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Adaptive and sensory-friendly clothing for children with ASD

Adaptive and Sensory Friendly Clothing for Children With ASD

by

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Abstract

In recent years, there has been a rise in air travel as the preferred mode of long-distance transportation for both business and leisure. However, airlines are ill-equipped to accommodate the needs of children with Autism Spectrum Disorder, creating an unenjoyable experience for the child, the family and other passengers. For children with Autism Spectrum Disorder, the entire process from packing to reaching final destination is riddled with stress and anxiety. From the moment a child is introduced to the idea of travelling, there are many environmental checkpoints that can trigger the child and induce a change in behavior. This may occur at home, at the airport check-in counter, through security lines, boarding and finally inside the airplane. These triggers can be large crowds, unpredictable behavior of others, intimidating machines, loud noises and small spaces within the cabin. This thesis proposes an in-depth study of these various environments and aims to collect data by conducting observational studies, as well as interviews and surveys in compliance with the Research Ethics Board. The objective is to compile a detailed analysis of this data and enhance the physical, auditory and visual air travel experience for children with ASD. To understand the feasibility of this concept, a one-to-one scale buck will be developed to aid in the evaluation of ergonomics, human factors and full-bodied human interaction design. This will lead to a developed solution that enhances the air travel experience for children with ASD and provides a deeper understanding of the ways in which air travel can be made more accessible.

Acknowledgements

"If you've met one person with autism, you've met one person with autism" – Stephen Shore.
Dedicated to all the amazing children on the spectrum who are more than their diagnosis.

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I would also like to thank my advisors who have helped guide me throughout this study. The parents, guardians, and most importantly, the children diagnosed with ASD, whom I've had the pleasure of speaking with, and learning from about their lived experiences. I am forever thankful that they chose to share their experiences of ASD with me and I hope to have done some justice. I am thankful to my professional advisors; Faryal, for keeping me on track, and Tetiana for helping this little designer navigate the world of garment-making.

I cannot forget to thank and congratulate my friends, peers and fellow designers. We started this journey together four years ago, endured a weeks-long strike, a global pandemic, virtual learning, and many many late nights of laughter and fun. It has been a pleasure learning and growing as designers alongside each and every one of you. I take comfort in knowing, that despite the difficulties of our final year, I am graduating many friends richer.

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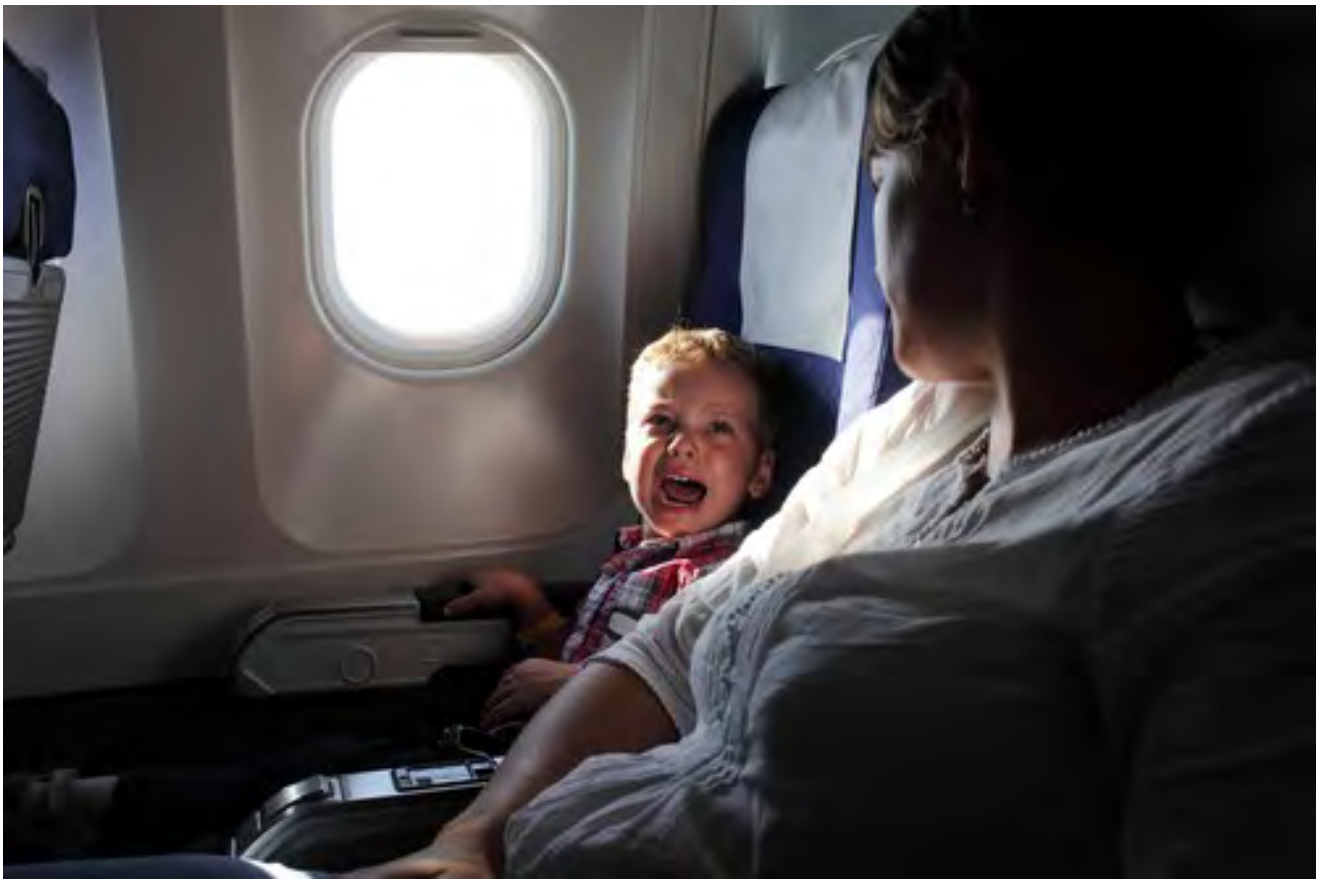


Figure 1-1 - 30 Things Parents of Children on the Autism Spectrum Want You to Know, https://www.appliedbehavioranalysisprograms.com/things-parents-of-children-on-the-autism-spectrum-want-you-to-know/

1.1 Problem Definition

Air travel has become a convenient and accessible mode of transportation in this day and age, shortening distances as well as one's travel time. However, for children diagnosed with Autism Spectrum Disorder, air travel can actually be a high risk and anxiety-inducing experience. The changes in routine, unpredictability of the process, large crowds, new noises and sights can all create an uncomfortable experience for children with ASD, as well as their travel companions. Parents go through a great deal of preparation to ensure child has a comfortable journey, minimizing their exposure to any potential triggers that may exist. These triggers present themselves at various stages of the journey, starting from home, through the airport and all the way to the cabin of the aircraft. Because autism is a hidden disability, it is even more

challenging for parents to navigate the stressful checkpoints and the unpredictability of their child's behaviour. Airports and airlines are beginning to gain a better understanding of the difficulties experienced by autistic families, but more can be done to "demystify" and minimize the potential for surprises. The goal with of thesis is to create a better air travel experience for a child with autism, ensuring their journey is comfortable beginning from home to destination.

1.2 Investigative Approach

Over the past few years, steps have been taken to make air travel more predictable for children with Autism Spectrum Disorder. This includes the emergence of programs like Wings for Autism, mock boarding programs at selective airports, introduction of Virtual Reality in some instances and the use of general autism tools by parents prior to travel. For the purpose of this report, these tools and programs were studied along with qualitative and quantitative research methods to create user-centered solutions. Several research tools were further utilized to narrow down the approach, including but not limited to;

- Literature reviews
- User observation
- Video Analysis
- User interviews
- Surveys and questionnaires
- Benchmarking analysis
- Information searches
- Ergonomic studies

Key Research Areas Investigated	Key Questions Answered
User Demographics	How may we improve air travel for children with Autism Spectrum Disorder?
Autism Spectrum Disorder Characteristics	What are the primary needs of children with ASD?
Airport Standard Operating Procedures	How might we innovate existing designs and systems utilized in this area?
Ergonomic Studies	How will the study of design and ergonomics influence the direction taken?
Application of Virtual Reality	What impact will sustainability have on the proposed design solution?

Table 1 – Key Questions and Key Research Areas

The information gathered from the use of these research methods will help create a design solution that aims to improve air travel for children with ASD.

1.3 Background, History and Social Context

The aviation industry is one of the fastest growing in the transportation sector, with commercial airlines carrying “more than 4.5 billion passengers in 2019. The number of international tourist arrivals to the US increased from 1.32 billion arrivals in 2017 to 1.4 billion in 2018; more than half of tourists chose to reach their destination by air transportation” (Mazareanu, 2020). However, for children with ASD, air travel is not always as easy as booking a flight and boarding a plane. In 2020, approximately 1 in 54 children have been identified with

ASD, according to CDC's Autism and Developmental Disabilities Monitoring Network. While these children share a diagnosis, the symptoms they experience may range from intellectual, developmental disabilities, cognitive challenges, speech and language impediments and delayed social skills.

These symptoms make it increasingly difficult to predict a child's behaviour, especially in an uncontrolled environment like the airport. In recent years, there have been steps taken to ensure a child's travel journey is made as comfortable as possible, with the introduction of programs like Wings for Autism and use of new technologies like VR to create mock boarding scenarios. But these programs aren't as widely available at airports and are individual solutions to a much larger problem. With air travel being practically unavoidable, the need to create inclusive spaces is important for the wellbeing of the child, parents and other passengers.

CHAPTER 2 – User Research

This chapter will provide a detailed analysis of the user profile, and compile relevant information through video analysis, primer user interviews and surveys and questionnaires. This in-depth analysis of user demographics will be followed by benchmarking and technical analysis of current products and market trends.

2.1.1 User Profile – Persona

Along with the profile of a child with ASD, this report will identify additional secondary and tertiary users. An image search will be conducted to gather primary information on the child, and what they look and behave like. A literature search will also be performed to better understand the user demographic.

Figure 2-1 - The Hardships of Families with Autistic Children. Retrieved from https://www.tehrantimes.com/news/422310/The- hardships-of-families-with-autistic-children

Persona
Name: Johnny Kid **Age:** 6

Occupation: N/A

Family Income: $95,000

Education: First Grade

Sibling Relations: One sister, One brother

Location: Toronto, Ontario

Special Education Needs: Yes

Age of Diagnosis: 2.5

Social: High social activity with siblings – low external social activity

Frequency of Activity: Low-Mid

Profile

Johnny Kidd is a Caucasian six-year old, residing in Toronto, Ontario, with his family. He is the youngest of three children, with the oldest being a daughter and thereafter, a son. Johnny is going to first grade and is enrolled in a private Toronto school.

User Behavior

Johnny enjoys the time he spends at home with his family, he is familiar and comfortable with the routine his family has provided for him. He was diagnosed with Autism Spectrum Disorder at the early age of 2, when his parents noticed an unfamiliar pattern of behaviour. Johnny would frequently avoid eye contact; he was delayed in language development and would often repeat the same words over and over again and would exhibit inadequate social interactions. With the proper diagnosis, Johnny's parents were able to provide him with the appropriate resources he needed to develop, although, there were area that needed continuous work. For example, Johnny requires extra attention, he has minimal social interaction with children outside of his siblings, but with the appropriate after-school programs and special education curriculums, Johnny is able to manage his ASD diagnosis.

Johnny's Experience Flying

Johnny has always had challenges with flying, or even with the idea of being at an airport. Johnny doesn't like large crowds and is often resistant to minor changes in his routine or environment, so Johnny's parents need to take extra precaution, and take extra measures when packing and preparing for a flight. Johnny finds comfort with his building blocks and is often given an iPod to soothe any irritability that may arise from flying. However, these measures are not enough for long-haul flights, so Johnny's parents only travel short distances, even when flying.

User Profile Summary

User	Description
Primary	Child with ASD
Secondary	Parent or Guardian of Child with ASD
Tertiary	Other Passengers on Plane

Demographics

A literature search was conducted on the Humber Library Search Engine as well as Google to collect vital statistical information regarding the target demographic. The following search terms were used:

- "Autism Demographics"
- "Autistic Children Demographics"
- "Autism Travel Challenges Statistics"
- "Autism Travel Survey"
- "Autism Challenges Survey"

***Findings**:* The findings from the data collected have been summarized according to all the categories being observed: Age, Gender, Ethnicity, Family Income, Education Level, and Sibling Relations.

***Gender**:* As seen in the graphs shown below, ASD disproportionately affects males over females. For every 1 girl, about 4.3 boys were affected by ASD.

Age: The discussion of age when conducting this particular research is two-fold: the first is the age of the child upon receiving a diagnosis, and secondly, the average age of children with ASD. The average age of diagnosis was 3.1 years, for children with ASD, and as seen in the table below, the age by which they receive the diagnosis was declining. This shows an improvement in

that children are receiving their diagnosis earlier, creating an opportunity to optimize prognosis through treatment and resources.

Race and Ethnicity. Again, it is obvious that ASD affects non-Hispanic White children more than any other race or ethnicity. Second in prevalence, are non-Hispanic Black children with about 18 per thousand children being diagnosed with ASD.

Education: Statistics surrounding education so that about 11% of children experiencing ASD required special education services in 2016 (in the United States).

Income: Statistics regarding income show that children whose family lived below the poverty line, received their ASD diagnosis later than children whose family income was higher.

Demographics Summary

Demographics		**User Behaviour**		**Personality**		**Cognitive Aspects**	
Age	2-13	Prevalence of Symptoms	Early Diagnosis	Locus of Control	ê	Technical Skill	é
Gender	Predominantly Male			Self-Efficacy	é	Pre-Requisite Knowledge	ê
Ethnicity	Caucasian	Social	Low-Social	Changeability	é		
Income	Middle Class ($40,000 to $80,000)	Level of Focu	Low	Uncertainty Avoidance	é		

Education	Kindergarten – Grade IV	Location	Residential – Rural/ Urban				

Table 1-1 – Demographics Summary

2.1.2 User Observation – Current User Practice

The following data was investigated and recorded from current user practices, particularly the practice of travelling by air with children who have Autism Spectrum Disorder. The findings collected from such observation and data collection was then used to hypothesize best user practices, within this environment. Due to the restrictions posed by the pandemic, user observation happened through a series of image and video analysis.

A literature search was also conducted to study the user behaviour of children with Autism Spectrum Disorder. This was done utilizing Google Search Engine as well as Humber's Library and Catalogue for relevant information. The search was done using the following terms:

- "Autism Interests"
- "Autism Children Symptoms"
- "Personality Interests Autistic Children"

The following categories were identified and summarized with the findings: Lifestyle; Prevalence of Symptoms, Personality and Cognitive Abilities, Circumscribed Interests, and Group or Solitary Activity.

Lifestyle

Data analyzed for this portion of the research indicated "lower levels of physical activity and higher levels of sedentary behaviour among children with ASD. Furthermore, that age is consistently inversely associated, and sex inconsistently associated with physical activity" (Jones, 2017).

Prevalence of Symptoms

The data collected for the chart below highlighted the United States as the country with the highest prevalence rates in the world (2020). The important of researching and pulling statistics regarding ASD prevalence has to do with the comorbidity rates present amongst children with ASD. For example, children with ASD also suffer from other disorders, at a much higher rate than non-ASD children, such as attention deficit hyperactivity disorder, a learning disability, or an intellectual disability.

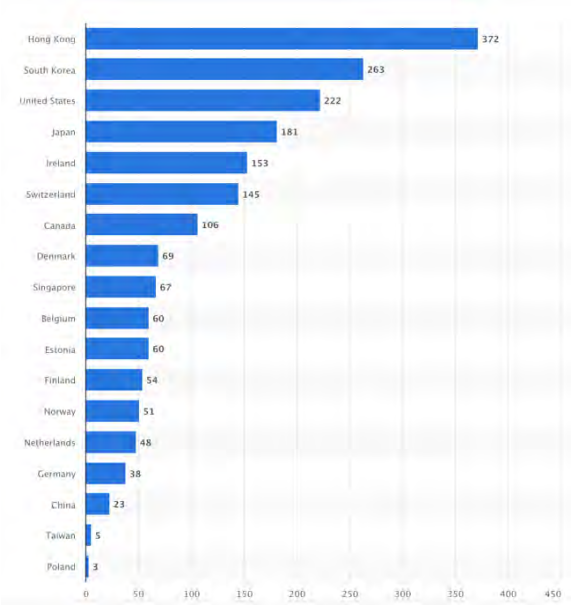


Figure 2-2 – Prevalence of ASD Among Children in Select Countries Worldwide as Of 2020. Retrieved from https://www.statista.com/statistics/676354/autism-rate-among-children-select-countries-worldwide/

Personality and Cognitive Abilities

Research taken from a study done on personality and self-insight in children with ASD shows a comparison between the personalities and self-insight traits of a child with ASD and a "typically developing" child. The studies "demonstrated that children, adolescents, and young

adults with ASD have distinct personality profiles as compared to TD individuals. As hypothesized, individuals with ASD tended to be higher in Neuroticism and lower in Extraversion, Agreeableness, Conscientiousness, and Openness to Experience. These personality differences were observed in samples of children and adolescents as well as adults, were perceived similarly by both self and parents, were similar for males and females, and held after controlling for IQ" (Schriber, 2015).

Figure 2-3 – Personality and Self-Insight in Individuals with ASD. Retrieved from

Table 3

Study 2: Do Personality Traits Differ Between ASD and TD Children According to Self- and Parent Reports?

	Child self-reports						Parent reports					
	ASD Group			TD Group		d^a	ASD Group			TD Group		d^a
Big Five dimension	*M*	*(SD)*		*M*	*(SD)*	ASD-TD	*M*	*(SD)*		*M*	*(SD)*	ASD-TD
Extraversion	3.22	(.58)	<	3.55	(.80)	−.48**	2.99	(1.04)	<	3.74	(.83)	−.80**
Agreeableness	3.50	(.73)	<	3.92	(.63)	−.62**	3.37	(1.01)	<	4.33	(.53)	−1.19**
Conscientiousness	3.18	(.66)	<	3.48	(.63)	−.46*	2.48	(1.00)	<	3.67	(.78)	−1.33**
Neuroticism	3.05	(.74)	>	2.55	(.62)	.73**	3.77	(.88)	>	2.25	(.76)	1.84**
Openness	3.64	(.63)	=	3.86	(.55)	−.37†	3.32	(.80)	<	4.04	(.57)	−1.03**

Note. For child self-report, $n = 50$ ASD and $n = 50$ TD; for parent report, $n = 50$ ASD and $n = 49$ TD. ASD = Autism Spectrum Disorder; TD = Typically Developing.

[a]Difference between ASD and TD scores in standard deviation units (i.e., Cohen's *d*).
†$p < .10$;
*$p < .05$;
**$p < .01$.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4122539/

Circumscribed Interests

Circumscribed interests (CIs) are "idiosyncratic areas of intense interest and focus and are a core symptom of ASD that may be associated with social development" (Cho et.al, 2017). Circumscribed Interests are a type of restricted and repetitive behaviours and interests, also known as RRBI, which are often non-functional behaviours that interfere with daily activities. "A specific subtype of RRBIs that are seen in 75–95% of children with ASD are circumscribed

interests (Cis). Cis are defined as an intense focus on and/or interest in certain objects or topics (e.g. watching the circular movements of a washing machine or memorizing numbers;).

Although Cis can allow a child to become very skilled and focused (e.g. becoming efficient with memorizing numbers), the intensity and pervasiveness of Cis can lead to challenges with reciprocal social interaction and communication" (Cho et.al, 2017). The table below, taken from the same research study, shows the highest circumscribed interests being Legos, with the lowest being sport. This reconciles with the data analyzed earlier, indicating physical activity levels being low amongst children with ASD.

