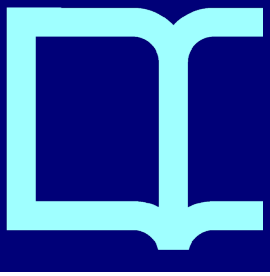

Segmentation of passengers on the autism spectrum in their use, preferences and acceptance of digital technology at airports in Spain

Abstract

Purpose

Following the COVID-19 pandemic, airports have begun implementing more digital technologies. While these technologies can enhance the airport experience for passengers on the autism spectrum, this population tends to be studied as a single segment. However, people on the autism spectrum have different preferences, skills and abilities, and levels of acceptance of digital technologies. We aim to explore the acceptance of recently implemented digital technologies, self-service kiosks and other digital technologies such as biometric facial recognition in the airport environment among passengers on the autism spectrum, who are not a single segment.

Design/methodology/approach

We carried out an academic-industry collaboration project in 2022 at Barcelona's Josep Tarradellas Airport with the Spanish airport operator Aena, Vueling Airlines, three associations representing people on the autism spectrum (stakeholders) and 60 participants on the autism spectrum recruited by the three associations. Interviews were conducted during the airport visits to compare airport experiences: Group 1 provided input on the traditional airport experience using manual or analogue processes, and Group 2 provided feedback on the airport experience using digital technologies.

Findings

The use of cluster analysis revealed three distinct segments: traditional, automated with assistance from others, and digital. Our findings provide airports with insight into recently implemented digital technologies at airports for passengers on the autism spectrum.

Originality

This article brings new knowledge about passengers on the autism spectrum and their relationship with digital technologies in the airport environment, a topic that has not been previously studied.

Keywords: Airport, Digital technology, Cluster analysis, Autism spectrum

Introduction

Research has recognised the importance of studying the passenger experience of air travel in order to improve it (Wattanacharoensil, 2019; Jiang and Zhang, 2016). Digital technology is an important part of this experience and is therefore a key factor in airport investment decisions (Brida et al., 2016). A wide range of digital technologies are currently in use, including biometric facial recognition, contactless and touchless solutions, and interactive navigation. However, when making investment decisions on digitalisation, airports need to consider the best solutions for all. In this study, we focus on passengers on the autism spectrum as part of the disability market. Budd and Ison (2020) show that technology can benefit people on the autism spectrum, for example by providing intuitive, visual and audio formats that make communication interfaces more accessible and thus easier to understand for those with cognitive disabilities (Cerdan Chiscano and Darcy, 2022). However, as the use of digital technologies requires specific skills and resources (Darcy et al., 2017), it can also lead to social exclusion for people on the autism spectrum.

According to the Centers for Disease Control and Prevention (CDC, 2023), one in 36 children are on the autism spectrum. Increasingly, passengers on the autism spectrum require assistance from airport services and are becoming one of the largest groups of passengers at airports (Small et al., 2021). The travel experience is recognised as a complex embodied practice that requires a deep understanding of the overall planning process (Darcy et al., 2022) and poses enormous challenges for people on the autism spectrum (Dempsey et al., 2021; Hamed, 2013; Cerdan Chiscano, 2022). For example, the airport experience can be perceived as overwhelming (Halpern and Graham, 2013; Graham, 2018), particularly for passengers on the autism spectrum for whom air travel can be challenging, with access barriers from check-in to in-flight services (Cerdan

Chiscano, 2021; Dempsey et al., 2021; Poling and Ehrhardt, 2017). The World Health Organization has issued an urgent call to address inequalities in access to services for people on the autism spectrum (WHO, 2014, 2021). In particular, more empirical evidence on the recent implementation of digital technologies in services following the pandemic (Heinonen and Strandvik, 2020) is needed to better understand and implement technologies for unobserved populations such as people on the autism spectrum. Despite this, people with intellectual disabilities are rarely considered in terms of their transport needs (Falkmer et al., 2015). While there has been research on the use of assistive technologies in education and healthcare for people on the autism spectrum, scarce autism research has been undertaken on the use of digital technologies in transport for this population.

