reactions to situations vary from individual to individual (Casini et al., 2020). Some become overwhelmed by the slightest changes in their routines, while others exhibit a tremendous amount of resilience even during times of great uncertainty and turmoil (Casini et al., 2020).

Obviously, this variability of reactions is related to individuals' mental make-up and psychology. Specifically, because personality shapes individuals' reactions to and interactions with the surrounding milieu (Allport, 1937), personality traits may play a vital role in affecting individuals' travel behaviour. Past studies have examined varied measures and models of personality attributes; among these, the five-factor model is the most prominent and well-utilised in the psychology literature and in tourism research (Ying & Norman, 2014).

The five-factor model proposed by Costa and McCrae (2008) explains the genetic, biological and causal underpinnings of five traits—neuroticism, conscientiousness, extraversion, agreeableness and openness to experience. These traits, which are universal, are also termed the 'Big Five' personality traits. Widely investigated for the past four decades (Jani & Han, 2013; Tang & Lam, 2017), this model has emerged as a popular theoretical framework for examining individuals' personalities in general and in the tourism domain in particular (Moghavvemi et al., 2021; Youn et al., 2017; Leung & Law, 2010). Indeed, personality traits are well-acknowledged predictors of consumers' travel behaviour in the related literature (e.g. Kim et al., 2018; Ong & Musa, 2012). For instance, Kim et al. (2018) found that anxiety attachment has a moderating effect on the relationship between visitors' personality traits and expo (expositions) attachment. Similarly, Ong and Musa's (2012) study of tourist Scuba divers' experiences found a positive association between personality and responsible underwater behaviour. Leung and Law (2010) also observed a strong association between personality and service satisfaction.

The preceding discussion can be summarised in two key observations: (a) consumer behaviour in terms of their readiness to travel is a key consideration for assessing the trajectory of the tourism sector's recovery after being devastated by the pandemic, and (b) personality traits may facilitate examining the behaviour of tourists in the COVID-19 context. Building upon these observations, we argue that scholars must examine the readiness of consumers to travel in the context of the pandemic by investigating the personality traits proposed by the five-factor model as drivers of their intentions to travel during and after the pandemic. This approach enables us to respond to calls for research

related to the recovery of the tourism sector even as the pandemic and its effects continue to loom large. We propose advancing this investigation via two research questions (RQs): **RQ1:** How do the Big Five personality traits influence individuals' intentions to travel for leisure during and after the pandemic? **RQ2:** What are the differences in the relative influence of the five traits on individuals' intentions to travel for leisure during and after the pandemic? To respond to the above research questions, we collected data from 500 individuals residing in Japan and analysed it using an artificial neural network (ANN) approach.

The uniqueness of our study derives from its three key aspects. First, the study offers insights into tourist behaviour in the context of a health crisis. With the pandemic still raging, such an investigation provides a novel perspective to the pandemic-related tourism literature, which remains in an embryonic state. Second, the study utilises the five-factor model to explain travel intentions in the context of pandemics. Although the model has been used extensively in the tourism and hospitality context, it has not been extended to explain tourist behaviour/intentions during a crisis such as the current pandemic. Thus, our study enriches the knowledge base in the area. Finally, the study employs ANN as a tool for data analysis, thereby contributing to methodological advancement in the tourism literature. Although recent studies have acknowledged ANNs as a robust method for examining associations between variables that have non-linear as well as linear relationships (e.g. Talwar, Talwar, Kaur et al., 2021; Talwar, Talwar, Tarjanne et al., 2021), existing scholarship has not applied this method to examine consumer behaviour in this area. In sum, the present study offers novel and valuable theoretical and practical insights.

The remainder of the study is structured as follows. Section 2 presents the theoretical background while Section 3 presents the conceptual model. Sections 4, 5 and 6 provide the data and methods, results and discussion. The study concludes with implications, future research areas and limitations.

2. Theoretical background

2.1. COVID-19 and tourism research

The existing scholarship has acknowledged the onset of the pandemic and its impact on travel as a key cause and concern, motivating academic research on related themes. While some scholars have focussed on the adverse impact and recovery of the sector from the pandemic, most studies have focussed on individuals' travel intentions. Noting the severity of the pandemic's impact, Abbas (2021) highlighted the importance of resilience and crisis management. Focussing on the future of travel, Sanjita et al. (2021) predicted the number of foreign tourists using an ANN approach. Numerous studies have been conducted to explain the impact of COVID-19 on individuals' intentions to travel (Zheng et al., 2021; Pappas, 2021; Liu et al., 2021; Gupta et al., 2021). For instance, in a study on adult residents of Greece, Pappas (2021) confirmed the impact of the pandemic on holiday intentions. Similarly, Gupta et al. (2021) found a significant positive association between perceived risk of travelling, perceived severity of and perceived vulnerability to COVID-19, on one hand, and intentions to evade travel, on the other. At the same time, the study found an inverse association between personal efficacy and intentions to evade travel. In another related study, Zheng et al. (2021) reported that threat severity and susceptibility can enhance 'travel fear', thereby inducing protection motivation and protective travel behaviour after the pandemic. Findings have also revealed that 'travel fear' can evoke various coping strategies. In a similar vein, Perić et al. (2021) observed that the risk perceptions of Serbian tourists negatively affected their intentions to travel during the pandemic while Garcia and Leoni (2021) revealed that individuals exposed to COVID-19 had a relatively higher willingness to travel. Contributing to the growing literature in the area, Liu et al. (2021) found that the perception of COVID-19 had a negative impact on outbound travel by individuals residing in China while risk tolerance had a

negative moderating influence on the association between COVID-19 perception and travel intentions after the pandemic. In addition, Xie et al. (2021) revealed a significant moderating impact for empathy and perceived waiting time on the association between risk message frames and post-pandemic travel intentions.

2.2. Five-factor theory

Costa and McCrae's five-factor model (FFM; Costa & McCrae, 1992) rests on personality traits that represent essential building blocks of human personality. Initiated by the work of Fiske (1949), Tupes and Christal (1961) and Norman (1963), which Smith (1967) and McCrae and Costa (1987) advanced, scholarship around this theory has evolved throughout the years. The model comprises five personality traits—neuroticism, conscientiousness, extraversion, agreeableness and openness to experience. Neuroticism, a negative emotional state that leads to emotional instability (Myers et al., 2010), is related to feelings of insecurity, distress, guilt, anger, depression, anxiety and aggression, while conscientiousness is linked to being more goal-oriented, organised, determined, perseverant and dedicated in nature. Next, extraversion is associated with being expressive, sociable and outgoing, whereas openness to experience is related to being imaginative, creative, curious and broad-minded. Finally, agreeableness is linked to being compassionate, caring, generous, trusting and cooperative. Developing the model further, Olson and Evans (1999) explained that neuroticism and extraversion influence individuals' emotions, while agreeableness, openness to experience and conscientiousness influence their cognition.

