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## Perceived accessibility by air transportation

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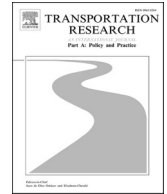
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# Transportation Research Part A

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## Perceived accessibility by air transportation: A focus group study of potential air travelers in The Netherlands<sup>☆</sup>

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### ABSTRACT

This study explores perceived accessibility specific to air transportation in the Dutch context through a focus group study. Five focus group sessions were held with a total of 24 participants with air travel experience within the past five years. Online focus groups were held during the period that the COVID-19 pandemic travel restrictions were in effect, specifically around 12 months after the travel restrictions were implemented globally. In terms of the importance of activities accessible by flight, we observe that travelers particularly attach importance to visiting family and relatives, while the importance attached to the business and recreational activities accessible by flight varies among participants. As far as the transport component of accessibility is concerned, we find that, in addition to conventional variables in air transportation research, such as cost and travel times, unconventional variables such as uncertainty during flight schedule disruptions or the mood of staff and other passengers contribute to perceived accessibility by air transportation. Based on the results, we further discuss characteristics specific to perceived accessibility by air transportation, directions for further qualitative and quantitative research regarding perceived accessibility by air transportation, and implications for policy and planning.

### 1. Introduction

Air transportation plays a crucial role in providing access to activities located at long distances (in some papers referred to as ‘opportunities’). In the Netherlands, the most commonly pursued activity by air transportation is recreational activities followed by visiting friends and relatives (VFR) and business activities in 2018 (Zijlstra and Huibregtse, 2018). The literature also shows that air travelers may engage in recreational activities on business trips, combining travel motives (Lichy and McLeay, 2018; Batala and Slevitch, 2024). From the perspective of (potential) air travelers, a desirable air transportation sector is one that provides high perceived levels of accessibility to such activities.

Hansen (1959:73) defined accessibility as ‘the potential of opportunities for interaction,’ while Geurs and van Wee (2004:128) defined it as ‘the extent to which land-use and transport systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport mode(s).’ While studies on long-distance accessibility by air transportation can be found in existing literature, these studies are heavily based on spatial data involving locational and transportation characteristics (Park and O’Kelly, 2017; Dai et al., 2018; Sun and Lin, 2019) with little or no consideration to travelers’ perceptions related to accessibility.

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However, in reality, accessibility levels for travelers are determined by far more diverse contributing factors than just those related to locational and transportation characteristics (Geurs & van Wee, 2004). Disregarding contributing factors beyond locational and transportation characteristics, and ignoring perceptions of such characteristics may result in accessibility assessments that do not match accessibility levels actually perceived by travelers (Lättman et al., 2018; Pot et al., 2021). Perceived accessibility levels from the same origin and destination can vary depending on the various characteristics of (groups of) individuals, such as age and abilities (Martin et al., 2008; Ryan et al., 2016; Lättman et al., 2018), preferences (Geurs and van Wee, 2004), awareness of transportation and locational characteristics (van Wee, 2016), or individuals' temporal constraints (Hägerstrand, 1970). Van Wee (2016) and Pot et al. (2021), used the term 'calculated accessibility' (based on spatial data of the transportation and land-use system) to refer to accessibility indicators calculated based on spatial data, in contrast to perceived accessibility.

Existing literature demonstrates that perceived accessibility and calculated accessibility can yield different results in the same context of study (van der Vlugt et al., 2019). Departing from the definitions of Hansen (1959) and Geurs and van Wee (2004), we define perceived accessibility as 'the perceived ease of reaching activities or destinations by (groups of) individuals by means of a (combination of) transport mode(s), enabled by the land-use and transport systems. Research regarding perceived accessibility by air transportation (PAA) may provide insights into accessibility levels to activities located at long distances using air transportation as perceived by air travelers. Such insights can be used in policy and planning where a risk of potential negative impact of future policies on accessibility levels and equity in terms of accessibility exist. Such policies can be the result of directly needed air transportation climate policies (Willberg et al., 2024). However, as potentially numerous factors can influence perceived accessibility, measuring perceived accessibility is not an easy task. Incorporating characteristics of individuals may add complexity to research with heterogeneity in backgrounds, abilities and preferences of individuals.

The literature on long-distance accessibility by air transportation (AAT) incorporates travelers' perceptions of accessibility only to a limited extent. One reason perceived accessibility and calculated accessibility can differ is due to people's preferences regarding factors contributing to accessibility. Several papers include these preferences, albeit to a limited degree. Within the topic of AAT, the weights of travel attributes are often differentiated depending on the purpose (business or leisure) of travel (Beria et al., 2017), considering the difference in preferences for travel time and costs between business and leisure travelers. In their analysis of accessibility levels of Italian universities by university students, Cattaneo et al. (2016) included route and mode substitutability as well as presence of low-cost carriers (LCC) as contributing factors to accessibility to account for the fact that university students are more sensitive to travel costs than other types of travelers. Some studies make use of values of time (VOT) adopted from other air transportation studies or reports to account for travelers' preferences regarding travel times (Beria et al., 2017; Laurino et al., 2019; Moyano et al., 2018; Mueller and Aravazhi, 2020; Mueller, 2021; Avogadro et al., 2021). In other studies, researchers have included travelers' preferences via attribute weights and penalties to generalized transport costs (GTC), such as specific weights for in-vehicle transport times, waiting times, or transfer penalties (Gutiérrez et al., 1996; Mueller and Aravazhi, 2020; Avogadro et al., 2021; Mueller 2021). Personal time constraints are considered to some extent in the literature by using daily accessibility measures, in which the time constraints of business travelers seeking same-day return trips are taken into account (Cao et al., 2013; Moyano et al., 2018). Mueller (2021) adopted preferences towards arrival times by including the time difference between ideal arrival times and scheduled arrival times of flights in the accessibility measure. Koster et al. (2011) and Bergantino et al. (2020) utilized choice models under the random utility theory to study airport accessibility, which is another one of multiple contributing factors to PAA.

In addition to preferences, some studies explored what motivates individuals to travel by air and individuals' circumstances in relation to perceptions regarding air travel. Specific insights relevant to the 'perceived' aspect of AAT were found in a study by Graham and Metz (2017) investigating potential reasons behind infrequent air travel for residents of the U.K., Belgium, the Netherlands and Germany. Although the study focused on travel behavior, the findings are relevant to PAA. Their dataset included socio-demographic data as well as survey responses regarding personal circumstances related to the frequency of air travel, such as type of occupation, disability and health condition, presence of children in the household, and internet access. They concluded that socio-economic status and personal circumstances contributed to non-flying rather than specific aviation factors. Halpern and Bråthen (2011) empirically studied the perceived importance of regional airports in Western and Northern Norway. The geographical context of the study was focused on Western and Northern Norway providing detailed insights into how regional airports impact the PAA of survey respondents and why access to activities by air transportation is important under specific geographic and climate conditions of the regions. They reveal that residents of more remote regions show higher frequency of domestic air travel, but significantly lower frequency of international air travel. The flight route network offered by local airports influenced the frequency of holidays, which is in contrast with the findings of Graham and Metz (2017). The major purpose of air travel was work related and visiting friends or relatives. Local airports were important for resident location and retention in remote regions. However, the survey used for the study was designed based on the opinions of experts in industry and academia, meaning that the concept and contributing factors of accessibility were primarily defined by experts rather than being based on input from travelers who perceive the notion of accessibility.

This overview of the literature shows that research regarding PAA is still in its early stages. In particular, no study was found in which the differences between PAA and local/regional perceived accessibility was investigated. AAT involves relatively high levels of GTC compared to GTC in local/regional accessibility context and uncertainty levels may be higher in AAT as frequency of air travel is often significantly lower than the frequency of local trips, and destinations may be unfamiliar, at least for leisure travelers who choose to visit destinations that they have not visited before (Yoo et al., 2024). How these differences influence perceptions has not yet been studied. Additionally, because knowledge regarding PAA is scarce in the literature, there is insufficient evidence from which future researchers can decide which accessibility measures would be suitable, or how conventional measures must be adjusted for quantitative assessment of PAA. To advance the understanding of PAA, this study aims to answer the following questions: (1) How is AAT defined by travelers in comparison to local accessibility, and what are the contributing factors to PAA? (2) How crucial are the

activities accessible by air transportation to air travelers and to what extent can activities be substituted? (3) Which conventional accessibility measures are suitable for quantitative PAA research?

This study aims to answer these questions based on focus group meetings (FGMs) in the Netherlands. At the time of conducting this study, the COVID-19 pandemic had severely impacted passenger air transportation for close to twelve months, and the majority of people in the Netherlands had not flown for a considerable period of time. These circumstances allowed us to investigate the importance of flying and factors that were critical in dramatically decreasing long-distance accessibility levels by air transportation. In addition, because of the pandemic restrictions, we were forced to conduct the FGMs online. Since the meetings were lead by an experienced mediator, we are able to compare this with regular face-to-face meetings and will do so in the discussion section.