One way to understand the relationship between digital technologies and unobserved populations such as people on the autism spectrum is to study how they use these technologies, what their preferences are in this regard and how accepting they are of them. In our research, we have moved beyond studies proposing theoretical models of digital technology use. Instead, we aim to explore accessible digital technologies for passengers on the autism spectrum and to gain new insights of the interaction between human cognition and digital technologies in the context of airport navigation and performance. Our goal is to provide new knowledge on how adults on the autism spectrum behave when interacting with digital technologies, how they use them, what their preferences and skills are in this regard, and what reasonable adjustments are needed to enable them to use these technologies in an airport environment. Greater consideration needs to be given to those who are not interested in or familiar with digital technologies to avoid social exclusion at airports. The preferences of passengers without disabilities for digital technologies such as biometric facial recognition, self-service technology (SST) kiosks and information

services have already been studied (mainly Taufik and Hanafiah, 2019; Morosan, 2016, 2018; del Rio et al., 2016; Bogicevic et al., 2017; Gures et al., 2018; Lu et al., 2009; Brida et al., 2016). However, to the best of our knowledge, passengers on the autism spectrum and their use, preferences and acceptance of recently implemented digital technologies have not been studied. To help airports prioritise investments in the airport experience of passengers on the autism spectrum, we use segmentation as a valuable tool that can also be employed strategically for social inclusion.

In the following sections, we first provide background literature related to our research questions. We then present the research design, followed by the results, conclusions and discussion of our main findings. We then discuss the theoretical contributions and managerial implications of our research, followed by its limitations and our suggestions for future research.

Background

Using transport involves a range of cognitive and physical tasks, including understanding information and timetables and navigating unfamiliar environments (Levinson et al., 2006; Davies et al., 2010). Managing the airport experience can lead to negative outcomes such as anxiety and stress for people on the autism spectrum (Pfeiffer et al., 2020; Falkmer et al., 2015). This is because many of them have difficulty coping with unexpected situations and environments (Hamed, 2013). For example, most people in this population feel overwhelmed with delays (Falkmer et al., 2015). People on the autism spectrum can also be hyper-reactive to sensory stimuli (Chien et al., 2019; Grandin and Scariano, 2005; Dunn, 2007), making crowding in certain situations difficult for them to manage (Falkmer et al., 2015). Significant stress can be a particularly negative outcome for people on the autism spectrum due to their inability to filter sensory information (DSM-IV

symptomatology, American Psychiatric Association, 2020). This can lead to them experiencing high levels of discomfort in airport environments (Soccini et al., 2020). For example, when an airport is very crowded, the social and communication difficulties of having to ask for assistance from staff or other passengers can lead to increased anxiety (Moseley et al., 2011)

The DSM-IV (American Psychiatric Association, 2000) explains that people on the autism spectrum may be affected by at least two of three personal dimensions: social interaction, restricted or repetitive behaviours, and communication problems. These dimensions can occur at different levels, from severe intellectual disability to high-functioning Asperger's syndrome. Some examples of difficulties that are common to most people on the autism spectrum include difficulty understanding facial expressions and body language, resistance to change, difficulty interacting socially with groups, and presenting as a withdrawn person. Digital technologies can benefit people on the autism spectrum and their families' daily lives (Kumm et al., 2022). For example, digital and interactive technologies are predictable and do not require social interaction, which can lead to successful outcomes for them (Kientz et al., 2013). However, this means that a better understanding of the autism spectrum is required to successfully design digital technologies to meet the needs of this population. It is also possible to circumvent cognitive challenges (McMahon et al., 2015) when engaging in tourism experiences (Lancioni et al., 2020) using digital technologies. Despite the challenges faced by people on the autism spectrum, this population is still unobserved and suffers from transport inequalities. For example, there is a paucity of research on how adults on the autism spectrum perceive airports, including their interaction with digital and non-digital aspects. Furthermore, the literature on airports has mostly focused on families with children on the autism spectrum (Dempsey et al., 2021; Hamed, 2013; Cerdan Chiscano, 2021).