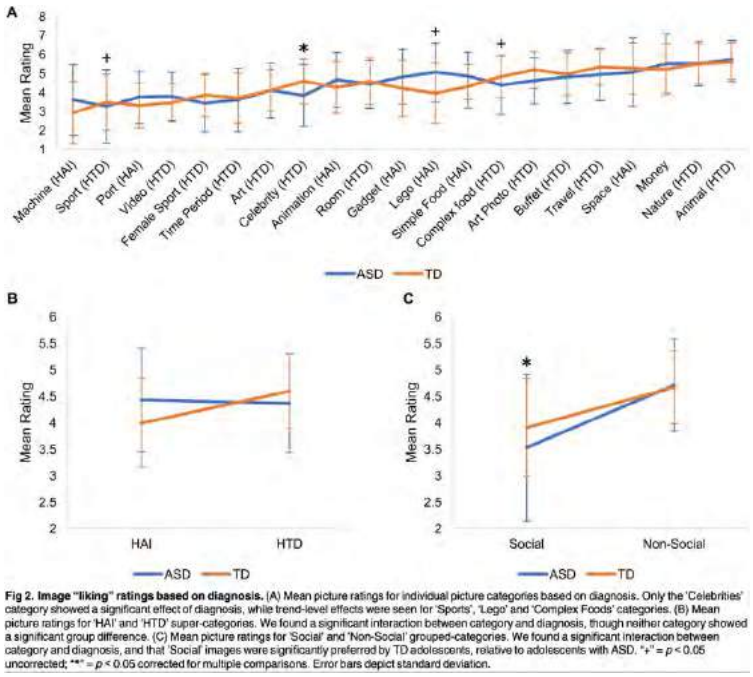


Fig 2. Image "liking" ratings based on diagnosis. (A) Mean picture ratings for individual picture categories based on diagnosis. Only the 'Celebrities' category showed a significant effect of diagnosis, while trend-level effects were seen for 'Sports', 'Lego' and 'Complex Foods' categories. (B) Mean picture ratings for 'HAI' and 'HTD' super-categories. We found a significant interaction between category and diagnosis, though neither category showed a significant group difference. (C) Mean picture ratings for 'Social' and 'Non-Social' grouped-categories. We found a significant interaction between category and diagnosis, and that 'Social' images were significantly preferred by TD adolescents, relative to adolescents with ASD. "+" = $p < 0.05$ uncorrected; "*" = $p < 0.05$ corrected for multiple comparisons. Error bars depict standard deviation.

Figure 2-4 – Interests in Adolescents with ASD. Retrieved from https://search-proquest-com.ezproxy.humber.ca/docview/1959206669?pq-origsite=summon&accountid=11530

Group or Solitary Activity

For the target demographic, and the user profile studied, the activity is typically a group and social activity. A child between the ages of 2 and 8 participates in air travel with their parents or guardians, often accompanied by siblings which defines their experience in many ways.

Travelling is a social experience, and the particular environment being studied for the purpose of this report poses many challenges in both a group and solitary instance.

Steps	Image Observation	Insights
1) Arrangements are made with the airline/airport for child with ASD.		In many instances, parents of children with ASD will make arrangements with th airport and/or airline before hands for any special accommodations they may need upon arrival.
2) Family, with child packs and travels to the airport for departure.		Family packs any travel essentials for the child, which may include tools and products that assist children with ASD such as sensory toys, electronics, and books.
3) Child, with family checks-in at front desk.		Family checks-in their luggage, often opting to travel light in order to minimize the time they spend in line and in crowds waiting for luggage.

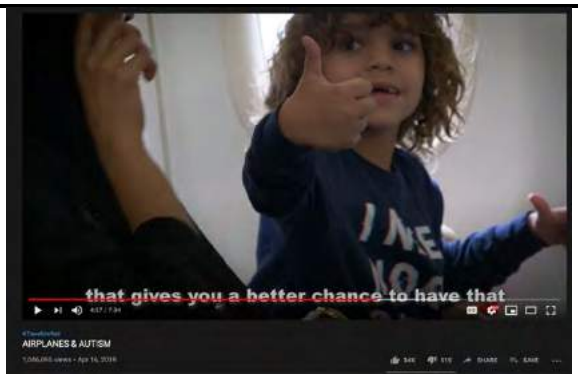
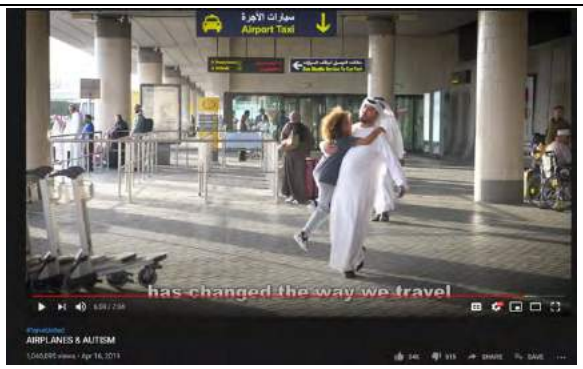
4) Child boards aircrafts with family.		Family, along with child, boards aircraft, often allowed to board early so a to minimize any stressors for the child.
5) Child, with family, settles into seat inside cabin.		The child, along with the family settles into their seats. Family often opts for front row seats with more leg room.
6) Child, along with family deboards and lands at destination.		The family of the child with ASD disembarks the plane, often allowed to deboard the plane first for the comfort of the child.

Table 2-2 – User Observation and Activity Mapping

2.1.3 User Observation – Activity Mapping

The nature of the pandemic, and the restrictions brought on by Covid-19 during the research of this thesis topic has presented a set of unique challenges to the process of activity mapping. For the purpose of this report, user observation was conducted through a series of

video analysis in conjunction with a thesis advisor, to study, step-by-step, the nature of air travel and various stages of the journey our user goes on. This following series of images defines the experience and typical activities involved in the process of travelling through an airport, into the aircraft

Observation Research Insights

Through this observational analysis, it was determined that the stressors for children with Autism Spectrum Disorder begin at home, upon being introduced to the idea of travelling. This affects the child's behaviour at home, at school, and at other social gatherings which affects the child's experiences with air travel. It became obvious that the stressors existing at the airport start from check-in, through security, boarding and into the cabin of the aircraft. These stressors arise from large crowds, overhead noise, unexpected crowd behaviours, unpredictability of others and the general uncomfortableness experienced in the confined and small space of the cabin aircraft. Three key design aspects were narrowed down for improvement:

1) Limiting noise and light pollution for the child with ASD

2) Reduction of restricted interests and repetitive and challenging behaviours.

3) Use of assistive technology and sensory integration therapy as a way to cope with stressors.

2.1.4 Human Factors – Research of Existing Products

Most sensory clothing used by children with ASD provides a similar functionality and utilizes similar ergonomic considerations in their design. This is because the ergonomics of sensory clothing is crucial to the performance of the garment. Weighted garments provide a specific and unique function for the child, they help provide deep sensory relief around the chest and upper torso, the area most likely to be "hugged" to induce a sense of calm and comfort. If weighted vests or compression clothing were to provide sensory relief in areas which are unnatural to the child, they would lose their ability to perform and provide sensory relief, rendering them useless in the moment of need. Similarly, fidgets and sensory toys are designed to provide tactile

stimulation for the child. They are designed to target the self-stimulating nature of children with ASD, hence, require optimal ergonomic considerations to be successful.

2.1.5 Safety and Health – Research of Existing Products

Health and comfort are fundamental to the functionality of sensory-friendly and adaptive clothing and the proposed design features rely heavily on providing a comfortable user experience for the child. Crowded and busy airports create an environment full of triggers and stressors for a child with ASD. The goal of this proposed design is to minimize the reaction a user may have to these triggers by providing a comfortable experience through adaptive clothing, designed for each of these triggers. This includes a seamless interior within the garment, with heat bonded construction for flat hems, replacing buttons and zippers with invisible magnetic strips, placing pockets further up front for each access while sitting, using insulated acoustic fabrics within the construction of the hood to create a sound-blocking experience and placing haptic sensors within the pockets for the user to receive regulated sensory feedback. These features are designed to improve the overall health and comfortability of the user, validating the notion that a busy and crowded airport can be a stressful environment for someone diagnosed with ASD.

In addition to health and comfort, the user's safety is a fundamental consideration in the proposed design solution. With the understanding that the user is a minor, often accompanied by a guardian when travelling, the goal of this design is to create sensory friendly clothing which is safe for the user to operate. A handheld air pump, located in a discreet pocket and attached to the interior air pockets can be removed for the garment and manually operated by the user, either child or adult. The handheld air pump is simple in its design, using textured surfaces to provide a tactile sensory experience for the user as they operate the air pump. Similarly, the guardian can monitor the child's health using biometric data which measures and collect the child's heart rate and temperature.

2.2 Product Research

2.2.1 Benchmarking – Benefits and Features

Product benchmarking air travel as an autistic child relies on a very small data set of existing products. In the current market, there are virtually no products that meet the user needs and demands that this thesis project has aimed to satisfy. Current products are generic solutions to the user's individual needs, nevertheless, the benefits and features of four products were studied for the purpose of this report.

Products Compared Floreo

"Floreo is leveraging the power of Virtual Reality to develop a supplementary method of teaching social and communication skills for individuals with Autism Spectrum Disorder (ASD). Our library of lessons is fun and engaging for the learner, while also providing a supervising adult the opportunity to monitor and track the learner's progress. Floreo is currently being used by schools, therapy practices, and parents. Floreo's lessons are science-based; we are currently running several research studies including a study in collaboration with the Center for Autism Research at Children's Hospital of Philadelphia and National Institutes of Health" (Floreo, 2020).

	Benefits and Features
1.	immersive & repeatable
2.	providing context difficult to replicate in home or office
3.	supervised experience by parents or therapists
4.	supervision helps make the process more guided, fun and engaging
5.	affordable – mobile VR price point makes it accessible
6.	automated capture & analysis of previously unavailable data
7.	used to help acclimate children to airports prior to travelling
8.	growing content library based on established social and communication skills
9.	partnerships with leading academic, therapy and civic partners

Figure 2-5 – VR Apps for Autism. Retrieved from http://msensory.com/how-vr-is-helping-children-with- autism-navigate-the-world-around-them/

Wings for Autism

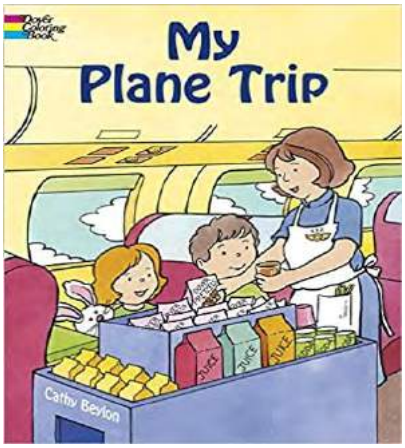
"The Arc's Wings for Autism®/Wings for All® (Wings) program gives families and aviation professionals the confidence to take to the skies with ease by providing an airport "rehearsal," as well as a presentation on the aircraft features and in-flight safety protocols. Chapters of The Arc, local partners, and airport/airline/TSA personnel work collaboratively to design and carry out each Wings event" (Wings for Autism, 2020).

Benefits and Features
1. Alleviate stress of flying for children with autism
2. Opportunity to learn about how the person with autism will react to different stimuli in the airport
3. Opportunity for airport personnel to observe, interact and deliver services in a structured environment
4. Re-enact different stages of air travel from check-in, boarding, passing through TSA security, waiting for boarding, and interior of aircraft.
5. Improve disability competency and accommodations for passengers
6. Offered by various airports

Figure 2-6 – Flying High with Wings for Autism. Retrieved from https://www.ahrcnyc.org/news/flying- high-wings-autism/

Books (My Plane Trip)

"The large, easy-to-color pictures in this book help youngsters prepare for an exciting plane trip. Twenty-two captioned illustrations — all designed to ease children through their first flight — depict a young couple and their two children at the airport, going through security checks, and waiting to board a plane; a jet being refueled; a pilot and copilot seated in the cockpit; flight attendants giving instructions; air traffic controllers tracking planes; and fifteen other scenes."



Benefits and Features
1. 22 illustrations, easy to read
2. 15 different scenarios through the airport
3. Easy to carry-on and pack in bag
4. Non-electronics, no need to charge or stow away
5. Lightweight

Figure 27 – My Plane Trip Coloring Book. Retrieved from https://www.amazon.com/Plane-Trip-Dover-Coloring-Books/dp/0486439828

Foam Rocker Board

"For On-the-Go Sensory Breaks - Take a sensory break anytime, anywhere! Use our lightweight rocker board to improve balance, core strength, reaction skills and muscle tone. Students who need movement can stand on it during class or use as a foot fidget while seated. Lightweight design makes for easy travel on-the-go between home, school and the clinic" (FunandFunction, 2020).

Benefits and Features
1. 4-way balance point
2. Stand, sit or kneel to balance
3. Supports sensory seekers with active movement
4. Challenges balance and core strength
5. Made by Fun and Function
6. Age 3+
7. Holds up to 150 lbs.
8. Lightweight, durable closed-cell foam.

Figure 2-8 – Foam Rocker Board. Retrieved from https://funandfunction.com/

The products studied above are typical products used by parents to make the travel experiences of their child more comfortable. As is obvious from the benefits and features tables, some of the recurring benefits and features found in these travel essentials include the ability to be lightweight, provide a sensory or educational experience and supervision and coordination with parents and/or guardians.

2.2.2 Benchmarking – Functionality

While there are a few products on the market that present as sensory clothing for children with ASD, the common element amongst them is that they are limited in their functionality and what they can provide the child at any given time. For example, compression clothing is often used by children with ASD to provide deep sensory relief in different environments such as school, playgrounds, at home and other social settings.

Figure 2-9 – Children Wearing Weighted Vests. Retrieved from https://funandfunction.com/weighted-compression-vest.html

Garments such as the weighted vests above provide sensory relief for children with ASD, helping them to calm down, focus, or cope with sensory overload. The compression provides a reassuring, hug-like feeling to the child and can be modified by adding or removing weights based on the child's liking. However, weighted vests as seen above, are limited to providing one single

function to the child. The child may still need additional tools to help find relief when feeling sensory overload. These additional tools may be objects like fidgets that help with self-stimulation, or other sensory toys that help physically redirect the child's energy when stimming. Stimming tools like the one shown below provide tactile stimulation to the child, promoting calm and concentration when the child is occupied with an activity. Usually, the child will resort to self-stimulatory behaviour that needs to be redirected into something else. Caregivers will often resort to using fidgets as a way to "distract" the child from whatever self-stimulatory behaviour they are engaging in.

Figure 2-1- – Fidget. Retrieved from https://funandfunction.com/product-type/fidgets.html.

2.2.3 Benchmarking – Aesthetics and Semantic Profile

Part of the benchmarking process was to analyze existing products and their aesthetics and semantics profile. Existing sensory clothing for children with ASD, even when gender neutral, utilize darker, cooler tones in their design. For example, many of the weighted vests and weighted clothing, along with compression garments, come in colors such as dark grey, dark blue and dark green. This is because children with ASD often prefer cooler tones, as wearing bright and warm colors lead to visual sensory overload. Bright colors often can be distracting for a child with ASD, coupled with the stress of travelling and the unpredictability of air travel in particular, it is important to keep the child feeling as less overwhelmed as possible.

In contrast to compression and sensory clothing, the fidgets and sensory toys that children with ASD utilize are brighter and more playful in their design and aesthetic presentation. For example, the fidget shown above, along with other tools listed on the Fun and Function website are brighter, warmer, and more playful in nature. They use sharp colours, glittery and shiny components and textured surfaces because children are often drawn to them as toys and tools. The element of fun is attractive to children with ASD and helps provide a distraction for the child when they are overstimulated and overwhelmed.

2.2.4 Benchmarking – Materials and Manufacturing

Adaptive clothing, which is designed to increase comfort and mobility for its wearers, can be made from a variety of materials. They're typically designed around the user's sensory needs, utilizing soft materials and special fabrics in the construction and design of the garment. Children's clothing also utilize a variety of materials, many of which are beginning to incorporate ecofriendly fabrics and consider end of life cases. Such fabrics include linen, cotton, and bamboo. These materials are chosen for their durability, breathability, antimicrobial properties and ability to biodegrade. Some non-eco-friendly fabrics still used in the design of children's clothing include fabrics made of polyester, acrylic and often leather. These fabrics are not considered sustainable because the former are synthetic fibers made from petroleum that require the use of toxic chemicals and a lot of energy to create. They are also incapable of biodegrading (Mayhead, 2018).

The proposed design solution in question looks to achieve its function while maintaining sustainability at the core of its design. The exterior of the garment utilizes soft sand washed linen, a staple eco-friendly fabric known for its durability and longevity. Linen is made from flax and consumes far less water to produce than its counterpart, cotton. It is breathable, lightweight, absorbent, and antimicrobial. It requires no pesticides or fertilizers to mill and most importantly, it is biodegradable (Mayhead, 2018). Similarly, the inner seamless garment which is designed to come into contact with the user's body is constructed from ecofriendly viscose, combined with 27% nylon and 5% spandex for stretch. Ecofriendly viscose, which is manufactured using the lyocell process, produces little waste products and is considered far more ecofriendly than its traditional manufacturing counterpart. Viscose, in this form, combined with the nylon and spandex

is a breathable fabric which doesn't trap body heat, making it ideal for an inner seamless garment. It is highly absorbent, relatively light and soft and comfortable for the user to wear.

A core component of this proposed design solution are the inflatable air pockets contained within the garment. Fabrics typically used in technical clothing to create jacket linings or thermal jacket shells utilize polyesters which are synthetic and not known to be sustainable in their production and end of life. This proposed design solution will, in turn, use 100% GRS recycled polyester taffeta with a fabric weight of 38 gsm (Vivify Textiles, 2020). The design of the handheld air pump includes the use of natural rubber, harvested in the form of latex and treated to create a non-toxic and flexible material. Natural rubber is safe for children to use and play with, it is flexible and soft, and has little impact on the environment during harvesting, sourcing and manufacturing. It can be continuously recycled, and a rubber tree can be replaced with a new sapling when reaching its end of life.

The fashion industry's larger manufacturing processes have come under spotlight for their questionable labour practices and unsafe working conditions. Children's clothing, both traditional and adaptive, are made in factories around the world, depending on the company, often by individuals and even children paid little to nothing. In recent years, there have been calls for greater accountability and transparency by corporations, drawing attention to the social aspect of sustainability in fashion.

With that in mind, the proposed design solution aims to manufacture locally in North America, partnering with factories that employ ethical labour and have as little impact on the environment through their production processes. One of the ways to tackle this is through the fabric dyeing process. Most traditional dyed contain harmful chemicals and vast amounts of water to process. During the dyeing process, much of the dyed wash out and pollute rivers throughout the developing world. In fact, even white fabric which is often bleached releases dioxin in its bleaching process, "a chemical that the US Environmental Agency says can cause cancer and damage bodily systems" (Cowles, 2020). A greener alternative is to go the natural route or use low impact dyes. These are derived from plants, insects or animals and contain no toxic chemicals and require less water to process (Cowles, 2020).

2.2.5 Benchmarking – Sustainability

Materials used in benchmarked products are as follows.

Material	Properties	Reference
Recycled Polyester	"Recycled polyester is almost the same as virgin polyester in terms of quality, but its production requires 59 percent less energy compared to virgin polyester, according to a 2017 study by the Swiss Federal Office for the Environment."	https://fashionunited.uk/news/fashion/how-sustainable-is-recycled-polyester/2018111540000
Linen	"As a fabric it's breathable, durable, lightweight, absorbent, antimicrobial, moth-resistant, and cool (as in it lowers your body temperature in summer, as opposed to cotton). In terms of sustainability, it requires far less water than cotton and doesn't require any chemical fertilizers or pesticides. Bonus: It's biodegradable, too."	https://www.mindbodygreen.com/articles/eco-friendly-fabric-ranking
Cotton	While cotton is a natural fiber that can biodegrade at the end of its life, it is also one of the most environmentally demanding crops there is. The cotton industry now uses 25 percent of the world's insecticides and 10 percent of the world's pesticides. According to the World Health Organization, in developing countries 20,000 individuals die of cancer and miscarriages as a result of chemicals sprayed on conventional cotton. Cotton crops also require a huge amount of water to grow which in turn places a substantial strain on the environment."	https://www.mindbodygreen.com/articles/eco-friendly-fabric-ranking
Polyurethane	• Non-brittle • Loadbearing • Abrasion resistant	https://www.argonics.com/news/its-plastic-its-rubber-no-its-polyurethane/

	• Bonds well to materials like aluminum, steel, fiberglass, and plastic • Minimizes vibration and noise • Formulation for use in wet or dry conditions	

Table 2-3 Benchmarked Materials

2.3 SUMMARY

The goal is for sustainability to sit at the core of this design, blending with form and function to create adaptive apparel which aims to improve the overall experience of stressful environments for children diagnosed with ASD. This can be accomplished through a variety of design considerations, beginning with the use of eco-conscious materials explored above, to ethical manufacturing processes including labour practices and safe work environments. Crucial to the sustainability of this design is the appropriate end of life considerations. Typically, end of life disposal involves apparel ending up in landfills, even when there is the opportunity to recycle or reuse. Even when clothing utilizes biodegradable and/or recyclable materials, consumers are ill-informed and will dispose garments through easier means. Unless there are specific buy-back programs in place, and the existence of appropriate garment recycling facilities, ensuring the end of life of a garment is difficult. Additionally, the appeal of reducing one's environmental impact through the considerations mentioned earlier often requires a large investment by manufacturers, affecting the cost of the final product and the disposal of said product through alternative means. This is not to say that these sustainability goals are out of reach. Assuming that these considerations are addressed in the future and are accessible during the process of design to manufacturing, the goal of improving environmental stewardship within this industry is within reach.