2.3. Personality, intentions and tourism research

Because it is relatively stable over time (Servidio, 2015) and responsible for individual differences (Moghavvemi et al., 2021), personality serves as a reliable perspective for examining user behaviour. Personality traits are immensely important because they reflect individuals' values, attitudes and behaviour (Huang et al., 2014). Differences in an individual's personality trigger a variety of positive and negative emotions in response to different situations and in the decision-making process (Moghavvemi et al., 2021; Tang & Lam, 2017). Travel intentions refer to individuals' intent to travel or choose a particular destination (Lee, 2009; Wu, 2010; Cheng, 2009; Lu, 2010). Several past tourism studies have confirmed the association of personality traits with intentions and behaviours. In fact, the exploration of tourism behaviour from the perspective of personality began in 1972 (Huang et al., 2014; Plog, 1972). Subsequent studies have revealed interesting findings. For instance, Moghavvemi et al. (2017) found that openness to experience and agreeableness positively influence tourism-related attitudes, such as an individual's sympathetic understanding and welcoming nature.

Personality traits of agreeableness and extraversion have also been shown to moderate the association between consumer behaviour characteristics, i.e. emotional closeness and welcoming nature, and tourism-related attitudes (Moghavvemi et al., 2017). Similarly, personality traits influence individuals' intentions to travel (Hajibaba et al., 2015; Hajibaba et al., 2016; Lepp & Gibson, 2008; Yoo & Gretzel, 2010). In addition, Jani and Han (2013) noted that personality traits influence hotel guests' emotions. Specifically, their results indicated that openness to experience was less useful in explaining positive and negative consumption emotions and social comparison, while conscientiousness impacted only social comparison. At the same time, extraversion was positively associated with both positive and negative emotions and comparison, agreeableness significantly influenced both consumption emotions, and neuroticism influenced social comparison and negative consumption emotions. In another study, Tan et al. (2004) found that agreeableness and neuroticism influenced positive emotions among fast food restaurant diners, while neuroticism had a negative influence on guest satisfaction in the hotel industry. In a similar context, Tang and Lam (2017) revealed a positive association of agreeableness and

extraversion with attitudes towards green hotels.

Past studies have employed the FFM to examine consumer behaviour towards activities related to tourism, such as mountain-biking tours and mountaineering. Matzler et al. (2005) revealed that neuroticism contributed to negative emotions, while extraversion resulted in positive emotions among customers of mountain-biking tours; these emotions, ultimately, influenced customers' satisfaction levels. Contributing further, Faullant et al. (2011) observed that extraversion was positively correlated with mountaineers' joy, while neuroticism was positively correlated with fear.

Existing scholarship has also noted the impact of personality traits on people's responses to a crisis. For example, Huang et al. (2014) contended that personality influences the ways in which individuals respond to the environment and situations. It also impacts individuals' behaviour and ability to cope with stressful situations (Youn et al., 2017; Vollrath, 2001). In the specific case of the tourism sector, Hajibaba et al. (2015) evaluated active travellers during a crisis, noting that they scored high on openness to experience, agreeableness and conscientiousness and low on neuroticism. Similarly, Hajibaba et al. (2016) demonstrated that personality influences individuals' cancellation-related decision-making during a crisis. Drawing upon these findings, recent studies have examined the impact of personality on individuals' COVID-related behaviours. For example, Kim et al. (2021) observed that personality significantly moderates the associations among attitude, personal norms and behaviour during the COVID-19 pandemic. Another recent study confirmed the impact of the Big Five personality traits on Chinese individuals' engagement with COVID-19 measures (Carvalho et al., 2020).

3. Conceptual model

Building upon the evidence in the extant literature (e.g. Youn et al., 2017; Hajibaba et al., 2016; Jani et al., 2014), we propose to examine the influence of the Big Five personality traits on intentions to travel for leisure during and after the COVID-19 pandemic. Fig. 1 presents the underlying research model, while Table 1 describes the five traits.

3.1. Openness and intentions to travel for leisure during and after the pandemic

Openness is related to the need for arousal (Chang et al., 2019). Individuals high on openness tend to be creative, curious, artistic, intellectual and insightful. In addition, individuals who are more open remain confident during times of adversity (Schutte et al., 1998). Although scholars have not yet examined the association between openness and intentions to travel in the context of a pandemic, the description of the trait suggests that the travel intentions of individuals who are more open to experiences will be comparatively less impacted by the risk and uncertainty surrounding the pandemic both before and after it is over. Furthermore, because individuals high on openness are imaginative, creative, curious and broad-minded, their intentions to travel during and after the pandemic are likely to be positive. Thus, we anticipate openness to positively influence individuals' travel intentions in the context of the COVID-19 pandemic.

3.2. Conscientiousness and intentions to travel for leisure during and after the pandemic

Conscientious individuals are organised in nature, which enables them to make planned and predictable consumption decisions (Chang et al., 2019). Otero-López and Villardefrancos (2013) observed that such individuals avoid engaging in impulsive and compulsive purchasing decisions. Conscientious individuals are usually goal-oriented and determined to achieve their aims. In addition, individuals high on conscientiousness are quite disciplined, methodical, dependable and diligent (Witt et al., 2002). Hence, they are highly likely to make decisions based on available guidelines and established goals, and it is