An increase in the use of technology by people with intellectual disabilities has been observed in recent years (Palmer et al., 2012; Cerdan Chiscano and Darcy, 2021). Digital technologies can provide useful information through user-friendly applications. It has also been shown that "voice-activated interfaces to access information and portable electronic assistive technology" (Collins and Collet-Klingenberg, 2018, p. 215) facilitate accessibility in their use. Furthermore, according to Brown et al. (2016), virtual reality has recently been used to help neurodiverse individuals learn personal skills. Despite this, previous research has shown that technology abandonment occurs at higher levels among people with disabilities than among non-disabled people (Darcy et al., 2017). Problems reported by some people with disabilities, including people on the autism spectrum include poor understanding of what is required in the interface: what to press, in what order and which slots to use (Smith, 2013, Ch. 1). Another important reason for abandonment is low social influence and a lack of support for people with disabilities, including people on the autism spectrum to encourage them to use digital technologies, which could contribute to increased use with the right support and resource allocation.

Imposed service innovation in the wake of COVID-19 has been acknowledged in the literature (Heinonen and Strandvik, 2021), and research has provided a variety of models of user acceptance of digital technology, explaining that users' perceived acceptance of technology depends on three main factors (Adams et al., 1992; Davis, 1989) that are relevant to preventing technology abandonment in people on the autism spectrum: (a) perceived ease of use; (b) perceived benefits, i.e. the person believes that using the technology will help them to make their daily lives easier; and (c) attitudes towards the technology. However, these have not been tested and considered as accessibility factors, which is key to designing technologies for all, as these factors can have a positive or negative impact on a person's behaviour and intentions towards digital technology. In

addition, Venkatesh et al. (2003, 2012) identified the Unified Theory of Acceptance and Use of Technology (UTAUT), which provides a useful tool for targeting user populations that may be less familiar with or interested in adopting and using new technologies, while allowing managers to assess newly implemented digital technologies among users to better understand and design strategies such as training and marketing.

Previous research has used segmentation to understand user preferences for service attributes in air travel (Halpern et al., 2020; Teichert et al., 2008). Specifically, Halpern et al. (2020) used a general survey to empirically segment the general population of passengers based on their preferences for the use of digital technologies at airports. The segmentation criteria used in this study are the perceptions and preferences of passengers on the autism spectrum and their acceptance of the use of digital technologies and non-digital airport services at key encounters or touchpoints along the airport journey.

Against this background:

RQ1. How do passengers on the autism spectrum use digital technologies at the airport, what are their preferences in this regard and how accepting are they of these technologies?

RQ2. What segments of passengers on the autism spectrum can be identified according to their use, preferences and level of acceptance of digital technologies?

Research design

From January to September 2022, an inclusive airport research project was carried out as part of an academic-industry collaboration involving six employees of the Spanish airport operator Aena, four employees of Vueling Airlines, six representatives of three advocacy associations (Dincat-Plena Inclusió, the TEB Foundation and the Paideia Foundation) and

60 participants on the autism spectrum recruited by the three associations. In the first phase of the research, two online focus groups were held to design the questionnaire that would be used to interview the participants on the autism spectrum (10 and 17 February 2022). Phase 2 consisted of two visits to Barcelona's Josep Tarradellas Airport with the participants and stakeholders (17 and 18 March 2022). Thirty people on the autism spectrum participated in each visit (60 in total). They were randomly divided into two groups of 15 on both days. Group 1 used the airport's traditional manual processes, while Group 2 used the available digital technologies. The visit procedure was identical on both days, lasting 1.5 hours, and included interviews with participants on the autism spectrum using the designed questionnaire. These interviews provided the data needed to analyse and compare the participants' airport experiences (manual process or digital). The interview question strategy considered that air transport research describes a number of stages or touchpoints associated with the airport experience: "booking, check-in, bag tag, bag drop, passport control, boarding" (SITA, 2019b). In our study, participants did not bring bags, did not have entertainment at the airport, and did not experience in-flight services.