CHAPTER 3 – Analysis

This chapter will analyze the primary needs of our user and take a further look into how the proposed design solution best meets these needs. These needs will be evaluated through a variety of research methods that include user observation, activity mapping, ergonomic testing and analysis, health and safety as well as research into materials and sustainability. The goal is that this evaluation will help to better understand and improve the user experience for a child with ASD, going through their air travel.

3.1 Analysis Needs

Current product solutions for use by children with ASD in airports are singular, one-track solutions that are either too simplistic in nature, or don't address the wide user needs for a child with autism. Children with ASD come across a variety of challenges when travelling by air including sensory overload, anxiety around large crowds and loud noises as well as the stress induced by being in new spaces and a change in environment. Current product solutions may address one of those solutions but do very little to address the cognitive and behavioral challenges that may arise for the child. This, in turn, presents challenges for the parents and guardians travelling with the child as well as other passengers on the flight. Therefore, a wearable product solution that aims to better the user experience, provide comfort for the child from home to destination, and be a functional yet aesthetic form will be in all-in-one solution that is not yet available in the market.

3.1.1. Needs and Benefits Not Met by Current Products

As mentioned above, current products used by children with ASD when travelling by air are very singular in the solutions they provide and have a broad range of benefits and features that they provide that can be difficult to integrate to provide the most optimal experience. Upon deeper research into each of these product solutions, three main product categories were identified through analysis. The first of these product categories are pre-existing personal electronic devices. Parents of children with ASD often travel with chargeable electronic devices like iPads and music

players, using them to distract children during their flight by plugging into headphones that drown out external noise. The challenge with electronic devices is the need to frequently charge, administering parental controls as well as carry-on limitations with many airlines. While electronic devices may address issues surrounding noise pollution and distraction from large crowds, it does little to actually soothe a child's physical needs. There are also very few electronic products that address a parent's need to locate and track their child, in situations where they may wander off. A second category identified through this research includes hand-held product solutions like children's books that help prepare a child for upcoming travels, sensory toys and tools that a parent may pack in their carry-on and take out as the need arises and also includes wearable solutions like compression clothing that reduce a child's anxiety and stress when travelling. Each of these product solutions address a standalone need and create a whole range of challenges when travelling by air. To pack hand-help items such as books, toys and other gadgets takes up lots of space in a carry-on and require the parent or guardian to introduce each of these items individually, which cannot always be done when moving through an airport at various stages. These individual items have been used by children with ASD many times to address their individual needs but are not an efficient product solution for air travel. A third and final category identified through our research includes services for children with ASD, often provided by airlines and associated groups. For example, these services like Wings for Autism, or Floreo, a virtual reality simulation used to acclimate children to the airport environment are just some of the various services being offered in each locale. The challenge with these services as a product solution is that they aren't widely available and may not be accessible for children with various special needs. The use of technology to help acclimate children is innovative and efficient, however, there are many scenarios in which parents may not be able to access these services in their geographic location. As a standalone service, these product solutions only address one half of the needs of our primary user. The goal is to use this research and integrate the most pertinent user needs with ergonomic design to create a singular product solution which addresses the needs of our primary user. The following table provides a summary for possible improvements within air travel for children with ASD, and the benefits not provided by current product solutions.

Needs	Benefits
Style	- Aesthetic design in line with children's clothing trends - Haptic feedback through smart fabric, designed to target stress areas
Comfort	- Comfortable fabrics that can be worn in long flights - Easy to put on and remove when using the bathroom - Soft materials that provide appropriate compression upon wearing - Waterproof or spill proof fabric
Ergonomics	- Flexible materials that move and adjust with the child's movements - A fabric that grows with the child and can accommodate the ergonomic needs of children aged 4-9.
Ease of Use	- Easy to wash and clean - The user must be able to wear the product efficiently and easily.
Fun	- A customized experience tailored to each child's needs - The use of colorful and textured fabrics to create a fun sensory experience for children

Table 3-1 Needs and Benefit Chart

3.1.2. Latent Needs

Maslow's Hierarchy of Needs were used to evaluate the fundamental human needs in relation to the benefits of improved air travel for children with ASD.

Figure 3-1 – Maslows Hierarchy of Needs. Retrieved from https://www.simplypsychology.org/maslow.html

Benefit	Fundamental Human Need	Relationship with Benefit
Style	Esteem and Self-Actualization	Moderate
Comfort	Physiological, Safety and Esteem	Strong
Ergonomics	Physiological and Safety	Strong
Ease of Use	Safety and Esteem	Moderate
Fun	Self-Actualization and Belongingness	Moderate

Table 3-2 – Relationship Between Latent Needs and Benefit

3.1.3. Categorization of Needs

The design process will focus primarily on comfort, improving user experience and trauma mitigation which were all determined through user interviews, a series of user observation as well as video analysis. The user needs are categorized below and will used to influence the design direction moving forward.

Wishes/Wants

- Lightweight and breathable
- Easy to don and take off
- Meets aviation regulations

Immediate Needs

- Mitigate stress and anxiety in airport environments
- Compression wear through padding and cushioning
- Full mobility

Latent Needs

- Stylish
- Grows with child

3.1.4. Needs Analysis Diagram

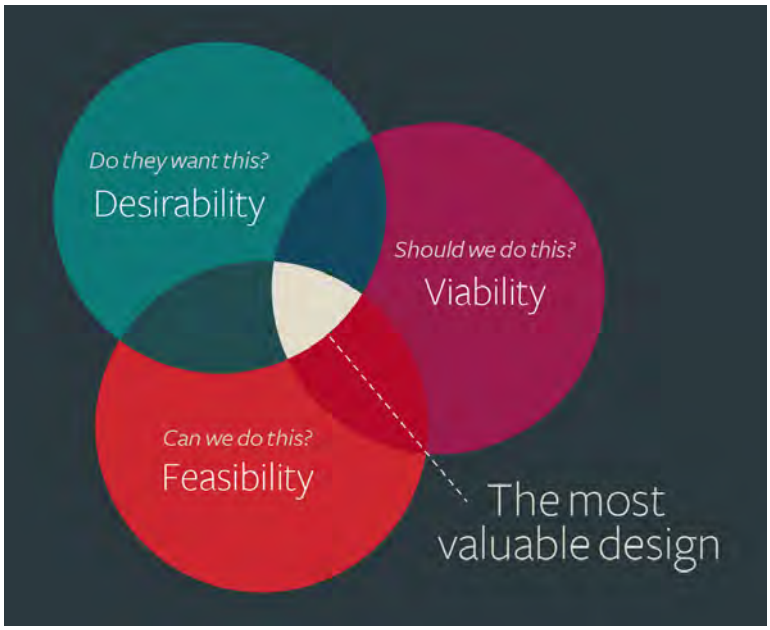


Figure 3-2 – Needs Analysis Diagram. Retrieved from https://designthinking.ideo.com/

Desirability

Air travel for children with ASD is a difficult experience, one that many neurotypical users do not experience in the same fashion. The most mundane of tasks as simple as packing for a trip, walking through an airport, passing through security or sitting in an aircraft create a plethora of challenges for a child with ASD. With air travel being a common form of long-distance transportation, there is a great need for improvement within this space. Once the objectives of this thesis are met, our primary user will no longer have to experience high stress and anxiety levels in situations that are quite typical to air travel.

Viability

While this proposed design solution is meant to improve and enhance air travel for children with ASD, there is nothing to suggest that it cannot be used to cater to the special needs of other children with a diagnosis of neurodivergence. There is a larger need to enhance the general user experience of children with disabilities whether that is at an airport, at school, grocery stores or at other social activities.

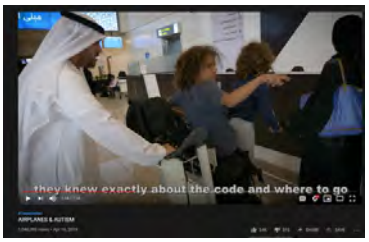
Feasibility

The technology used in current product solutions are very simplistic or are general solutions not meant to specifically target the user's needs. By creating a unified product solution that utilizes smart fabrics and innovative compression methods, the user will have a more targeted product meant specifically for this scenario. Smart fabrics and new and innovative compression fabrics are within reach. However, research shows that the proposed design solution utilizes technology and materials that have not been used in this application and for this purpose thus far.

3.2 Functionality

3.2.1 Activity – Workflow Mapping

In order to gain a better understanding of the complete air travel experience, an observational analysis was conducted via videos found online. Due to the nature of the pandemic when this report was written, in person user observation could not be conducted. Each stage of the process was broken down and analyzed to gain a better understanding of the challenges presented at each stage for children with ASD.

Activity	Image Observation	Insight
1. Pack for travel and arrange for special needs assistance		- Requires calling the airline to make any arrangements for any special needs that the child may have. This may not always be available depending on the airline and airport the user is travelling through.
2. Journey to the airport		- Prepare the child for travels, by using storytelling and other shared experiences. - Packing all toys and tools that will help make the journey easier
3. Check-in counter		- Reaching the check-in counter, waiting in line may create stress for the child, especially if there are long lines and large crowds
4. Proceed through security		- The strange noises and machines may create stress and disturbance for the child which will require special attention. - The child may have to go through extra screening is challenges arise

5. Board aircraft		- Waiting in preboarding area with large crowds and loud noises may be unsuitable for the child. - Many airlines will allow the families of children with ASD to board first. - Letting your child use the bathroom alone is challenging
6. Get seated in assigned seats		- Small and cramped seating areas create challenges for the child so often emergency exit seats need to be booked with larger leg room - Confined spaces, take-off and landing restrictions like no headphones means the child will need to be soothed in ways that don't involve electronics.

Table 3-3 – Analysis of user observation

3.2.2 Activity – Experience Mapping

Current products meant for children with ASD to use during their air travel are varying in the benefits they provide to the user. They are singular solutions that address individual needs, without a unified approach. Because of their inability to appropriately address the user's needs for comfort, stress and trauma mitigation as well ease of use, they experience they provide a less than optimal user experience.

Activity	Current Experience	Potential Improvements
Packing for trip	- Prepare child for travels by sharing stories and setting their expectations	- Acclimate child to an airport environment while at home - Familiarity with clothing
Checking-in at airport	- Waiting in long lines and speaking with airport authorities for unexpected periods of time	- Use distraction techniques while in line or in crowds
Passing through security	- Large machines and strange noises	- Physical comfort during stressful moments

	- Passing through machines alone as commands are being given - Daunting and scary experience	through the use of compression fabrics
Waiting for boarding	- Large crowds and loud noises - Difficult to use restrooms alone - Presence of strangers and unexpected crowd behaviours	- Drown out large crowds and loud noises by utilizing sound and light therapy
Seated in aircraft	- Sitting in small and confined spaces for long periods of time - No use of electronics during take-off and landing - Turbulence and other passengers can create stress	- Compression clothing provide comfort in long-haul flights - Tech-integrated clothing removes the need for electronics and can be used during take-off and landing
Disembarking aircraft and waiting for luggage	- Passing through large crowds and long lines to get to luggage - Being “interrogated” at immigration - Presence of strangers and unexpected crowd behaviours	- Drown out large crowds and loud noises by utilizing sound and light therapy - Physical comfort during stressful moments through the use of compression fabrics

Table 3-4 – Potential areas for improvement

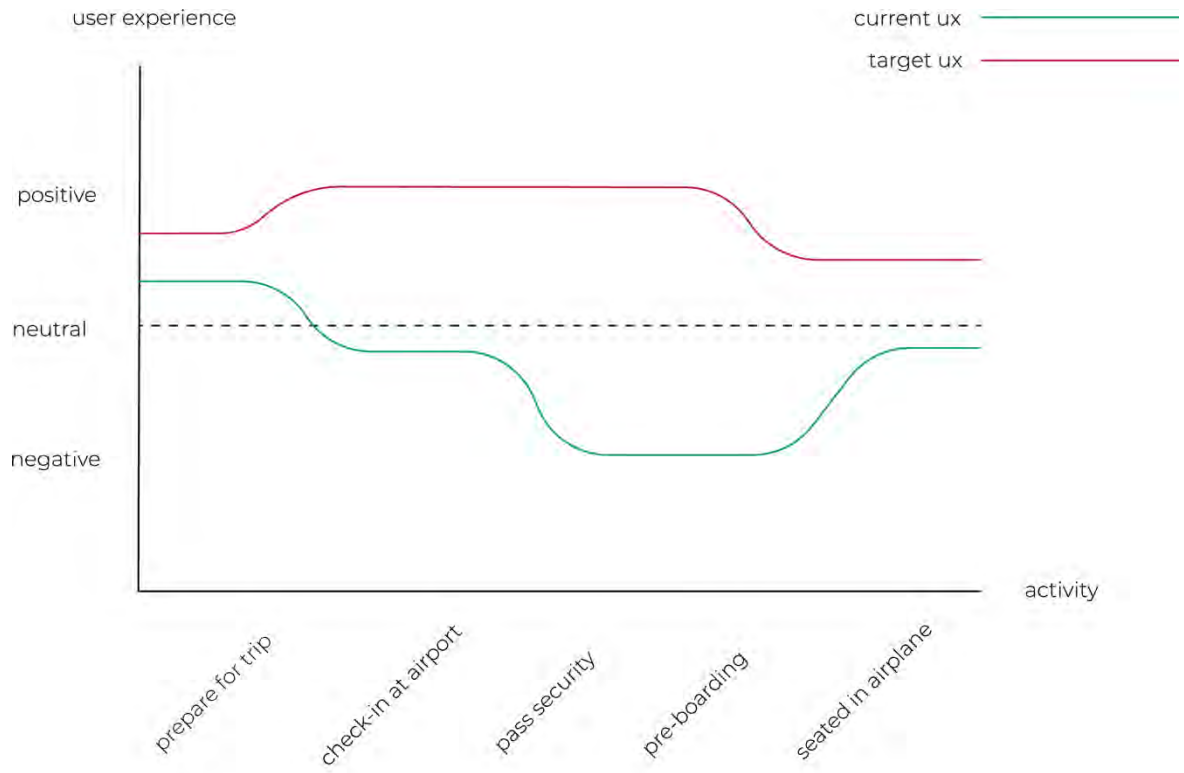


Figure 3-3 – Target User Experience Against Current User Experience

3.3 Usability and Human Factors

For children diagnosed with Autism Spectrum Disorder, air travel can actually be a high risk and anxiety-inducing experience. “The changes in routine, unpredictability, crowds, new noises and sights can all make the experience difficult for people on the spectrum and their families” (Autism Speaks, 2020). In fact, for children diagnosed with ASD and for those concurrently experiencing Sensory Modulation Disorder, there are a great deal of environmental triggers that present themselves at various stages of the journey. This is why clothing, tailored specifically to the needs of children diagnosed with autism, is an innovative yet completely plausible way to deal with the triggers these children may face when travelling.

This report studied the ergonomics involved in designing smart clothing for children with ASD and the complete human-body interaction which make such clothing comfortable to wear for long periods of time and the success of such clothing in mitigating the stress and anxiety that arises in loud and crowded environments.

Literature Review

Anthropometric data referenced in this ergonomic study comes from The Measure of Man and Woman (Tilley & Dreyfuss, 2002). The overall dimensions of 50th percentile female and males will be used for the purpose of this report. Specifically, it will reference and consider various seating variations as well as arm and knee movements to study the ergonomic viability of clothing worn in this specific environment. In this regard, this study will reference Ergonomics and Fashion: The OIKOS Methodology for Usability and Comfort Evaluation in Clothing and Fashion (Martins, 2012).

Methodology

The product solution created for the purpose of this thesis include two individual garments, mainly jacket and trousers. An ergonomic buck was created for each piece of clothing, with special consideration for the hexagonal air channels designed to inflate and provide deep sensory pressure for children under extreme stress and anxiety. The ergonomic buck is also meant to study the fit of each garment, as well as the dis(comfort) brought on by the inflated air channels, pertaining to all "physiological aspects of its wear, the measurements of comfort, the application of textile materials and specially the usability" (Martins, 2012). This ergonomic evaluation with the following objectives in mind.

Objective(s)

The goal of this ergonomic study was to determine the viability of this proposed solution, ensuring that the proposed design features are plausible and do not hinder the overall functionality of the garments, with the goal being to provide full-bodied human interaction design and ergonomic comfort.

Decision(s) To Be Made

The goal of this report was to study the follow interactions relevant to three major body part areas. The purpose of this investigation was to minimize the negative experiences and enhance the positive experiences of:

1. Getting into and out of the jacket and pants

2. Blocking sound when auditory over stimulation occurs
3. Deep sensory pressure when overstimulated through the use of inflated air pockets

Description of Users Targeted by Product

The target demographic for this study includes children between the ages of 6 and 10, both female and male. The demographic used were all located withing the Greater Toronto Area, specifically in South Etobicoke and Mississauga. The children belonged to families earning $50k annual income and were not all diagnosed with Autism Sensory Disorder or Sensory Modulation Disorder but were able to provide critical feedback on the ergonomic considerations of the two garments.

Evaluation process

The evaluation process consisted of designing a full scale (1:1) ergonomic buck of the sensory jacket and trousers, specific to the anthropometric measurements of a 90th percentile female. The following movements specific to the user experience were analyzed during the consideration process for the ergonomic buck:

1. Getting into the jacket and trousers
2. Putting hands into the jacket pockets in the manner intended
3. Putting hands into the trouser packets in the manner intended
4. Providing feedback on the textured surfaces within each pocket
5. Fit and feel of the garments with the inflated air pockets (for the purpose of this study, air pockets were stuffed with filling to mimic the act of inflating with air)
6. Zipping up hoodie to create a noise-blocking and insulated cocoon
7. Removing jacket and trousers

Description of User Observation Environment Used in this Study

For the purpose of this study, and due to the nature of provincial restrictions during a global pandemic, the user observation environment was limited to the participant's home. An environment similar to that of an airport or airplane could not be reconstructed, but the participant

was required to complete the entire list of functions to best understand the ergonomic viability of the proposed design solution.

Location and Timeframe

Date of Observation(s): January 12 – January 15, 2021

Location of Observation(s): Minto Long Branch Community

Ergonomic Diagrams

This study benefitted from the construction of a schematic layout, utilizing vector diagrams to demonstrate anthropometric measurements for both the 5th percentile and 95th percentile male youths purpose of this ergonomic analysis. The results below display measurements shown in inches.

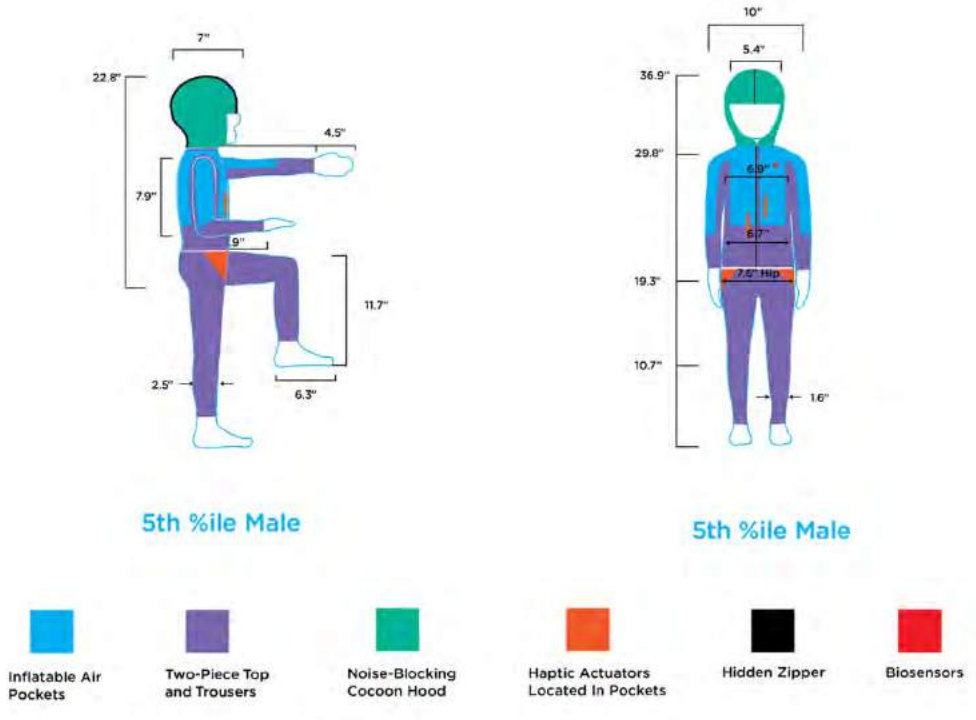


Figure 3-4 – Product Schematic Diagram

The schematic layout shown below demonstrates the proposed design solution for the purpose of this ergonomic analysis. The results below display measurements shown in inches.

These 5th percentile measurements account for the smallest measurements found in our target age group of 6 to 10-year-old. At the age of six, both male and female children of the 5th percentile have similar, if not the same measurements. For the purpose of this study, male measurements were utilized for ergonomic analysis.