In the discussion section, based on the results, we draw policy implications for equitable air transportation climate policy in terms of PAA. We focus on air transportation climate policy because results of this study may be used to enhance PAA, which can lead to increase in air travel frequency, exacerbating the already urgent issue of climate impact from the air transportation sector. The literature demonstrates that there is a correlation between the frequency of air travel and airport accessibility levels (Enzler, 2017; Kim and Mokhtarian, 2021; Mattioli et al., 2021) which contributes to PAA. Willberg et al. (2024) further emphasizes that future accessibility research should focus on measuring just accessibility in addition to considering planetary boundaries. Travel by air is not equitably distributed on both the global and national scales (Gössling and Humpe, 2020) and while the air travel tax models based on emissions from taking flights, flight frequency, or a combination of the two were found to be distributionally progressive in terms of household income (Büchs and Mattioli, 2024), they make explicit that some tax models may burden lower-income migrants, who are likely to be frequent VFR flyers due to dispersed social networks, more than other tax models. Therefore, we focus our policy implication discussions on air transportation climate policy in terms of equity of PAA, as well as PAA in general.

The next section explains the accessibility framework that underlies our study. This is followed by a description of the methodology in Section 3 and a description of the results in Section 4, where we answer research questions (1) and (2). Section 5 presents conclusions from the results, followed by discussions, in which we provide answers to research question (3).

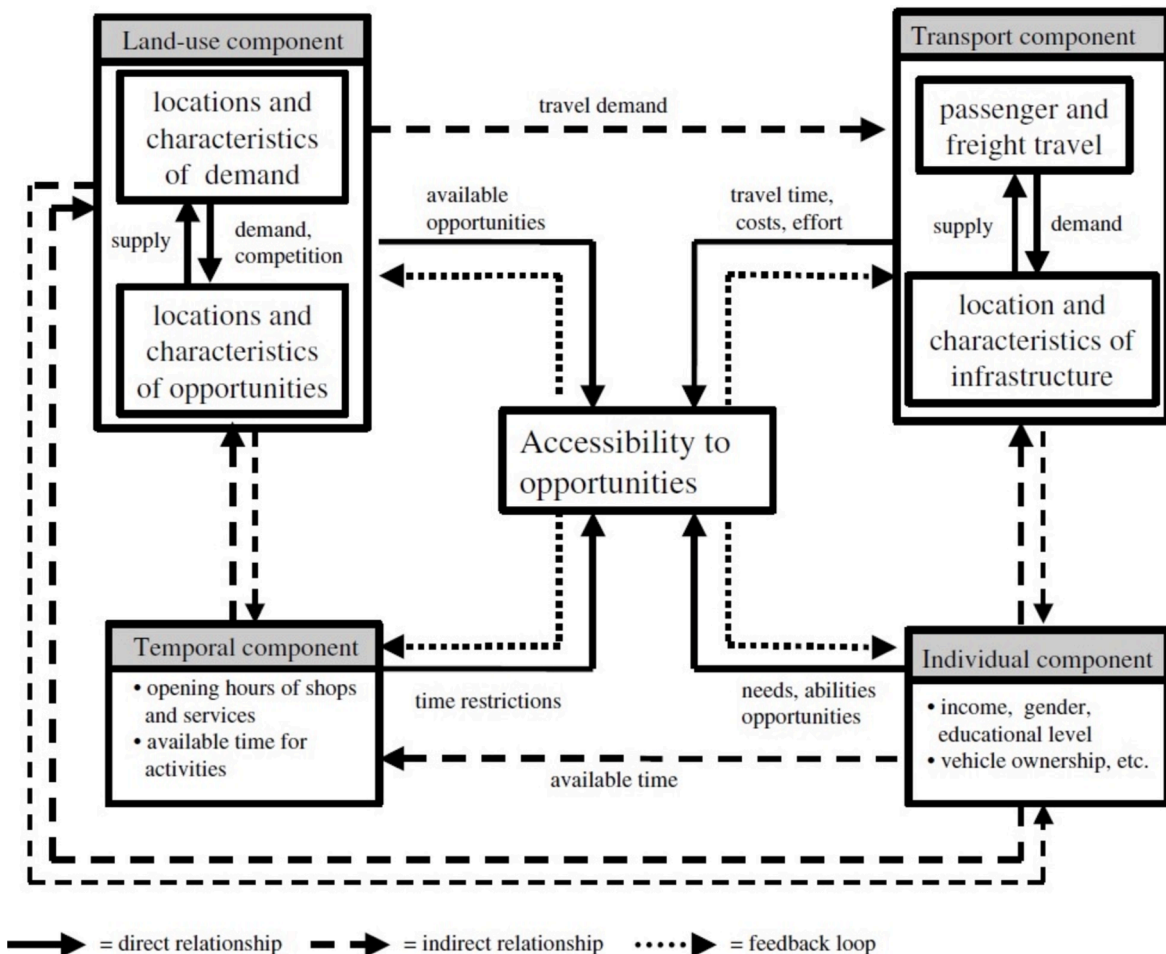


Fig. 1. Theoretical framework of accessibility by Geurs and van Wee (2004).

## 2. Underlying theory of accessibility

We use the theoretical framework of [Geurs & van Wee \(2004\)](#) as the underlying theory of accessibility for this study, as it organizes potentially numerous contributing factors of accessibility into four components and their interactions with accessibility as shown in [Fig. 1](#), which can be applied to accessibility research in diverse contexts. The four components consist of the transport component, the land-use component, the individual component, and the temporal component. The transport component refers to contributing factors to accessibility that are related to aspects of transportation connecting the origin and potential destinations. This is closely related to the elements of friction or impedance in gravity-based accessibility frameworks. The land-use component includes elements related to the quality and spatial distribution of activities and origin locations. Although the component is named the 'land-use component,' the scope of the component is not limited to the spatial distribution of activities influenced by land-use characteristics but includes all aspects of activities including quality and attractiveness of the activities. The land-use component is equivalent to the attraction of activities in gravity-based accessibility frameworks. In local or regional accessibility, land-use policies and characteristics may have a significant impact on the spatial distribution of activities and origin locations as they may designate the locations of residential areas, schools, office parks, commercial areas etc. In the context of AAT however, the influence of land-use policies is probably lower compared to local and regional accessibility, because such policies can only limitedly influence the attractiveness and spatial distribution of activities unless major leisure or business districts have been intentionally planned by national governments to attract long-distance visitors. Nevertheless, we use the term 'land-use component' throughout this study to avoid confusion in organizing the results according to the framework of [Geurs and van Wee \(2004\)](#). The individual component refers to characteristics of individuals that can influence accessibility, such as personal abilities and preferences. The temporal component covers elements of accessibility related to the time windows that activities are available and the time windows that individuals have to access them. The four components and accessibility interact with one another with direct or indirect relationships or feedback loops as shown by the arrows in the figure.

## 3. Methodology

### 3.1. Motivation for using FGMs

FGMs is a qualitative research method where the researcher obtains data regarding opinions about a given topic by observing discussions of small groups ([Basch, 1987](#)). Two major reasons motivated the use of FGMs for this study. First, perceived accessibility can be influenced not only by personal experience or knowledge but also by experience of others ([Pot et al., 2021](#)). FGMs allows the researcher to observe the opinions of the participants in a social context where they can be influenced by the opinions and comments of others ([Kitzinger, 1994](#)). From this, researchers can also observe whether participants are in agreement or disagreement with certain opinions. Secondly, there may be differences between accessibility as conceptualized by researchers and accessibility as perceived by air travelers. Compared to one-on-one interviews, FGMs lowers the risk of the researchers revealing their perspectives regarding the subject of study to the interviewees during interactions with participants, as the interactions are not always between the researcher(s) and participant(s). FGMs has been utilized in settings where potential differences in perspectives exist between researchers and participants ([Morgan, 1996](#)). Because accessibility is a broad and complex concept, we considered that there may be differences between the frameworks of accessibility in literature and the way potential air travelers perceive accessibility.

Because we conducted the FGMs during the pandemic, the meetings were organized online. The author who performed the role of the main moderator in the meetings was experienced with FGMs prior to this study. Hence, we are able to compare the online FGMs with physical meetings and will reflect on this in [Section 4](#).

### 3.2. Recruitment of participants

FGM participants were limited to people with Dutch nationality with air travel experience in the past five years, including at least one intercontinental destination and one within Europe. According to [Airbus \(2019\)](#), the Netherlands ranked 41st among 'nations and territories' in terms of average number of air trips per capita per year in 2019, with 1.7 outbound trips per capita per year. A report by [Hopkinson and Cairns \(2021\)](#) shows that around 58 percent of the Dutch population took flights more than once in 12 months according to 2016 data, which is the highest proportion among countries included in the report. Considering that 42 percent of the population flies less than once in 12 months and flights within Europe are much more common than intercontinental flights from Europe, the FGM participant group consisted of potential travelers with relatively diverse and recent flight experience. Such a restrictive recruitment criterion was adopted to avoid gathering information based on outdated experiences or speculation from inexperience of not having made at least one intercontinental flight. Non-user perceptions regarding AAT are also an important aspect of PAA, but including perceptions from both participants with recent experience and those without recent experience was considered too broad of a scope for one study.

