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The Impact of Airport Physical Environment on Perceived Safety and Domestic Travel Intention of Chinese Passengers during the COVID-19 Pandemic: The Mediating Role of Passenger Satisfaction

Guofeng Ma, Yue Ding * and Junyi Ma

School of Economics and Management, Tongji University, Shanghai 200092, China; 06125@tongji.edu.cn (G.M.); 2030375@tongji.edu.cn (J.M.)

* Correspondence: apcto001@163.com

Abstract: The COVID-19 pandemic, which has become an important new research topic, has exerted a huge impact on airports and the antecedents of passengers' travel decisions following its outbreak. In the current study, we aimed to investigate the influences of four attributes of airport physical environment (facility functionality, facility aesthetics, layout accessibility, and cleanliness) on passengers' perceived safety, satisfaction, and travel intention, as well as the mediating role of passenger satisfaction. We built a structural equation model to assume the relationship between these variables. A total of 398 domestic travelers were asked to fill out a survey in order to reveal their perceptions of airport physical environment, perceived safety, satisfaction, and travel intention. The results indicate that passengers with positive perceptions of the facility functionality, layout accessibility, and cleanliness of airports had a higher degree of satisfaction and might be more willing to engage in more air travel in the future. In particular, a clean airport environment significantly improved passengers' perceived safety. Moreover, facility functionality, layout accessibility, cleanliness, and perceived safety all had an effect on travel intention through the mediating role of satisfaction. Overall, these findings offer suggestions for airport authorities aiming to revive demand for air travel. Discussions about airport physical environment improvements along with limitations and suggestions for future research are provided.

Keywords: COVID-19; physical environment; perceived safety; passenger satisfaction; travel intention

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1. Introduction

After COVID-19 was first described as a pandemic on 12 March 2020, airports have been severely affected by the pandemic [1]. At airports, passengers spend a long time in a physical environment such as a waiting room. Thus, the perceived quality of the physical environment can have an important impact on passenger satisfaction and perceived safety. According to the Ministry of Culture and Tourism of China, the total number of domestic tourists in 2021 was 3.246 billion, an increase of 367 million or 12.8% over the previous year (recovering to 54.0% of that in 2019) [2]. Chinese airports have launched the practice of running health checks on passengers before boarding in accordance with policy requirements in order to ensure the travel safety of passengers and prevent the spread of COVID-19 across regions. Overall, we believe that government policies and travel restrictions have different impacts on domestic and international travelers, as China has built strict border control regulations and isolation period standards for inbound travelers due to COVID-19. Compared to international travel, domestic air travel is easier because passengers need only to take their temperature, be disinfected, and show their health code before boarding. This study focuses on Chinese travelers' domestic travel intentions.

Airport physical environments can be divided into four dimensions: facility functionality, facility aesthetics, layout accessibility, and cleanliness [3,4]. The relationship

between physical environment and customer response has previously been explored [5]. In the tourism industry, the importance of repeated tourism to sustainable development has been confirmed [6–8]. The continued growth of airport revenue is largely dependent on passengers who tend to travel many times [9]. The relationship among the physical environment of the airport, satisfaction, and behavioral intention has been examined in several studies [4,10,11]. Past studies have tested whether perceived safety is a moderator between satisfaction and behavioral intention in the aviation industry. Despite the fact that the moderation effect of perceived airport safety is invalid, perceived safety might be a direct driver of satisfaction through additional analysis [12]. Regardless of the scientific rationale, an airport's physical environment and security measures inevitably affect travelers' satisfaction and perceptions of airport safety and travel decisions.

However, very few studies have focused on the overall mechanism of effect between physical environment, perceived safety, satisfaction, and travel intention. First, the effect of perceived safety on travel intention has been generally ignored. Second, although the influence of passengers' perceived safety on passenger satisfaction and enplanement intention has been verified [13,14], the mediating role of satisfaction has been ignored. Third, few studies have tested the impacts of facility functionality, facility aesthetics, layout accessibility, and cleanliness on perceived safety, respectively. Moreover, most of these studies considered the general situation and paid less attention to emergency situations such as the COVID-19 pandemic. Considering the adverse impact of COVID-19 on airports and passengers, we believe that a study set in the COVID-19 context is necessary.

To fill the research gaps mentioned above, the following central questions need to be answered: (1) What is the overall effect mechanism of airport physical environment, perceived safety, passenger satisfaction and travel intention? (2) Which attribute of the airport physical environment plays the role of generating passengers' perceived safety, satisfaction, and travel intention? and (3) How has perceived safety affected travel intentions during the COVID-19 pandemic?

This study contributes to the literature in several ways. First, the present study explores the effect mechanism between airport physical environment, perceived safety, passenger satisfaction, and travel intention. Hence, this study enriches the literature on airport servicescapes and provides managers of airports with guidance on improving passengers' perceived safety and satisfaction. In particular, the study verifies that facility functionality, layout accessibility, cleanliness, and perceived safety have effects on travel intention through the mediating role of satisfaction, thus enriching the literature on antecedents of airport travel intention during the COVID-19 pandemic.

This article includes six main parts: an introduction, literature review and hypotheses development, methods, data analysis and results, discussion, and conclusion. We studied the impact of airport physical environment on passengers' perceived safety, satisfaction, and domestic travel intention as well as the mediating role of satisfaction in the context of the COVID-19 pandemic.