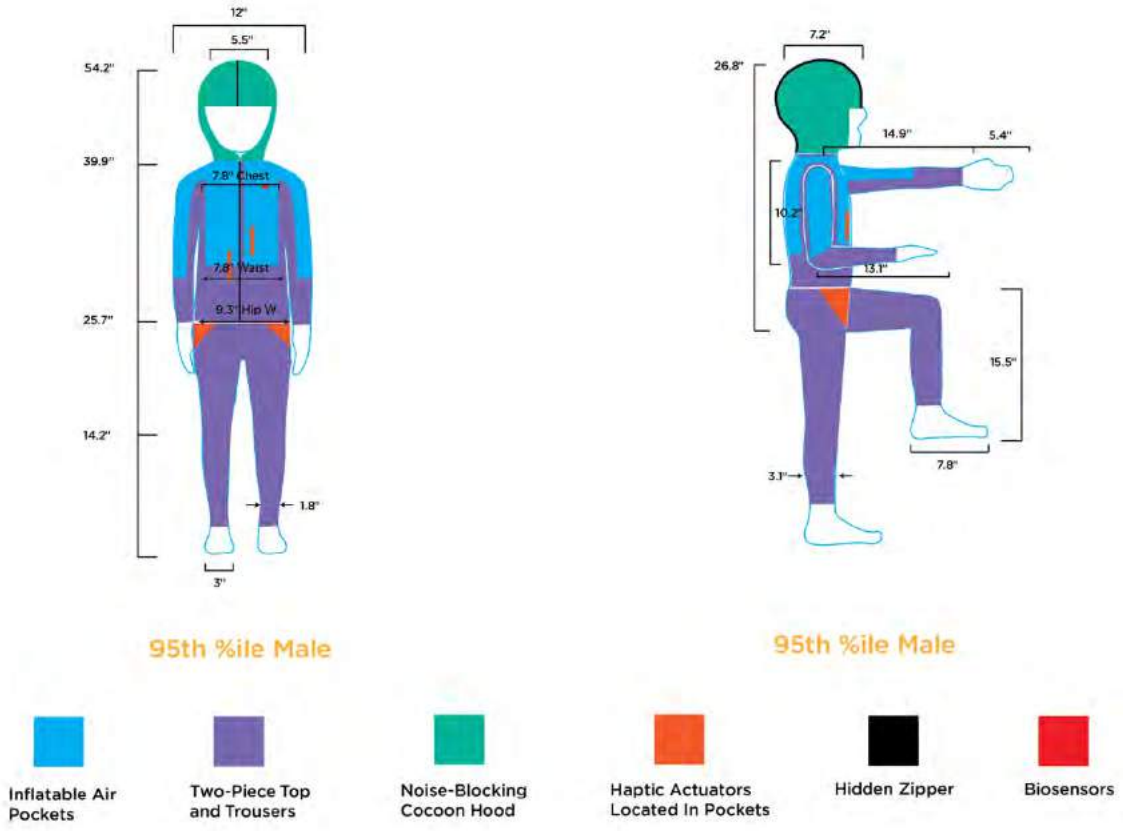


Figure 3-5 – Product Schematic Diagram

Similarly, for the 95th percentile, male anthropometric measurements were again used because they account for the largest size for youths (both male and female) aged 10. The schematic diagram represents the features intended for the proposed design solution. The purple represents the two garments, a jacket and both trousers. The blue identifies the location of

inflatable air pockets, intended to provide deep sensory pressure to children when inflated, mimicking the feeling of a hug without the social touch that many do not prefer. The green represents the noise-blocking, insulated cocoon-like hoodie which, when zipped up, covers the child's eyes so that they can find some visual and auditory relief in stressful and chaotic environments. The colour orange, lining the strategically placed pockets, represent vibrotactile actuators placed within the interior fabric of each pocket. The intent is for the child to place their hand within their pockets and receive regulated haptic pulses when they're experiencing sensory overload. These regulated pulses, along with an internal fidget allow the child some relief from their environment.

Ergonomic Buck User Observation

Figure 3-5 and 3-6 – Ergonomic Buck

Figure 3-7 and 3-8 – Ergonomic Buck

Analysis

The user testing with the ergonomic buck provided valuable feedback regarding the proposed design solution. The ergonomic buck was created using the 50th percentile measurements of a 10-year-old youth. The schematic configurations shown above represent both the 5th and 95th percentile measurements of a male youth, validating the idea that the proposed solution fits the entire target age group of 6 to 10-year-old. This user testing was conducted on a participant, who was not willing to have their photo taken. Due to the restrictions, the ergonomic buck could not be tested on more individuals, hence, the images shown below show the ergonomic buck worn by a user not represented in the 50th percentile measurements simply for the purpose of showing the ergonomic buck in use.

The purpose of this ergonomic analysis was to observe the 1:1 scale proposed design in its environment and to be tested the intended user. In this case, the user is a child between the ages of 6 and 10 who is diagnosed with Autism Spectrum Disorder and Sensory Modulation Disorder. Due to the restrictions presented by the global pandemic, the analysis was unable to be conducted on a child with ASD, especially one who is sensory-seeking or sensory-avoiding. As an

alternative, a child in the 95th percentile, aged 10, was asked to participate in the observation and ergonomic testing. Furthermore, this proposed design solution is intended to be used in an airport environment, designing for the various challenges that present themselves at the different airport checkpoints. Children with ASD or SMD are not fully equipped to deal with the overstimulation that may occur in large crowds and noisy spaces. Due to the restrictions presented by the global pandemic, the ergonomic buck was not tested within an airport or airport-like environment, hence, the environment could not be fully recreated at home.

The goal with the ergonomic buck was to perform a garment test fit using the participant's (95th percentile) anthropometric measurements. It was imperative that the participant have complete mobility while donning the clothing and be able to put on and take off the garments with ease. A primary goal of the ergonomic buck was to test the comfort of the garments with inflated air pockets. Given the limitations in the making of the buck, smaller cushions filled with polyester stuffing were used to simulate the air pockets and attached to the interior of the garment, allowing the user to "feel" the deep sensory relief in lieu of the air channels. The ergonomic buck was also limited in the materials used, however, another important objective in its testing was to understand and validate the overall human factors design especially with regards to the sound-blocking, cocoon-like hood. While the materials were subbed for a more cost-effective fabric, the goal was to test the overall design of the hood along with the user experience. A step-by-step analysis follows below.

Step 1 - Donning the Garments

This step was fairly simple, most children are familiar with donning a garment and do so every morning before they start their day. The simple design represented in this ergonomic buck was fairly straight forward. The participant began by donning the trousers. Some adjustments had to be made to the belt, tightening it slightly to accommodate the user's measurements. The final design solution with have an easy to wear to feature so that the user faces no challenges in wearing and adjusting their trousers. While this feature isn't defined, it may be in the form of an elastic waistband that grows with the user, or simple button mechanism for children with limited dexterity. The ergonomic buck did not reflect this feature as the intent was not to validate this concern.

Step 2 - Testing the Air Channels

Due to the limitations of the ergonomic buck, the air pockets had to be simulated within the garment using fabric stuffed with a polyester filling. This “cushion” was approximated to be the depth and size of the air pockets when inflated and were inserted into the interior of the jacket, mimicking the inflated air channels. The goal of this ergonomic analysis and particular feature within the ergonomic buck was to understand and validate the fit and feel of the garment once inflated. While actual air pockets could not be used for the purpose of this ergonomic analysis, the participant was comfortable with the simulated pockets when wearing the jacket and had complete mobility. The participant agreed to feeling some sensory pressure that mimicked a hug. Future refinements can benefit from testing this ergonomic buck on a participant diagnosed with Autism Spectrum Disorder and to be worn for a longer period of time so that the parent can monitor the behaviour and emotional output of the participant.

Step 3 - Positioning of Pockets

The positioning of the pockets was important, as it provides the user with sensory relief and mimics the act of a hug, without the uncomfortable social touch that many sensory-avoiding children do not desire. It was important that the ergonomic analysis validates the positioning of the pockets as it changes when the garments are graded. Grading the process of sizing the clothing and involves a change of measurements to adjust to the various sizes (xs-xl is the standard). The process of grading would accommodate the various ages and measurements of the target user but would affect the positioning of the pockets according to the size. In this user observation with the ergonomic buck, the participant was able to comfortably utilize the pockets. Due to the limitations of the buck, the pockets were not lined with textured and soft fabric nor did it include a sensory fidget for the child, or the vibrotactile actuators.

Step 4 - Donning the Hood

This step involved the participant zipping the hood to create a sound-blocking, cocoon-like environment. The participant required some help locating the flattened and unzipped hood on their back along with the zipper. Once the zipper was in their hands, they were able to seamlessly bring

the panels forward to create a complete visual and auditory-deprived cocoon. Unfortunately, the limitations of the ergonomic buck meant that the fabric was not sound blocking, nor did it provide some visual relief for the child with the foldable panel that covers the eyes. This had to be simulated using excess fabric, but the participant was satisfied with the feature.

Step 5 - Removing Garments

This was also a simple step, given that the participant, and the target user are familiar with this particular interaction point. In this study, the participant began by unzipping the hood and laying it flat on their back. This step provided a small challenge, i.e. the zipper used in this particular ergonomic buck was small and difficult for the user to find with their hands above their forehead and with no visual aid. This particular user interaction can benefit from further development and refinement of the concept. This may require further research into different fasteners and what is appropriate for the target user to independently and comfortably use. Removing the garments required little effort. The participant simply unzipped the jacket and removed as typically done. They then removed the trousers as is typically done.

Limitations and Conclusions

Some of the limitations identified during this ergonomic analysis include:

- The participant involved in this observation did not belong to the percentile that this ergonomic buck was designed for, hence, there were challenges with certain measurements that were unavoidable.
- There were limitations to the construction of air pockets designed into the sensory jacket. The alternative was to mimic the air pockets using polyester filling, which does not provide the actual sensory experience of that air pockets do.
- Other limitations include the material considerations which do not align with the materials used in the making of this ergonomic buck.
- The lack of tech integration led to the participant unable to fully experience the regulated haptic feedback for a complete sensory experience.
- Lack of sewing experience and limited resources available during the pandemic led to an ergonomic buck which did not fully represent the sound-blocking cocoon-like hood.
- Due to the restrictions put in place during the pandemic, the ergonomic analysis was limited in the participants involved, so the design solution could not be tested on participants diagnosed with Autism Spectrum Disorder or Sensory Modulation Disorder.

In conclusion of this study, the participant observation aspect was successful in validating certain claims and concerns arising from concept development. The ergonomic buck allowed this study to validate the ergonomic dimensions and design aspects that would otherwise be unfulfilled. The ergonomic buck also answered some key questions that were raised during the period of concept development, allowing the proposed solution to make the appropriate changes in order to better the user experience and refine the proposed concept.

Some Ergonomic Issues That Are Still Not Yet Resolved

The ergonomic buck was limited in the feedback and testing that could be done around the material considerations of sound-blocking fabric and the blackout cocoon-like environment provided by the hood. Similarly, the internal fabric and outer fabric materials were not completely represented in the ergonomic buck. There are further opportunities, when considering material sustainability, to hone in on specific textiles appropriate for this design solution. Additionally, there are more opportunities to study the ergonomic issues around the rate of inflation within the air pockets and how that might affect the user experience. This is an area where little could be done due to the limitations of creating the ergonomic buck and performing the observation at home. Therefore, there are still opportunities to address these challenges through further design refinement.

Alternate Possibilities for The Future

Alternate possibilities for the future include the following:

- A refined mock-up of the ergonomic buck with a simulation of air pockets and automatic inflation, to better understand the user experience it provides
- Creating a secondary ergonomic buck with final material considerations
- Expanding the observation phase to test the ergonomic buck with children diagnosed with Autism Spectrum Disorder in order to understand their sensory needs and relief

This study was helpful in identifying some of the key challenges to the proposed solution and helped refine the features in real-time with the feedback provided by participants in the user observation phase. While there were many questions that were answered through this ergonomic analysis, the limitations of creating an ergonomic buck at home due to the pandemic provided more opportunities for design refinement in the future.

3.4 Aesthetics and Semantics Profile

The process of benchmarking and viewing the aesthetics and semantics presentation of existing products helped to narrow focus on the design of the final solution. Perhaps the most crucial takeaway from the study of benchmarked products was the need to stick to neutral, darker and cooler tones that are often found in existing sensory products. These colours are not overwhelming for the child wearing them and do not cause over stimulation as the brighter and warmer colours do.

There was also a need to incorporate tactile features, something that is often missing from sensory clothing and leads to children looking for tactile stimulation elsewhere. An important takeaway from the study of aesthetics and semantics within benchmarked products was their rudimentary, non-childlike design. Compression clothing is very minimalist in nature so that it could focus on its functionality. However, sensory clothing like weighted garments is rudimentary in its design, often seeming like they are designed for seniors and not children. They don't incorporate the fun elements of design that children are drawn to, focusing on the functionality with little on the form. However, appealing to your target audience is a crucial part of any design consideration. By designing for children, this design solution will have greater appeal compared to other products in the same category.

3.5 Sustainability – Safety, Health and Environment

The purpose of designing adaptive clothing for children diagnosed with Autism Spectrum Disorder, is to create clothing, which is comfortable for the user to put on, take off and function when wearing. The intent is to create a sensory friendly experience, a cocoon-like environment for the child to wear and escape within when confronted with environmental stressors.

Health

Health and comfort are fundamental to the functionality of sensory-friendly and adaptive clothing and the proposed design features rely heavily on providing a comfortable user experience for the child. Crowded and busy airports create an environment full of triggers and stressors for a child with ASD. The goal of this proposed design is to minimize the reaction a user may have to

these triggers by providing a comfortable experience through adaptive clothing, designed for each of these triggers. This includes a seamless interior within the garment, with heat bonded construction for flat hems, replacing buttons and zippers with invisible magnetic strips, placing pockets further up front for each access while sitting, using insulated acoustic fabrics within the construction of the hood to create a sound-blocking experience and placing haptic sensors within the pockets for the user to receive regulated sensory feedback. These features are designed to improve the overall health and comfortability of the user, validating the notion that a busy and crowded airport can be a stressful environment for someone diagnosed with ASD.

Safety

In addition to health and comfort, the user's safety is a fundamental consideration in the proposed design solution. With the understanding that the user is a minor, often accompanied by a guardian when travelling, the goal of this design is to create sensory friendly clothing which is safe for the user to operate. A handheld air pump, located in a discreet pocket and attached to the interior air pockets can be removed for the garment and manually operated by the user, either child or adult. The handheld air pump is simple in its design, using textured surfaces to provide a tactile sensory experience for the user as they operate the air pump. Similarly, the guardian can monitor the child's health using biometric data which measures and collect the child's heart rate and temperature.

3.6 Commercial Viability

The fashion industry has made great strides in the past decade to propagate and bring into mainstream ethically made and sustainably sourced clothing. Research into non-toxic fabrics and alternative manufacturing methods has changed the way we consume clothing and discourse around it's end of life cycle. Sustainability is beginning to take shape within the fashion industry as more and more brands turn to ecofriendly clothing and calls for greater transparency in their manufacturing processes. Even so, adaptive clothing catered to the needs of an individual with ASD has a long way to go in terms of innovation in design as well as sustainable materials and manufacturing processes.

3.6.1 Materials and Manufacturing Selection

Adaptive clothing, which is designed to increase comfort and mobility for its wearers, can be made from a variety of materials. They're typically designed around the user's sensory needs, utilizing soft materials and special fabrics in the construction and design of the garment. Children's clothing also utilize a variety of materials, many of which are beginning to incorporate ecofriendly fabrics and consider end of life cases. Such fabrics include linen, cotton, and bamboo. These materials are chosen for their durability, breathability, antimicrobial properties and ability to biodegrade. Some non-eco-friendly fabrics still used in the design of children's clothing include fabrics made of polyester, acrylic and often leather. These fabrics are not considered sustainable because the former are synthetic fibers made from petroleum that require the use of toxic chemicals and a lot of energy to create. They are also incapable of biodegrading (Mayhead, 2018).

The proposed design solution in question looks to achieve its function while maintaining sustainability at the core of its design. The exterior of the garment utilizes a lyocell and organic cotton blend, a staple eco-friendly fabric known for its durability and longevity. It is breathable, lightweight, absorbent, and antimicrobial. It requires no pesticides or fertilizers to mill and most importantly, it is biodegradable (Mayhead, 2018). Similarly, the inner seamless garment which is designed to come into contact with the user's body is constructed from ecofriendly viscose, combined with 27% nylon and 5% spandex for stretch. Ecofriendly viscose, which is manufactured using the lyocell process, produces little waste products and is considered far more ecofriendly than its traditional manufacturing counterpart. Viscose, in this form, combined with the nylon and spandex is a breathable fabric which doesn't trap body heat, making it ideal for an inner seamless garment. It is highly absorbent, relatively light and soft and comfortable for the user to wear.

A core component of this proposed design solution are the inflatable air pockets contained within the garment. Fabrics typically used in technical clothing to create jacket linings or thermal jacket shells utilize polyesters which are synthetic and not known to be sustainable in their production and end of life. This proposed design solution will, in turn, use 100% GRS recycled polyester taffeta with a fabric weight of 38 gsm (Vivify Textiles, 2020). The design of the handheld air pump includes the use of natural rubber, harvested in the form of latex and treated to create a non-toxic and flexible material. Natural rubber is safe for children to use and play with, it is flexible and soft, and has little impact on the environment during harvesting, sourcing and

manufacturing. It can be continuously recycled, and a rubber tree can be replaced with a new sapling when reaching its end of life.

The fashion industry's larger manufacturing processes have come under spotlight for their questionable labour practices and unsafe working conditions. Children's clothing, both traditional and adaptive, are made in factories around the world, depending on the company, often by individuals and even children paid little to nothing. In recent years, there have been calls for greater accountability and transparency by corporations, drawing attention to the social aspect of sustainability in fashion.

With that in mind, the proposed design solution aims to manufacture locally in North America, partnering with factories that employ ethical labour and have as little impact on the environment through their production processes. One of the ways to tackle this is through the fabric dyeing process. Most traditional dyed contain harmful chemicals and vast amounts of water to process. During the dyeing process, much of the dyed wash out and pollute rivers throughout the developing world. In fact, even white fabric which is often bleached releases dioxin in its bleaching process, "a chemical that the US Environmental Agency says can cause cancer and damage bodily systems" (Cowles, 2020). A greener alternative is to go the natural route or use low impact dyes. These are derived from plants, insects or animals and contain no toxic chemicals and require less water to process (Cowles, 2020).

3.6.2 Cost

The cost of adaptive clothing for children with special needs can vary greatly, depending on the garment. Compression clothing, often used by children with ASD ranges anywhere from $20 USD for simpler garments, to $100, for adaptive clothing with greater functionality. In order for this design solution to be a viable product for children with ASD, it needs to be appropriately priced for the market. To balance accessibility with sustainability in the clothing industry is a challenge, however, this design solution aims to find a middle ground in terms of price point.

3.7 Design Brief

The overall goal of this design thesis is to mitigate the stress and anxiety that may arise from being in an uncomfortable environment, in particular, the various environments within airport as

perceived by a child with ASD. The following list of ten objectives will be used to create the final design solution.

1. Mitigate the stress/anxiety that may occur from being in large crowds at the airport
2. Mitigate the stress/anxiety that may occur from being exposed to loud noises at the airport
3. Eliminate the need for various electronic devices carried on flight
4. Integrate deep pressure input to expose children to tactile and proprioceptive sensory input
5. Monitor child's vitals and moods to predict changes in behaviour
6. Ensure the garment grows with the child's physical and ergonomic needs
7. Ensure the product is comfortable to wear for both long and short travel periods
8. Ensure the product can be easily worn and taken off
9. Improve the aesthetic appeal of wearables for children with ASD
10. Incorporate sustainable materials in the final design solution

CHAPTER 4 – Design Development

The following chapter focuses on the final design for the adaptive and sensory-friendly clothing. It looks at the entire design process, from the initial stages of mind mapping, to the ideation process, detail development and lastly, the final concept along with the building of the physical model. This chapter goes through the design process, utilizing various methods like concept sketches, imagery and other visual mediums.

4.1 Idea Generation

4.1.1 Aesthetics Approach

A series of inspiration boards were created, pulling imagery from platforms like Pinterest and Behance to inform the styling direction, branding and concept development of the adaptive and sensory-friendly apparel. These inspiration boards also helped benchmark in the areas of aesthetics and visual philosophy, creating a composition that represents the design intent.

4.1.2 Mind Mapping

At the start of the design process, a mind map was drawn to understand the wider scope of the problem area. This phase was divided into five branches: mainly, ergonomics, user, materials, challenges and technology. This mind map was integral in the design process as it paved the way towards the final design solution.