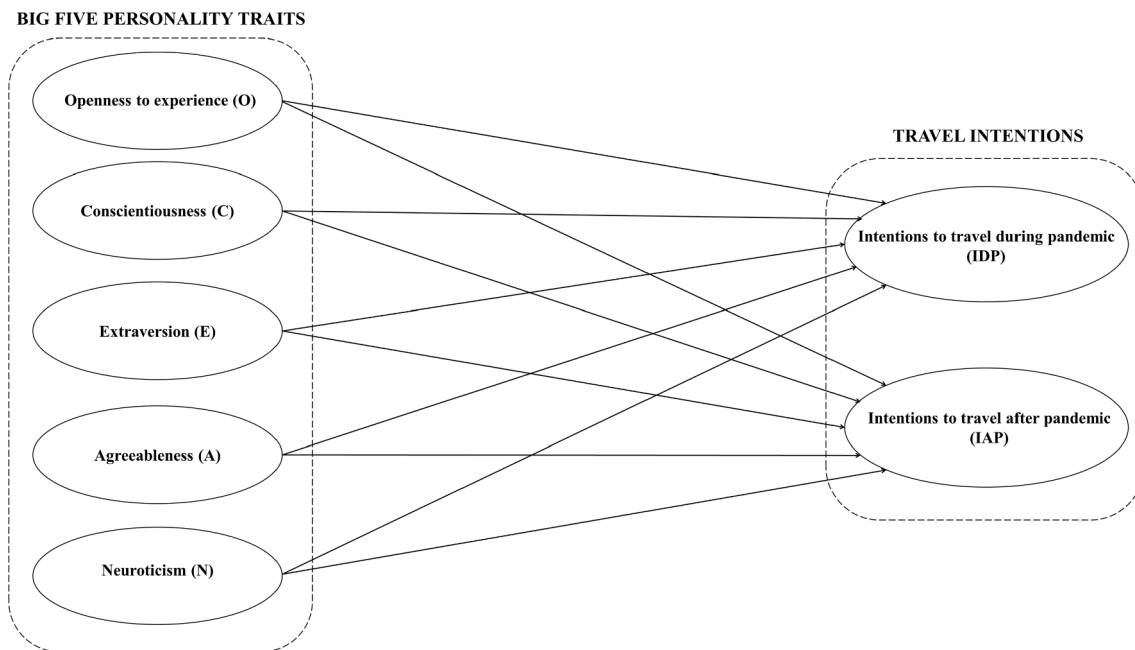


Fig. 1. Conceptual model.

reasonable to assume that such individuals would be inclined to follow all rules and regulations imposed by governments to control and stop the spread and/or recurrence of a health crisis. Because the key control measures related to the COVID-19 pandemic include efforts to avoid contact with others and travel, we expect conscientiousness to impact intentions to travel during and after the pandemic. Further, we anticipate the influence of conscientiousness on travel intentions to be negative, indicating that individuals with this trait would act responsibly and avoid travel during and after the pandemic. Based on the preceding discussion, we posit that conscientiousness will negatively influence the travel intentions of individuals during and after the pandemic.

3.3. Extraversion and intentions to travel for leisure during and after the pandemic

Extraverts are typically excitement-seeking individuals who desire to be unique (Chang et al., 2019). They are generally outgoing and venturesome in nature (Elshaug & Metzger, 2001). Furthermore, such individuals tend to express themselves quite confidently (Chang et al., 2019; Otero-López & Villardefrancos, 2013). In addition, Chang et al. (2019) linked extraversion with the need for status, and earlier research found that extraversion leads to positive emotions among individuals in the hospitality and tourism industry (Faullant et al., 2011; Matzler et al., 2005). Although no past study has investigated the effect of extraversion on the tendency to travel when the related risk is high, research confirming the role of extraversion on the decisions of individuals associated with the hospitality and tourism industry, coupled with evidence supporting extraverted individuals' gregariousness and need for status, enables us to speculate about extraverts' travel-related decisions during and after the ongoing pandemic. In this context, we contend that extraverts may be driven by their outgoing nature to travel without regard for pandemic-related risks. This is also plausible because engaging in travelling during and after the pandemic could enable these individuals to enhance their status by directing the attention of their social group to them. It is equally arguable that extraverts are motivated to travel by their voluntary and venturesome nature, which makes them feel responsible for taking the initiative to travel and show its consequences to others. In sum, we draw upon the characteristics of extraverted individuals to propose that extraversion will positively influence the intentions of such individuals to travel during and after the pandemic.

3.4. Agreeableness and intentions to travel for leisure during and after the pandemic

Agreeableness is empirically associated with being prosocial and generous in nature (Carlo et al., 2005). Individuals with this trait also tend to be cooperative and display a higher likelihood of adhering to normative rules (Bellou et al., 2018). In the context of the COVID-19 pandemic, these characteristics lead us to anticipate that individuals high on agreeableness will be inclined to follow the guidelines established by governments and healthcare agencies to control the spread of the virus. As discussed above, one of the key guidelines has been to avoid nonessential travel. Similar situations occurred around the world. We posit that individuals high on agreeableness will tend to avoid travel not only during but after the pandemic until the governments give a clear mandate that their citizens can travel freely around the world. In other words, we anticipate agreeableness to negatively influence travel intentions during and after the pandemic.

3.5. Neuroticism and intentions to travel for leisure during and after the pandemic

The emotional stability of individuals is reflected in a personality trait termed neuroticism; neurotic individuals have low emotional stability, self-esteem and self-confidence (Bellou et al., 2018; Mehmetoglu, 2012). Their lack of confidence and self-esteem is evident from the fact that neurotic individuals devote a significant amount of time to selecting destinations and otherwise working to minimise risks that may arise due to faulty planning (Jani et al., 2014). In addition, individuals with a higher level of neuroticism struggle to regulate their feelings and emotions (Youn et al., 2017; Gunthert et al., 1999). In fact, existing scholarship has noted neuroticism's association with negative emotions (Faullant et al., 2011; Matzler et al., 2005; Orth, Limon & Rose, 2010; Orth, Robins & Soto, 2010). Neurotic individuals are also more likely to become stressed when exposed to difficult situations (Bolger & Zuckerman, 1995). Based on the above discussion, we suggest that individuals with neurotic personalities are highly likely to feel stressed and anxious about exposure to the COVID-19 virus, and this anxiety, in turn, is likely to reduce their intentions to travel not only during the pandemic but also immediately after it is over. In sum, we posit that neuroticism, which makes individuals feel insecure, vulnerable, emotionally unstable and

Table 1
Operational description of the constructs.

Variable	Description	Reference
Extraversion	Extraversion relates to the energy individuals exhibit when encountering the social and material world. The trait is associated with being expressive, sociable and outgoing.	Goldberg, 1981, 1990; Costa & McCrae, 1992; John & Srivastava, 1999; McCrae & John, 1992; Moghavvemi et al., 2017; Youn et al., 2017; Leung & Law, 2010
Conscientiousness	Conscientiousness is an individual's tendency to control impulses, act in a socially suitable way and exhibit goal-directed behaviour. This trait is linked to being goal-oriented, organised, determined, perseverant and dedicated in nature.	
Openness to experience	Openness to experience represents the deepness and intricacy of an individual's mental life and experiences. The trait is related to being imaginative, creative, curious and broad-minded.	
Agreeableness	Agreeableness represents an individual's tendency to be compassionate, caring, generous, trusting and cooperative. The trait is linked with an individual's ability to interact with others.	
Neuroticism	Neuroticism is related to an individual's feelings of insecurity, distress, guilt, anger, depression, anxiety and aggression.	
Intentions to travel during the pandemic	Intentions to travel during the pandemic captures tourists' intent to travel while the COVID-19 virus is still spreading.	Lee, 2009; Cheng 2009; Lu, 2010
Intentions to travel after the pandemic	Intentions to travel after the pandemic measures tourists' intent to travel once the COVID-19 virus is no longer spreading.	

stressed, will have a negative influence on their pandemic-related travel intentions.