2. Literature Review and Hypothesis Development

2.1. Physical Environment

Environment and atmosphere are the 'silent language' of communication. Early research on the physical environment and customer psychology suggested that atmosphere could be used as a marketing tool [3]. Bitner introduced the concept of the 'servicescape' (the man-made physical environment) to explore how the physical environment influences customers and employees, and divided the physical environment into three dimensions: (1) ambient conditions; (2) spatial layout and functionality; and (3) signs, symbols, and artefacts [5]. Bakerd et al. categorized the physical environment in the retail shop environment into environmental design and social factors [15]. Wakefield and Blodgett categorized the physical environment aspect in leisure services facilities into five dimensions based on Bitner's research: (1) layout accessibility; (2) facility aesthetics; (3) seating comfort; (4) electrical equipment and displays; and (5) cleanliness, and narrowed the study to the

context of a hotel–casino [16]. In the early 20th century, researchers conducted multidimensional physical environment studies in specific sectors such as restaurants, hotels, casinos, and museums [17–20]. In the aviation industry, Moon et al. hypothesized that four aspects of the airport physical environment, namely, facility functionality, facility aesthetics, layout accessibility, and cleanliness, had valid impacts on passenger mood and further influenced passenger satisfaction [4]. Based on previous studies, four physical environment variables were selected for this study: facility functionality, aesthetics, layout accessibility and cleanliness. These four variables include the attributes of the physical environment that passengers usually pay attention to. Especially, facility functionality (including seating comfort, electrical equipment, and displays) was chosen as the attribute of the physical environment.

Researchers have verified the relationship between the servicescape and passenger satisfaction [10,21–23]. Wakefield and Blodgett stated that the servicescape had a direct impact on customer perception [24]. Prentice and Kadan suggested that airport facilities and servicescapes make significant contributions to passenger satisfaction [25]. However, these studies considered physical environment as a single undifferentiated construct and did not explore the respective impact of each variable of the physical environment on passenger satisfaction. A recent study dealt with the relationship between airport physical environment, perceived safety, and customer satisfaction, and verified the relationship between several physical environment variables and passenger satisfaction [12].

2.1.1. Facility Functionality

Facility functionality indicates the ability to arrange machinery, equipment, and furniture to facilitate performance and achieve goals [5]. Han and Ryu defined functionality as the ability of physical objects (e.g., furniture, equipment, physical machinery, and facilities) to perform their functions effectively and help customers obtain a pleasant experience [26]. Bitner suggested that seating comfort is critical to the services environment [5].

In casinos, seating comfort was confirmed to be a key factor influencing gamblers' perceptions [19]. Seating comfort is affected by the seat itself as well as the space between the seats. If one seat is very close to the other, customers may feel physically and mentally uncomfortable. Providing customers with comfortable seating can increase their satisfaction with the physical environment [27], while uncomfortable seats may cause dissatisfaction among passengers [28]. For passengers who have to wait for several hours at airports, uncomfortable seating conditions may cause inconvenience and limited space may make passengers feel that their privacy is being infringed [29]. In addition, during the COVID-19 pandemic larger personal space allowances provide passengers with a perceived sense of safety. Moreover, obtaining timely and effective pandemic-related news through electronic screens and broadcasting may alleviate passengers' worries about getting infected. Moon et al. believed that facility functionality (including the number of seats, seat comfort, electronic equipment displays, etc.) have a direct positive impact on passengers' perceived safety and satisfaction [4]. Zheng suggested that the space and width of seating aisles and provision of electronic equipment can positively influence overall customer perceptions of the physical environment [29]. When passengers have to stay in the lounge for a long time, seat comfort is particularly important. Furthermore, information such as airport timetables should be broadcast clearly in a timely manner via display screens and audio equipment. In addition, user-unfriendly electronic equipment may cause inconvenience to and complaints from passengers [30]. Consequently, the discomfort of and inconvenience to passengers can lead to insecurity and dissatisfaction.

Hypothesis 1a (H1a). *Facility functionality has a positive influence on perceived safety.*

Hypothesis 2a (H2a). *Facility functionality has a positive influence on passenger satisfaction.*

2.1.2. Facility Aesthetics

Facility aesthetics refers to interior and architectural design that aims to enhance the attractiveness of the physical environment [16]. Specifically, architecture, colors, materials, and styles are all included in the aesthetic construction of the store environment [15].

When guests step into facilities, they inevitably observe them and evaluate them from the perspective of aesthetics. Baker et al. suggests that customers' assessment of facility interiors significantly influences their attitudes [15]. Hyun and Kang confirmed that decor and artifacts lead to greater pleasure of customers in restaurants [31], and pleasure further contributes to the satisfaction of customers. Facility aesthetics has been proposed to be a predictor of travelers' emotional disposition and satisfaction in airports [4]. As passengers' perceived safety is closely linked to their state of mind, it is reasonable to use facility aesthetics as one of the influencing factors of perceived safety. During the COVID-19 pandemic, facility aesthetics may positively affect passenger satisfaction and perceived safety to a certain extent.

Hypothesis 1b (H1b). *Facility aesthetics has a positive influence on perceived safety.*

Hypothesis 2b (H2b). *Facility aesthetics has a positive influence on passenger satisfaction.*

2.1.3. Layout Accessibility

Layout accessibility refers to the size, shape, and arrangement of equipment and furnishings and the spatial relationships between them as well as to the convenience of the layout provided [5]. As a service encounter is "a period of time during which a consumer interacts with a service" (for specific consumer needs), the layout accessibility and function of physical environment is particularly important. A reachable layout is a crucial factor of service quality [32]. It is essential for passengers to make their way through an airport without trouble in order to reach the gate, facilities (i.e., restrooms), or conveniences (i.e., shops and snack bars) [33].

Layout accessibility greatly affects customer perception and pleasure [14]. Specifically, passengers' expectations of signs influence their perceptions of the airport [27,33]. In the context of COVID-19, many airports distinguish between passenger passages and cargo passages and between domestic and international parcels. Taking the wrong way at the airport is not only a waste of time; it can be dangerous for passengers as well. Therefore, a lack of signs may increase passengers' perception of potential risks and unsafety. When passengers are satisfied with the airport, they do not particularly care about layout accessibility, however, they can become disappointed when signs are missing or unclear.