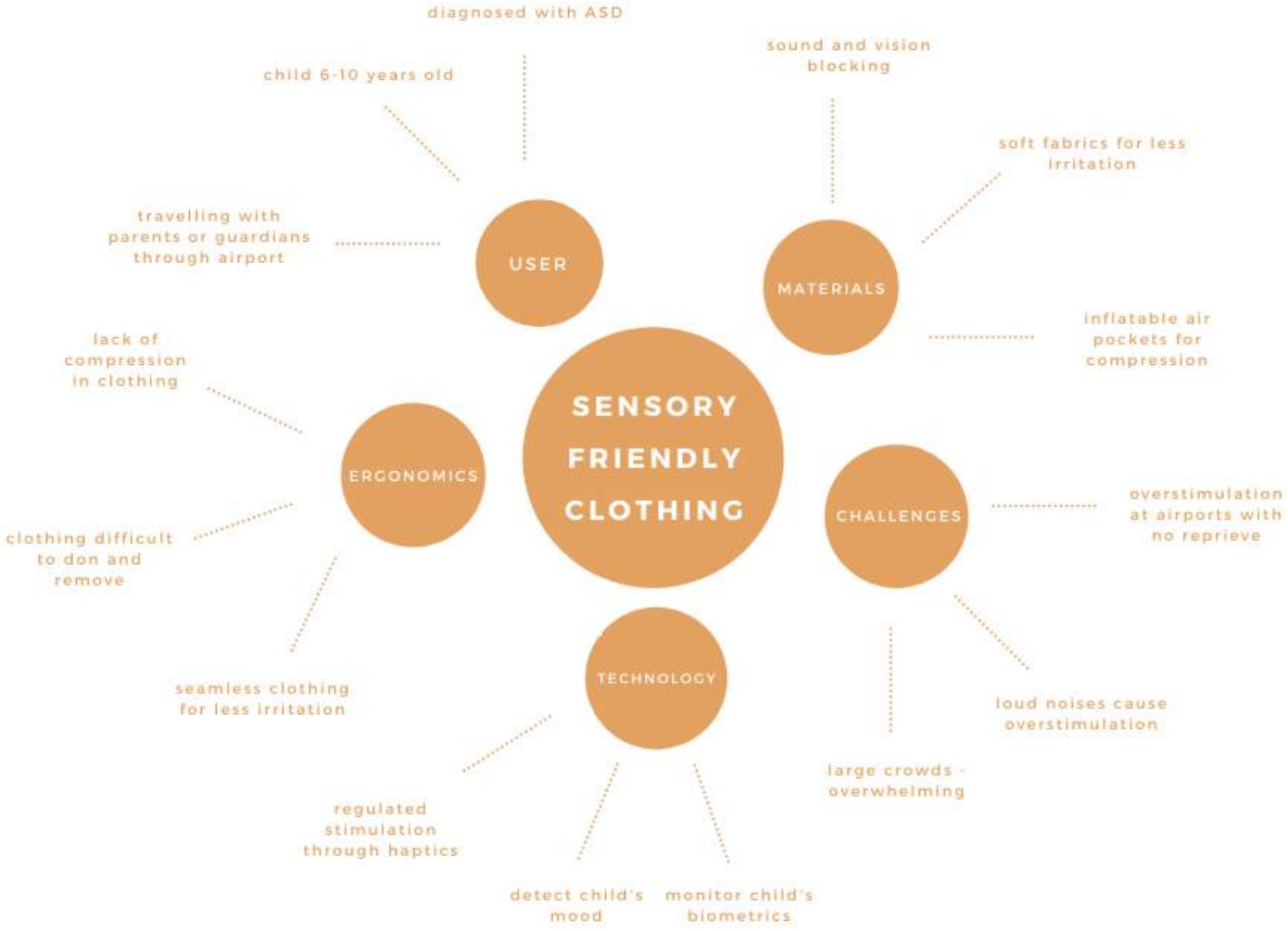


Figure 4-10 – Mind Mapping Diagram

4.1.3 Ideation Sketches

The design process began its early stages through an exploration of initial ideations. This included a preliminary probe into airline interiors and the experience of walking through an airport, from the perspective of a child with ASD. These ideation sketches explored a variety of

concepts in the form of carry-on luggage, modified seating in airplanes, as well as personal electronic devices. These sketches can be seen in detail below.

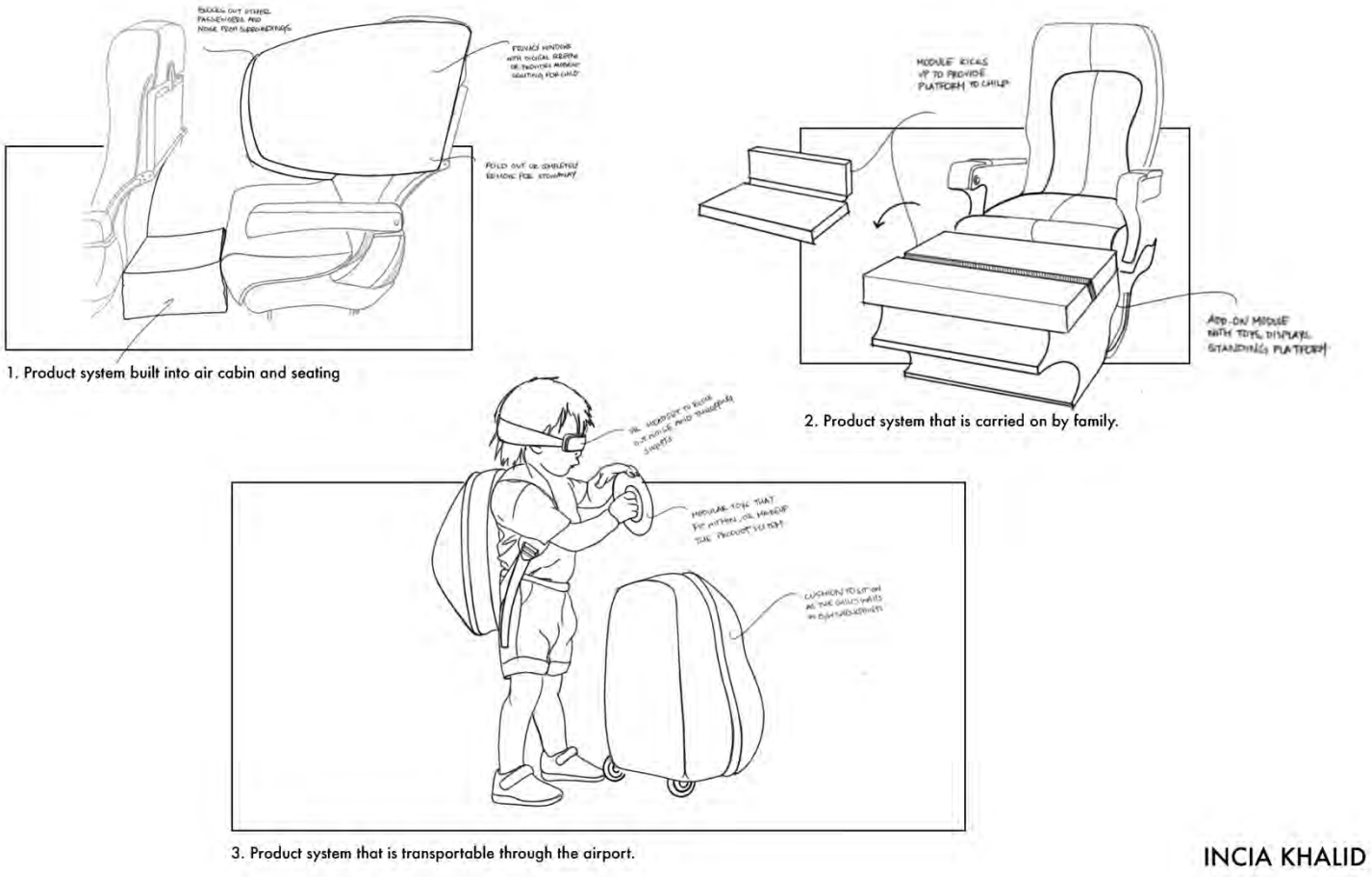


Figure 4-11 – Ideation Sketches

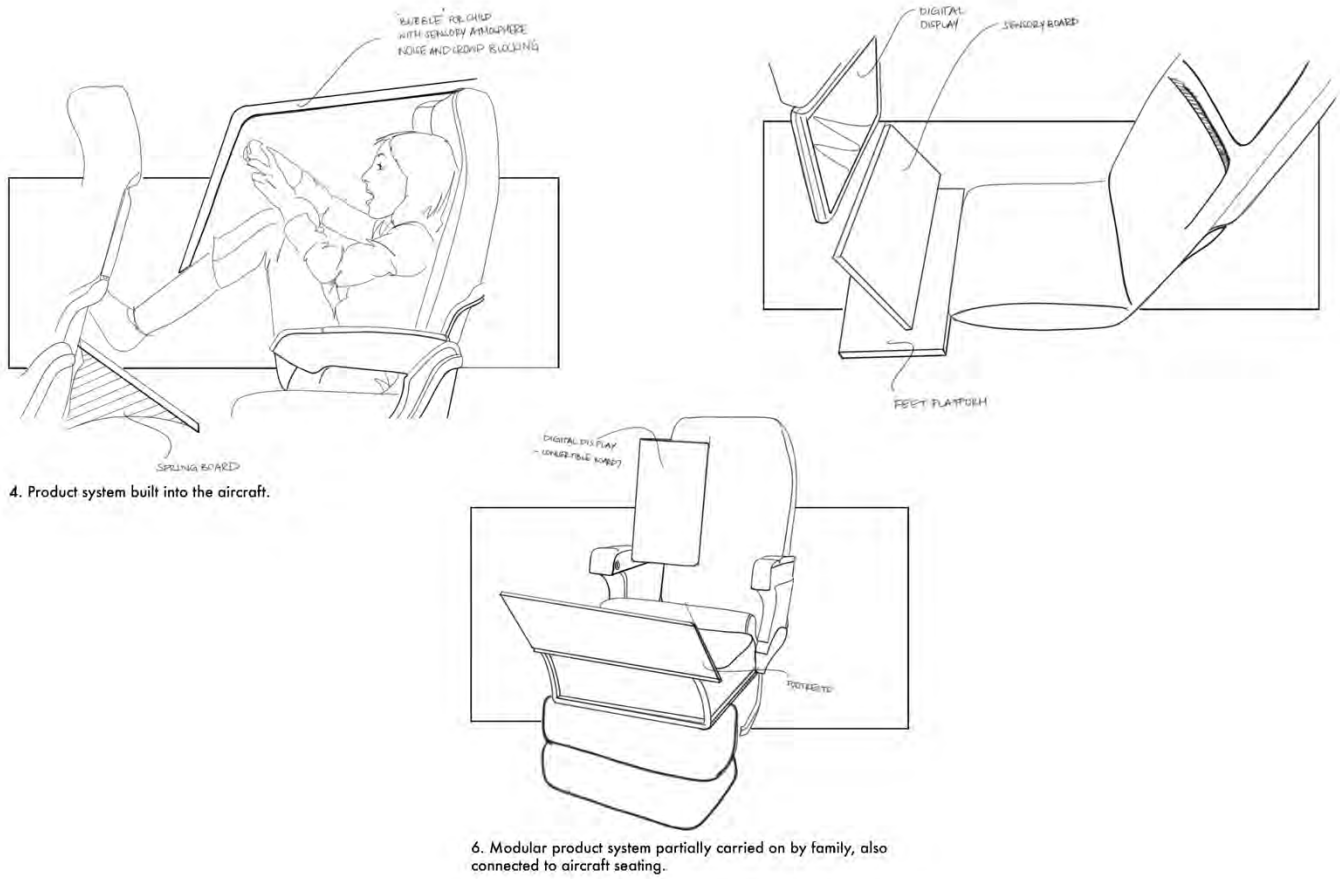


Figure 4-12 – Ideation Sketches

4.2 Preliminary Concept Explorations

The preliminary ideation sketches were then expanded upon to explore these concepts further. Through a series of sketches, the sensory challenges experienced by children with ASD, when going through the various stages of air travel, were visualized and tackled to create adaptive and sensory-friendly clothing. The sketches below show some exploration into various technologies that can be utilized to monitor a child's biometrics, provide regulated stimulation through sensors as well as compression throughout the clothing. At this stage, the concept also

began to explore other features that tackle stress-related challenges such as auditory and visual overstimulation in large crowds and loud environments.

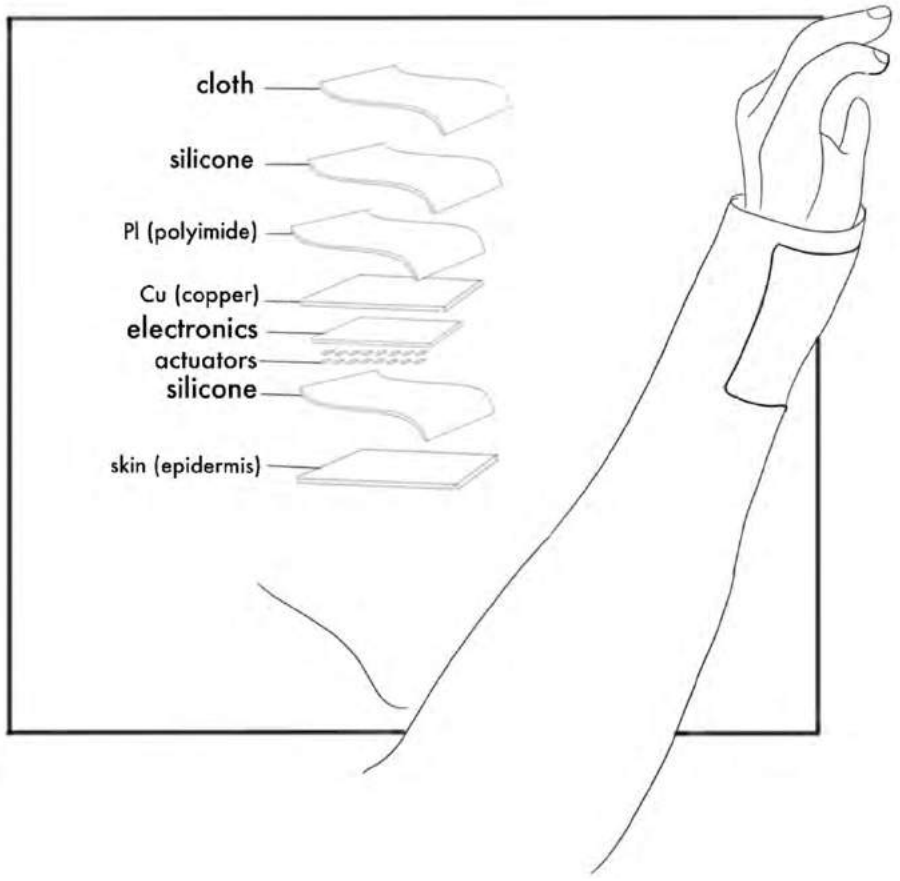


Figure 4-13– Preliminary Concept

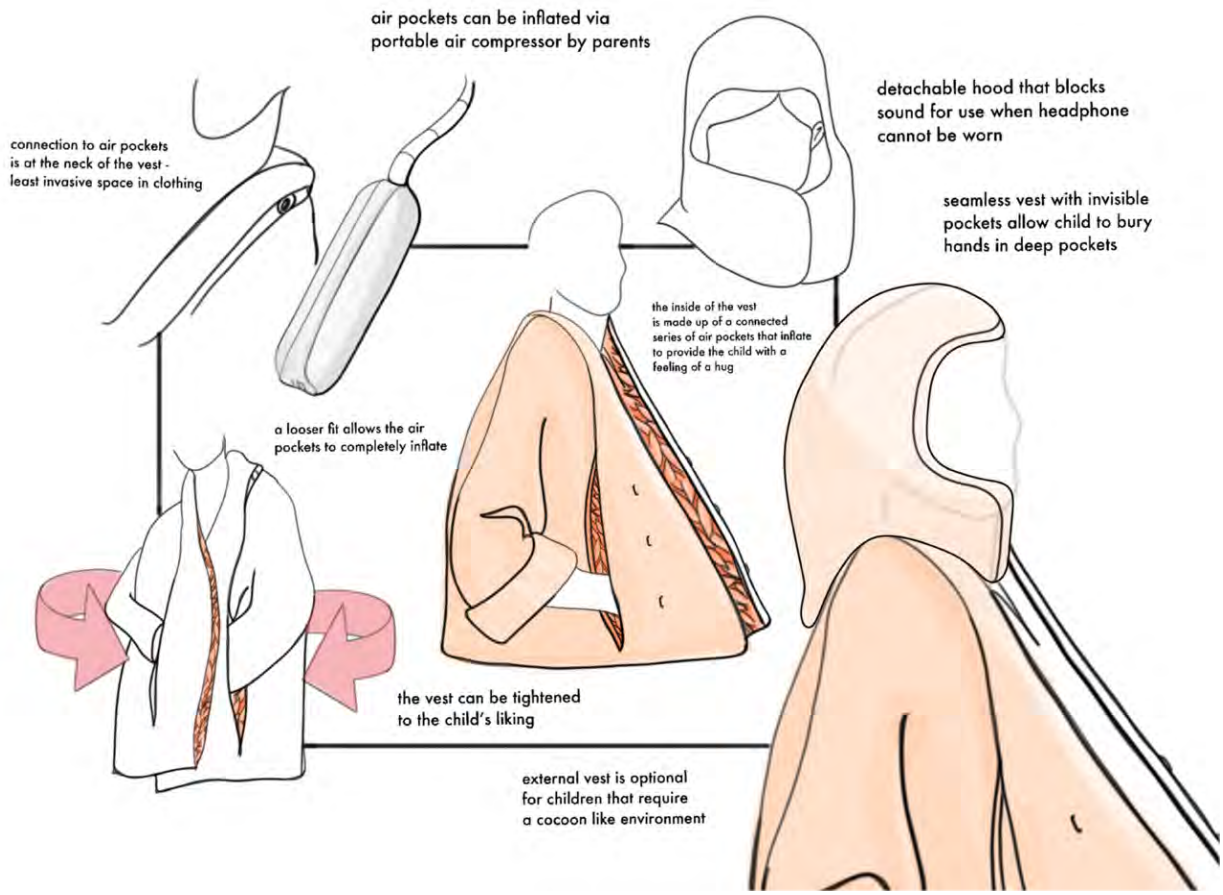


Figure 4-13 – Preliminary Concept

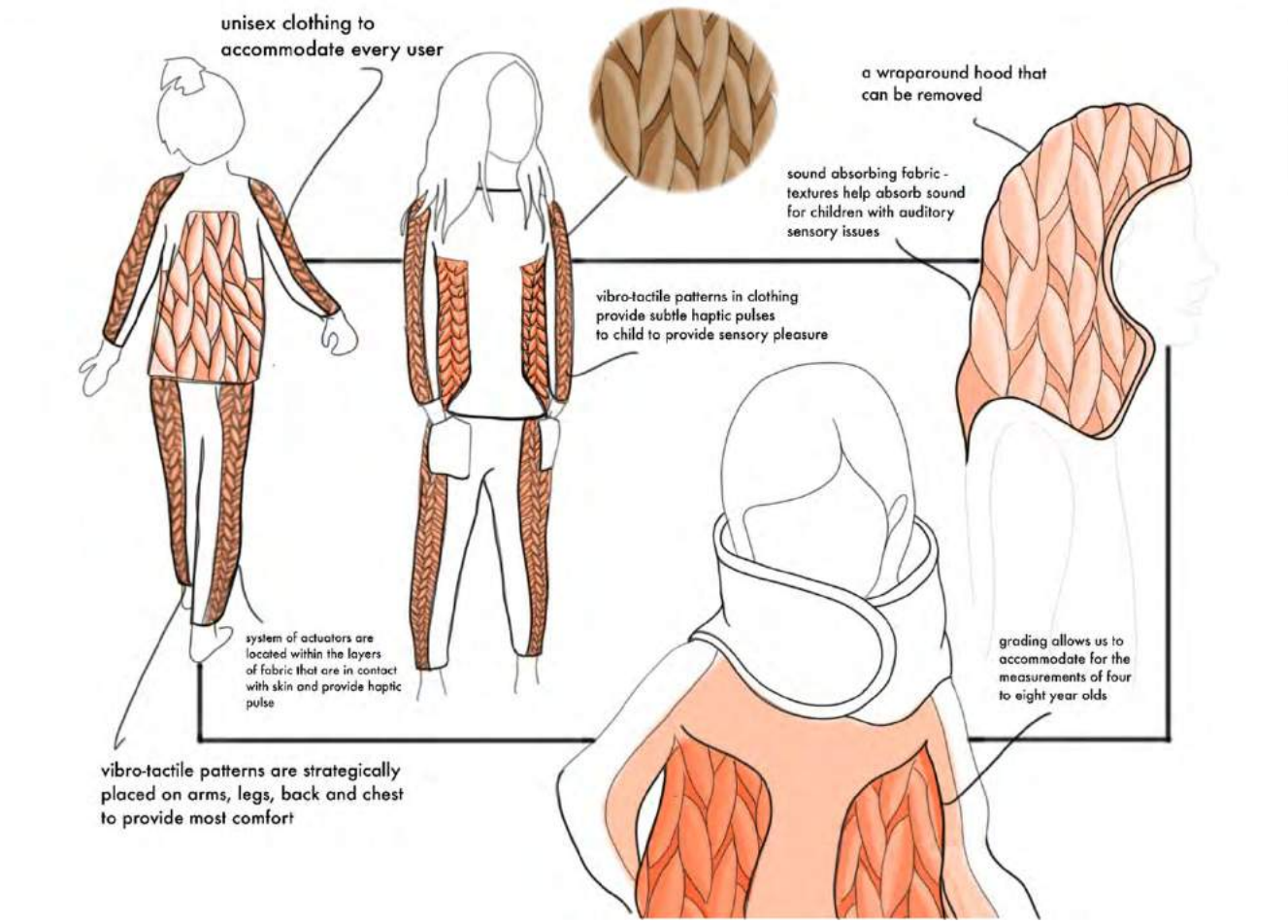


Figure 4-14 – Preliminary Concept

4.3 Concept Strategy

The earlier concept exploration helped inform the direction taken towards sensory-friendly clothing for children with ASD. A schematic layout was created to help understand the various configurations and hone in on the design features crucial to each concept. These layouts can be seen in detail below.