As business and leisure travel have several differences in travel circumstances, notably the fact that business trips are paid for by employers rather than the travelers, and arguably have more limitations in freedom to choose the destination, separate meetings for the two groups were organized. In addition to the travel experience requirement mentioned above, participation in the business travel group meetings was limited to those with business travel experience within the past five years. Most participants in the group with business travel experience also had leisure travel experience, and some participants in the group with leisure travel experience had business travel experience. The term 'leisure travel' for this study includes both VFR trips and trips made to access other recreational activities. We did not limit discussions to travel experiences relevant to the travel purpose (business versus leisure) of the FGM sessions,

as it was deemed natural for the participants to simultaneously consider both business and leisure trips in their ideas about AAT. Additionally, while some travelers may have combined leisure activities with business trips as suggested in the literature (Lichy and McLeay, 2018; Batala and Slevitch, 2024), we considered that motivating those participants to think of the two activities separately could hinder our observations of participants' perceptions. After exploring the results, we found that in terms of perceptions towards AAT, no substantial differences between the FGM sessions consisting of participants with business travel experience and those consisting of participants with leisure travel experience exist, apart from the fact that the groups with business travel experience were more active in expressing opinions and provided more diverse insights compared to the groups with leisure travel experience. Three FGM sessions were planned for groups with business travel experience, and another three sessions for groups with leisure travel experience. However, since we did not observe new information from the second group with leisure travel experience, we considered that we had reached saturation of information (Conradson, 2013; Guest et al., 2017) for the leisure travel experience category and canceled the planned third meeting. Hence, we organized three meetings with groups with business travel experience and two meetings with groups with leisure travel experience.

Regarding the number of participants per FGM session, the rule of thumb for the number of participants is six to ten, as stated by Morgan (1994). However, considering that online discussions may not be as natural as discussions in physical settings, we were not certain whether this number applies to online discussions. A pilot meeting with five participants (see section 2.3) lasted around 80 min, and we projected that six-person group meetings would require considerably more time to allow room for all participants to speak out. At the same time, we considered it important to avoid the risk of participants losing concentration from sitting in front of a screen for a long time. Eventually, we decide to recruit five participants for each meeting. However, in one of the meetings with participants with leisure travel experience, one participant failed to join, so that meeting only had four participants.

As FGMs typically does not intend to study representative samples of the population but instead strive to explore a variety of ideas, opinions and underlying reasons, we did not strive for representativeness of the Dutch population. We aimed to recruit participants with air travel experience prior to the outbreak of the COVID-19 pandemic, but not too long before, so that the air travel experiences were relatively recent. The age of participants ranged from the late 20 s to mid-50 s for participants with business travel experience and from early 30 s to mid-50 s for participants with leisure travel experience. The gender mix was seven female and eight male participants for the business travel experience group and six female and three male participants for the leisure travel experience group. Eleven people were working as employees, while four participants in the groups with business travel experience were entrepreneurs. In the groups with leisure travel experience, eight participants were working as employees, with one student working part-time. To ensure anonymity, we replaced all participant names with fictive ones, reported provinces of residence (as opposed to cities), and replaced company names by business types. Participants were recruited through a company that provides research-related services and were offered vouchers worth EUR 45 as incentives for 1.5 h of participation. All meetings were conducted in the Dutch language.

### 3.3. FGM session design

A pilot study was conducted before the main study to test the questions and identify unexpected difficulties in the discussions. During the pilot study, we found that the term "accessibility" tended to bias discussions towards transportation aspects in long-distance travel, with less focus on the destination or pursued activities. To mitigate this bias, an introductory video was created to remind the

**Table 1**  
FGM session question sequence.

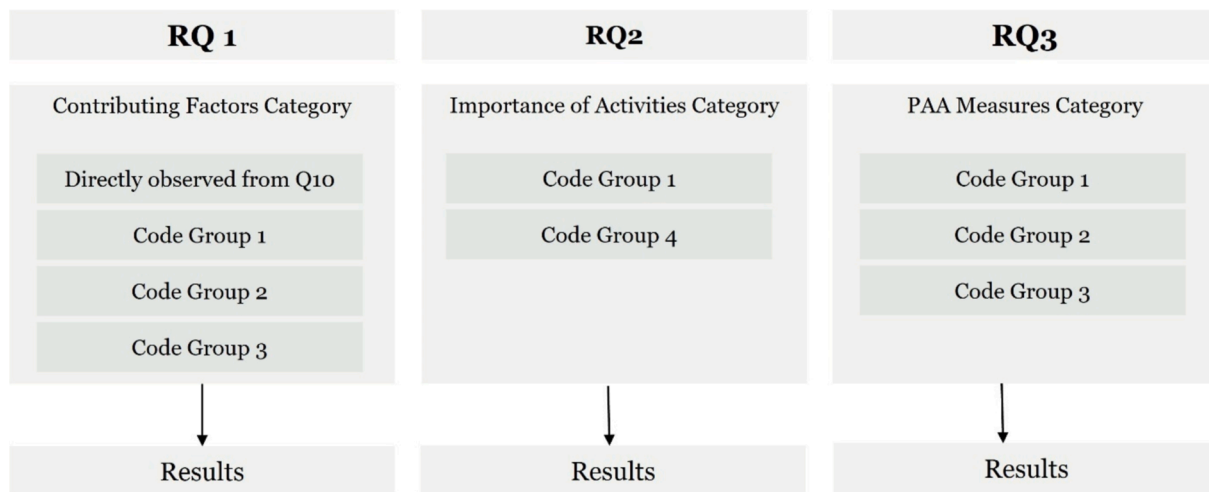
Questions	Planned duration
1. Please tell us your first name, main occupation and anything else you'd like to share about yourself.	20 min
2. Talk about a good travel experience and a bad travel experience you've had that involved air transportation.	
3. You are to repeat the previously mentioned trips, but teleportation is available at the same cost and travel duration of taking flights. You are not conscious of the journey process and will appear at your final destination. Would you teleport or take flights, and why? (Assume the COVID-19 situation has long been resolved).	20 min
4. (For participants who chose flying over teleportation in Q3) Improvements have been made to teleportation. Now you don't have to pay and the trip is instantaneous. Would you choose teleportation over flight	20 min
5. Assuming the world returns to normal after the pandemic, what is the first trip by air that you would make, and why?	
6. Have you traveled by air during the COVID-19 pandemic period or did you have to cancel plans to travel by air during this period? Why or why not?	15 min
7. Suppose that air travel is unavailable from next year onwards. What would that mean for you personally?	15 min
8. If the COVID-19 pandemic situation is not fully stopped (that is, COVID-19 will stay around like influenza), how would it affect air travel for you?	
9. (If there are air travel attributes in the checklist that have not been mentioned) In academic research regarding long distance accessibility by air, [unmentioned attribute] is considered an influential factor to accessibility. Is [attribute] an important feature for you when traveling by air? Why or why not?	10 min
10. How would you define 'accessibility by air transportation'? What does long distance accessibility mean to you compared to local accessibility such as accessibility of grocery stores, workplace, etc.?	
11. Post-survey: In planning for your next vacation (business meeting), which aspects of air travel do you feel are important to you? List as many as you would like in order of importance with your name and send it by Please assume that vaccination for COVID-19 has been fully distributed and therefore pandemic situation has ended.	
12. Please state whether your opinion regarding accessibility by air has changed by participating in this meeting.	

main study participants of all aspects of air travel, from trip planning to accessing desired activities at the destination. Additionally, in the initial questions posed during the main FGMs, “air travel” was used instead of “accessibility by air transportation,” where feasible. However, the use of the term “accessibility” was inevitable in the research description for recruitment, as precise communication was necessary for ethical reasons.

The sequence of questions was organized so that participants could initially discuss their travel experiences without being influenced by the researchers’ points of interest. Table 1 shows the full list of questions. After a round of introductions by the moderators and participants, the moderator asked question 2 to find out which factors contributing to PAA (both positive and negative) remained memorable to the participants from their own experiences. Questions 5 and 7 aimed to gather information on how important or desirable activities accessible by flight are for air travelers. Question 6 shared this aim as we considered that activities pursued despite pandemic measures limiting air travel could be regarded as very important or essential. At the same time, we aimed to reveal which factors related to the pandemic measures rendered distant activities inaccessible by air transportation. Question 8 specifically aimed to investigate whether health concerns were considered critical determinants of PAA after the participants became aware of the health implications of COVID-19 and the danger of infections. With question 9, the moderator asked for opinions about factors contributing to AAT found in the literature, but not mentioned by participants up to that point in the sessions. We aimed to explore whether some variables often included in the literature in this field were omitted during discussions because they were too obvious or because they were not important to the participants for some reason. This question was asked in the later part of the meetings to avoid revealing factors that are considered important in research to the participants and influencing them with this information. Questions 3 and 4 were inspired by the study by Russell and Mokhtarian (2015) to examine whether traveling by aircraft is always considered a disutility, as assumed in gravity-based accessibility studies (and many other studies making use of the concept of GTC). Question 10 aimed to reveal what fundamental differences exist between perceived long-distance AAT and perceived accessibility in a local context. Finally, questions 11 and 12 were distributed via email as a post-survey after the meetings to examine whether new information would be provided in a private setting without others listening and whether the participants had been influenced by the opinions of others.