Hypothesis 1c (H1c). *Layout accessibility has a positive influence on perceived safety.*

Hypothesis 2c (H2c). *Layout accessibility has a positive influence on passenger satisfaction.*

2.1.4. Cleanliness

Cleanliness is one of the key factors of servicescapes, especially when travelers have to stay in public facilities or recreational facilities for an extended period of time [16]. Cleanliness has been defined as the state of being scrubbed and unsoiled [19]. Due to the impact of COVID-19, cleanliness has begun to be measured at the hygienic level.

During the COVID-19 pandemic, cleanliness is 'half of faith' [34]. Clean and well-maintained airport facilities increase passenger satisfaction, thereby creating a positive image in terms of passenger perception [35]. Following the outbreak of COVID-19, the impact of cleanliness on passengers' perceived safety has been particularly significant. Cleanliness is a key variable that induces satisfaction and customer loyalty [36,37]. Past studies have determined that the cleanliness of airport restrooms, food service areas, and even pavement significantly affects passenger satisfaction [12,35].

Hypothesis 1d (H1d). *Cleanliness has a positive influence on perceived safety.*

Hypothesis 2d (H2d). *Cleanliness has a positive influence on passenger satisfaction.*

2.2. Perceived Safety

Passengers' perceived safety greatly depends on perceived risk or perceived threat. Perceived risk, an important construct, has been defined as the subjective expectation of risk and loss [38], which can arouse feelings of uncertainty, discomfort, and anxiety [39]. Safety concerns refer to a sense of worry, fear, and anxiety which is caused by stressful environmental climate [40]. Airports try to minimize risks associated with air travel through various security measures [41]. However, it is difficult to objectively and directly evaluate the security level of airports in the circumstances of the COVID-19 pandemic. Therefore, it can be measured through passengers' perceived level of safety.

The perception of airport safety is a critical factor triggering passenger satisfaction, meaning that airport users who feel safer at the airport are more likely to feel satisfied [12]. It has been confirmed that the relationship between perceived safety and customer satisfaction is significant, and customers' perceived risk generally lowers their satisfaction [13,42]. On the other hand, passengers' perceived safety may positively affect passenger satisfaction in the context of the COVID-19 pandemic.

Hypothesis 3 (H3). *Perceived safety has a positive influence on passenger satisfaction.*

Fear is often interrelated with perceived risk [43], in which trip-related potential dangers are associated with changes in the intention to revisit a given destination [44]. The perceived risk of being infected somewhat discourages potential passengers from flying. If passengers' perceived risk of COVID-19 infection is reduced, their perceived safety can be improved. Perceived safety has a significant impact on passenger' enplanement intention [14], choice of airline, and travel destination [45,46].

Hypothesis 4 (H4). *Perceived safety has a positive influence on travel intention.*

2.3. Passenger Satisfaction

Previous researchers have provided a comprehensive definition of customer satisfaction. Customer satisfaction is often considered a vital constituent of the customer post-purchase decision-making process [47,48], and are the main structure of consumer experience [49], involving post-consumer evaluation and judgment of products, services, or companies [50–52]. As the aviation industry grows, the significance of passenger satisfaction has substantially increased. Passenger satisfaction depends on passengers' expectations and perceptions, which in turn influences their behaviors and attitudes towards the airport.

Passenger satisfaction plays a prominent role in travel intention. Kim and Hyeong Jang believed that by maximizing satisfaction and then increasing trust, passengers tend to revisit a destination [53]. Kim et al. verified that passengers who are satisfied with airport attributes (accessibility, facilities, operations, etc.) are usually more likely to travel next time [11]. It has been noted, however, that passenger satisfaction may have a less significant impact on travel behavior in the context of COVID-19 due to certain mandatory travel restrictions. Although these policies inevitably affect domestic travelers' travel intentions, we assume that an airport which satisfies passengers might boost their intention to travel.

Hypothesis 5 (H5). *Passenger satisfaction has a positive influence on travel intention.*

2.4. Travel Intention

One way to enhance airport revenue is to make passengers willing to travel by air, which means encouraging them take multiple trips. Loyal customers are highly attractive to businesses because they are less price sensitive and require less communication effort [42]. Repeat tourism is one of the most important factors for the sustainability of the

tourism industry [6–8]. The sustainable growth of airport revenue is largely dependent on passengers who travel many times [9].

Servicescapes have an indirect impact on travel intention [24]. It has been confirmed that the physical features of airline lounges are an influential factor in creating passenger satisfaction and travel intention [54]. Satisfaction both plays a critical role in travel intention and acts as a mediator. Based on previous theory, it is reasonable that the four attributes of physical environment positively affect travel intention through passenger satisfaction. Accordingly, the following hypotheses are proposed:

Hypothesis 6a (H6a). *Passenger satisfaction has a positive influence on the relationship between facility functionality and travel intention.*

Hypothesis 6b (H6b). *Passenger satisfaction has a positive influence on the relationship between facility aesthetics and travel intention.*

Hypothesis 6c (H6c). *Passenger satisfaction has a positive influence on the relationship between layout accessibility and travel intention.*

Hypothesis 6d (H6d). *Passenger satisfaction has a positive influence on the relationship between cleanliness and travel intention.*

Satisfaction is considered a mediator between passengers' perceived value and travel intention [55]. Based on previous studies, passengers' perceived safety has an impact on both their satisfaction and intention to fly [13,14]. As an important psychological medium, satisfaction often appears in a mediating role in the literature on airport physical environment and services. Thus, the suggested hypothesis is as follows:

Hypothesis 7 (H7). *Passenger satisfaction has a positive influence on the relationship between perceived safety and travel intention.*

3. Methods

3.1. Conceptual Model

This study adopted the customer satisfaction index model as the basic framework. The customer satisfaction index model uses structural equation modelling (SEM). Referring to classic models [4,16], several potential variables were constructed in this paper: facility functionality, facility aesthetics, layout accessibility, cleanliness, perceived safety, passenger satisfaction, and travel intention. Hypotheses involving these variables were proposed. We constructed the antecedents of passengers' travel intention in the model and hypothesized the mediating effect of passenger satisfaction. The conceptual model is shown in Figure 1.

