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Evaluation and Analysis of Solutions to Challenges of Neurodivergent Individuals During Air Travel

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ABSTRACT

For individuals with autism spectrum disorder (ASD), traveling via airplane can be an arduous process. Factors such as hostile architecture, unfamiliarity with surroundings, and the inability to properly accommodate or prepare individuals for air travel can play a role in causing or exacerbating the difficulties neurodivergent individuals face. By isolating the causes of certain issues that individuals with ASD encounter during the air travel process, a better understanding of how to best move forward with developing procedures, designs, and architecture to help accommodate individuals with ASD can be developed. The paper evaluates previously established methods for preparing and accommodating neurodivergent individuals for different parts of the air travel process. Published research papers were divided into groups based on whether they approached the problem from an architectural or procedural standpoint, and then methods within each category were evaluated to find the best overall solutions. Ultimately, using the ASPECTSS system proved to be a promising approach to mitigating the challenges from a design standpoint (especially as it pertained to acoustic design and sequencing of a space). From a procedural standpoint, the gamification approach proved to be extremely effective yet costly, while the POV-Video approach showed some promise in being superior to gamification from a resource-intensiveness standpoint. By combining these approaches, great strides could be made in improving the air travel experience for individuals with autism.

Introduction

Of the challenges faced by individuals with autism in everyday life, long-distance air travel is one of the most significant. Neurodivergent individuals often struggle with sensory issues (e.g., adverse reactions to bright lights, loud noises, and pungent odors) and/or communication problems (caused by unfamiliarity with new individuals, tendencies toward hypervigilance, and/or neurological differences among individuals with autism spectrum disorder (ASD). These difficulties can be compounded by an unfamiliar environment, whether that be in the airport, using a different transportation system in a foreign country, or staying in a hotel.

Some of the most common difficulties experienced by individuals with ASD during long-distance travel are heightened anxiety, sensory overload, and disorientation. Although these issues were faced by many individuals with ASD across all ages, a general rule of thumb was that the younger the child, the more severe the challenge imposed by traveling (this was primarily due to the heightened presence of comorbidities in young children with autism-the combination of the two diseases can exacerbate difficulties throughout the process)[1]. The design of critical points during long-distance travel is also notorious for its unfriendliness toward neurodivergent individuals (e.g., fluorescent lights, sharp edges, complex layouts, and a lack of directional aids all contribute to the difficulties experienced by traveling neurodivergent individuals)[2]. The experience of being on an airplane itself also will contribute to difficulties that come about as a result of the heightened weather salience many individuals with ASD experience [3]. For example, being in the low-pressure environment of an aircraft cabin might alter the sensory inputs of individuals with ASD because humans have been shown to have altered behavior in low barometric pressure environments, trending towards increased aggression and altered psychiatry [4]. However, there is not yet sufficient evidence to confirm beyond the shadow of reasonable doubt that this would also be the case for individuals with ASD. The

cramped layout of an aircraft cabin has the potential to increase anxiety and distress as a result of being a high-stimulus and high-object-density environment [5].

Despite these difficulties, there are steps individuals with ASD can take to improve their experiences with long-distance travel. These techniques can be categorized into three different methods: familiarity (immersion into the environment before actually traveling to reduce confusion and chaos), repetition (practicing what will be done during the travel process in order to become more comfortable with actually traveling), and mitigation (limiting the severity of the challenges posed by air travel). As a general rule, most airports and airlines will also be able to accommodate neurodivergent individuals [6].

Methodology

In order to research autism and air travel, PubMed was utilized in order to develop a broad understanding of some of the neurological causes and effects of autism, as well as some challenges experienced in life by individuals with ASD. Then, in order to understand the impact that being neurodivergent has on long-distance travel, Google Scholar was utilized to collect more research papers. In both instances, the following keywords were utilized in order to narrow down my searches: autism, neurodivergent, travel, air travel, and virtual reality. Once 22 papers had been collected, the next step was to narrow down the field of what the paper was analyzing using certain criteria. It was ensured that the papers were from reputable institutions, either a well-respected research journal or from an accredited university. In addition, to simplify the analysis, only papers that did not discuss hypothetical possibilities were included. Papers that did not produce significant results were also ruled out during this process. Finally, papers that did not provide background to the problem or address either the environmental or procedural approaches to solving this problem were ruled out. Ultimately, 12 papers that could be used were chosen to use for analyzing the best solutions to the problems neurodivergent individuals face in air travel.