Our focus is on the new digital technologies available at different touchpoints along the airport experience (Zaharia and Pietreanu, 2018; Kovynyov and Mikut, 2019; Halpern et al., 2021b) and on the changes in traditional service delivery between service providers and passengers due to the implementation of digital technologies (Liljander et al., 2006) and the intensified interactions between passengers and technologies. For instance, the newly implemented SST kiosks and the increasing use of mobile phones at check-in desks allow passengers to obtain their boarding passes themselves (Wittmer, 2011; Inversini, 2017). Biometric facial recognition technology (Negri et al., 2019; Morosan, 2016, 2018), which is used by pre-registering at the SST kiosks or before arriving at the airport for

access to passport control, security and boarding gates brings value to passengers by significantly reducing the time spent in queues, which is particularly valuable for people on the autism spectrum. “While there is an increasing presence of other digital technologies which are not yet well-known, such as body-embedded ID, Bitcoin, and drone-based baggage collection and delivery” (Halpern et al., 2021, p. 102005), our focus is on digital technologies and traditional manual processes that currently exist in airports in Spain (as well as in many other countries). Online chat services and QR codes for customer services were also excluded from this study.

We conducted the interviews in situ during the airport visits using a designed questionnaire for the following three reasons: (1) it would provide ecological validity; (2) the advocacy associations had reported typically low use of digital technologies among people on the autism spectrum; and (3) collecting participants’ experiences in situ would provide more useful insights than surveys of airport passengers.

The project was approved by the University Research Ethics Committee (*name withheld to protect anonymity*) with file number Exp: CE22-PR04. All participants signed a consent form through the abovementioned associations before the airport visits took place. In accordance with the Ethics Committee’s protocol, the faces of the participants have been blurred in all photographs to protect their anonymity.

Participants

The 60 participants belong to three advocacy associations of people on the autism spectrum (Dincat-Plena Inclusió, the TEB Foundation and the Paideia Foundation). The purposes of the article have adopted identity first language as outlined in Bottema-Beutel et al (2021) and participants were screened and recruited by the staff of these associations following DSM-5 criteria (American Psychiatric Association, 2013). The participants

presented on the autism spectrum levels 1 and 2 and were mid-functioning according to the DSM-5 (American Psychiatric Association, 2013). This means that they were slightly below normal intellectual functioning. They also had social difficulties and social-emotional reciprocity. Some participants also showed limited non-verbal behaviour and narrow interests during social interaction. One of the criteria for screening the participants was the possession of a smartphone with mobile internet access, as this was needed to interact with the SST kiosks at the airport.

Of the 60 participants, 75% were men and 25% were women. Their ages ranged from 18 to 32 years. Eight had other disabilities, four had visual impairments and four had reduced mobility. Sixty per cent had previous airport experience, but none had previous experience using digital technologies at the airport, although 50% did have some experience using digital technologies such as self-service digital kiosks in metro stations.

Key variables

The key encounters in the airport visit were designed with a specific focus for each of the two groups (Group 1 and Group 2). In-person staff and personal assistance given to participants when using digital technologies were considered for both types of airport visit. Digital technologies such as chatbots, robots and holograms were not considered.

Group 1: Stages of the traditional manual processes of an airport visit:

- Check-in
- Obtaining a boarding pass
- Passport and personal identification (ID)
- Security control and screening
- Navigating through the airport
- Accessing the boarding gate

- Accessing passenger airport services

Group 2: For those taking part in the digital airport visit, the self-service digital kiosks and biometric facial recognition system were explored.

Data collection

Phase 1: Online focus groups: Designing an interview questionnaire by identifying the level of previous experience of passengers on the autism spectrum using digital technologies in transport environments

Two online focus groups were conducted with the abovementioned stakeholders (four managers from the Spanish airport operator Aena, two managers from Vueling Airlines and six members of the three advocacy associations) and two of the participants on the autism spectrum. These took place on 10 and 17 February 2022 before the airport visits to prepare for the experience. The aim was to gain some insight into the participants' level of use and knowledge of digital technologies to help us make decisions about the research design of the airport experience and the data collection techniques that would best suit the project. Through discussion, it became clear that this level was low among the participants in the airport setting due to a lack of previous airport experience in most cases and the very recent implementation of digital technologies at the airport during COVID-19. Therefore, in order to collect data on the participants' perceptions of their interactions with digital technologies in the airport context, it was decided to conduct interviews with the participants during the airport visits using a designed questionnaire. The focus groups were also used to plan the airport visits, taking into account the participants' access needs.