3.2. Questionnaire Design

The questionnaire, based on previous studies, introduced four attributes of the physical environment (facility functionality, facility aesthetics, layout accessibility, and cleanliness) as well as travelers' perceived safety, satisfaction, and travel intention, along with appropriate modifications, in order to measure travelers' perceived safety during the COVID-19 pandemic [4,42,56]. The measurement items of each construct in the questionnaire were adopted from previous studies [4,24,57]. In the end, 24 items, translated into Chinese by members of the translation team of the professor's research group at Tongji University, were utilized to evaluate variables. The final version of the survey items is listed in Table A1. According to the index system of research variables constructed in this paper, each item is measured by a seven-point Likert scale classified as "strongly disagree", "disagree", "relatively disagree", "relatively agree", "agree" and "strongly agree", corresponding to a point score of 1, 2, 3, 4, 5, 6, and 7, respectively. The answer options filled in by the respondents were translated into corresponding scores to form the original data sample for analysis. The demographic data of the interviewees, including their age, gender, occupation, travel

frequency, and purpose of air trip, was surveyed in order to ensure the diversity of the sample. To ensure the reliability of the data, the questionnaire opened with contextual questions such as "Please recall the airport you chose for your most recent airline trip". We conducted a pretest on 50 respondents and made minor alterations to the questionnaire. Two items about pandemic prevention were deleted to avoid incomprehensible situations for interviewees.

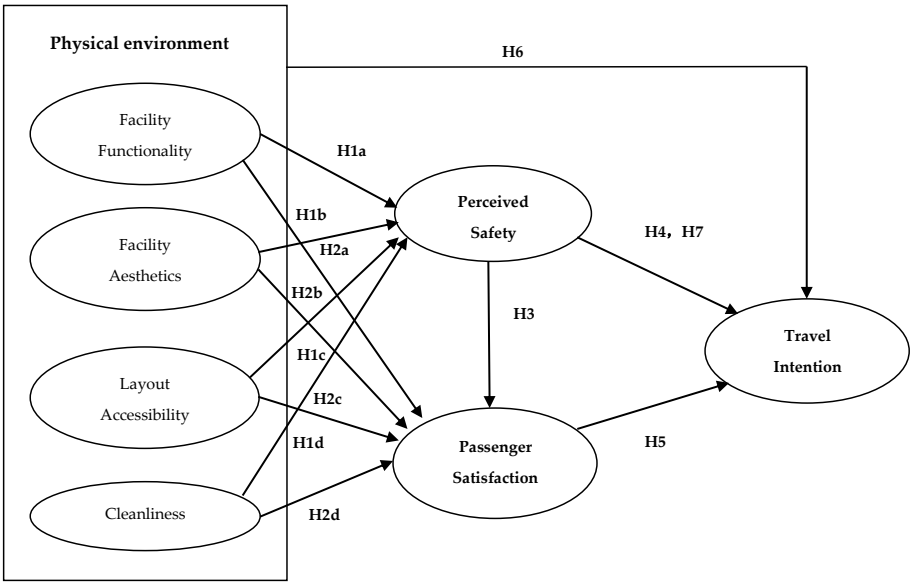

Figure 1. Conceptual model.

3.3. Data Collection

Due to the pandemic, our data were collected through a web-based survey. We collected the data through various channels such as e-mail, WeChat, WeiBo, and other smartphone applications from October 2021 to April 2022. The contact information of respondents was obtained from the social platforms and the online survey firm's database. Over 200 respondents were found in WeChat using the snowball method, which has the advantage of gathering data from a hidden population [58]. In addition, more than 200 respondents were randomly selected from an online survey firm's database; the respondents were asked to click the URL included in the survey invitation e-mail in order to fill in the survey questionnaire. All respondents were asked to evaluate a domestic airport they visited recently, and were paid for completing the questionnaire. The names of airports the respondents visited and the dates of their flight were confirmed in the questionnaire to ensure data reliability.

In the end, 445 questionnaires were distributed. Invalid questionnaires were excluded either because they were completed in a short span of time or because the reported time of travel was not during the COVID-19 pandemic. In total, 398 valid questionnaires were used for analysis, yielding a usable response rate of 89.4%. The airports visited by the respondents included major airports in China, including Shanghai Pudong Airport, Shanghai Hongqiao Airport, Beijing Daxing Airport, Sichuan Shuangliu Airport, Guangzhou Baiyun Airport, etc. To ensure sample diversity, a profile of the respondents is tabulated in Table 1, which is divided into five classification items: gender, age group, occupation, frequency of air travel, and purpose of air travel. In regard to their frequency of air travel, the respondents were divided into low- and high-experience groups by median split analysis [59,60]. Passengers who engaged in air travel once or twice a year were considered to be low-experience travelers, while passengers who engaged in air travel three or more times a year were considered to be high-experience. For the purpose of air travel, respondents were provided with four choices, as follows: business trip, vacation, personal or family affairs, and student or school related. Passengers falling into the first category were con-

sidered business passengers, while passengers falling into the other three categories were considered non-business or leisure passengers [61].

Table 1. Respondent profile.

Items	Characteristics	%
Sex	Male	59
	Female	41
Age	Under 25	33
	25–40	45
	Over 40	22
Profession	Full-time student	19
	Manager	16
	Professionals	25
	Migrant workers	24
	Other	16
Frequency of air travel	1–2 times a year	53
	3–4 times a year	31
	≥5 times a year	16
Purpose of air travel	Business trip	39
	Vacation	27
	Personal or family affairs	20
	Student or school related	14

4. Data Analysis and Results

4.1. Measurement Model

We chose PLS (path modelling method)-based SEM over covariance-based SEM [62,63]. Considering the complexity of our model and the large number of latent and observed variables, PLS-based SEM is more appropriate to discuss the proposed causality because it applies to self-constructed models and there are no improper or nonconvergent results when using PLS path modelling [64].