In order to best understand the impacts of the different tools, mechanisms, and treatments studied, the papers were categorized into three different points of evaluation: anxiety levels, ease of using travel infrastructure, and relationship with the idea of traveling. I also categorized the papers based on how they approached the problems people with autism face during air travel: either a live walk-through of the travel infrastructure, a virtual reality experience, or an immersion into the airport environment without doing either a walk-through or a virtual reality experience. With the categories set up, the methods were ranked based on their effectiveness in statistically improving the experience of neurodivergent individuals (based on the evaluation criteria mentioned earlier).

Discussion

In order to understand how best to approach the issues that neurodivergent individuals face during the air travel process, I looked at the issue from a variety of different lenses. The majority of the research papers that are used in this review are based on testing solutions, which could help ease the difficulties of air travel for individuals with autism. However, an alternate approach, which was taken by a few literature reviews, was to identify the neurological causes of autism and the exacerbating factors that worsen its effects.

These neurological causes can be broken down into three categories: the part of the brain that deals in memory, the sensory processing part of the brain (which is addressed in the solutions that have been tested thus far by scientists in the VR, immersion, and repetition setups), and the language processing part of the brain. While there is debate surrounding how much each part of the brain factors into causing neurodivergence, there is consensus that each factor at least plays some role. Looking at other diseases, which are impacted by similar parts of the brain, we can then analyze the treatments of the other diseases and make a determination as to whether parts of those treatments can be applied to developing more effective root-level solutions to problems in the air travel process that are caused by neurodivergence.

It is unclear what in the brain actually causes ASD. However, there are some causes that we can rule out entirely, which will help develop a better understanding of how to tackle the issues that present themselves. While it is true that autism has been connected to Attention Deficit/Hyperactivity Disorder (ADHD), Bi-polar Disorder, Schizophrenia, and even Post-Traumatic Stress Disorder because of a common thread of hypersensitivity to unfamiliar environments and a low sensory threshold [5], there is no definitive evidence to prove a relationship between ASD and any of the other conditions. According to the American Psychological Association, there is no correlation between schizophrenia and ASD in infants, but there is evidence of overlap between childhood-onset schizophrenia and ASD (which is most clear in terms of similarity in social interaction).

Another potential cause of neurodivergence stems from the language-processing part of the brain. There are direct parallels between individuals with ADHD and ASD, which are made more pronounced by the fact that over half of all neurodivergent individuals also have some form of attention-related disorder. For example, individuals with ADHD and ASD are often known for overfocusing their attention on highly specific topics. Both groups also tend to struggle in social environments and with social interaction in general. In both cases, inattention can play a major role in these social issues [7]. However, while the medication for ADHD and ADD tends to be reasonably effective (around 50% of patients with ADHD & ASD reported improvements after treatment [8]) for solving attention problems of individuals with that problem alone, clinical trials of using ADHD medication on individuals with ASD shows reduced effectiveness [9]. In the case of stimulants, such as methylphenidate and amphetamine, individuals with both ADHD and ADD will tend to experience negative side effects in addition to not seeing improvements in their present conditions [7]. These negative side effects can include social withdrawal, anxiety, and depression, meaning that the use of stimulants would actually make air travel more difficult for neurodivergent individuals.

Another method for solving this problem can be to look at ways in which the environment can be better suited for use by individuals with autism. By understanding some of these key issues, we can better design the air travel experience to accommodate neurodivergent individuals.

One example of this is developing environments that can help reduce sensory hyperstimulation. We can do this by first identifying certain factors in existing designs that are key causes for hyperstimulation and then developing designs or solutions to reduce the impact of these factors from a sensory intensity standpoint. Skeptics may point to issues such as high cost, difficulty of implementation, and struggles for neurotypical individuals in such spaces as reasons to avoid focusing on the design of environments around neurodivergent individuals. Taking a look at the ASPECTSS Index, a method for evaluating an environment's ability to accommodate individuals with autism, we can evaluate how different environmental factors can harm or help a neurodivergent person's ability to navigate the air travel process [5]. In many of the suggestions for building design laid out by the ASPECTSS index, there are ways to improve the experience of using a building for neurodivergent individuals that can simultaneously provide a tangible benefit to neurotypical individuals.