Location of These Components

1 Sensory and tactile patches

2 Compression fabrics

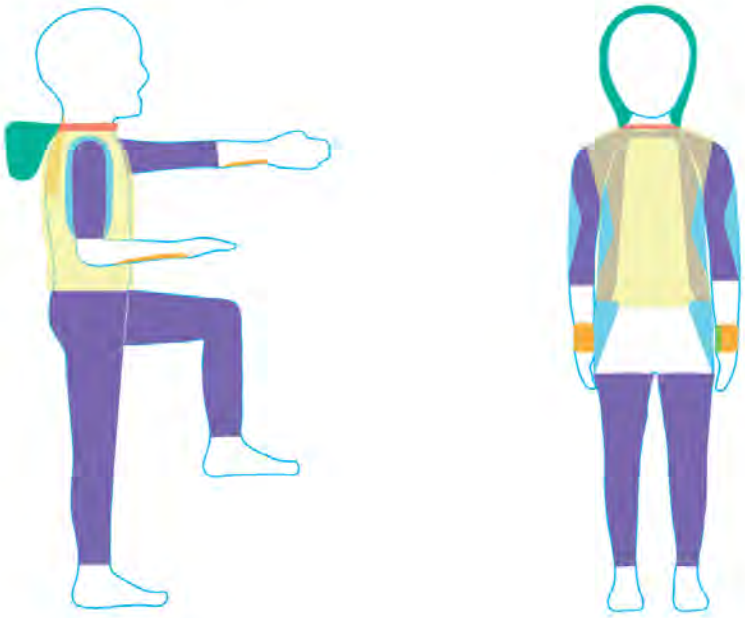
3 sound-blocking hood

4 biometric tracking

5 system of actuators

6 cushion and padding

Product Schematic 1



Location of These Components

1 Sensory and tactile patches

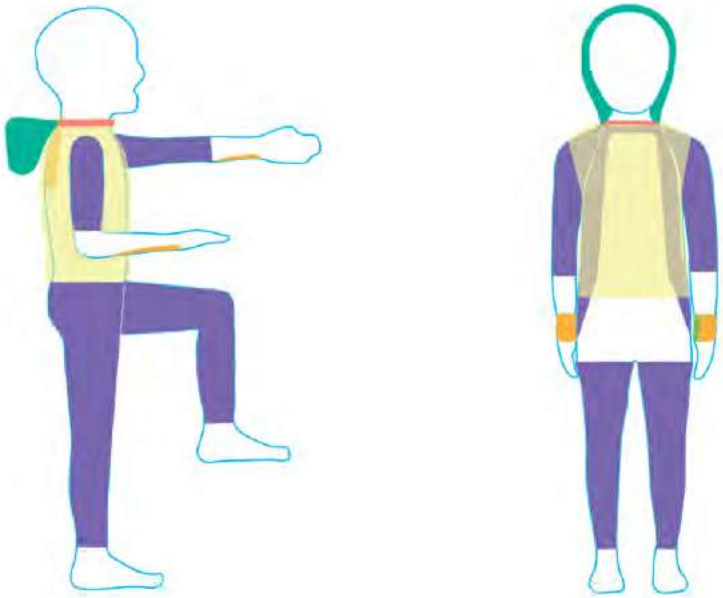
2 Compression fabrics

3 sound-blocking hood

4 biometric tracking

5 system of actuators

Product Schematic 2



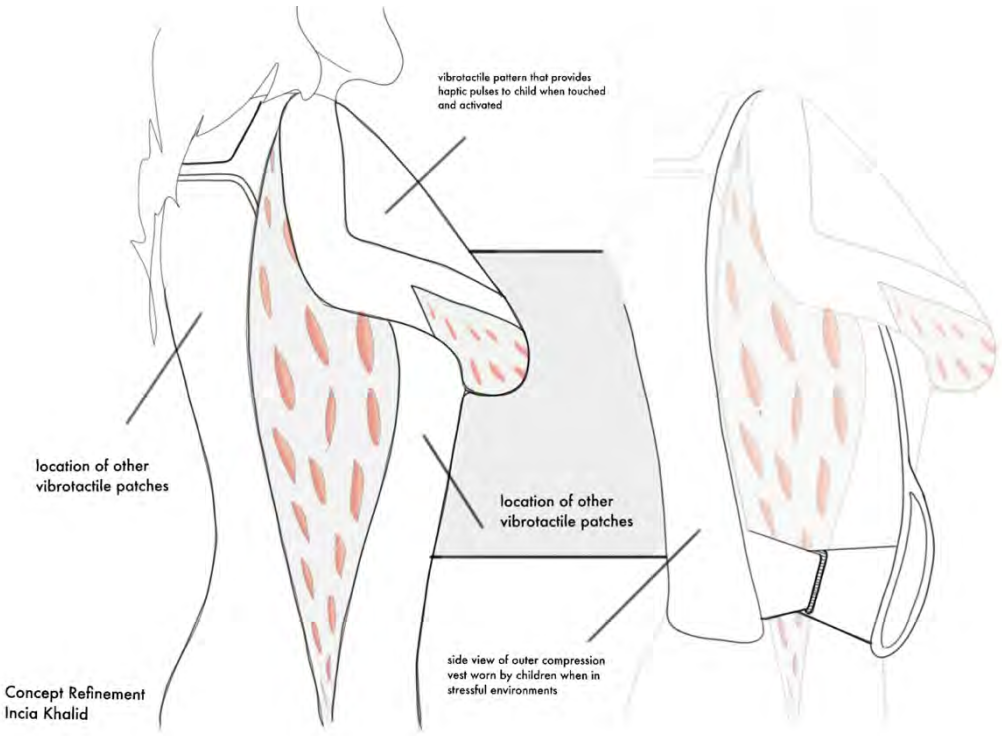


Figure 4-16 – Refined Concepts

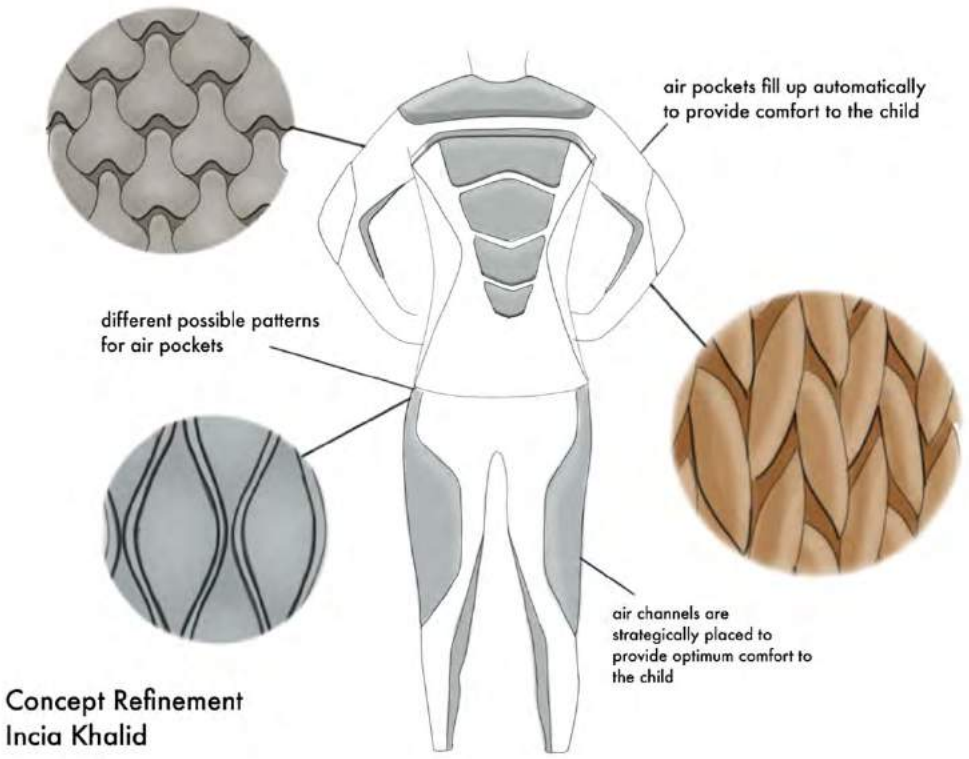


Figure 4-17 – Refined Concept

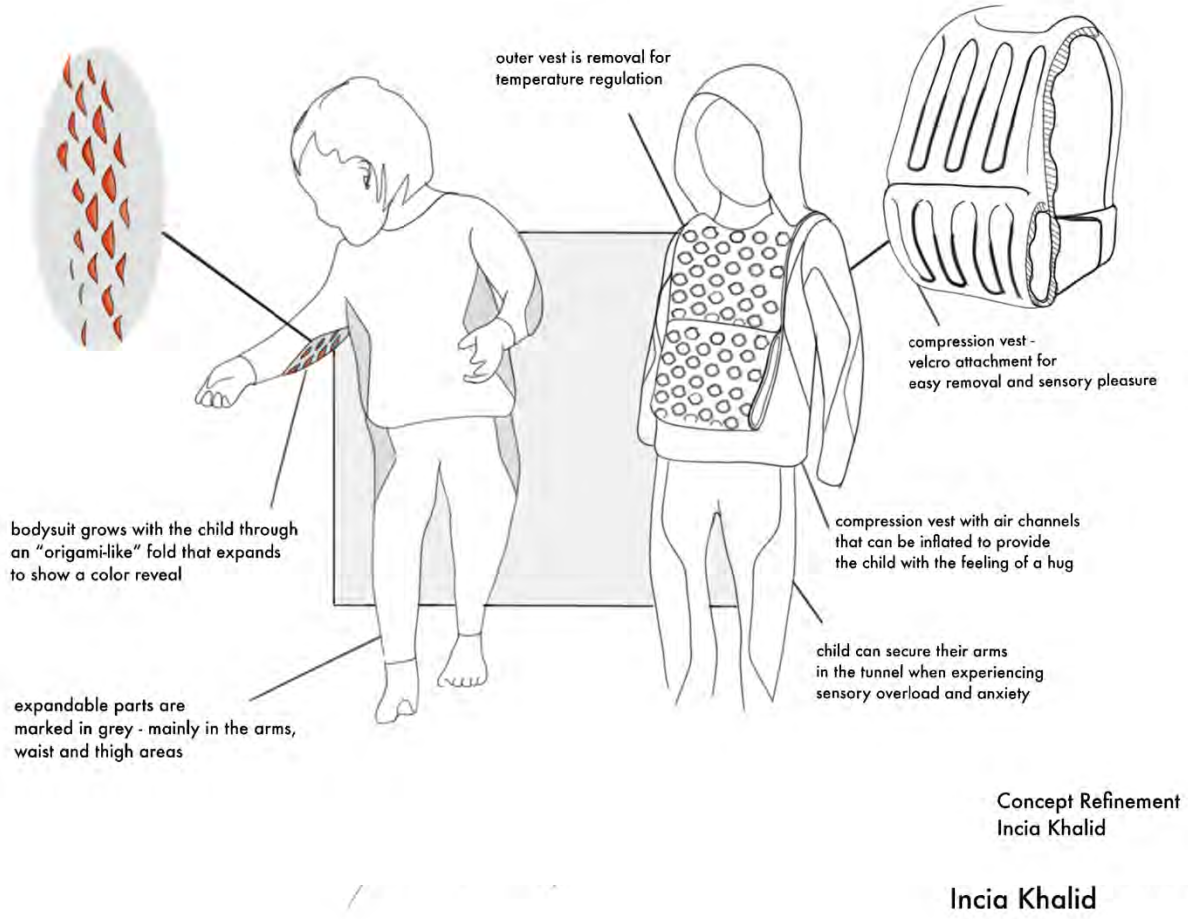


Figure 4-17 – Refined Concept

4.5 Design Realization

4.5.1 Physical Study Models

A full-scale model was created to help with the final design of the sensory-friendly clothing intended for children with ASD. The full-scale model was built primarily to assess the ergonomics and determine the dimensions for the clothing, meant for children aged 6-10. The full-scale models consisted of two individual garments, mainly jacket and trousers. This was created for each piece of clothing, with special consideration for the hexagonal air channels designed to

inflate and provide deep sensory pressure for children under extreme stress and anxiety. The physical model was intended to study the fit of each garment, as well as the dis(comfort) brought on by the inflated air channels, pertaining to all “physiological aspects of its wear, the measurements of comfort, the application of textile materials and specially the usability” (Martins, 2012).

side view of the placement of stitching for air pockets in the arms

placement of pockets to visualize child "hugging" themselves while using the sensory

placement of stitches defining air pockets on the back of the jacket.

placement of stitches defining air pockets on the back of the jacket.

placement of stitches defining air pockets on the back of the jacket.

Figure 4-18-25 – Physical Model Study

4.5.2 Product Schematic

The physical study models were created in tandem with refined product schematics. This new configuration aligned with the final design direction, helping to understand the final design features, and their location on the adaptive and sensory-friendly clothing. This new schematic can be seen in detail below, along with anthropometric data for a 5th percentile and 95th percentile male. These measurements were chosen because, at this specific age range, both the 5th and 95th percentile measurements represent the smallest and largest spectrum of the measurements for the age group.