To confirm the reliability and internal consistency of each variable, Cronbach's alpha was introduced. The Cronbach's α values based on the standardized terms all exceeded the minimum requirement of 0.7 [65]. The Kaiser–Meyer–Olkin (KMO) value was 0.932, achieving a satisfactory level [66]. Bartlett's test of sphericity ($\chi^2 = 3800.647$, $p < 0.001$) was acceptable as well. Exploratory factor analysis (EFA) was conducted via SPSS 25.0. Principal component analysis of a total of 24 measurement terms was performed with maximum variance rotation. The results show that the eigenvalues of all 24 items exceed 1 and that the items can be classified into four categories. The four factors (facility functionality, facility aesthetics, layout accessibility, and cleanliness) account for 74.49% of the variance. The measurement items of the variables in this study were based on previous studies [12,24,57].

We performed convergent validity tests on the measurement models to assess path coefficients, combined reliability (CR), and average variance extracted (AVE). Table 2 shows that all alpha values exceed the minimum requirement of 0.7 [65]. CR, an indicator of how well a latent variable can be represented in a set of observed variables, was used to assess convergent validity in the study and exceeded the recommended value of 0.7. AVE was used to test the internal consistency of the structural variables, and exceeded the recommended value of 0.5 [67]. The next step was to evaluate discriminant validity in order to prove statistically that those indicators that should not be correlated with the preset construct were indeed irrelevant to this construct. It can be seen from Table 3 that the square root of the AVE (diagonal value) of each construct is greater than the corresponding correlation coefficient, reflecting sufficient discriminant validity [68].

Table 2. Measurement model results.

Structure	Items	Loading	Cronbach's α	CR	AVE
Facility Functionality	FF1	0.832	0.862	0.916	0.679
	FF2	0.898			
	FF3	0.921			
	FF4	0.706			
Facility Aesthetics	FA1	0.862	0.873	0.913	0.723
	FA2	0.868			
	FA3	0.842			
	FA4	0.829			
Layout Accessibility	LA1	0.817	0.862	0.916	0.785
	LA2	0.829			
	LA3	0.917			
Cleanliness	C1	0.927	0.866	0.941	0.816
	C2	0.865			
	C3	0.928			
	C4	0.854			
Perceived Safety	PS1	0.823	0.876	0.918	0.742
	PS2	0.862			
	PS3	0.84			
Passenger Satisfaction	S1	0.941	0.935	0.914	0.828
	S2	0.937			
	S3	0.951			
Travel Intention	TI1	0.902	0.899	0.912	0.824
	TI2	0.868			
	TI3	0.915			

FF = facility functionality, FA = facility aesthetics, LA = layout accessibility, C = cleanliness, PS = perceived safety, S = passenger satisfaction, TI = travel intention, CR = composite reliability, AVE = average variance extracted.

Table 3. HTMT result.

	PS	C	S	LA	TI	FF	FA
PS	1						
C	0.791	1					
S	0.815	0.712	1				
LA	0.53	0.615	0.766	1			
TI	0.614	0.642	0.799	0.819	1		
FF	0.531	0.677	0.648	0.583	0.714	1	
FA	0.505	0.551	0.676	0.717	0.614	0.752	1

FF = facility functionality, FA = facility aesthetics, LA = layout accessibility, C = cleanliness, PS = perceived safety, S = passenger satisfaction, TI = travel intention.

4.2. Structural Model

We used RMSEA (root mean square error of approximation), NFI (normed fit index), and R^2 to test model fit. We examined the model fit using the entire sample (N = 398), with RMSEA = 0.081 and NFI = 0.817 (close to 0.9). The R^2 values of perceived safety, passenger satisfaction, and travel intention were 0.189, 0.699, and 0.615, indicating good explanatory power of the structural model [69]. We used the method of Hair et al. to evaluate the structural model and obtained the standardized path coefficient and corresponding t value using the bootstrapping procedure with 5000 bootstrap replicates [67]. Considering our amount of data was relatively small, and thanks to the convenience of the software, we used SmartPLS 3.0 to complete the structural model evaluation. The results show that during the COVID-19 pandemic facility functionality, facility aesthetics, and layout accessibility had no significant impact on passengers' perceived safety, while cleanliness had a significant impact. Therefore, H1d is verified. In particular, cleanliness was the only physical factor to affect passengers' perceived safety ($\beta = 0.268$, $p < 0.001$). However, facility aesthetics,

facility functionality (β = 0.203, $p < 0.001$), layout accessibility (β = 0.169, $p < 0.01$), and cleanliness (β = 0.314, $p < 0.001$) were all important predictors of passenger satisfaction during the COVID-19 pandemic; in other words, with the exception of H2b, the other three hypothesis (H2a, H2c and H2d) were all verified.

These results show that passengers' perceived safety has a significant positive effect on passenger satisfaction (β = 0.248, $p < 0.001$), which validates H3. However, the direct influence of passengers' perceived safety on behavior intention was not established, hence H4 is not established. The positive effect of satisfaction on travel intention is confirmed (β = 0.533, $p < 0.001$), which validates H5 and is consistent with the conclusion of Moon et al. that passenger satisfaction is the most important factor that triggers passengers' travel intention [12]. Table 4 provides the relevant parameters, while Figure 2 illustrates the results of path analysis.

Table 4. Structural model results.