### 3.4. Analysis

Video recordings of the FGM sessions were made, which were later transcribed and translated into English for analysis. The analysis was conducted using open coding based on the principles outlined by Elo and Kyngäs (2008). Fig. 2 illustrates how the code groups were categorized to address the five research questions presented in the introduction. Four groups of codes were assigned to the statements from participants. The first group of codes was based on the four components of accessibility from the accessibility framework of Geurs and van Wee (2004) explained in Section 2. The second group of codes consisted of detailed contributing factors belonging to one or more of the four accessibility components. The third group of codes was assigned based on whether a contributing factor had positive or negative contributions to PAA, whether it was a deal-breaker, and whether the statement indicated trade-off between factors contributing to PAA. For statements related to the importance of the activities pursued using air transportation,



Q10: How would you define accessibility by air transportation? What does long distance accessibility mean to you compared to local accessibility such as accessibility orocery stores, workplace etc.?

Code Group 1: Accessibility components from Geurs & van Wee (2004)

Code Group 2: Contributing factors to PAA mentioned by participants

Code Group 3: Positive/negative contribution to PAA, deal breakers, trade-off factors

Code Group 4: Substitutability and degree of importance of pursued activities

Fig. 2. Code groups and categories for investigating research questions.

the fourth group of codes was assigned based on the substitutability of the activities and/or activity locations with those that can be accessed by other transportation modes, and the level of importance of the activities according to the expressions and reasoning in the statements of participants. Relevant code groups were then categorized to answer each research question.

Participants' definition of AAT was directly observed from participants' answers to question 10 in Table 1. The contributing factors to PAA organized into the four accessibility components of Geurs and van Wee (2004). During the analysis, we noticed that the individual component often accompanied other components in the discussions regarding aspects of air travel, as in most cases, participants had personal reasons for perceiving certain aspects of travel to be positive or negative.

For the land-use component, we specifically aimed to categorize the perceived importance of pursued activities as this is a gap in the literature. Literature indicates that the perceived importance of activities accessible by air transportation can vary across individuals (Randle et al., 2019). For this study, we categorized the importance of activities into three categories: 'essential,' 'important,' and 'substitutable,' based on responses to questions 5, 6 and 7. Table 2 illustrates how the importance of activities was categorized. Activities categorized as 'essential' were those perceived by participants as essential to avoid negative impact on their quality of life or work ('need to have'), with no feasible equivalent alternative available without the use of air transportation. 'Important' activities were those sought to enhance the quality of life or work ('nice to have'), rather than to avoid negative impact, but with no equivalent alternative accessible without the use of air transportation. Finally, 'substitutable' activities were those sought to enhance the quality of life or work, with equivalent alternatives available without the need to fly. However, during data analysis, we observed that the contribution of activities to quality of life or work and their substitutability without the use of air transportation were subjective and required interpretation. Therefore, strict categorization of the importance of activities could not be made.

#### 4. Results

The results from the FGMs provide answers to the first and second research questions in the introduction section. Definitions of AAT by potential air travelers is presented in section 4.1. and the contributing factors to PAA observed from the FGMs are presented throughout section 4.2. Answers to the second research question are presented in section 4.2.1. where we present findings regarding the land-use component.

##### 4.1. Participants' definitions of long distance accessibility by air

Participants gave various definitions of AAT, focusing on distance, travel cost, airport to airport travel times, door-to-door travel times, and the number of transfers, including those for airport access and egress. When asked about the difference between local accessibility and long-distance AAT, for the latter they frequently referred to the need for planning and organizing, and the lack of spontaneity or flexibility as a consequence, with one participant stating, "the more you have to organize, the less accessible it becomes." Low frequency of flights and limited or no options for alternative routes or transportation modes were cited to explain why there is little room from spontaneity or flexibility. One participant defined AAT as 'whether the travel time is worth it for the destination,' which aligns with the occurrence of distance decay in the gravity framework often used in accessibility research (Bruinsma and Rietveld, 1993; Hsu and Shih, 2008; Hesse et al., 2013; Avogadro et al., 2021). Terms and statements reinforcing the importance of 'effort,' 'comfort,' and 'ease of reaching a destination' were also observed in participants' definitions of AAT, with one participant specifically explaining that flying with children influences the level of effort required for air travel. One participant explained AAT as having no limitations in terms of GTC as long as the destination is worth it. She stated that with air transportation, "if you want to get there, you'll get there... If you make a long transfer, it means it's worth it to get to your destination".

##### 4.2. Contributing factors to PAA

This section presents the results, organized according to the four components of accessibility of Geurs and van Wee (2004) as explained in the introduction.

###### 4.2.1. Land-use component

The land-use component in the focus group discussions mainly consisted of activities and destinations that the participants accessed or sought to access by using air transportation. Substitution of activities or destinations were also discussed, but aspects related to the spatial distribution of desired activities or destinations were not mentioned. Participants described the activities they pursue as 'business' or 'recreational' activities, 'new experiences' or 'engaging in personal or professional social activities.' The term 'destination' or names of countries and cities were also used to represent the activities that participants sought to access via air travel.

**Table 2**  
Categorization of the importance of activities.

Characteristics of activity	Importance of activities		
	Essential	Important	Substitutable
Pursued to avoid negative impact on quality of life/work	✓		
Pursued to enhance the quality of life/work		✓	
Not substitutable without the use of air transportation	✓	✓	✓



We categorized three activities, namely visiting relatives, business activities and recreational activities according to the criteria explained in section 3.4. Statements from participants with family or relatives living abroad indicated that visiting relatives is an ‘essential’ activity. The following are statements from participants regarding air travel for family visits:

- (1) Luke: *I’m mainly worried about my girlfriend because she won’t be able to see her family for a third year in a row now. It’s especially unfortunate because you can’t drive to Canada. I could go by boat. That would take a long time, especially with my 2 young kids.*
- (2) Andy: *Not being able to see them (family) in real life would be a disaster.*
- (3) Sean: *Not being able to fly at all would be dramatic. I have family abroad so flying is important to me.*
- (4) Tina: *I’d never be able to see my sister-in-law anymore, who emigrated to Australia! I won’t be able to go there, and she won’t be able to visit me anymore.*
- (5) Whitney (husband’s family lives in Suriname): *The first big journey (after the pandemic measures are lifted) will be to Suriname of course but we will do that in a big holiday, so the summer or in December. But if it’s possible we would like to go somewhere before then as well.*

Strong expressions such as ‘disaster’ and ‘dramatic’ were used. Furthermore, Luke’s statement suggests that visiting relatives is important enough to ponder the idea of using a transportation mode that requires significantly more time and effort than flying. Four out of the five participants cited above stated that they would first visit their families or relatives when asked what would be the first trip by air transportation once the COVID-19 pandemic restrictions are lifted. Furthermore, Whitney and Randy stated that online video meetings were not equivalent substitutes as ‘being able to meet, touch, and hug family in person is important.’ On the other hand, one participant who stated that she had been traveling to Italy every six weeks to visit a friend did not use expressions suggesting that the trip was ‘essential’, but mentioned that it would be the first trip once the pandemic measures are lifted. We observed that for VFR travel, visiting relatives is ‘essential’, but visiting friends ranges between ‘essential’ and ‘important’.

Business activities, on the other hand, were described in manners considered to be ‘essential’, ‘important’, or ‘substitutable’ depending on the participant. We considered business activities ‘essential’ for participants who had gone on business trips despite the pandemic lockdown, experienced major shortcomings of online events as substitute means for physical events, or used strong expressions towards not being able to fly for business activities. One participant, Sonya, stated that she would change her occupation in a hypothetical situation where air travel is no longer available and her job doesn’t involve business trips anymore. On the contrary, another participant, Randy, stated that although he enjoys attending conferences as part of his job, not being able to attend conferences isn’t important enough for him to consider changing his job. We considered that for Sonya, business activities can be categorized somewhere between ‘essential’ and ‘important’, while Randy’s comment suggested that business activities would better fit into the ‘important’ category. Statements such as “I’ve seen that it (using online means instead of flying) is doable this past year” indicated that for some participants, online activities could substitute business trips. Other options the participants mentioned for replacing business trips by flight included hiring local staff to do the job instead or acquiring equivalent business activities at locations accessible by surface transportation.

The importance of recreational activities accessible by flight also varied across participants. While we did not observe statements directly describing recreational activities as ‘essential’, one participant mentioned that she would prioritize flying for a holiday once the pandemic measures were lifted, despite business trips being ‘high on the list’ of trips she has to make. Another participant likened recreational travel to other major life decisions such as ‘getting a dog or starting a family’.