4. Data and methods

4.1. Data

Cross-sectional data were collected for analysis from Japan in December 2020. The survey instrument was administered through the online system of Macromill, Inc., which is among the well-known market research firms in Japan. The sampling criteria were set to produce a gender balance (50% male) in the respondents, with ages between 25 and 79 years and residence in Tokyo. In addition, the respondent recruitment criteria were set to exclude students and ensure that the respondents were divided equally between solo and group travellers. Data were collected in one wave only. The questionnaire was adapted from pre-validated scales used in the extant literature. The Big Five personality traits were measured using Yoo and Gretzel's (2011) 25-item inventory. The items were measured on a seven-point rating scale, with 7 indicating 'strongly agree' and 1 indicating 'strongly disagree'. The measures' content validity was assessed by obtaining feedback from three professors in the areas of tourism, hospitality and psychology. After incorporating these experts' suggestions, we conducted a pilot

study with ten respondents representing the target segment to ensure face validity.

The final instrument was then administered through Macromill, Inc. Although we initially collected 513 responses, we removed 13 outliers based on Z-scores. The remaining 500 valid and complete responses were subjected to further analysis. Table 2 details the profile of the respondents.

4.2. Data analysis method

Researchers (e.g. Dhir et al., 2021; Kumar et al., 2021) frequently utilise structural equation modelling (SEM) as a data analysis approach. However, the two types of SEM (covariance-based, or CB-SEM, and variance-based, or VB-SEM) have certain prerequisites related to data, as discussed in recent studies (e.g. Talwar, Talwar, Kaur et al., 2021; Luqman et al., 2021). For instance, CB-SEM has certain sample size requirements. In addition, the sample must not include outliers, and the data should be linear, normally distributed, homoscedastic and free from multicollinearity (Talwar, Talwar, Kaur et al., 2021). While VB-

Table 2
Respondents' demographic details.

Gender	Percentage	Frequency
Female	49.20	246
Male	50.80	254
Age group		
25–34 years	18.60	93
35–44 years	22.20	111
45–54 years	18.60	93
55–64 years	18.20	91
65 years and above	22.40	112
Marital status		
Unmarried	50.80	254
Married	49.20	246
Children		
No children	56.80	284
Children	43.20	216
Household income in JPY		
Less than 2 million	4.60	23
2–4 million	18.80	94
4–6 million	18.40	92
6–8 million	12.40	62
8–10 million	8.40	42
10–12 million	8.20	41
12–15 million	5.00	25
15–20 million	2.40	12
20 million or more	1.20	6
Do not know	11.40	57
Missing values	9.20	46
Personal income in JPY		
Less than 2 million	22.20	111
2–4 million	23.80	119
4–6 million	17.60	88
6–8 million	9.80	49
8–10 million	4.80	24
10–12 million	2.60	13
12–15 million	2.20	11
15–20 million	0.60	3
20 million or more	1.00	5
Do not know	6.80	34
Missing values	8.60	43
Profession		
Public official	2.60	13
Manager and official	3.00	15
Company employee (clerical)	26.40	132
Company employee (technical)	10.80	54
Company employee (Other)	10.40	52
Self-employed	3.60	18
Freelancer	4.40	22
Housewife (househusband)	14.80	74
Part-time job	8.40	42
Others	2.80	14
Unemployed	12.80	64

SEM has more relaxed sample-related requirements, it also requires the data to be linear and possess other multivariate characteristics (Hew et al., 2019; Talwar, Talwar, Tarjanne et al., 2021). Consequently, scholars suggest using an ANN approach for data that exhibit both linear and non-linear associations and deviate from other multivariate characteristics mentioned above (e.g. Leong et al., 2020; Talwar, Talwar, Kaur et al., 2021).

ANN is an artificial intelligence and machine-learning based approach that uses input, hidden and output neurons to generate output in terms of the influence of antecedents on outcome variables. The network of neurons is trained with new information to conduct analysis and generate output. The training process is driven by a two-way (i.e. forward and backward) information flow. Multiple rounds of the training process help to minimise errors. In the current study, we applied ANN by dividing the available data into training and testing data to generate output in terms of the relative importance of each proposed antecedent. We used the root mean square error (RMSE) values of various models to evaluate the accuracy of the predictions.

5. Results

5.1. Data characteristics

We employed the Kolmogorov-Smirnov (K-S) test recommended by scholars (e.g. Simard & L'Ecuyer, 2011) to examine whether the data in our study conformed to the Gaussian distribution. Based on the asymptotic significance (two-tailed) of the test statistic, we rejected the null hypothesis proposing normality. We also examined the data for multicollinearity issues based on tolerance and variance inflation factor (VIF) values, as in recent studies (e.g. Talwar et al., 2020; Tandon et al., 2021). Because the tolerance values for all constructs exceeded 0.1 and the VIF values were well below the recommended cut-off value of 5 (Hair et al., 2011), the absence of multicollinearity is indicated. Further supporting this assertion, the values of the inter-construct correlations were also less than 0.80 (Hair et al., 2011). Table 3 provides the specific values.

Because the presence of non-linearity is a key indicator for the fact that ANN is better suited for data analysis, we examined the data for the presence of same using the recommended ANOVA test (Hew et al., 2019). The test indicated that the first dependent variable, intentions to travel during a pandemic, had linear relationships with openness to experiences and agreeableness and non-linear relationships with conscientiousness, extraversion and neuroticism. On the other hand, the second dependent variable, intentions to travel after the pandemic, had linear relationships with conscientiousness, agreeableness and neuroticism and non-linear relationships with openness and extraversion. The existence of both linear and non-linear relationships further indicates the suitability of ANN for data analysis.