One example of this is the Acoustics category of the ASPECTSS index. In order to improve the Acoustics category for a space, it should be optimized such that echoes, reverberation and background noise are minimized [10]. While this helps decrease sensory overload for individuals with autism, a quieter and less discordant environment also provides a better experience for neurotypical individuals in the form of reduced stress. Similarly, the Safety category of the index suggests that an environment should be designed such that sharp edges, protruding objects, and rough surfaces should be avoided so as to reduce the hazardous risk present to individuals (and especially children) with ASD. However, this can also be beneficial to individuals without ASD, since these design choices will create a safer environment overall for them as well [5]. A third example of this is Transition Spaces. Although traditionally used so that individuals with ASD are able to better recalibrate to different environments, from a design standpoint, Transition Spaces also make sense from an architectural standpoint, as they can serve to reduce confusion during navigation, divide larger rooms by their purposes, and make it easier to cultivate certain moods or atmospheres depending on the needs of the surrounding buildings/rooms. Ultimately, it is clear that environmental modifications targeted toward individuals with autism can also benefit individuals without it.

We can then create guidelines for aircraft and airport design based on the ASPECTSS index. Looking at the first category, Acoustics, we can optimize a room to reduce sound levels, by using acoustic panels and thicker walls made of materials such as foam or bamboo to prevent sound from neighboring areas from entering a room. For aircraft design, this is more difficult, as such modifications would add extra weight to the aircraft and thus lead to reduced aircraft efficiency. This would then lead to additional costs for the airline. However, offering noise-canceling headphones to individuals with ASD would be an alternative solution that would help individuals with autism deal with the noise pollution on board an aircraft.

Spatial sequencing is another criterion that can be improved in airports. According to the spatial sequencing category, a space should be designed such that it is sequenced based on function. An example of that is diagrammed below. Notice how in the layout on the left, it is clear where the start and end points are, and the space is designed such that individuals are directed to where they need to go with minimum distraction. The potential for confusion has been reduced as much as possible. However, in the layout on the right, with many many more choices and decisions to make in order to reach the final destination, the environment can be much more challenging to use and navigate.

Taking a look at the different approaches individuals themselves can take to solve this issue, gamification is a very effective process as 93.8% of individuals who use the technique report some level of improvement in making their way through the air travel process [11]. It also provides a much more hands-on approach to experiencing air travel than any other method since gamifying, by definition, demands live interaction from the user. By placing the user in a simulated environment and having them perform a set of tasks, the individual is able to gain familiarity with what they have to do in the real world.

The POV approach is less resource-intensive than gamification. It is also less effective, considering a 78% Improvement Rate of Difference, versus the 93.8% improvement rate for the gamification approach [12]. However, this changes between POV priming and POV prompting. POV prompting creates up to an 88% improvement rate of difference, whereas, priming (the most popular technique so far observed) has a 72% improvement [12]. Prompting was where an individual watched a video one section at a time, practicing the actions of each section before moving to the next part of the video. Priming was where an individual watched a preparatory video all at once and then replicated the action.

Conclusion

Although the study of this field is still developing, there are several promising methods and solutions that may help ease the difficulties faced by neurodivergent individuals during the air travel process. For example, the use of gamification (almost 94% of individuals reported reduced anxiety about travel after usage) and variations of the POV approach (effectiveness in moving through the travel process improved in 72% to 88% of participants in the study) have shown great success in helping reduce the stress of air travel for individuals with ASD. On the flip side, analysis of the neurological causes of autism did little to provide solutions for the challenges ASD-afflicted people go through during this process. Although some breakthroughs have been made in potential treatments for neurodivergence (especially in combination with other disorders such as ADHD or schizophrenia), there was little conclusive evidence to suggest the potential of a genuine possibility for improvement. From an environmental standpoint, the ASPECTSS system can help guide the design of airliner interiors and airports in order to make travel safer for neurodivergent individuals by using design choices, which serve to reduce complexity, sensory overload, and other difficulties that would otherwise negatively impact the ability of individuals with ASD to properly navigate the air travel process. In order to continue improving the ability of individuals with ASD to travel via airplane, researchers should find a way to quantify the effectiveness of the ASPECTSS system to see whether implementing it into aviation infrastructure would provide benefit to individuals with autism.

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