Relationships	Coefficients	*p* Value	T Value	Hypothesis	Result
FF→PS	0.081	0.254	1.142	H1a	×
FA→PS	0.076	0.272	1.099	H1b	×
LA→PS	0.117	0.104	1.629	H1c	×
C→PS	0.268	0	3.708 ***	H1d	√
FF→S	0.203	0	3.609 ***	H2a	√
FA→S	0.012	0.811	0.239	H2b	×
LA→S	0.169	0.006	2.75 **	H2c	√
C→S	0.314	0	5.171 ***	H2d	√
PS→S	0.248	0	4.839 ***	H3	√
PS→TI	0.103	0.101	1.64	H4	×
S→TI	0.533	0	9.282 ***	H5	√

FF = facility functionality, FA = facility aesthetics, LA = layout accessibility, C = cleanliness, PS = perceived safety, S = passenger satisfaction, TI = travel intention. ** $p < 0.01$, *** $p < 0.001$.

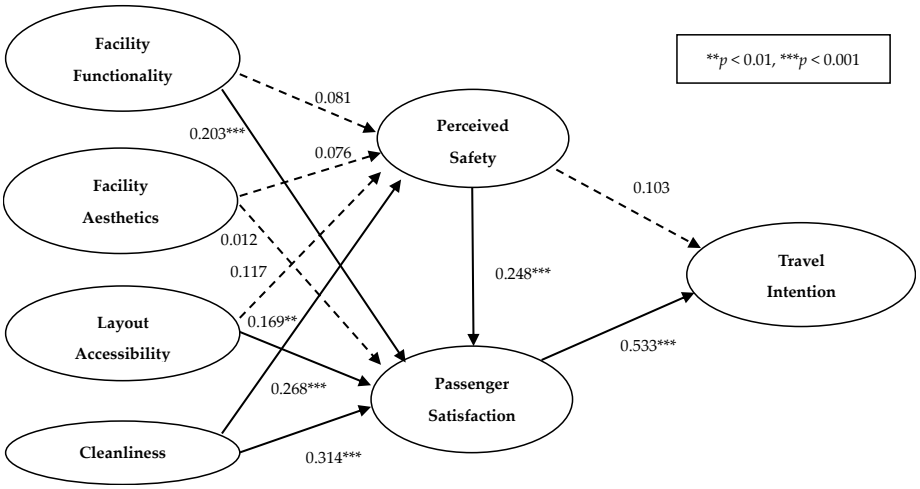

Figure 2. Path analysis by PLS4.3 Mediation model.

In order to examine the mediating effect of passenger satisfaction, we used SmartPLS 3.0 to calculate the mediating effect based on the Bootstrap method. Using satisfaction as a mediating factor, there was a significant positive effect on the relationship between facility functionality ($p < 0.001$), layout accessibility ($p < 0.01$), cleanliness ($p < 0.001$), and travel intention, except for the relationship between facility aesthetics and travel intention. Thus, H6a, H6c, and H6d are validated and H6b is rejected. In addition, passenger satisfaction significantly mediated the relationship between perceived safety and travel intention ($p < 0.001$); thus, H7 is validated. The relevant parameters are shown in Table 5.

Table 5. Structural model results.

Relationship	Indirect Effect	SE	97.5% CI		*p* Value	T Value
			Lower	Higher		
FF→S→TI	0.108	0.107	0.076	0.188	0.002	3.173 **
FA→S→TI	0.006	0.009	0.026	0.157	0.81	0.24
LA→S→TI	0.09	0.087	0.091	0.247	0.008	2.639 **
C→S→TI	0.168	0.166	0.046	0.177	0	4.337 ***
PS→S→TI	0.132	0.132	−0.044	0.06	0	4.34 ***

FF = facility functionality, FA = facility aesthetics, LA = layout accessibility, C = cleanliness, PS = perceived safety, S = passenger satisfaction, TI = travel intention. ** $p < 0.01$, *** $p < 0.001$.

4.3. Multiple Group Analysis

A totality of 398 valid questionnaires (211 for low-experience passengers and 187 for high-experience passengers) were used in the multiple group analysis. After establishing the measurement invariance, PLS-MGA was used to compare the differences between the two groups [70], which were divided by median split analysis. Table 6 reveals significant differences in the path from facility functionality to perceived safety. A positive effect of facility functionality on perceived safety was found in the low-experience group (β = 0.425, $p < 0.001$) and not in the high-experience group. Therefore, H1a is partially validated. Except for this relationship, all the other hypothesized paths showed no differences between the two groups.

Table 6. Low-experience group and high-experience group analysis.

Hypothesis	Relationships	Low-Experience Passengers Coefficients	High-Experience Passengers Coefficients	Coefficients Differences	MGA *p*-Value
H1a	FF→PS	0.425	−0.162	0.587	0.001
H1b	FA→PS	0.06	0.374	−0.314	0.862
H1c	LA→PS	−0.004	0.158	−0.162	0.36
H1d	C→PS	0.034	0.283	−0.249	0.3
H2a	FF→S	0.187	0.231	−0.044	0.463
H2b	FA→S	−0.074	0.05	−0.124	0.561
H2c	LA→S	0.252	0.103	0.149	0.468
H2d	C→S	0.377	0.292	0.085	0.728
H3	PS→S	0.19	0.134	0.056	0.847
H4	PS→TI	0.05	0.277	−0.227	0.867
H5	S→TI	0.728	0.445	0.283	0.462
H6a	FF→S→TI	0.166	0.033	0.133	0.697
H6b	FA→S→TI	−0.054	0.022	−0.076	0.584
H6c	LA→S→TI	0.183	0.046	0.137	0.374
H6d	C→S→TI	0.274	0.13	0.144	0.979
H7	PS→S→TI	0.139	0.06	0.079	0.857

PLS-MGA was used to identify differences between business passengers and leisure passengers. The data on 157 business passengers and 241 leisure passengers were used in the analysis. As shown in Table 7, there was no significant difference in the hypothesized relationship between the two groups.