Although ANN does not depend on the multivariate characteristics of the data, we also examined the data to assess whether they were homoscedastic or heteroscedastic because this allowed us to understand the nature of the data more fully. We employed two approaches for this purpose—first, by using the Glejser test for heteroscedasticity (Glejser, 1969) and, second, by plotting the standardised regression residuals and the dependent variables (Figs. 2 and 3). Visual inspection confirmed the

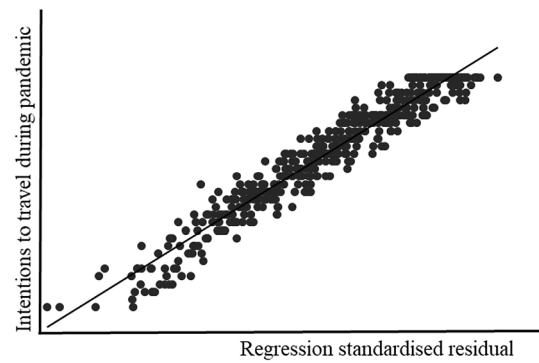


Fig. 2. Plot of standardised residuals (IDP).

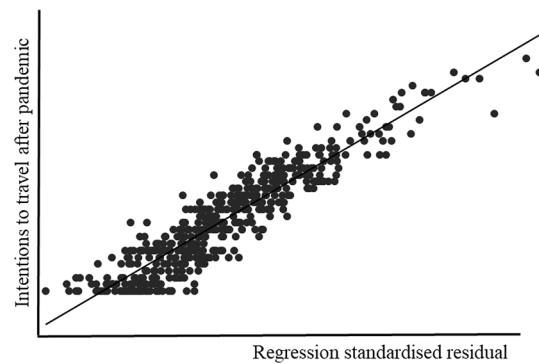


Fig. 3. Plot of standardised residuals (IAP).

data to be homoscedastic.

5.2. Common method bias (CMB)

Because the data for both the explanatory and outcome variables were collected through a single, self-report instrument, the data may exhibit the common method bias (CMB). We attempted to control for CMB at the point of data collection itself by adhering to the prescribed precautions of maintaining respondent anonymity and designing the questionnaire accordingly. However, to further confirm that CMB was not an issue in our data, we used Harman's single factor test in consonance with recent studies (Talwar et al., 2020). Because a single factor explained only 23.06% of the total variance (less than the recommended cut-off value of 50%), we concluded that our data had no such bias.

5.3. Validity and reliability measures

Consistent with the recommended approach, we assessed the robustness of the survey instrument and the measurement items through certain validity and reliability measures (Hair et al., 2010). First, we confirmed the reliability of the instrument using Cronbach's alpha and composite reliability (CR) values. All computed values conformed to the recommended cut-off value of 0.7, confirming the instrument's

Table 3
Descriptive and reliability validity statistics.

	Mean	SD	A	CR	AVE	MSV	ASV	O	C	E	A	N	ITV	ITT
O	3.05	1.00	0.89	0.89	0.63	0.39	0.16	0.79						
C	3.13	0.94	0.87	0.87	0.57	0.39	0.12	0.63	0.76					
E	4.27	1.23	0.88	0.89	0.61	0.23	0.11	0.43	0.33	0.78				
A	3.45	0.87	0.86	0.86	0.56	0.23	0.10	0.44	0.31	0.48	0.75			
N	3.76	1.11	0.85	0.86	0.55	0.03	0.02	0.16	0.15	-0.08	0.17	0.74		
ITV	5.08	1.54	0.95	0.95	0.81	0.07	0.03	0.14	0.08	0.23	0.11	-0.05	0.90	
ITT	2.78	1.21	0.94	0.94	0.72	0.12	0.07	0.35	0.35	0.21	0.25	0.07	0.26	0.85

reliability. Individual values for each construct appear in Table 3. Next, we used the average variance extracted (AVE) to confirm the convergent validity of the study constructs. Again, the computed values exceeded the suggested cut-off value of 0.5 and thus support the constructs' convergent validity. Finally, we evaluated discriminant validity by comparing the square roots of the AVEs with their respective correlations. As presented in Table 3, all values of the former exceeded the latter, confirming discriminant validity.

5.4. Results of ANN

We generated ANN models using five input neurons, two hidden neurons and two output neurons (Fig. 4) and then examined the RMSE values to determine the predictive accuracy of these alternative models. The RMSE values presented in Table 4 indicate the acceptable prediction accuracy of the alternative models for intentions to visit during the COVID-19 pandemic, with the training data's mean RMSE value equalling 0.2806 and the testing data's mean RMSE value equalling 0.2904. The RMSE values presented in Table 5 likewise reveal the acceptable prediction accuracy of the alternative models for intentions to travel after the COVID-19 pandemic, with the training data's mean RMSE value equalling 0.3859 and the testing data's mean RMSE value equalling 0.4084.

5.5. Sensitivity analysis

We conducted a sensitivity analysis to determine the strength of the Big Five personality traits' influence by calculating their normalised importance, which was computed by expressing each value as a percentage of the maximum relative importance. As presented in Table 6, extraversion had the maximum influence on intentions to travel during the COVID-19 pandemic, followed by conscientiousness and openness to

Table 4
RMSE values (IDP).

ITV Models	Random_state	Training		Testing	
		N	RSME	N	RSME
0	34	400	0.2790	100	0.2856
1	283	400	0.2720	100	0.2730
2	201	400	0.2814	100	0.2919
3	70	400	0.2907	100	0.3002
4	175	400	0.2728	100	0.2830
5	106	400	0.2815	100	0.2897
6	155	400	0.2794	100	0.2905
7	11	400	0.2958	100	0.3071
8	55	400	0.2804	100	0.3040
9	141	400	0.2724	100	0.2786
Mean			0.2806		0.2904
SD			0.0077		0.0110

RMSE = Root mean square error, ITV = Intentions to travel during the pandemic.

experiences. Agreeableness and neuroticism had approximately the same relative influence. In comparison, openness had the maximum influence on intentions to travel after the COVID-19 pandemic, followed by neuroticism, extraversion, conscientiousness and agreeableness (Table 7).

6. Discussion

The data analysis provides interesting insights about the influence of personality traits on individuals' travel intentions during and after the COVID-19 pandemic. Tables 8 and 9 summarise the outcomes. The results for the extent of influence are interpreted based on the normalised relative importance value (%), and for the direction of influence, i.e. increase or decrease, based on the direction of the correlation.