The first draft of the questionnaire was designed by the researchers in collaboration with the participants of these online focus groups. Key encounters were also identified from the literature and discussed. For example, we decided to focus on departures rather than

arrivals, domestic departures rather than international departures, and to avoid baggage check-in and transfer services as it was too much to expect participants to bring a suitcase to the airport visits.

Phase 2: Interviews with participants during the airport experience using a designed questionnaire

The research data was collected by interviewing the participants during the airport experience using the pre-designed questionnaire. Doing the interviews in situ increased the ecological validity of the context for people on the autism spectrum and their reactions when interacting with digital technology (Schmuckler, 2001). The six representatives of the advocacy associations assisted the researchers in collecting data during the two visits.

The airport visits took place on 17 and 18 March 2022 at Josep Tarradellas Barcelona-El Prat Airport. Thirty people on the autism spectrum participated in each visit (60 in total). They were randomly divided into two groups of 15 on both days. Group 1 used the airport's traditional manual processes, while Group 2 used the available digital technologies. The visit procedure was identical on both days, lasting 1.5 hours, and included interviews with the participants on the autism spectrum using the designed questionnaire. The aim was to observe and interview the participants as they interacted with traditional manual processes and digital encounters, with a view to exploring segmentation. To make the airport visits as real as possible, Vueling Airlines provided a mock flight booking and the participants were expected to perform the airport activities as if they were in a real situation. On both visits, the participants spent 1.5 hours navigating from the airport entrance to the boarding gate. While Group 1 interacted with the manual processes and traditional encounters available before COVID-19, Group 2 interacted with the newly implemented digital encounters. Throughout the experience, they were interviewed by the researchers. Vueling gave a pilot digital identification card

to the Group 2 participants, who were invited to use the digital technologies, basically the SST kiosks (e.g. ticketing kiosks, baggage drop, online check-in, etc.) and the biometric technology to navigate through all the areas of the airport, from the check-in lobby to the security checkpoint and on to the boarding gates. Our aim was to compare the results of the two groups (Group 1 and Group 2) in terms of their use, preferences and acceptance of digital technologies or manual process for segmentation purposes.

As they had few language problems, the best way to interact with the participants was to explicitly ask them to explain their perceptions of digital technologies and non-digital services while using them in a real environment. An inclusive approach was adopted when interacting with them: for example, we displayed a friendly demeanour, used easy-to-read language developed with the aforementioned associations, and ensured that responses were in line with the participants' perceptions, preferences and acceptance levels (Corby et al., 2015). We also recognised that people on the autism spectrum participating in interviews may need extra time and flexibility, so we used plain language and offered repetition to ensure they understood the questions, two appropriate measures in inclusive research (Coons and Watson, 2013).

Although people on the autism spectrum may tend to avoid social interaction, we were careful to clearly explain the aim and scope of the research and the nature of the questions to make the interview process less daunting. The participants were accompanied by a representative of their association, and thanks to the flexible and friendly climate we created, participants appeared to feel confident in sharing their views and perceptions.

In designing the interview question strategy, we drew on Venkatesh et al.'s (2003, 2012) UTAUT, as it provides a useful tool for targeting groups of users who may be less familiar with or interested in adopting and using new technologies, and for advising managers on

how newly implemented digital technologies are accepted by users in order to better understand them and design strategies accordingly.

The questions were strategically divided into six blocs and related to the participants' preferences and level of technology acceptance (Venkatesh et al., 2003, 2012). Blocs 1 to 5 dealt with digital technologies and Bloc 6 with traditional manual processes (see Table 1).

Insert Table 1 near here

Bloc 1: Enabling conditions. Do you have the knowledge to use technology? Do you have the necessary technology tools?

Bloc 2: Performance expectation. Do you have help when you don't know how to do something? Is technology useful for you? Do you feel better when using technology? Are you faster when using technology? Do you do your tasks better if you use technology?

Bloc 3: Expectation of effort. Is the technology you use simple? Is it easy for you to use technology? Do you know how to use technology? Do you learn how to use technology quickly?