Several participants explained recreational activities in a manner suitable to be categorized as ‘important’. For participants who planned repeated visits to the same country or destination due to familiarity, substitute destinations may not offer the same familiarity and low level of uncertainty. Cohen (1979), explains that a certain level of familiarity in travel reduces the risk of uncertainty disturbing pleasure and relaxation. Another participant emphasized his desire to travel around the world, which may also be infeasible without taking flights. Nicolau (2008) links such tendencies with a desire to explore or seek variety. Attractiveness of a specific destinations that are accessible only by flight is also an activity that is not substitutable through use of other means of transportation. One participant expressed a desire to visit Tokyo, which is difficult to fulfill with substitute destinations, considering that cities accessible without taking a flight from the Netherlands are unlikely to offer similar experiences in terms of culture, climate or landscape.

Finally, there were statements suggesting that recreational activities accessible by air transportation are ‘substitutable’ through alternative activities or destinations that do not require flying. Engaging in recreational activities other than traveling, as well as traveling by car or caravan, were mentioned in a positive manner as substitute activities to pursue in hypothetical situations where air travel is no longer available. However, attitudes towards alternative transportation modes and destinations were mixed. While one participant stated that there are enough destinations accessible by car, others showed varying degrees of dissatisfaction with the idea of not being able to fly, stating that ‘great vacation’ destinations accessible without flights are limited, or by using expressions such as “well, we’d just have to accept it” or “that would be annoying”.

Another observation made from the transcripts was that participants showed intentions to combine business and leisure travel motives, which is in line with findings in the literature (Lichy and McLeay, 2018; Batala and Slevitch, 2024). Two business travelers directly stated that they are planning to combine business travel with leisure travel. One participant stated that she would pursue leisure activities during her upcoming business trip in the U.S., while another participant stated that after attending a conference in Australia, he would also travel to New Zealand.

#### 4.2.2. Transport component

##### *Travel time and cost.*

While travel times and costs were not always immediately mentioned as important contributing factors, answers to question 9 and post-survey question 11 confirmed that both are important contributing factors. We speculate that time and costs were not mentioned frequently in earlier parts of the FGM sessions because their strong influence on PAA is obvious. On the other hand, some participants confirmed that they do not pay attention to costs for business trips because the employer pays for the trips.

From the transcripts, we observed that travel time and cost were discussed in three different scopes, namely airfare and flight duration, door-to-door transit time and cost, and overall time and cost budget for the entire trip. Although the costs at destinations is part of the land-use component, we present the findings here because of the frequently mentioned links between costs at destinations and overall travel costs. The overall time and cost budget for the entire trip were discussed as deal breakers, as participants would not be able to travel unless the budgets for both are available. Several participants mentioned that overall cost is important, which is in line with the findings of [Larsen and Guiver \(2013\)](#). Time and cost for transportation were not mentioned as deal breakers and one participant specifically revealed intentions to trade-off between the two costs by stating that she would consider a transfer route to save money and spend more at the destination. Participants also expected trade-offs between airfare and service levels, using expressions such as “you get what you paid for”. One participant also showed intentions for trade-off behavior between airfare and departure time, stating that she would depart very early or very late if the tickets were cheaper.

Time and costs for transit were both considered as disutility in travel, and thus increase the level of impedance in PAA. Flight duration was particularly described as a disutility by those who stated that they cannot sleep on flights. Some participants mentioned that flights with enough time to sleep and rest are easier to handle than short flights. Similar observations were made in a study by [Lyons et al. \(2007\)](#) regarding the time use of rail passengers in Great Britain, where sleeping or snoring during transit made the travel time worthwhile for some travelers. As for costs, participants who often travel with multiple companions stated that small differences in airfare also matter because they add up to become large cost differences, supporting the findings of [Hsieh et al. \(1993\)](#). Attitudes towards airport access costs were heterogeneous, with some saying that it is important and others saying it doesn't matter.

##### *Delays, cancellation and uncertainties in transportation*

Discussions regarding delays and flight cancellations were dominant in all FGMs when participants were asked about their worst air travel experiences. Although this paper is not focused on quantitative analysis, we suspect that flight delays and cancellations are significant contributing factors to PAA because in four out of five FGMs, participants first mentioned these aspects. We do not believe that delays and cancellations being mentioned by the first participant to respond to question 2 completely directed other participants to focus on these aspects, as there were also participants who mentioned other aspects of air travel to have been decisive in creating the worst experience, such as bad mood in cabins, illness of a travel companion, mishandled baggage, or unfriendly staff. Delays and cancellations were mentioned as the reasons for worst experiences even by participants who stated that they were compensated adequately. For some participants, delays lead to missed connecting flights or arrivals at times when no public transport service was available for egress. However, there was also one participant who stated, “I've flown a lot, so I'm pretty used to delays and other unpleasant events. I've learned to accept it. I'm not really bothered by it”.

Uncertainty that followed or accompanied delays or cancellations was also discussed as an influential contributing factor to worst air travel experiences, although with more heterogeneity in valuations compared to delays or cancellations themselves. Lack of transparency in communications or misinformation from airlines regarding delays or cancellations were often stated to have escalated bad situations. Moreover, some participants stated that they do not use intermediary air ticket booking services or agents, stating that bookings are ‘unreliable,’ ‘uncertain’ and communication with airlines is ‘annoying’ during unforeseen delays or cancellations, as indirect communication with the airline through the booking agents is necessary in some cases. However, different opinions were observed regarding the effect of transparent communications during delays or cancellations. While one participant stated, “if there is a delay and they tell me why, I can live with that. But when they leave me in the dark I get quite irritated”, others stated that transparent communications do not make the situation better. Overall, the results suggest that routes with frequent schedule disruptions, or destinations served only by airlines with frequent schedule disruptions and inadequate handling of such situations, may be perceived to have lower accessibility by some travelers.

Uncertainties unrelated to delay situations or cancellations were also cited as significant negative contributing factors. As the main reasons for not planning trips by air during the pandemic period, some participants mentioned uncertainties regarding changes in disease control policies at state border entries, successfully obtaining negative COVID-19 test results close to flight dates, or the possibility of insurance claims for pandemic related travel disturbances. Several participants explicitly stated that they wouldn't consider COVID-19 a problem at all in air travel decisions when asked how COVID-19 would affect their travel behavior if it became similar to the common flu.

##### *Behavior and mood of other people, personalized service and human touch in transportation*

The human touch during air travel was discussed as an important aspect by some participants. “Unfriendly staff” was frequently mentioned as a contributing factor to worst experiences, while “friendly staff” was often mentioned in discussions about best experiences. Participants used expressions such as “you're treated like cattle,” and “I get the feeling that I'm just a number to them” in describing lack of human touch. Airline personnel giving priority to passengers of other flights during delay situations, and a flight attendant's refusal to provide a blanket while a participant was ill on the flight were mentioned as worst experiences. Another participant whose travel companion had a broken seat in the cabin, stated that the fact that her group had to go through ‘a bit of drama’ to have the travel companion relocated ‘wasn't nice,’ despite an upgrade to business class.

On the other hand, good personalized services and being given priority were mentioned by some participants during their discussions regarding their best air travel experiences. In some cases, experiences described as ‘personalized services’ explained during

best air travel experience discussions were merely standard practices of airlines, such as being given priority due to having very young or very old travel companions or flying business class. Other participants shared experiences about more unusual human touches such as a flight attendant offering interesting conversation or pilots offering a cockpit tour to children. One participant described the captain's decision to take votes from passengers to decide whether to divert or not due to toilet malfunctions in the cabin during flight as 'funny,' even though it was part of her worst air travel experience. Although unrelated to his best travel experience, one participant mentioned being given priority and personalized service due to accumulated air miles with a certain carrier as a positive contributing factor to air travel. Discussion regarding service standards was also extended to the land-use component, with one participant stating that he found some countries to have more service-oriented service industries than others.

The influence of behavior of other people extended beyond behavior of airline personnel. During discussions of worst air travel experiences, three participants mentioned crowded and noisy cabin situations and a generally 'grumpy' mood inside the cabin. Conversely, positive behavior of other passengers was mentioned to have alleviated a frustrating situation for one participant during a 17 h delay. She stated, "passengers started taking care of each other, sharing their food and foreign currency! That was nice to see." Another participant also stated that she sometimes finds it 'nice' to fly because there are 'interesting passengers to talk to.' Social traditions with travel companions during the journey was also described as a positive aspect of traveling by flight. One participant stated "at Schiphol, we drink the first beer together, and then another one on the flight. That gives me a really nice holiday feeling!", while another participant stated that her children enjoy eating at McDonalds at Schiphol airport before taking flights.

The results show that behavior and mood of employees of transportation service providers or other sharing the flight experience can influence the level of impedance in PAA. The former can be controlled by transportation service providers to some extent to lower the level of impedance in PAA to long distance destinations. Training airline or airport staff to create a more pleasant atmosphere during flight trips (at airports or in cabin) may to some extent influence the latter to lower the journey impedance.