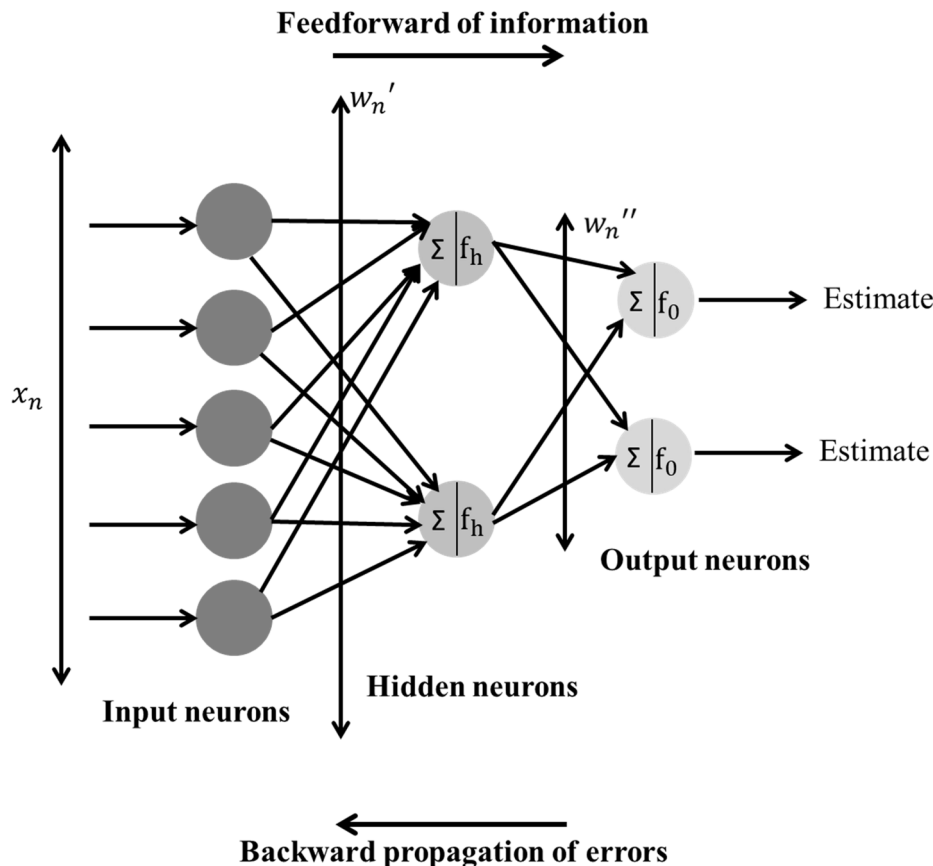


Fig. 4. ANN model.

Table 5
RMSE values (IAP).

ITT Models	Random_state	Training		Testing	
		N	RSME	N	RSME
0	51	400	0.3885	100.0000	0.4092
1	142	400	0.3724	100.0000	0.3867
2	288	400	0.3731	100.0000	0.3918
3	72	400	0.3906	100.0000	0.4132
4	18	400	0.3910	100.0000	0.4136
5	29	400	0.3789	100.0000	0.4287
6	240	400	0.3925	100.0000	0.4070
7	211	400	0.3916	100.0000	0.4111
8	47	400	0.3909	100.0000	0.4144
9	181	400	0.3898	100.0000	0.4086
Mean			0.3859		0.4084
SD			0.0079		0.0118

RMSE = Root mean square error, ITT = Intentions to travel after the pandemic.

Table 6
Normalised relative importance of independent variables (IDP).

Models	O	C	E	A	N
0	0.1970	0.0726	0.5513	0.0292	0.0362
1	0.0862	0.1571	0.5176	0.0315	0.0163
2	0.0095	0.0773	0.6703	0.0898	0.0158
3	0.0309	0.2145	0.5542	0.0080	0.0811
4	0.1218	0.2935	0.3800	0.0504	0.0180
5	0.0218	0.2874	0.3816	0.0561	-0.0004
6	0.2630	0.0148	0.5098	0.0009	0.1055
7	0.0252	0.2711	0.4284	0.0994	0.0361
8	-0.0174	0.1268	0.5715	0.0307	0.0465
9	0.0201	0.4194	0.3856	0.0253	0.0077
Mean	0.0758	0.1934	0.4950	0.0421	0.0363
Normalised value	15.32%	39.08%	100.00%	8.51%	7.33%

A = Agreeableness, O = Openness to experience, C = Conscientiousness, E = Extraversion, N = Neuroticism, ITV = Intentions to travel during the pandemic.

Table 7
Normalised relative importance of independent variables (IAP).

Models	O	C	E	A	N
0	0.2566	0.1174	0.0558	0.0253	0.0645
1	0.0536	0.0801	0.0345	0.0820	0.0543
2	0.0119	0.0376	0.5084	0.0146	0.1661
3	0.4328	0.0565	0.0234	0.0840	0.2570
4	0.3227	0.2430	0.0551	0.0170	0.1887
5	0.4147	-0.0085	0.1152	-0.0207	0.0147
6	0.3653	0.0715	0.0369	0.1999	0.0526
7	0.0994	0.1291	0.0340	0.1872	0.1219
8	0.1387	0.0028	0.0099	0.0348	0.1249
9	0.0957	0.0697	0.1369	0.1136	0.0479
Mean	0.2191	0.0799	0.1010	0.0738	0.1093
Normalised value	100.00%	36.47%	46.10%	33.67%	49.86%

A = Agreeableness, O = Openness to experiences, C = Conscientiousness, E = Extraversion, N = Neuroticism, IAP = Intentions to travel after the pandemic.

Table 8
Summary of findings: IDP.

Personality traits	Normalised relative importance (%)	Correlation	Linear/non-linear
Openness to experience	15.32%	0.14	Linear
Conscientiousness	39.08%	0.08	Non-linear
Extraversion	100.00%	0.23	Non-linear
Agreeableness	8.51%	0.11	Linear
Neuroticism	7.33%	-0.05	Non-linear

Table 9
Summary of findings: IAP.