Table 7. Business group and leisure group analysis.

Hypothesis	Relationships	Business Passengers Coefficients	Leisure Passengers Coefficients	Coefficients Differences	MGA *p*-Value
H1a	FF→PS	0.008	0.101	−0.093	0.847
H1b	FA→PS	0.151	0.191	−0.04	0.74
H1c	LA→PS	0.099	0.01	0.089	0.637
H1d	C→PS	0.476	0.206	0.27	0.529
H2a	FF→S	0.216	0.219	−0.003	0.151
H2b	FA→S	0.036	−0.089	0.125	0.393
H2c	LA→S	0.141	0.198	−0.057	0.385
H2d	C→S	0.3	0.357	−0.057	0.753
H3	PS→S	0.252	0.191	0.061	0.98
H4	PS→TI	0.106	0.103	0.003	0.718
H5	S→TI	0.599	0.637	−0.038	0.741
H6a	FF→S→TI	0.129	0.139	−0.01	0.753
H6b	FA→S→TI	0.021	−0.057	0.078	0.729
H6c	LA→S→TI	0.084	0.126	−0.042	0.553
H6d	C→S→TI	0.18	0.227	−0.047	0.769
H7	PS→S→TI	0.151	0.122	0.029	0.392

5. Discussion

5.1. Summary of Findings

This study analyzes the relationship between physical environment, perceived safety, passenger satisfaction, and travel intention in the context of the COVID-19 pandemic utilizing the structural equation model. We examine the antecedents of passenger travel intention, highlighting the influences of facility functionality, layout accessibility and cleanliness.

First, cleanliness has a significant effect on perceived safety. Under the conditions of the COVID-19 pandemic, airports must ensure cleanliness in order to arouse a perception of safety in passengers. The perceived safety of low-experience passengers is more influenced by facility functionality compared to high-experience passengers. We assume this is because more experienced passengers are already familiar with airport facilities. Therefore, airports need to provide passengers with service guidance on facility functions.

Second, facility functionality, layout accessibility, and cleanliness are key determinants of passenger satisfaction and travel intention, which is in line with previous conclusions [35,71]. Convenient and user-friendly facilities and electronic devices in airports greatly affect passenger experience. Although signage and broadcasting are not the most critical antecedents of passenger satisfaction, insufficient accessibility of amenities can cause dissatisfaction among passengers.

Third, our study reveals that passengers' perceived safety is a strong driver of satisfaction [4,13,42], especially in the context of the COVID-19 pandemic. Furthermore, while satisfaction positively affects travel intention, we found no evidence that perceived safety directly affects travel intention, although we were able to verify that perceived safety has an impact on travel intention, primarily through the mediating role of satisfaction.

Fourth, our results demonstrate the importance of passenger satisfaction. This construct acts as both an outcome variable and as a mediating variable that establishes a meaningful causal path between other organizational factors. Passenger satisfaction positively influences travel intention and mediates the respective relationship between travel intention and facility functionality, perceived safety, and cleanliness. Highly satisfied passengers produce positive publicity, which can help increase the visibility and reputation of an airport.

5.2. Theoretical Implications

By dividing respondents into a low-experience group and a high-experience group as well as a business group and a leisure group, this study reveals several insights into

the literature by validating the effects of the airport physical environment on passengers' perceived safety, satisfaction, and travel intention. To the best of our knowledge, most previous studies have only investigated the effect of the physical environment on customer satisfaction or loyalty, ignoring the effect on perceived safety [25,56]. Thus, this study examined the antecedents and consequences of passengers' perceived safety in the context of the COVID-19 pandemic and verified the positive influence of physical environment on perceived safety as well as the positive effects of perceived safety on passenger satisfaction.

Although several relationships (such as physical environment and passenger satisfaction) have been previously examined [7,10,49], this study represents the first time that an overall effect mechanism has been explored. In this way, all these constructs were integrated into the SEM model. The empirical evidence supports most of our hypotheses. Furthermore, the indirect effect of facility functionality, layout accessibility, cleanliness, and perceived safety on travel intention is mediated by passenger satisfaction, thereby providing evidence for higher order effects of the airport physical environment.

Finally, this study was conducted in the research context of the COVID-19 pandemic. Few studies have yet paid attention to airports' physical environment or passengers' perceptions under emergency scenarios such as the COVID-19 pandemic, a public health emergency much more severe than SARS, EBOLA, bird flu, or H1N5 influenza (which lasted for relatively shorter time periods and exhibited lower rates of symptomatic infections). Border restrictions and quarantine measures in previous outbreaks were not as rigorous as those during the COVID-19 pandemic [44]. Thus, this study represents a trial attempt to build a model covering the influencing mechanisms between the airport physical environment, perceived safety, passenger satisfaction, and travel intention in the context of the COVID-19 pandemic. Different from previous conclusions that were not reached within the context of COVID-19 [10,12], we were able to verify that facility aesthetics does not have significant effect on perceived safety or satisfaction during the pandemic. This indicates that passengers pay little attention to facility aesthetics. Instead, they are concerned about facility functionality, layout accessibility, and cleanliness during the pandemic.

5.3. Practical Implications

As the positive effects of the physical environment on passenger satisfaction were confirmed in the context of COVID-19, airports must constantly measure and monitor the quality of airport environment in order to improve passengers' satisfaction and increase their travel intentions [72].

First, one of the most critical points is cleanliness and hygienic conditions. Public areas such as lounges, catering areas, rest rooms, and elevators must be cleaned and disinfected regularly. The frequency of this cleaning requires a scientific basis. Self-serving food could be added in dinner areas in order to reduce close contact between passengers. Second, improvements to staff training, management methods, and regulatory mechanisms are necessary in order to improve the quality of the airport environment. Third, airports should pay more heed to facility functionality. As facility functionality affects low-experience passengers' perceived safety as well as all types of passengers' satisfaction, airports should enhance their infrastructure (e.g., seats, toilets) and inform passengers of information via electronic screens broadcasting quickly and efficiently. In addition, online self-service machines can improve the efficiency of the check-in process and reduce the risk of infection with COVID-19. Fourth, layout accessibility is meaningful in improving passenger satisfaction. In order to ensure reachability for passengers, it is necessary that signs in airport are clear and the information desk service is effective.