#### *Airline.*

Names of airlines were often spontaneously mentioned in responses regarding both the best and worst air travel experiences. While some experiences were related to operational practices directly controlled by airlines, such as in-flight service arrangements, communication channels, or airline-specific safety procedures, there were also instances where the responsible party for good or bad experiences was vague, such as experiences with mishandled baggage or delays, which could have been caused by mismanagement from either the airport or the airline. Nevertheless, it was frequently observed that participants associated service levels and schedule reliability with specific airlines. One participant stated that the 'availability of preferred airline' is an important contributing factor to AAT, and another participant went as far as to state that due to a bad in-flight experience with a certain airline, he will never fly with them again.

#### *In-cabin experience.*

In the responses to the post-survey, several participants included in-cabin seating comfort as an important contributing factor to air travel experience. One participant specifically explained that she pays attention to aircraft type when flying business class because older aircraft do not have seats that fold flat into beds in business class. While most participants described business class travel experience as positive, and even more desirable than teletransportation for some, one participant stated that even the space given in business class is not enough to feel comfortable. As another positive aspect of in-cabin experience, being 'cut off from communications, your work, your family' was mentioned as a 'really nice' aspect as it provides 'time for yourself.' The 'experience of flying' was also mentioned to be a desirable aspect of in-cabin experience. Several participants mentioned good food and beverage catering in the cabin as contributing factors to their best air travel experiences. One participant stated that she 'does not enjoy airplane food' and prefers to eat at the airport before taking flights. Another participant, who used the expression 'fantastic in terms of food' in describing in-cabin catering during his best travel experience, also mentioned that he would prefer to skip the journey by flight despite missing good catering when asked whether he would use teletransportation instead of flying if it was available. Low pressure within the cabin, tedious views outside the windows, being seated near toilets, and not being able to step outside for a long period (in contrast to train journeys) were also mentioned as negative aspects of in-cabin experience. Overall, results show that certain aspects of in-cabin experience increase the journey impedance while there are also aspects that lower the impedance, although the influences were heterogeneous across participants.

#### *Transfers.*

Transfers were generally described as a factor that increases impedance in PAA. Some participants stated that they make trade-offs between transfers and airfare. Two participants mentioned that the price difference between a direct flight and a transfer flight must be big enough to consider taking a transfer route. One of the two participants stated that she filters out tickets with two or more transfers when booking flights, suggesting that number of transfers can become deal breakers when choosing routes. Another passenger stated that she considers transfer routes only when she can 'afford to be tired' upon arrival at the destination. The attractiveness of transfer airports was another factor stated to be important in considering transfer routes. Dubai, Singapore, Hong Kong and Bonaire were cities explained to have attractive activities or convenient facilities during transfer times or layovers. In particular, one participant mentioned that shower facilities at airports are important for him. Another participant confirmed that sometimes he arranges self-transfers and takes transfer flights from an airport other than the one where he landed, and therefore airport locations are important.

In terms of transfer time, some participants stated that they prefer the shortest transfer time, with one participant specifically mentioning that she does not take routes with transfer times of over six hours. There were also several participants who stated that they prefer transfer times long enough to 'explore' the city or surroundings of the transfer airport or layovers for a 'mini vacation,' rather than transfer times that require them to wait in the airport. Those that stated to prefer long transfer times mentioned that the attractiveness of the city or surroundings of the airport is important in deciding whether or not to take tours during transfer or layover times. One participant stated that she intentionally booked a flight with a layover in Bonaire to enjoy the island.

#### *Characteristics of airports.*

There were also statements describing the importance of airport facilities and airport characteristics unrelated to transfers. In general, having to arrive early at airports to wait in long queues for check-in, security screening, border control, and being required to walk long distances to gates at large airports were discussed as inconveniences. Some participants specifically stated that they prefer smaller airports because they are 'easier to navigate,' 'relaxed,' and do not have to wait in long queues. One participant stated specifically that the availability of advanced check-in is important. Another participant described the experience of going through security screening in the U.S. as 'extreme.' Airport access and egress were also considered important by some participants, stating that the availability of public transportation access to the departure airport is important. Another participant stated that availability of egress transportation from the arrival airport to the accommodation location is important. In terms of airport facilities, some participants stated it is not important at all, while others stated that food and beverage stores, shops, and places to work while waiting for flights are important. Results show that various characteristics of airports contribute to the resistance of flights and therefore to PAA with some aspects being specific to certain airports, and others being generally applicable (not airport-specific).

#### *Baggage.*

Mishandled baggage and limitations on baggage were mentioned as inconveniences of air travel. For one participant, the experience of baggage arriving a week later than him at the destination contributed to his worst air travel experience. For another participant, strict baggage weight and size limitations are a 'real problem' for his hobby of climbing, as he cannot bring along all of the required equipment. Baggage size limitations were also mentioned as an inconvenience by another participant who explained that traveling with a pram is 'tough' because oversized baggage is always the last to arrive at baggage claim. Note that mishandled baggage is route or airline specific, whereas size or weight limitations for exceptional goods, like bicycles or prams, which are considered oversized luggage by all airlines.

#### 4.2.3. *Individual component*

##### *Attitudes towards planning and organizing.*

An interesting observation from the focus group discussions was that the participants used the terms 'planning' and 'organizing'<sup>1</sup> with distinction. While 'planning' was used when describing the process of selecting activities, destinations and flights, 'organizing' was mostly used when describing the process of making preparations necessary for the door-to-door journey. In general, 'organizing' was used with (slightly) negative tone, with participants saying it is a 'hassle' or "the more you have to organize, the less accessible it becomes". As explained in section 4.1, the need to organize was stated as a reason why there is no room for spontaneity or flexibility in air travel. One participant stated that even a spontaneous trip by air transportation using a last-minute flight deal is 'still an undertaking.' The disutility of organizing was also mentioned in discussions regarding air travel during the COVID-19 period. Multiple COVID-19 tests being required by airlines and disease control authorities before flights were stated to lower AAT. One participant stated that he chose to depart from an airport in Belgium because COVID-19 tests were not required at Belgian airports yet at the time of his trip, but rather strict for taking flights from airports in the Netherlands. Some participants stated that health risk was not as significant in their decision not to fly during the pandemic period compared to the inconvenience of additional organizing required due to travel restrictions.

While attitudes towards organizing were generally homogeneous, participants showed heterogeneity in attitudes towards planning. One participant used the expression 'hassle of planning and organizing', suggesting that all planning and organizing are negative for her. We also speculate that planning would be a negative aspect of air travel for the participant who said to enjoy spontaneous trips. However, several participants expressed positive attitudes towards planning, finding it enjoyable or even exciting processes of air travel. They used phrases such as "that (planning) is quite fun", "booking the airplane seats is quite exciting for the family" and "for me the fun of a trip is in the planning beforehand, and at the destination" to convey their sentiments.

##### *Other individual components.*

Travel companions were mentioned as important determinants of AAT by several participants. In particular, traveling with children was stated to influence air travel in various ways. Some participants considered it very unlikely that they would make air travel plans that include young children, while others included the opinions of their children in destination and route choice planning. Travel companions other than children, such as friends and family, were also stated to influence destination choices. Another interesting observation was the heterogeneous attitudes towards using air transportation. Positive attitudes towards flying were observed with some participants stating that taking flights gives the feeling of going far and adds to the holiday experience in leisure travel. During the discussion regarding the intent to travel by hypothetical teleportation device, one participant specifically stated that he would prefer to fly to the destination, but teleport when returning home. He explained that on outbound flights he feels excited about the trip and is looking forward to enjoying his time at the destination. On the other hand, on inbound flights, he mentioned that he 'just wants to get home.' While fast transport modes are generally associated with low intrinsic experience values (Lumsdon and McGrath, 2011), excitement about trying impressive aircraft (A380, Concorde) or even just the experience of flying were also mentioned as positive aspects of taking flights. On the other hand, some participants described taking flights as 'necessary evil,' 'hassle,' or stated that only the activity at the destination is important, with one participant saying "I just want to be there as soon as possible." One participant pointed to the environmental impact of flights as the main reason she avoids traveling by air.

<sup>1</sup> In Dutch, 'plannen' was used for 'planning' and 'organiseren' was used for 'organizing'.

#### 4.2.4. Temporal component

The temporal component involves the influence of time windows at which activities are available and the time individuals have to access them (Geurs and van Wee, 2004). In local and regional accessibility, activity patterns are set in the temporal component based on the opening hours of businesses, working hours and daily biological cycles of people. Some participants emphasized the importance of access and egress to and from airports at “logical hours”, with several business travel experience group participants prioritizing this over travel costs. For them, aspects like “arriving on time for meetings,” “having time to prepare for meetings” or “not being too tired for meetings at arrival” were crucial. These remarks highlight similar time-related constraints in the temporal component of PAA as seen in local accessibility contexts.

In addition to these more generic statements related to the temporal component, there were also remarks highlighting unique characteristics of the temporal component in the context of air travel. First, statements and responses suggested that boarding flights and accessing egress transportation were viewed as activities with time windows themselves. Travelers must factor in time for check-in, security screening, and reaching the destination airport within the operational time frames for egress transportation. Several participants emphasized departure and arrival times as crucial factors to AAT in their responses to the post-survey. During the meeting, one participant specifically stated that she ‘only travels using public transportation in the Netherlands’ and prioritized departure time over travel costs, as she doesn’t like ‘departing in the middle of the night.’ Conversely, another participant favored late-night departures, citing it as a time ‘buffer’ during the day before she has to arrive at the airport, in case something goes wrong and additional organizing is needed. Additionally, broader time windows were observed, such as the “right time of the year” and “right time of life,” for the participant who mentioned air travel decisions alongside major life choices such as “starting a family” or “getting a dog.”