Personality traits	Normalised relative importance (%)	Correlation	Linear/non-linear
Openness to experience	100.00%	0.35	Non-linear
Conscientiousness	36.47%	0.35	Linear
Extraversion	46.10%	0.21	Non-linear
Agreeableness	33.67%	0.25	Linear
Neuroticism	49.86%	0.07	Linear

Extraversion has the maximum influence on intentions to travel during the pandemic, with a 100% normalised relative importance score. In addition, the relationship between extraversion and intentions to travel is positive and non-linear. In comparison, extraversion ranks third in the order of influence on travel intentions after the pandemic, with a relative importance value of 46.10%, a positive correlation and a non-linear relationship between the two. This outcome is consistent with our expectations based on descriptions of extraverted individuals as talkative, assertive, vigorous, sociable and adventuresome (Tran et al., 2015; Fayombo, 2010). The impact of extraversion on travel intentions implies that individuals who interact freely with others at parties, are generally comfortable around people in various settings, can start conversations quickly and make friends easily harbour positive intentions to travel regardless of the pandemic or its underlying health threat. In sum, driven by their happy, excitement-seeking and outgoing nature (Diener et al., 1992; Chang et al., 2019; Elshaug & Metzger, 2001), individuals who are comfortable being the centre of attention will undertake travel during and after the pandemic. These findings align with the existing research. For instance, Tran et al. (2015) showed the presence of a statistically significant positive association between extraversion and social interaction, including travel.

Conscientiousness has the second strongest influence on pandemic travel intentions. Specifically, its impact is positive and non-linear, with the value of relative importance equalling 39.08%. The relationship between conscientiousness and intentions to travel after the pandemic is also positive but linear, with a relative importance value of 36.47%. In terms of the order of influence, conscientiousness has the fourth largest influence, exceeding only agreeableness. This result partially aligns with our proposition based on the characteristics of conscientious individuals, i.e. while the influence of the trait on travel intentions is confirmed, the *direction* of the influence is not as expected. To elaborate, based on prior findings confirming conscientious individuals' tendency to avoid taking risks (Weller & Tikir, 2011; Cooper et al., 2000), behave in a controlled and careful manner (McCrae & Costa, 2003), avoid hasty decisions and rely on meticulous planning (Chang et al., 2019), we had suggested that conscientiousness would reduce these individuals' intentions to travel. In other words, we expected a negative correlation between conscientiousness and travel intentions. Contrary to our expectations, however, our findings imply that individuals who make and execute their plans precisely, pay attention to detail and are always prepared and exact in their work will travel during and after the pandemic. While this finding seems implausible, one possible explanation is that individuals high on conscientiousness would, while travelling during and after the pandemic, plan their travel to areas with a lower risk of exposure using a safe mode of travel, which could increase their intentions to travel even in the context of the pandemic. Nonetheless, we feel that the relationship between this trait and travel intentions should be explored further with a larger and more diverse sample before any conclusive assertion about the positive influence of conscientiousness on travel intentions can be made.

Openness to experience has the third strongest influence on intentions to travel during the pandemic, with the value of relative importance equalling 15.32%. This relationship is, moreover, positive and linear. In contrast, openness has the strongest influence on intentions to travel after the pandemic, and this relationship is positive

and non-linear. This result implies that individuals who find new ideas exciting, possess a vivid imagination and enjoy thinking about multiple things will exhibit positive intentions to travel during and after the pandemic. In other words, individuals with this trait find it appealing to travel during and after the pandemic despite the continuing uncertainty because they find such travel exciting. This result is consistent with our expectations based on the existing literature's description of individuals who exhibit high openness to change as people who look forward to unconventional and unusual experiences (Schneider & Vogt, 2012) and remain confident in times of adversity (Schutte et al., 1998).

Agreeableness as a personality trait is fourth in the order of influence on intentions to travel during the pandemic. The value of relative importance is 8.51%, and the relationship is positive and linear. However, the influence of agreeableness on intentions to travel after the pandemic is the lowest of all five traits, with a relative importance value of 33.67%. Furthermore, the relationship is positive and linear. This result indicates that individuals who sympathise with others' feelings, respect others, have concern for others, believe that others have good intentions and trust others will have positive intentions to travel during and after the pandemic. This outcome only partially aligns with our expectations. Based on prior findings that individuals with a high level of agreeableness tend to seek security, behave morally and conform to norms and regulations (Fayombo, 2010; von Collani & Grumm, 2009), we had suggested that such individuals would prefer to follow government rules and regulations to control/prevent the further spread of COVID-19 infection by avoiding travel. In other words, we had expected a negative correlation between agreeableness and intentions to travel. However, our results indicate a positive intent. One potential explanation we can offer is that individuals with this trait would travel only as allowed by the rules, trusting that the government and various stakeholders in the tourism sector would take all precautions to ensure that tourists are not exposed to unnecessary risks. Despite the plausibility of this argument, we recommend that future research examine this relationship more extensively while taking into consideration probable intervening influences.

Neuroticism is lowest in the order of influence on intentions to travel during the pandemic, with a value of relative importance equalling 7.33%. At the same time, the relationship is negative and non-linear. However, neuroticism's influence on intentions to travel after the pandemic is the second strongest, with a 49.86% value of relative importance. Moreover, this relationship is positive and linear. This finding implies that individuals who panic and become stressed easily, tend to worry more, are filled with doubts and always fear the worst will be inclined to travel only after the pandemic is over. To elaborate further, the negative correlation of neuroticism with intentions to travel during the pandemic and its positive correlation with intentions to travel after the pandemic implies that neurotic individuals will not be comfortable travelling for leisure until the pandemic ends. This finding aligns with our expectations regarding intentions to travel during the pandemic, which we had formed based on prior studies presenting various characteristics of individuals with this trait (Youn et al., 2017; Faullant et al., 2011; Orth, Limon & Rose, 2010; Orth, Robins & Soto, 2010; Bellou et al., 2018). However, the findings are contrary to our expectations of a negative correlation between neuroticism and travel intentions after the pandemic. A potential explanation could be that individuals with this trait may feel comfortable travelling after the pandemic is over because they believe that, by that time, there will be no threat of recurrence. Nevertheless, we contend that further research is essential to understand this association better.

7. Conclusion

The recent pandemic has created an extraordinary level of anxiety and panic, which has not only produced negative repercussions for the tourism sector on a short-term basis but also threatened its future growth by impeding the post-pandemic recovery process. The sector's recovery

and growth largely depend upon tourists and their behavioural responses; among the key factors that can be expected to influence such responses are personality traits. This follows from the fact that personality traits, which are innate as well as consciously nurtured, can be triggered by the situations that occur in people's lives (McLeod, 2016). Although past research has examined the influence of personality traits in a variety of contexts, such as consumer behaviour and intentions in the hospitality sector (Rojas-Méndez et al., 2013), stock trading performance (Tauni et al., 2020), digital autopreneurial intentions (Yeh et al., 2020) and job burnout (Khedhaouria & Cucchi, 2019), a paucity of research considers the influence of the Big Five personality traits on tourists' travel intentions during a health crisis. Our study attempts to bridge this gap by addressing two research questions. **RQ1** sought to ascertain whether the identified traits—neuroticism, conscientiousness, extraversion, agreeableness and openness to experience—influence tourists' intentions to travel during and after the pandemic. The results of the ANN analysis of data collected from residents in Japan confirm the impact of all five traits on individuals' intentions to travel during and after the pandemic. **RQ2**, meanwhile, considered the differences in the relative influence of the five traits on tourists' intentions to travel during and after the pandemic. These results indicate that extraversion has the strongest relative influence and neuroticism has the weakest relative influence on travel intentions during the pandemic. In comparison, openness to experiences has the strongest and conscientiousness has the weakest influence on travel intentions after the pandemic. These findings entail useful implications.