Bloc 4: Social influence. Do your colleagues encourage you to use technology? Do people who are important to you think it is good to use technology? Do your monitors or caregivers want you to use technology?

Bloc 5: Intent-to-use. Will you use technology in the future? Will you always try to use technology for your tasks? Do you want to use technology a lot?

Bloc 6: Preferences. Based on your experience today (traditional or with manual processes and digital), which of the following stages of your airport journey do you prefer or not prefer?

Participants responded using a Likert scale (*1: low preference; 3: neutral; 5: high preference*).

Data analysis method: Hierarchical agglomerative clustering

Once the data had been collected, the lead researcher read the interview transcripts several times to become familiar with them. The transcripts allowed us to contextualise the interviewees' answers and to make sure that their Likert scale answers were really the answers they meant to give. A matrix was then created using Excel, linking each interviewee to each item on the scales used in the interviews, as shown in the example in Table 2.

Insert Table 2 near here

A construct was created for the variables *EC3*, *SI1*, *SI2* and *SI3* that summarised the results in terms of social influence on participants to use technology in their daily lives. A hierarchical agglomerative cluster analysis using SPSS Statistics was chosen to answer RQ2, with similar clusters merged sequentially to form groups. Groups were merged according to the researchers' decisions on distance and linkage measures. Due to the small sample size, Euclidean distance and linkage between groups were considered for our study.

The clustering of each participant according to the two groups (traditional with manual processes and digital) was based on the matrix described in Table 1. Cluster analysis to

identify homogeneous groups based on survey data has been widely used in travel (Dolnicar, 2002; Ritchie et al., 2016; Tiago et al., 2016). It should be noted that hierarchical agglomerative clustering consists in applying different techniques to identify subgroups within a data set (Kaufman and Rousseeuw, 2009). In other words, it allows us to identify how different groups of participants in the airport journey function in their interaction with the traditional and digital environments. The algorithm first treats each participant as a different cluster. It then sequentially merges pairs of clusters until a large cluster containing all the participants is achieved. The graphical representation is a dendrogram (see Figure 5).

In order to answer RQ1 on participant preferences and acceptance, a frequency analysis of passenger preferences (means) was conducted.

Cluster robustness was ensured by having a research assistant from one of the advocacy associations involved in the data collection re-run the analysis. This yielded the same clusters.

Findings

Frequency analysis

Most participants prefer to use a paper boarding pass (13.3% via a self-service kiosk, 86.7% with staff at a check-in desk). The task of obtaining a boarding pass via an SST kiosk can be daunting for most people on the autism spectrum, as it requires several manual interactions with the kiosk and decision-making. It is therefore a process where people on the autism spectrum may prefer to be assisted by staff at the check-in desk (Figure 1).

Insert Figure 1 near here

The recently implemented biometric facial recognition for ID management is available as soon as passengers have their digital boarding pass. It allows them to move through the entire airport journey without interacting with others or queuing, which can alleviate waiting time issues for people on the autism spectrum. The process requires little manual interaction from passengers and little decision-making, and was more widely accepted as a preference by participants, with 30% of participants preferring to use biometric ID and 13.3% preferring to use SST kiosks. Figures 2-4 show the participants with autism disorder interacting with the digital technologies at the airport visit.

Insert figures 2 and 3 near here

Around 30% of the participants preferred the use of camera ID recognition while walking through the airport (facial recognition), a process that seemed quite easy to handle with or without assistance, especially since security screening is a challenging part of the airport journey for people on the autism spectrum and queues are common. Thus, the perceived use and acceptance of the biometric facial recognition system was higher than for the SST kiosks (13.3%), as participants found it very useful and easy to use. However, the use of biometric facial recognition requires a prior step, namely obtaining an electronic boarding pass at the SST kiosk with a digital ID, which involves several manual interactions and decisions. As a result, 16.7% of these 30% had to be assisted by Vueling staff at the SST kiosk before using biometric facial recognition.

Insert Figure 4 near here

A paper boarding pass was preferred by most participants (86.7%), while all participants preferred to rely on staff when using digital technology and to be sure that human assistance could be provided if needed (100%). We found a low level of acceptance of digital access to customer services (5%). This shows that people on the autism spectrum prefer to interact with staff at all stages of the airport journey if they need to. However, the level of acceptance of digital technology when staff service is assured was higher than expected by the researchers (30%).