### 5. Conclusions and discussions

#### 5.1. Synthesis and Conclusions: A framework for PAA

The results from this study generates a framework of PAA which is a partial framework of Geurs and van Wee (2004), with a narrower theoretical scope, but with more details on how the individual component of accessibility influences PAA. Fig. 3 illustrates the framework of PAA from our results. All routes of the contribution of accessibility components to PAA are also present in the framework of Geurs and van Wee (2004). Evidence of feedback loops from PAA back to the accessibility components were not observed from our results. In addition, the indirect effects from the land-use component to the transport component, from the temporal component to the land-use component and from the individual component to the land-use component were not observed in our results. Changes involving the land-use component or transport component may be difficult for individuals to observe as major changes in the characteristics of destinations or the air transportation system takes place over long periods of time.

Our results supplement the findings of van der Vlugt et al. (2019) in which the difference in outcomes between calculated accessibility and perceived accessibility was observed. Fig. 3 demonstrates that the individual component influences the contribution

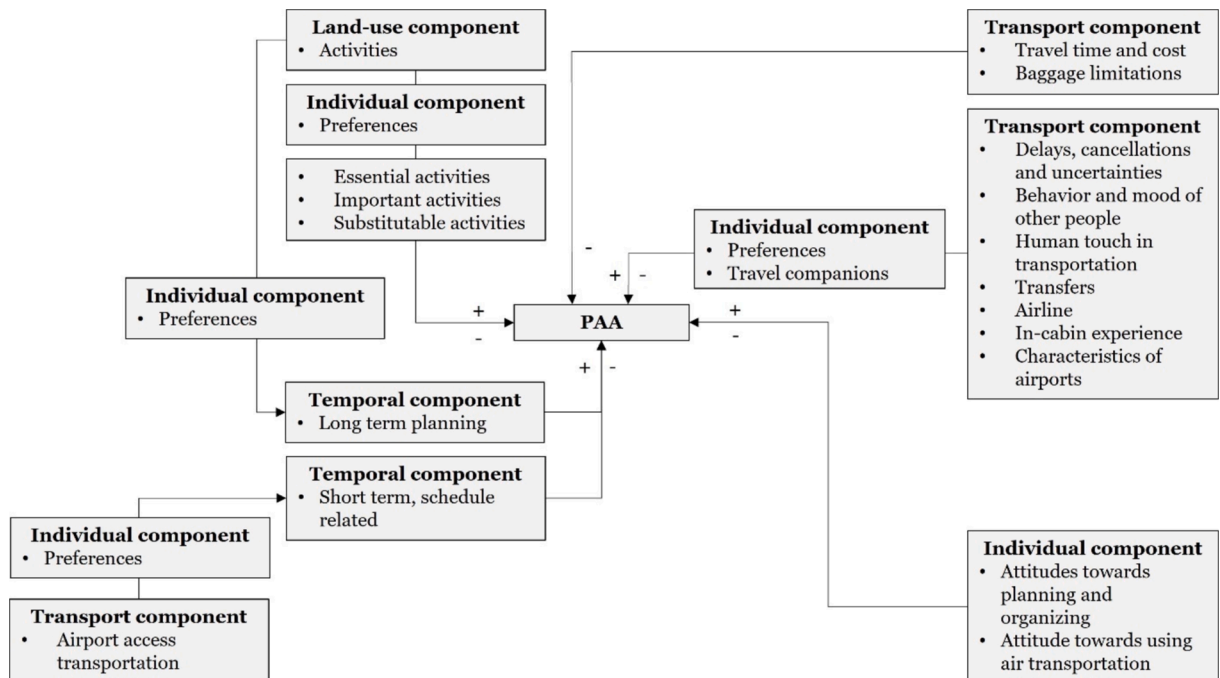


Fig. 3. Framework of PAA for (potential) air travelers.

of all accessibility components to perceived accessibility. For the trips made by the respondents, the land-use component has positive contribution to PAA. However, we speculate that this is because the discussions in the FGMs were mainly related to participants' past travel experiences and future travel plans in which the elements of the land-use components are considered to be at least 'acceptable'. In general, there are elements of the land-use component that can negatively impact PAA, such as very high costs, low security levels, or uncomfortable climate conditions etc. at destinations. Travel time and cost, and baggage limitations in the transport component have negative contribution to PAA, while contribution of other elements can vary depending on the specific element and individual preferences or circumstances. The temporal and individual components can also have positive or negative contribution to PAA depending on the specific element and the effect of the individual component. Overall, Fig. 3 shows that excluding the individual component in accessibility assessments is very likely to lead to mismatches in assessment results and how accessibility is perceived by travelers in real life. The influence of the individual component also leads us to conclude that PAA levels may vary significantly depending on the characteristics of (groups of) individuals. Even within the groups of participants with the same nationality recruited under specific travel experience requirements, we observed considerable heterogeneity in the individual component. Overall, we consider the individual component to be the key to PAA research, which requires thorough investigation.

### 5.2. Differences between PAA and local/regional perceived accessibility

Based on the results, we found that most differences as mentioned by participants related to the transport component. First, important differences between PAA and local or regional perceived accessibility can be attributed to very high levels of travel costs. Secondly, planning in advance is necessary for booking reasonably priced flight tickets and accommodation. Thirdly, and related, flexibility in making last-minute changes is very low as booking alternative flights or accommodation last minute can be very costly or even impossible. Therefore travelers often have no choice but to rely entirely on the airlines that they booked tickets with even if there are delays or cancellations. A fourth difference between PAA and local or regional accessibility is that PAA requires more organizing.

Regarding the land-use component, we observed that the long distance between origin and destination can increase the attractiveness of destinations or air travel itself for some recreational travelers, which seldom applies to local or regional accessibility contexts. In addition, the results indicate that travelers feel that there are no spatial or geographical boundaries in terms of accessible and inaccessible destinations when it comes to AAT. One participant explained that as long as the attractiveness of activities or destinations to be reached by air travel is high enough, travelers can prepare for the journey and eventually reach the destination. On the other hand, some activities were discussed to be difficult to access by air travel due to strict baggage limitations.

Next we discuss the individual and temporal components. Participants stated that high transportation costs can limit destination and route choices for families as airfare can add up to unaffordable levels in PAA. Additionally, the required 'organizing' and 'planning,' for even relatively spontaneous trips by flight may lead travelers to perceive AAT as a 'big undertaking', a factor that is also related to the individual component. In terms of the temporal component, we observed that selecting the 'right time to travel' can be influenced by major life events and long term personal circumstances, in contrast to local or regional accessibility where daily activity patterns and business hours are the main determinants.

### 5.3. Policy and societal relevance

As explained in the introduction section, we draw implications for air transportation climate policy from the results of our FGMs. As results revealed that the importance of the land-use component varies across travel purposes and individuals, we consider that an equitable air transportation climate policy could, at least in theory, aim to maintain PAA levels for essential trips while seeking to reduce emissions from non-essential trips or trips that could be substituted with destinations accessible by transportation modes with lower climate impact. In the literature, replacing short-haul flight services with surface transportation modes has been a topic of research (Baumeister, 2019; Avogadro et al., 2021) for reducing climate impact of air transportation, while curbing long-haul flight demand has received less attention, although it has the greatest climate impact mitigation potential (Dobruszkes et al., 2022).

Combining the climate impact mitigation opportunities with perceived importance of activities accessible by air transportation, we suggest that curbing demand for non-essential long-haul air travel is a low hanging fruit. This can be achieved to a certain extent by identifying long-distance destinations well known for non-essential activities and assigning high emissions offset costs on those routes. For example, destinations such as Cancun, Bali, or Mauritius are famous beach holiday destinations. For European travelers, there are alternative destinations for beach holidays (such as beach areas of Spain or Portugal) which are accessible by short-haul flights or even high speed rail (HSR). Assigning high greenhouse gas (GHG) emissions offset costs to long-haul beach holiday destination routes may discourage non-essential long-haul flights while maintaining perceived accessibility levels to similar nearby activities that incur lower transportation GHG emissions to access. Such policy may even encourage the use of HSR with longer travel times over short flights, as our results revealed that some travelers find short flight durations with insufficient time to rest or sleep less attractive than longer flights.

Selecting routes to assign high GHG emissions offset costs will depend heavily on which activities can be substituted with less travel distance in the specific regions where the policy planning takes place. At the same time, lower GHG emission taxes for travelers visiting family or relatives on the routes subjected to high emissions offset costs should be planned for equity reasons. However, the frequency of offering lower-taxed airline tickets to a traveler may need to be limited as high-frequency visits, even for visiting relatives, cannot be justified as essential travel. Additionally, the process of applying tax reductions must be concise as additional organizing was described to hinder PAA by the participants of the FGMs. A more generally applicable option could be to tax flights progressively: the first flight a person takes in a certain period (such as a year, or five years) is taxed lower than next flights. This would reduce inequity due to policies

that make flying more expensive.