Perceived safety can be a significant factor influencing passenger satisfaction. Even though the pandemic has been under control in China throughout 2021, it remains difficult to convince passengers that the airport environment is completely safe. During a pandemic, safety measures act as a driver of intention to re-travel or visit other destinations, surpassing other destination-specific attributes such as operator performance, personal values and consumer needs [73]. As the pandemic continues, airports need to implement strict safety

and hygiene standards. For instance, they may mandate the use of masks or respirators, social distancing, improved cleaning and disinfection methods, and temperature and symptom checks. These safety measures can be considered an irreplaceable part of safe travel in the future [74]. Through these measures, passengers' perceived risk might be reduced, and the perceived safety of passengers can be improved.

Finally, our findings suggest that airport managers should pay attention to the important role of passenger satisfaction during the COVID-19 pandemic. All measures to improve the physical environment of the airport and the perceived safety of passengers consequently satisfy passengers. In other words, these measures help to demonstrate that airports are concerned about their passengers. In this way, airports can create a better image and ultimately improve passengers' travel intention.

6. Conclusions

This paper aimed to develop a thorough theoretical framework encompassing the airport physical environment and passengers' perceived safety, satisfaction, and travel intention as well as the mediating role of passenger satisfaction, in the particular context of the COVID-19 pandemic. To this end, a research model was constructed and the variance-based SEM technique was used to verify the proposed model using 398 questionnaires. This study presents several key insights informing passengers' perceived safety, satisfaction, and travel intention. The empirical results indicate that facility functionality, layout accessibility, and cleanliness positively affect passenger satisfaction, and that cleanliness positively affects perceived safety. When passengers are satisfied with the comfort, availability, and cleanliness of airport physical facilities, they form positive feelings about the airport. Unlike previous conclusions in studies outside the context of COVID-19 [10,12], the present study revealed that passengers pay attention to facility functionality, layout accessibility, and cleanliness during the COVID-19 pandemic instead of facility aesthetics. Furthermore, higher satisfaction leads to higher travel intention. This study reveals that facility functionality, layout accessibility, cleanliness, and perceived safety affect travel intention through the mediating role of satisfaction. In the low-experience group more than in the high-experience group, perceived safety is positively affected by facility functionality, while there is no significant difference in the hypothesized relationship between business group and leisure group.

One vital contribution of our model is that it explores the necessary efforts required on the part of airports to boost the recovery of air travel demand. This research may provide airports with insights into ways to improve passengers' perceived safety and satisfaction, thereby improving passengers' travel intention. Specifically, the valid elements of physical environment such as facility functionality, layout accessibility, and cleanliness ought to be upgraded and maintained regularly in order to enhance passenger satisfaction. In addition, it is necessary for airports to offer an impression of safety to passengers in order to boost their satisfaction by keeping public areas well-cleaned. Airport managers need to consider enhancing the hygienic level, ensuring disinfection of airport public places, and providing more facility functions and searchable information in order to encourage travelers to place more trust in airports' safety.

Although this research is valuable, it has limitations. First, this study only interviewed participants from China. As COVID-19 is a global pandemic, future research should generalize these findings using data from international flights and transit flights. Compared to domestic travel, passengers spend longer periods of time and are often subject to stricter entry checks during international travel or transfers. A comparative analysis could be conducted between domestic and international flights as well as between direct and transfer flights. Second, low perceived safety may be caused by emotional restlessness. Therefore, passenger emotion could be considered as a mediating role in the relationship between the physical environment and passenger satisfaction in future studies.

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Appendix A

Table A1. Questionnaire.

Structure	Items	
Facility Functionality	FF1	In the terminal area, the airport provides ample seating and space.
	FF2	In the terminal area, the airport provides comfortable seats.
	FF3	The electronic display at this airport provides clear information.
	FF4	This airport has high-quality electronic displays.
Facility Aesthetics	FA1	The colors of the facilities at this airport are attractive.
	FA2	The color scheme of the interior walls and floors of this airport is very attractive.
	FA3	The facility structure of this airport is attractive.
	FA4	The decoration of the facilities at this airport is very attractive.
Layout Accessibility	LA1	The spatial layout of this airport makes it easy for you to get the airport services you want.
	LA2	The spatial layout of this airport makes it easy for you to move within this airport.
	LA3	In general, the layout of this airport makes it easy for you to get to where you want to go.
Cleanliness	C1	The airport's waiting room and eating area are in a relatively good state of disinfection and cleaning.
	C2	The toilets in this airport are in good disinfection and cleanliness.
	C3	The aisles and entrances and exits of this airport are in good condition.
	C4	The facilities in this airport are in good condition in terms of disinfection and cleaning.
Perceived Safety	PS1	I think the facilities at this airport are safe during the pandemic.
	PS2	I felt safe when I was at the airport during the pandemic.
	PS3	I didn't feel any anxiety at this airport during the pandemic.
Passenger Satisfaction	S1	In general, I am satisfied with my experience at this airport during the pandemic.
	S2	My decision to choose this airport is wise.
	S3	Overall, I had a great time at this airport.
Travel Intention	LI1	I plan to travel by air again in the near future.
	LI2	I am willing to visit this destination again.
	LI3	I am willing to go to another city next time.

FF = facility functionality, FA = facility aesthetics, LA = layout accessibility, C = cleanliness, PS = perceived safety, S = passenger satisfaction, TI = travel intention.

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