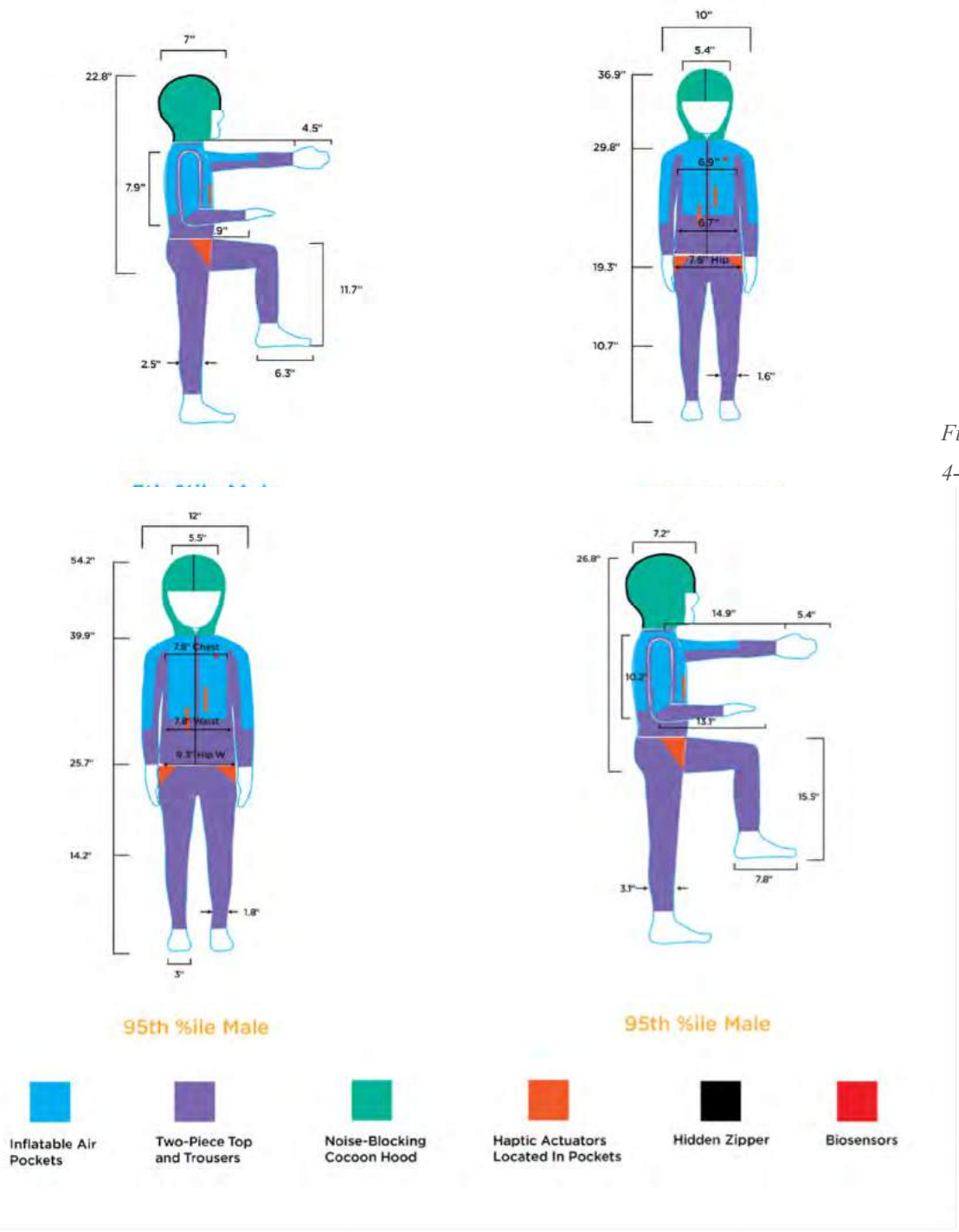


Figure 4-26 – Product Schematic Diagram

4.6 Final Design

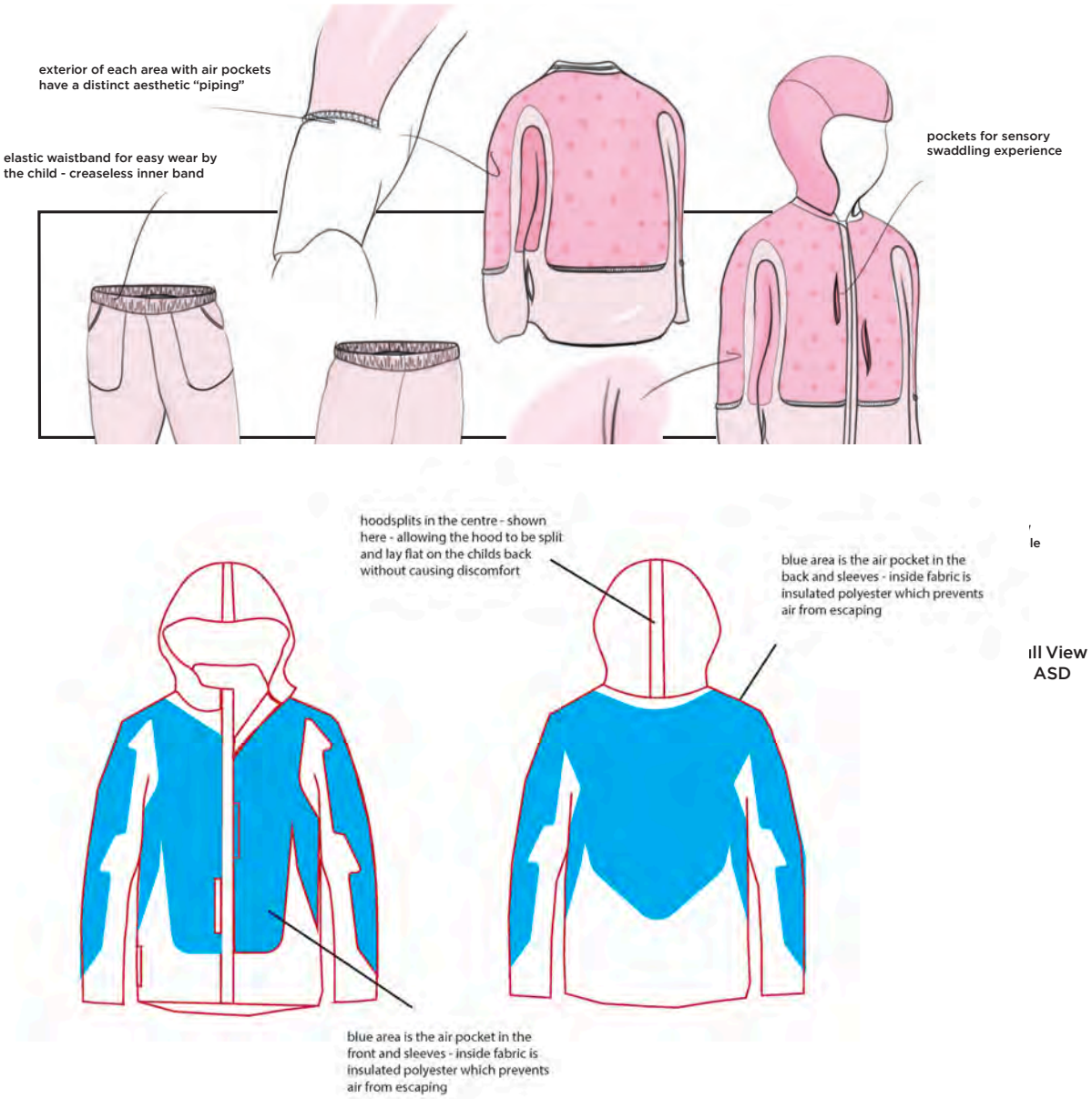


Figure 4-27-28 – Final Design Sketches

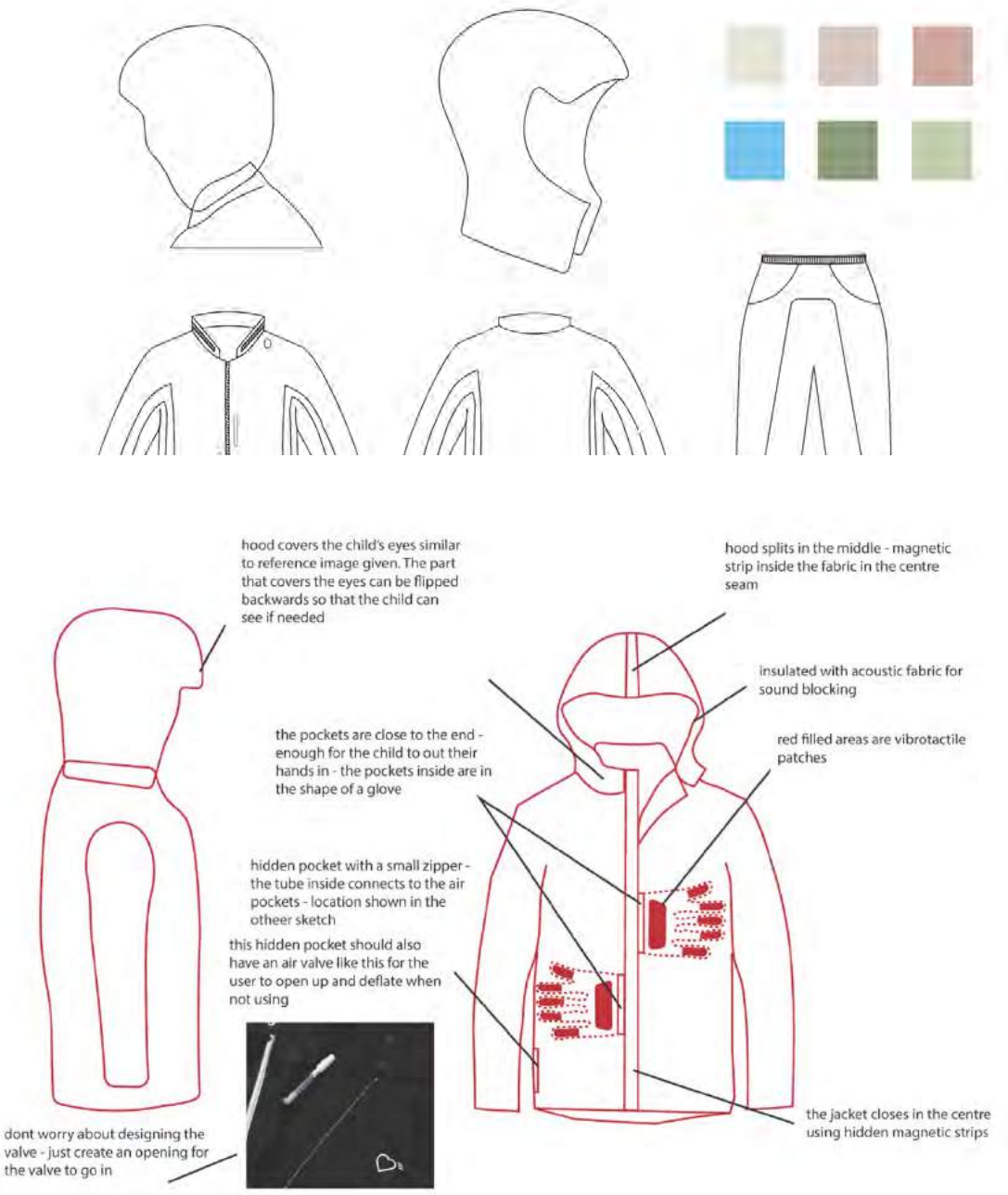


Figure 4-29-30 – Final Design

4.7 Physical Model Fabrication

The fabrication of the physical model was done utilizing a polyester blend of fabric for the outer shell, nylon taffeta for the inner air pockets and foam insulation in the hood. These materials were meant to simulate the performance fabrics used in the design of the two garments. The hand pump was modelled in Solidworks and printed in rubber. The following series of images showcase process work involved in the making of the model.

Figure 4 - 40 Phys Model Fabrication

Figure 4 - 41 Phys Model Fabrication

Figure 4 - 42 Phys Model Fabrication

Figure 4 - 43 Phys Model Fabrication

Figure 4 - 44 Phys Model Fabrication

Figure 4 - 45 Phys Model Fabrication

Figure 4 - 46 Phys Model Fabrication

Figure 4 - 47 Phys Model Fabrication

Figure 4 - 48 Phys Model Fabrication

Figure 4-31 Phy. Model Fabrication

Figure 4-32 Phy. Model Fabrication

Figure 4-33 Phy. Model Fabrication

Figure 4-34 Phy. Model Fabrication

Figure 4-35 Phy. Model Fabrication

Figure 4-36 Phy. Model Fabrication

Figure 4-37 Phy. Model Fabrication

Figure 4-38 Phy. Model Fabrication

Figure 4-39 Phy. Model Fabrication

4.8 CAD Development

The CAD for the adaptive clothing was completed in CLO3D, a software intended to 3D model garments and other soft goods. The patterns for both the jacket and pants were created in illustrator as a 2D design, then imported into CLO3D and stitched together using the software. Using various layers to distinguish between each design feature, the remaining components were created, such as the inflatable air pockets, the sound-blocking hood, and the jacket pockets containing vibrotactile sensors. The following series of images showcase the various components of the CAD model and their construction in CLO3D.

Figure 4-56 CAD Model

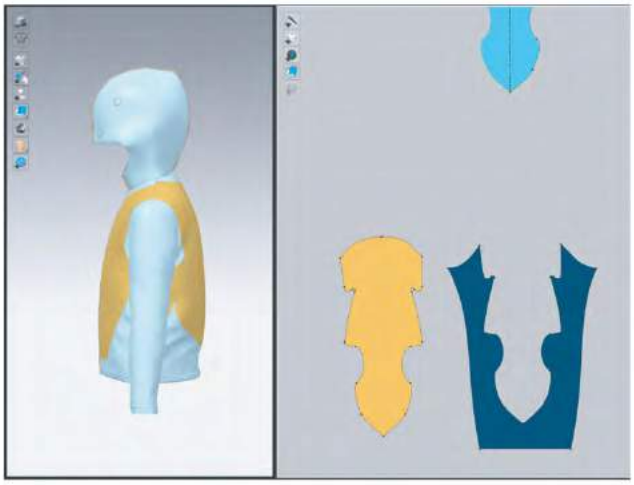


Figure 4-57 CAD Model

Figure 4-58 CAD Model

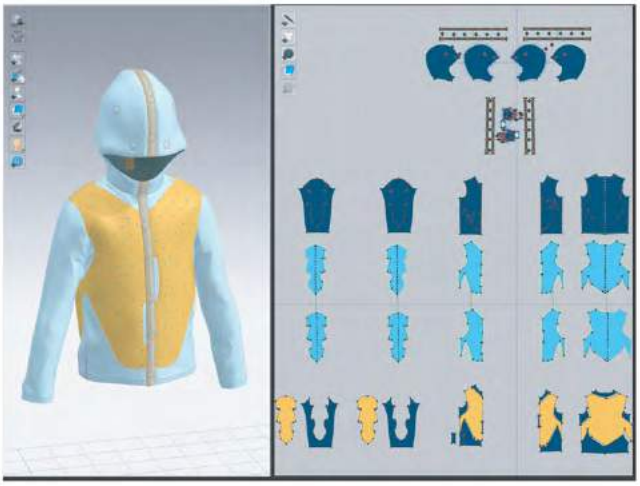


Figure 4-59 CAD Model

Figure 4-49 CAD Model

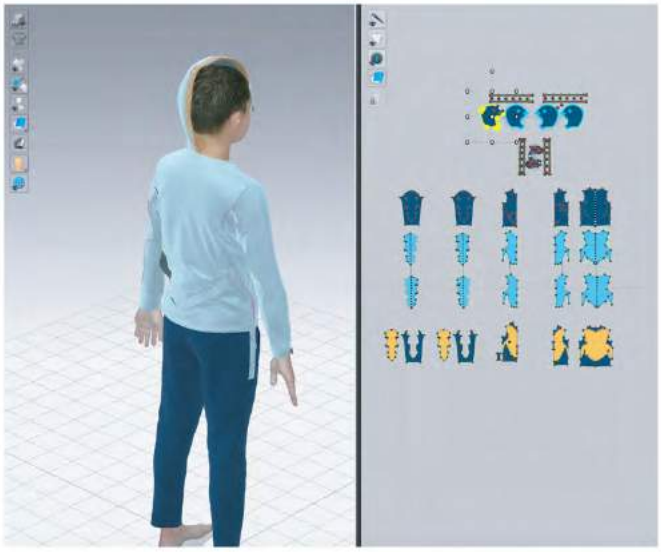


Figure 4-50 CAD Model

Figure 4-51 CAD Model

Figure 4-52 CAD Model

Figure 4-53 CAD Model

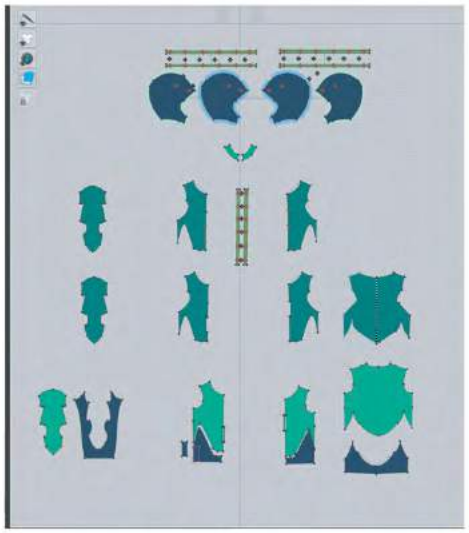


Figure 4-54 CAD Model

Figure 4-55 CAD Model

Figure 4-56 CAD Model

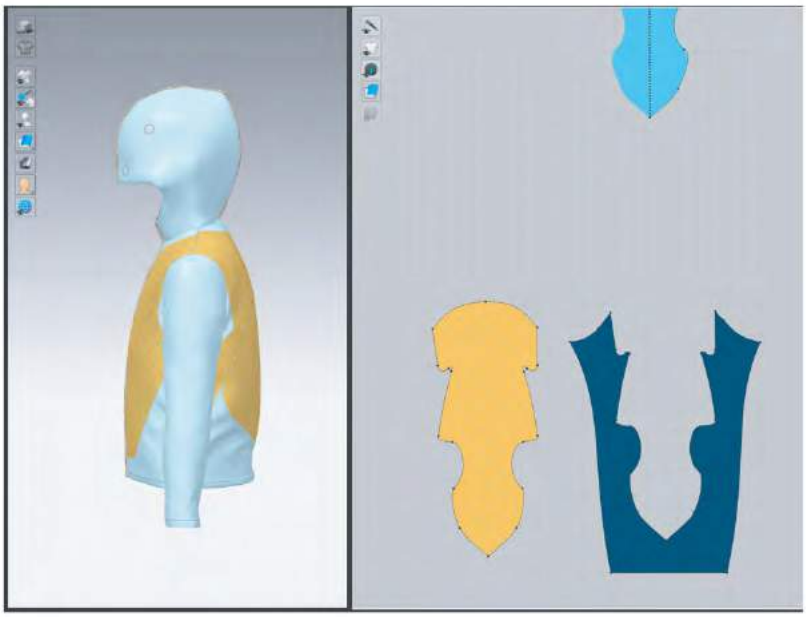


Figure 4-57 CAD Model

Figure 4-58 CAD Model

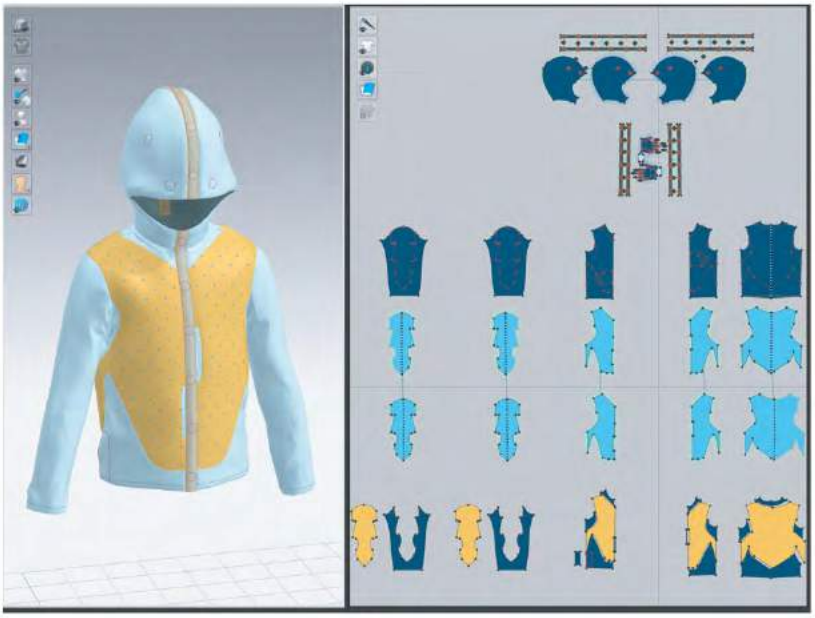


Figure 4-59 CAD Model

CHAPTER 5 – Final Design

5.1 Summary

Description

Cocoon is an adaptive and sensory friendly clothing option for children experiencing Autism Spectrum Disorder. It is designed specifically for use in environments like airport, for the challenges one has to endure when travelling by air.

Explanation

Children with ASD may share a diagnosis, but the symptoms they experience may be different and range from intellectual, developmental disabilities, cognitive challenges, speech and language impediments and delayed social skills. These symptoms make it increasingly difficult for a child in an unpredictable environment, like an airport. The presence of potential triggers at various stages of the journey can lead to a lot of anxiety for the child, and by proxy, the travel companion. Cocoon is designed to enhance a child's comfort, reduce their stress levels and help them reconnect with the world around them.

Benefit Statement

For children on the spectrum, and those experiencing sensory defensiveness, travelling isn't as simple as packing a bag and jumping on a plane. The entire process is riddled with moments that can be quite challenging for someone who is easily overstimulated to both auditory and visual sensory input. It can limit the child's willingness to explore, to learn, to play and participate in what should be an exciting experience. While Cocoon focuses on the challenges that arise during air travel, the adaptive and sensory-friendly garment can be used in various settings, like school, shopping malls, restaurants, concerts and movie theatres. Cocoon aims to make the experience easier and more comfortable for the child, accommodating their needs and helping them cope with a world that isn't always designed to be inclusive of those on the spectrum.

5.2 Design Criteria Met

The following section of the report pertains to the final design solution and its success in meeting the design criteria, particularly, full-bodied interaction design, materials and processes as well as it's feasibility and viability.

5.2.1 Full Bodied Interaction Design

Cocoon was designed with a special focus on ergonomic considerations collected as a result of user observation, prototyping and testing. The ergonomic requirements in garments are often different from physical product solutions. Anthropometric measurements are generally based on standard children's clothing sizes, with the option of grading to accommodate for smaller and larger measurements as the child grows.

Cocoon features a series of inflatable air pockets, placed strategically on the jacket, mainly the chest, back and outer arms. The placement of the air pockets was designed to resemble the touchpoints on a child when being given a hug. Often, with sensory defensiveness, the compression and sensory pressure applied during a hug helps but not every child is comfortable with social touch. The ergonomic placement of the inflatable pockets is the core feature for Cocoon. The jacket also features sensory pockets, placed in opposing directions, allowing the child to place their hands in their pocket to mimic a hug. Each pocket is lined with vibrotactile sensors, integrated into the fabric components, providing regulated haptic feedback to the palm and fingertips. If the child wants to use pockets in the conventional way, without the haptic feedback, they can utilize the pockets integrated in the trousers.

Cocoon also features a sound-reducing hood, design to be adaptive in nature, allowing the child to easily remove the hood to lay flat on the child's back. Many children with sensory processing disorder and autism spectrum disorder, do not like the sensation of fabric bunched around their neck, often with hoodies, that is the case. The adaptive hood allows the fabric to sit flat against the child's back, so when they're leaning against a surface, they are not overwhelmed by the sensation.

Cocoon is intended to be gender-neutral, allowing all genders and to feel comfortable in the garment. It utilizes soft materials, mainly organic cotton and lyocell to form the outer and inner shell.

5.2.2 Materials, Processes and Technology

Materials

Cocoon utilizes a variety of different materials for the different components of its design. For the outer shell of the jacket, Cocoon uses a mix blend of lyocell and organic cotton, blending their best properties such as softness and breathability to create a fabric that best suits the sensorial needs of a child with ASD. Lyocell is known for its buttery silkiness, and cotton, another soft material that is popular in children's clothing provide the softest material for the child so that they are not overwhelmed by the fabric touching their skin.

The inner inflatable panels are made from a recycled polyester, GRS polyester taffeta, which is a material used in the manufacturing of inflatable jackets and other inflatable goods. It provides the functionality needed to perform but is also a cool material that does not heat up when being used.

The manual hand pump is made from natural rubber, a material that is harvested in the form of latex and treated to create a non-toxic and flexible material. Natural rubber is safe for children to use and play with, it is flexible and soft, and has little impact on the environment during harvesting, sourcing and manufacturing.

Manufacturing

To honour its goal of being sustainable and socially conscious, Cocoon aims to partner with garment manufacturers and fabric mills that employ ethical labour, sustainable manufacturing processes and pay attention to the end-of-life cycle of each garment used.

Most traditional dyed contain harmful chemicals and vast amounts of water to process. During the dyeing process, much of the dyed wash out and pollute rivers throughout the developing world. In fact, even white fabric which is often bleached releases dioxin in its bleaching process, "a chemical that the US Environmental Agency says can cause cancer and damage bodily systems" (Cowles, 2020). A greener alternative is to go the natural route or use low impact dyes. These are derived from plants, insects or animals and contain no toxic chemicals and require less water to process (Cowles, 2020). Similarly, Cocoon would like to partner with fabric

recycling plants in North America to ensure the appropriate disposal of the garments and its integrated technology components.

5.2.3 Implementation – Feasibility and Viability

The following table represents the breakdown of costs for Cocoon. The fabric costs are broken down to USD per yard, as is the industry standard, for this on particular colourway. All technology components are listed under hardware. The figures given represent the cost breakdown according to existing products in the same market.