For each of the key variables, Table 3 shows the preference percentages for key variables

Insert Table 3 near here

Cluster analysis

Table 4 shows the percentage of participants in each cluster and the description of the tasks they typically perform using digital technology.

Insert Table 4 near here

The 19 key variables from the six blocs of interview questions were treated as ordinal variables in the analysis. Likert scales were used for the responses. Hierarchical agglomerative clustering was used as the clustering criterion. The number of clusters was predetermined to be three. Figure 5 shows the dendrogram.

Insert Figure 5 near here

Three clusters were identified and labelled “Cluster 1: Traditional”, “Cluster 2: Automated with assistance from others” and “Cluster 3: Digital” to reflect different levels of acceptance of manual processes, automated and self-service technologies with assistance from staff or others, and digital technologies such as biometrics.

The average linkage between groups shows the size of each cluster group. Participants belonging to the Digital cluster (13.3%) show a high level of acceptance of digital technology, along with high competence and skills in using it, and a high level of social influence on their use of digital technology, compared to participants belonging to the more traditional clusters. Participants belonging to the Automated with assistance from others cluster (16.7%) show a high level of acceptance of the use of digital technologies (preference for biometric facial recognition, which involves less interaction and decision-making during the process and a high perceived benefit to the participant), especially in the use of biometric facial recognition technology to navigate through the airport, but they have medium to low skills and competence in their use of technology, despite social influence supporting its use. Participants belonging to the Traditional cluster (70%) are the largest group. They prefer manual processes in their airport journey; show a low level of acceptance of digital technology, together with weak digital skills and competence and low social influence on their use of technology; and avoid using technology for their own purposes even when assisted by staff. Participants belonging to clusters 2 and 3 need staff support. This is especially true for the participants in Cluster 2, who need support from staff and others when using digital technology at all stages of the airport journey, especially at the SST kiosk, which was found to be more daunting for Cluster 2 than for Cluster 1.

Cluster analysis using SPSS was carried out independently by the two lead researchers to ensure consistency.

Table 5 shows the frequency of the means for each cluster, providing data to assess the validity and consistency of each cluster.

Insert Table 5 near here

The three clusters are described in more detail below:

- Cluster 1. Traditional cluster (70% of respondents). People in the Traditional cluster prefer to use manual processes such as paper boarding passes and personal ID in their airport journey. They also prefer to receive assistance from airport staff at a check-in desk. They accept manual processes throughout the journey, despite the inconvenience of queuing.
- Cluster 2. Automated with assistance from others (16.7% of participants). People in this cluster prefer to use a combination of manual and digital processes throughout their airport journey; for example, obtaining their boarding pass from an SST kiosk with assistance. Passengers in this cluster are more likely to use digital forms of personal ID, but still prefer the assistance of staff. This cluster lies between the Traditional and Digital clusters in terms of perceived satisfaction with the use of digital technologies.
- Cluster 3. Digital (13.3% of participants). The Digital cluster is the smallest of the three. People in this cluster prefer to use digital personal ID processes and are more interested in using biometric ID for their navigation through the airport, particularly biometric security screening.

Conclusions

Theoretical contributions and managerial implications

The main finding of this study is that passengers on the autism spectrum are not uniform in their preferences for and acceptance of digital technologies, which can be identified through segmentation to allow airports to better allocate the right resources to each cluster. The interviews conducted during the airport visits and the focus groups held earlier helped us to understand how passengers on the autism spectrum conceptualise their use of digital technologies, their preferences and capabilities when interacting with them at airports, and the barriers they face. This enabled us to identify three distinct clusters: Traditional, Automated with assistance from others, and Digital. By exploring the acceptance of recently implemented digital technologies, this study provides a better understanding of the digital airport journey for people on the autism spectrum in terms of technology use, preferences and levels of acceptance, which have been little explored in the airport environment. The study indicates a moderate level of technology adoption by passengers on the autism spectrum and highlights the importance of staff assistance for different segments at different levels, i.e. more intensive for Cluster 1 and less intensive for Cluster 3, where staff assistance is only required on request. The responses of the participants in our study confirm that staff assistance is key to preventing technology abandonment by people on the autism spectrum.