7.1. Theoretical implications

This study offers three theoretical implications. First, it is one of the earliest empirical studies to examine the drivers of travel intentions during and after the pandemic using data collected at a single point in time. By doing so, we attempt to capture and assess whether the fear induced by the pandemic has only short-term effects or is likely to reverberate long into the future. Such an investigation opens new vistas for research by focussing on the necessity of understanding the longevity of the effects of COVID-19 on individuals' psyches and, in particular, on their intentions to travel for leisure.

Second, this study extends the theoretical applicability of the FFM by utilising it to gauge individuals' travel intentions in the context of a pandemic. Admittedly, past studies on tourism have explored the associations between the Big Five personality traits and outcome variables such as motivation to visit religious sites (Abbate & Di Nuovo, 2013) and propensity to undertake adventure travel (Scott & Mowen, 2007), but none of these studies has attempted to gauge the influence of the five traits on travel intentions during a pandemic (Perić et al., 2021; Garcia & Leoni, 2021).

Finally, our study contributes to advancing methodological tools in the area by employing an ANN approach to analyse the data. Existing studies in the area have largely relied on the SEM approach to test the proposed associations (e.g. Salem et al., 2021). Meanwhile, more advanced techniques—such as ANN, which is sufficiently versatile to analyse variables exhibiting both linear and non-linear associations—remain relatively under-utilised. Hence, the present study adds to the literature by injecting a different and quite novel statistical perspective.

7.2. Practical implications

Our study entails four practical implications. First, it offers insights for tourism marketers and service providers about the role of the Big Five personality traits in expediting and/or impeding the sector's revival following the pandemic. Such knowledge can facilitate these stakeholders' efforts to devise strategies for engaging with tourists and preventing them from developing an irrational fear of travel in the aftermath of the pandemic, which may adversely affect the long-term

future of the sector. For instance, to assuage the fears of individuals with various personality traits, the sector's concerned stakeholders can utilise emotional appeals to positively re-frame travelling for leisure despite the pandemic's reverberating effects.

Second, our study reveals that the pandemic has made individuals more cautious and even wary of travelling for leisure; however, the level of caution tourists exhibit varies with their individual personality traits. It is, therefore, quite crucial for practitioners in the tourism sector to work purposively and consciously to re-establish individuals' confidence, trust and enthusiasm to travel. Because the tourism industry is perception-driven and the images of individual destinations, in particular, are likely to drive post-pandemic travel (Hoque et al., 2020), concerned managers should work to create an image of various destinations as hygienically safe and resilient. To this end, we suggest that the tourism sector lobby for health and medical certifications from regulatory authorities as a way of reducing potential leisure travellers' apprehensions about a given destination during and immediately after the pandemic.

Third, recognising that innovation and creativity help to develop resilience in the wake of any crisis or disaster (Orchiston & Higham, 2016; Prayag et al., 2020), we recommend that managers and service providers make special efforts to formulate novel forecasting models capable of estimating individuals' travel intentions in the context of the pandemic based on their past travel histories and personality traits.

Finally, because individuals high on agreeableness tend to follow rules and guidelines, concerned managers in the tourism sector should actively communicate pandemic-related regulatory measures and their interpretations through mass media and individual notifications where possible. Currently, these measures and their interpretations are implemented and altered quite dynamically, which leaves all affected parties unsure about what is allowed and what is not. By clarifying the status of pandemic-related travel regulations, concerned managers can better engage with individuals who, although they desire to travel, might not even have considered it due to the pandemic.

7.3. Limitations and future research areas

Although we have taken all possible procedural precautions to ensure the robustness of our study, our work nevertheless entails some limitations. First, we have not focussed on any demographic segment of the population, which constrains our specific conclusions and findings. Future work can take into consideration the role of socio-demographic factors, such as gender, age and annual personal income, on individuals' intentions to travel during and after times of uncertainty. Second, the scope of our study is limited to only five personality traits. While our conceptual model could have included many other traits and related aspects, such an approach had the potential to make the model too complex and less relatable. Future studies can examine other aspects, such as the impact of Type A and Type B personality on travel intentions. Moreover, future scholars should also work to include behavioural variables, such as psychological capital (resilience, hope and optimism), mindfulness, self-awareness, ethnocentrism and xenophobia, and thus increase the comprehensiveness of their models. In addition, scholars can undertake longitudinal and experiment-based studies to produce more statistically robust findings. Because the duration of the pandemic is not yet known, extensions of the same study at varying intervals also have the potential to produce interesting findings. Future studies might also examine the impact of government policies on tourists' travel intentions. Because the pandemic has affected tourist destinations globally, a comparative study among diverse countries can provide a clearer picture of the pandemic's impact on the psyche of individuals with different cultural and economic backgrounds.

In addition to the limitations of scope discussed above, we duly note the procedural limitations of our study as well. Due to social distancing constraints, certain limitations related to data collection may have affected the generalisability of our findings. With regard to

methodological limitations, we have analysed only quantitative data using an ANN approach. Future studies can utilise a mixed-method approach to augment these quantitative findings with qualitative insights and thus make the findings more granular and informative. For instance, scholars might conduct face-to-face interviews to gauge individuals' perceptions about travelling during and after the pandemic. Such an approach can be used to better map the travel-related coping responses of individuals across various countries to their personality traits.

CRedit authorship contribution statement

Shalini Talwar: Writing – original draft, Formal analysis, Data curation, Conceptualization. **Shalini Srivastava:** Writing – original draft, Formal analysis, Data curation, Conceptualization. **Mototaka Sakashita:** Data curation. **Nazrul Islam:** Conceptualization, Investigation, Supervision, Validation, Writing – review & editing. **Amandeep Dhir:** Writing – review & editing, Validation, Supervision, Methodology, Conceptualization.

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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