Our findings also reveal opportunities for maintaining perceived long-distance access levels where short-haul flights are banned on routes with rail service. While such policies may be beneficial for reducing the climate impact of transportation, reducing transportation options increase the friction in journeys and may negatively impact perceived accessibility. As transportation costs are determinants of long-distance accessibility, subsidizing long-distance transportation modes with lower climate impact (such as HSR) can play a crucial role in minimizing negative impact on perceived accessibility levels. In addition, improving the on-time performance of low-climate impact long-distance transportation modes and implementing guidelines for clear and prompt communications during schedule disruptions may reduce uncertainty and contribute to enhancing perceived long-distance accessibility by low-climate impact transportation modes. Furthermore, planning long-distance international HSR networks with increased journey lengths without the need to transfer may also decrease friction in accessing long-distance destinations by HSR. Results of the study show that travelers avoid transfers unless the price difference or the location of transfer is attractive enough, and transfers can be deal breakers when the number of transfers exceeds certain thresholds. At the same time, results also revealed that long distances can have a positive contribution to the attractiveness of destinations. For some travelers, being able to travel long distance by HSR with minimal transfers may be a more attractive option than changes in the land-use component to provide activities closer to home.

Finally, we observed that the names of airlines are often used as indicators for service levels and flight schedule reliability when discussing experiences regarding best and worst air travel experiences. Mandating climate impact scores or ranks to airlines (and flights) in a uniform manner globally and requiring the scores or ranks to be highly visible to travelers may influence the individual component of accessibility by motivating travelers to associate the names of airlines with climate impact. Consequently, airlines with low scores or ranks could adopt climate impact abatement measures more actively as the poor scores or ranks may be bad for business.

#### 5.4. Limitations of study

Although FGMs was considered the best method to explore PAA, the study was not without limitations. There were four limitations, two related to FGMs and two limitations from scope of research. First, related to FGMs, results could only be drawn from statements that participants were willing to share openly. There may have been aspects of PAA that participants were reluctant to openly discuss, or which they discussed in a manner that better ‘fits in’ with the general tone of the discussion of the group. In addition, incomplete knowledge regarding travel attributes, which is one of the potential reasons behind the mismatch between calculated accessibility and perceived accessibility (Pot et al., 2021), may have influenced the opinions or attitudes of the participants. Individual interviews, where the researcher has more time for in-depth investigation, or indirect observation of such factors, by including them as an attribute of choice alternatives in choice models, may be more effective for identifying contributing factors that participants may be less willing to share or for investigating further into possible effects of incomplete knowledge regarding attributes of PAA.

Secondly, whether some factors contributing to PAA mentioned in discussions had a positive or negative impact on PAA could only be speculated from the expressions that participants used and the travel circumstances that they described. For instance, while the best air travel experiences of some participants were focused on good in-flight experiences, it is difficult to determine whether the participants derived positive utility from the flight experiences, or whether the experiences were simply flight experiences with the least disutility. While one participant included a description of good catering during the flight, he also mentioned that he would prefer to skip the flight altogether if teleportation is available.

In relation to the scope of research, the first limitation was that the study was designed to focus on outbound accessibility rather than inbound accessibility. Accessibility levels of the Netherlands as perceived by potential visitors to the Netherlands is a relevant topic for PAA. This is not only important for travelers but also for others such as companies attracting many business trips, the leisure industry, and people being visited by family or friends. However, we consider that this is a broad topic that should be addressed in a separate research designed specifically for this topic. Secondly, our focus on gathering information from real-world experience led participants to discuss past trips. These discussions did not include details about elements of the land-use component that may have negatively affected PAA to activities at certain destinations they chose not to visit.

The online nature of this research introduced its own set of limitations. Interruptions during speech, an important source of ‘semi-verbal expressions’ (Trull, 1964), and non-verbal cues like eye contact were hindered in the online setting (Qu and Dumay, 2011). Some participants, who joined from home were interrupted by co-inhabitants. In addition, certain demographics were likely adversely affected by selection effects, the most likely effect being that recruiting elderly individuals posed a challenge as online participation might be less attractive or even not accessible to them. Notably, a segment of older individuals who frequently travel for leisure (e.g., family visits) and could have offered insights, particularly regarding the impact of COVID-19, remained unrepresented. Given that older age is associated with higher susceptibility to severe cases of COVID-19 (Zhang et al., 2023), this absence was especially impactful. Although the unique COVID-19 setting in which this experiment took place provided insights into PAA during a pandemic, we were not able to investigate the full effect of the pandemic as the pandemic and related effects (knowledge about the pandemic and vaccinations, shortage of staff, vaccination policies, travel restrictions, ...) continued to develop after the FGMs took place.

#### 5.5. Implications for further research

From our results, we discuss potential application of conventional accessibility measures for future quantitative research, answering the third research question in the introduction. For the theoretical basis of empirical studies we consider random utility theory as a strong theoretical basis for PAA research, as is frequently the case in air transportation research (Araghi et al., 2016; Lee et al., 2016; Molin et al., 2017; Choi et al., 2019). Note that utility-based accessibility measures are one category of accessibility

measures (Geurs and Van Wee, 2004). As of the time of this research, no academic research articles have been found in which random utility theory was used to study PAA. Results from the FGMs suggested that travelers rationally make travel decisions with little room for impulsive decisions, which adheres to the underlying assumptions of random utility theory (Train, 2009). In addition, statements often indicated that potential travelers consciously make trade-offs among various contributing factors to accessibility (e.g. airfare and the number of transfers, airfare and desired airline, travel time, and attractiveness of destination). Destination or activity substitutability is a topic within PAA suitable for investigation using a utility-based accessibility measure. With appropriate survey design, utility-based measures have the potential to estimate how much GTC savings would be required for travelers to substitute destinations or activities.

Heterogeneity in attitudes towards factors contributing to AAT can also be studied using discrete choice models based on random utility theory. The latent class modeling technique can be useful in addressing heterogeneity as it can be used to check for or identify classes of potential air travelers depending on their preferences regarding contributing factors to AAT. Mixed logit with random parameters is another option for observing the level of preference heterogeneity for factors contributing to PAA. Hybrid choice models can also be used to identify and measure latent attitudinal variables contributing to AAT.

The results also suggest potential accessibility, or gravity-based accessibility (Geurs and van Wee, 2004), as a strong candidate for studying PAA. FGM participants often mentioned that the activities at destinations must be ‘worth’ the time and cost to reach them, implying that they are generally aware of the attraction of activities and the friction in transportation to reach them. In the PAA context, gravity models must take account of all trip related costs, so both the costs at the destination, as well as the transport costs. The costs at the destination then influence the destination attractiveness (land-use component), whereas the transport costs influence the resistance of travel, and thus the transport component. Note that some participants considered both cost types simultaneously in their perception of PAA. For the Dutch travelers’ context, our observations suggest that the overall cost of the trip is important in the initial planning stage where potential travelers rule out deal breakers due to unaffordability. In the booking stage, the two different types of costs may be considered separately, with one participant of this study specifically mentioning that costs saved in transport will allow her to spend more at the destination. The effect of distance or travel time for recreational travelers may also require investigation as long-distance increases the attractiveness of destinations (statement romanticizing ‘feeling of going far’), but at the same time, increases friction in the transport component.

As for implications specific to future explorative studies aimed at further expanding knowledge regarding PAA, we found that potential air travelers focus heavily on the transportation aspect of accessibility when asked to discuss air travel experiences. We speculate that in the initial planning stage, potential travelers may pay more attention to the land-use component as it is the main reason travelers take trips by flight. This may also provide opportunities for observing the negative contributing factors to PAA from the land-use component. In place of question 2 in the sequence of questions for this study (Table 1), future studies may start the question sequence by asking participants to verbally plan the next trip using air transportation. Next, involving social networks, families, or business partners as participants could provide insights into how AAT is perceived by social groups. Understanding how different groups interact, negotiate, and prioritize travel considerations may be important as travelers often make trips with others (‘travel party’) and travel planning can be a social event (Fridgen, 1984).

We consider that data collection in an online setting has substantial benefits for PAA research, despite some limitations (see section 5.4) as more diverse participants can be recruited. For local accessibility, relevant FGM participants or interviewees may be located in a relatively small area. This is not the case for PAA research. Online FGMs or interviews can be especially advantageous in recruiting business travelers who may be reluctant to spend time traveling to meeting locations due to their high value of time.

### CRedit authorship contribution statement

**Sihyun Yoo:** Writing – original draft, Supervision, Resources, Project administration, Methodology, Formal analysis, Conceptualization. **Ruben Beumer:** Writing – original draft, Resources, Methodology, Investigation, Data curation. **Bert van Wee:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Niek Mouter:** Writing – review & editing, Methodology, Investigation. **Eric Molin:** Writing – review & editing, 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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