This study is consistent with Budd and Ison (2020) in empirically demonstrating that technology can benefit people on the autism spectrum. Clusters 2 and 3 found the use of digital solutions particularly beneficial, alleviating what Cerdan Chiscano (2021), Dempsey et al. (2021) and Poling and Ehrhardt (2017) describe as the main stressors in the airport journey for passengers on the autism spectrum, particularly significant waiting times and queuing. For those in Cluster 3, these solutions provided a sense of control over the airport journey, with staff assistance available as needed. Thus, despite the benefits

that digital technology can bring to people on the autism spectrum, staff assistance and human interaction must be ensured throughout the airport journey if needed.

Cluster 1 was identified as people on the autism spectrum who prefer manual and traditional airport services. Most of the participants preferred the traditional airport journey despite the various inconveniences (e.g. queuing) because they do not feel comfortable with digital technology, they do not intend to use it and they do not have enough digital skills or positive social influence to use digital technology. For this cluster, traditional assistance for passengers on the autism spectrum at airports was found to be essential.

Cluster 2, Automated with assistance from others, are those passengers on the autism spectrum who want more opportunities to benefit from the use of digital technology. They embrace digital technology that requires little interaction, such as biometrics, and seek personal autonomy over their airport journey with more personalised options. They have a medium level of digital competence but a high level of positive social influence on their use of digital technology. They prefer biometric processes that require little manual interaction with technology and less decision-making, but require the supervision of others (staff and caregivers). Participants in Cluster 2 prefer to use technologies such as biometric facial recognition that require less decision-making during the technology-human interaction, as opposed to SST kiosks that require constant decision-making throughout the process.

Finally, Cluster 3, Digital, is the smallest segment. Participants in this segment show high levels of digital skills, intention to use technology and positive social influence. They prefer biometric facial recognition and SST kiosks where staff are available if needed, rather than the traditional airport journey. Airports could tailor information, signage and staff training specifically for this segment.

While previous studies by SITA (2019b) and IATA (2019) found high levels of digital technology use among passengers, our findings show that for populations such as passengers on the autism spectrum, there are different levels of technology acceptance, digital skills and abilities, and social influences on their use of digital technologies. The passengers in clusters 2 and 3 display higher levels of digital technology acceptance, which supports Budd and Ison's (2020) claim that technology can benefit people on the autism spectrum if it is properly managed and support resources are in place, particularly staff assistance. The same is logically true in the airport environment and is important to prevent technology abandonment. From a management perspective, segmentation can help airports better target people on the autism spectrum and meet their needs through a combination of manual and digital processes and, importantly, a human approach to passengers. Airports can use the clusters to identify which segments of passengers on the autism spectrum are ready to embrace technologies that enhance their airport experience and make it more accessible, which groups require adaptations and staff assistance, and what type of assistance will be needed if traditional manual processes are not available in the future.

Cluster 2 shows that as passengers on the autism spectrum are guided through the use of automated and digital systems, their digital technology preferences, expectations and level of acceptance may change. This is because they experience the benefits of using it, such as avoiding queues at check-in and security. However, they still feel more confident about using it when staff are available to provide assistance when needed. Meanwhile, Cluster 1 shows that a traditional manual process is still preferred by most people on the autism spectrum, as it is for older passengers, so it is quite conceivable that the full digitalisation of airport services could lead to the social exclusion of this type of passenger if staff assistance is not guaranteed.

Limitations and future research

It is worthwhile to study the segmentation of passengers on the autism spectrum in terms of their use of the digital solutions implemented following COVID-19. However, our research has several limitations. Firstly, this study is not longitudinal as it focuses on a limited period of time. Another limitation is that the data collection was carried out in a single setting, so this issue should be investigated in different locations. Following cohorts of passengers on the autism spectrum through the entire air travel experience (departure and return), together with international travel (given the increased customs and security measures), would allow further testing of the approach. Finally, each person on the autism spectrum is unique and the common traits of the described above are not always present, so our findings need to be considered carefully.

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