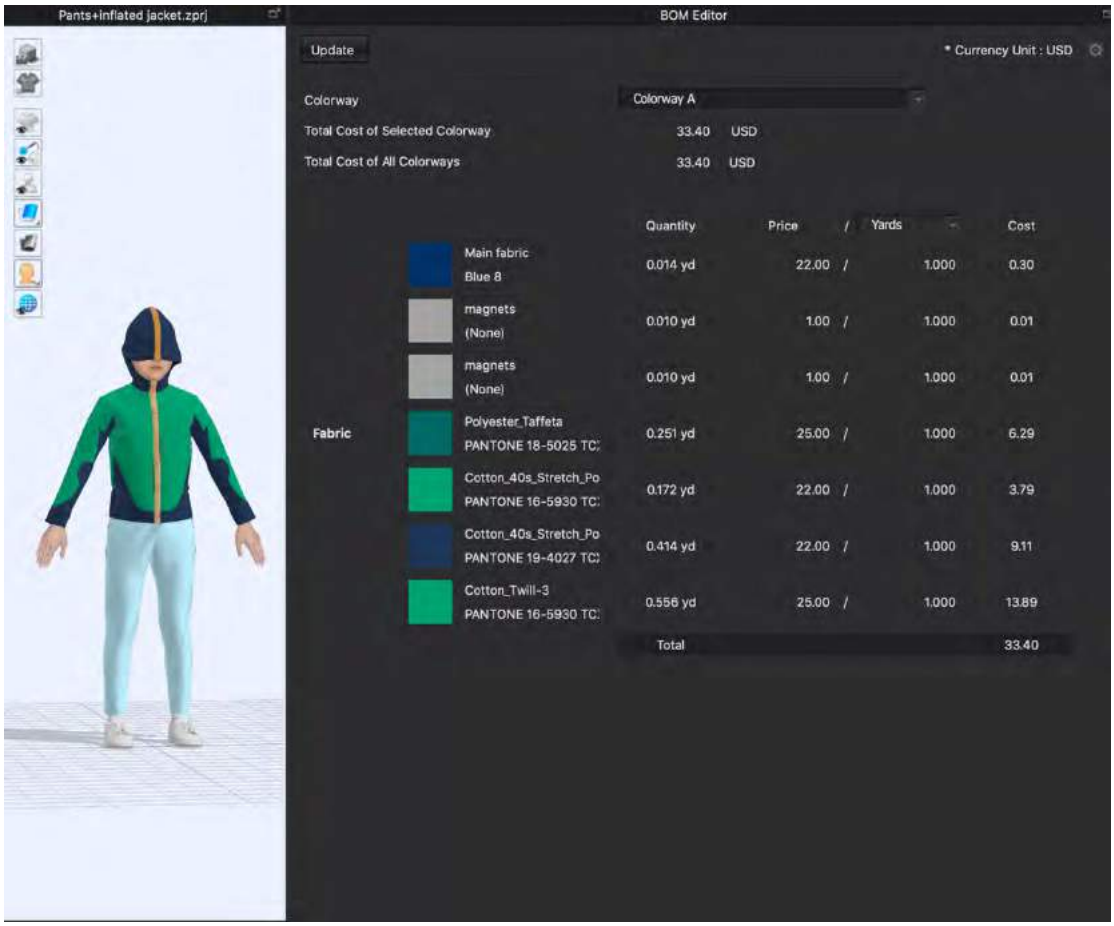


Table 5-1 Bill of Materials

These prices are listed according to the materials costs, not including manufacturing and labour. It can be inferred that other costs such as labour, overhead, permits, regulatory testing and other unknown costs will be added but are unknown at this time. Therefore, a complete and final cost cannot be calculated, and an estimate is being provided based on the materials given.

5.3 Final CAD Rendering

Figure 5-60 Insitu Render

Figure 5-61 Insitu Render

Figure 5-62 Insitu Render

Figure 5-63 Insitu Render

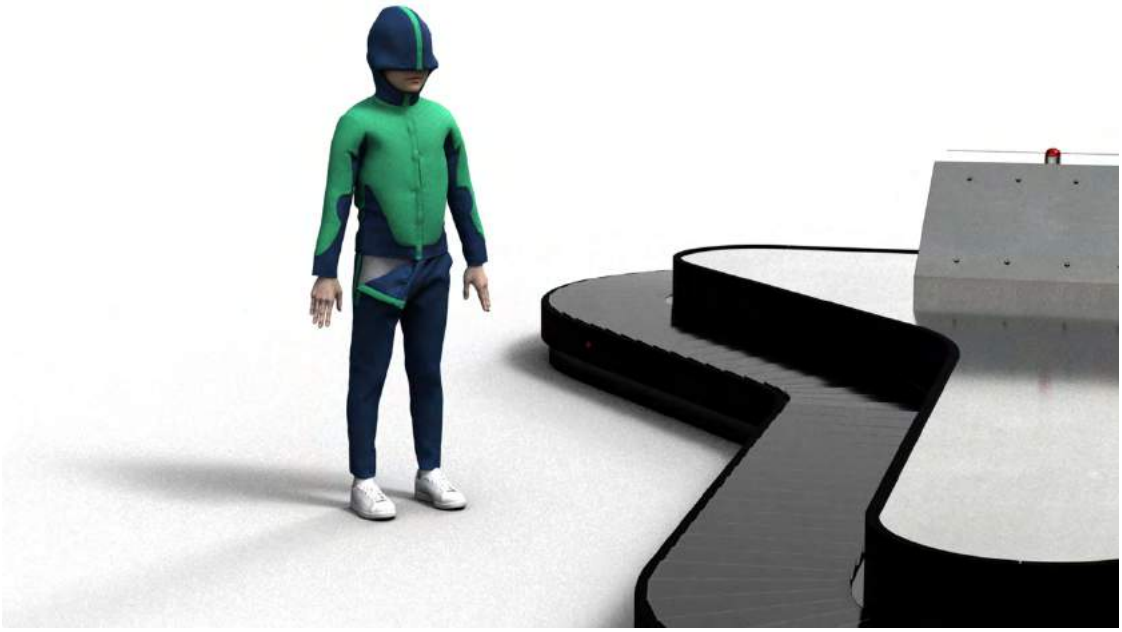


Figure 5-64 Insitu Render

Figure 5-65 Back View

Figure 5-66 Side View

Figure 5-67 Quarter View

Figure 5-68 Front View

5.4 Physical Model

Figure 5-69 Physical Model Side Pocket

Figure 5-70 Physical Model Side Pocket

Figure 5-71 Top View Hood

Figure 5-72 Sensory Pocket

Figure 5-73 Physical Model 3/4 View

Figure 5-74 Physical Model 3/4 View

Figure 5-74 Physical Model Back View

Figure 5-75 Physical Model Back With Hood

Figure 5-76 Physical Model Front View

5.5 Technical Drawings

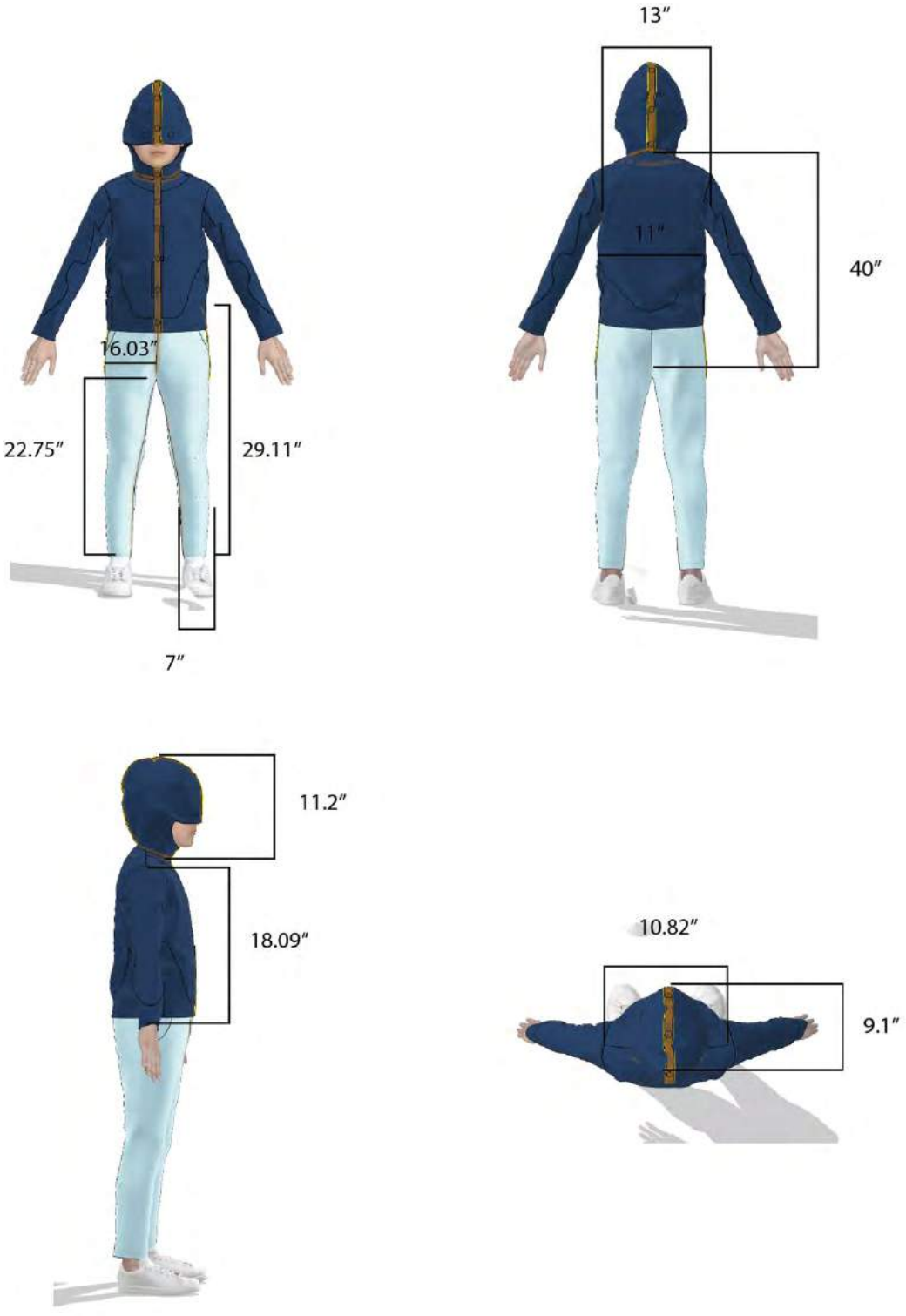


Figure 5-78 – Technical Drawings

5.6 Sustainability

Cocoon's sustainability permeates the core of its design. From its material choice, to manufacturing methods, Cocoon aims to be a socially conscious design solution in the niche space of sensory clothing. The following is a breakdown of the sustainable materials used in its design.

The jacket's outer shell is made from a blend of organic cotton and lyocell, both eco-friendly materials made responsibly. Lyocell is a plant-based fibre gaining more and more popularity for its buttery soft texture. It is sourced from eucalyptus leaves which grow very quickly, on barren land, and with very little irrigation and pesticides required. The production of lyocell doesn't use toxic chemicals, and 99.5% of the dissolving agent can be used repeatedly. Compared to cotton, lyocell has the potential to use less than half as much water in production. The fabric's breathability is also great for the planet, as it doesn't start smelling as quickly and can be washed less frequently, saving water (Schibli, 2019). Because lyocell will probably not replace cotton as a choice of fabric for many, Cocoon's creates a blend between lyocell and cotton to integrate both fabric's optimal qualities of softness and breathability keeping environmental stewardship in mind.

Cocoon also utilizes recycled polyester, another sustainable option in the garment industry, to create the inflatable air pockets contained within the jacket. It's counterpart, polyester, is a commonly used fabric in the athleisure industry. However, polyester, on its own, is not a very sustainable fabric. It's made from PET, meaning, much of our polyester clothing is made up of crude oil. Cocoon challenges the garment industry by producing its inflatable panels in its recycled counterpart. It retains the same properties, meaning, it is resistant to water or air transfer, allowing the jacket to inflate without losing its cooling properties. "Recycled polyester, also known as

rPET, is obtained by melting down existing plastic and re-spinning it into new polyester fiber. While much attention is given to rPET made from plastic bottles and containers thrown away by consumers, in reality polyethylene terephthalate can be recycled from both post-industrial and post-consumer input materials. But, just to give an example, five soda bottles yield enough fiber for one extra-large T-shirt" (Elven, 2018). Recycled polyester keeps plastics from ending up in landfills and in the oceans, it consumes less resources in its production and when blended with certain fibers like cotton, can still be appropriately recycled.

The manual hand pump built into the jacket is made up of natural rubber, a material that is harvested in the form of latex and treated to create a non-toxic and flexible material. Natural rubber is safe for children to use and play with, it is flexible and soft, and has little impact on the environment during harvesting, sourcing and manufacturing. It can be continuously recycled, and a rubber tree can be replaced with a new sapling when reaching its end of life.

The fashion industry's larger manufacturing processes have come under spotlight for their questionable labour practices and unsafe working conditions. Children's clothing, both traditional and adaptive, are made in factories around the world, depending on the company, often by individuals and even children paid little to nothing. In recent years, there have been calls for greater accountability and transparency by corporations, drawing attention to the social aspect of sustainability in fashion.

With that in mind, the proposed design solution aims to manufacture locally in North America, partnering with factories that employ ethical labour and have as little impact on the environment through their production processes. One of the ways to tackle this is through the fabric dyeing process. Most traditional dyed contain harmful chemicals and vast amounts of water to process. During the dyeing process, much of the dyed wash out and pollute rivers throughout

the developing world. In fact, even white fabric which is often bleached releases dioxin in its bleaching process, “a chemical that the US Environmental Agency says can cause cancer and damage bodily systems” (Cowles, 2020). A greener alternative is to go the natural route or use low impact dyes. These are derived from plants, insects or animals and contain no toxic chemicals and require less water to process (Cowles, 2020).

CHAPTER 6 – CONCLUSION

Cocoon is a set of sensory-friendly apparel, designed for children experiencing Autism Spectrum Disorder, and for use by children when travelling by air. Our world is full of sensory stimuli which can be overwhelming for a child with ASD, in turn, this can lead to increased stress and poor mental health. The changes in routine, loud noises, and unpredictable crowds can present as triggers, leading to anxiety for the child. In turn, Cocoon’s design features create a comfortable and safe experience for the child, reducing their stress and helping them reconnect with the world around them.

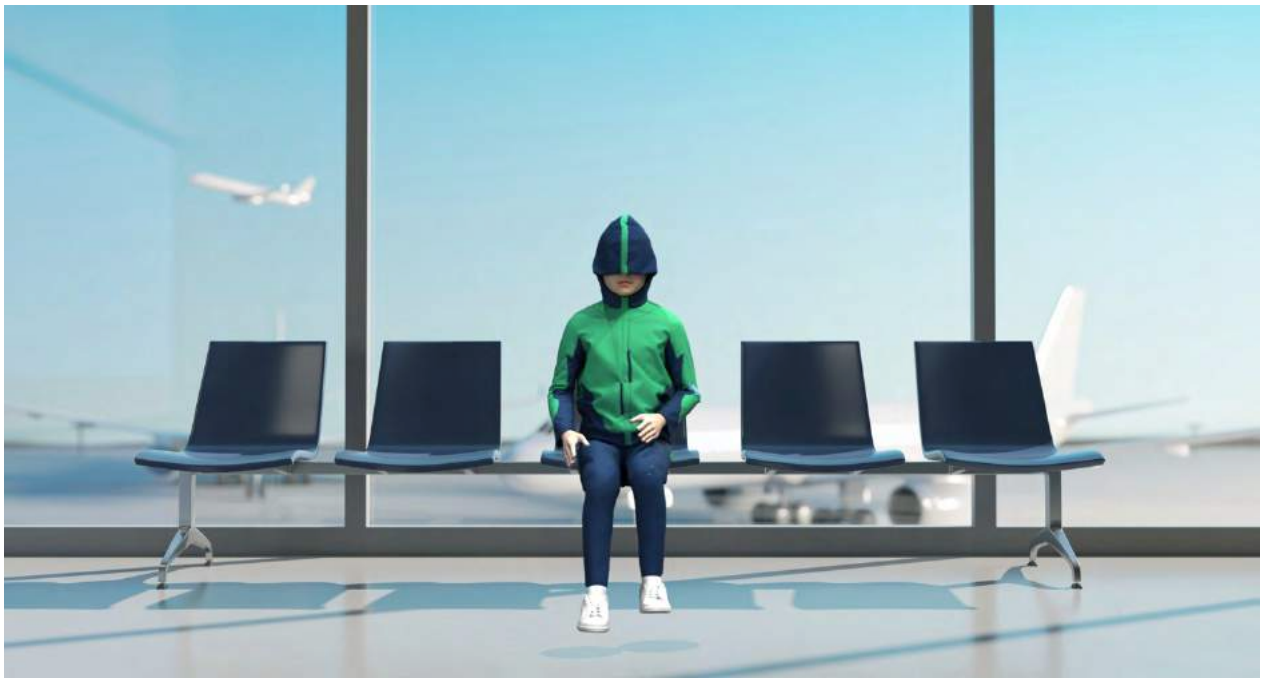


Figure 6-79 – Insitu Render of Cocoon

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CHAPTER 8 - Appendix

Appendix A – Discovery

Information Search - Preliminary

Key Article 1

Method

A key article for this topic was sourced and selected. Required article content (Abstract, Introduction, and Conclusion sections) was copied and highlighted.

- Search Engine: Humber Library Discover
- Key Words Used in Search: "ASD and air travel review"

Findings

Citation: Miller, I. T., Wiederhold, B. K., Miller, C. S., & Wiederhold, M. D. (2020). Virtual Reality Air Travel Training with Children on the Autism Spectrum: A Preliminary Report. *Cyberpsychology, Behavior, and Social Networking, 23*(1), 10-15. doi:10.1089/cyber.2019.0093

Key Content: is reproduced below.

Abstract

Autism spectrum disorder (ASD) is categorized by deficits in social communication and interaction, alongside repetitive, restrictive behaviors or interests (RRBIs). Previous research supports the efficacy of virtual reality (VR) to train a variety of specific skills (i.e., riding a bus or crossing the street) as well as more complex social skills, such as emotion recognition and functional communication. The present reports the implementation of a VR-based air travel functional communication activity in five children diagnosed with ASD. Using an iPhone X and *Google Cardboard* device, researchers delivered the VR intervention once per week for 3 weeks to each participant. During these interventions, researchers measured activity completion ability on a 4-point scale. At week 4, all children participated in a real-world air travel rehearsal at the San Diego International Airport. Parents were asked to rate their child's air travel abilities before week 1 and after week 4. All children improved their air travel skills from pre- to postintervention, reflected in both the researchers' and parents' observations. All children navigated the real-world airport under their own power. This preliminary report suggests the efficacy of VR to teach basic air travel skills to young children diagnosed with autism. Clinician observations regarding attention to the VR and strategies for helping participants accept the intervention technique are discussed. Future iterations of this program will require larger sample sizes and more robust clinical measurements—such as communication samples and physiological monitoring.

Introduction

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder characterized by deficits in social communication and interaction (SCI) often accompanied by restrictive repetitive behaviors or interests (RRBIs). Deficits in theory of mind (ToM) and language production are among the numerous interrelated symptoms associated with ASD. ToM indicates a sense of understanding of another person's mental state, a central element of SCI, whereas language production influences the development of ToM. This interaction can impact social functioning in many ways. For example, Chamberlain et al.[5] found that 398 autistic children self-reported feelings of strong social connectivity, whereas researchers observed weaker social networks, less acceptance, and fewer reciprocal relationships compared with typically developing (TD) peers. The incongruencies in observed versus reported social connection are suggestive of ToM impairment. Executive function (EF), predictive coding (PC), and other cognitive processes influence the expression of social development and communication deficits, and many RRBIs. Research exploring the cumulative effects of impaired cognitive processes in ASD indicate its vast implications. Relative to SCI, ToM, EF, and PC help individuals disambiguate complex environments (e.g., group settings, peer-to-peer interaction, and doctor's visits) "where mentalizing has to be intuitive, fast, and reflexive." In ASD, inhibited disambiguation of relevant and extraneous cues in such environments exacerbates feelings of stress and anxiety. A review by MacNiel, Lopes, and Minnes found that, compared with TD peers, autistic youth experience higher levels of anxiety.

Research suggests that mental states such as stress and anxiety give rise to the expression of RRBI in autistic individuals and that up to 85% of these behaviors serve a communicative function. As many as 40% of autistic children exhibit impaired ToM, communication deficits, *and* anxiety.

Since social development and communication have such vast implications, interventions teaching SCI skills are most often recommended by clinicians and sought after by parents. These approaches promote fundamental strategies such as functional communication and joint attention that help make dynamic environments more predictable, easier to navigate, less stressful, and reduce RRBI. Carol Gray's *Social Stories*™ are a standard SCI intervention technique and use pictures, props, and narratives to highlight salient contextual information in social contexts and prepare an individual for what to expect.

Conclusions
In all, VR-based interventions are an exciting and feasible intervention method. As an exploratory study, the results indicate that VR can help reinforce air travel skills and prime individuals for the air travel experience. It is particularly exciting in terms of mobile interventions. Using only a smartphone and *Google Cardboard* device, this intervention was inexpensive and easy to implement. Migrating toward mobile, accessible intervention techniques is important today as diagnosis rates continue to rise and therapeutic services are evermore impacted and overwhelmed. VR functional communication activities are an exploratory intervention technique but have been demonstrated to be effective in this young population.

Summary Statements

1. Autism Spectrum Disorder can be defined as deficits in social communication and interaction, alongside repetitive restrictive behaviors or interests. These are also known as RRBIs.
2. Majority of any SCI (social communication and interaction) skills are delivered in very controlled environments but there is a greater likelihood of success if these skills are translated to the real world in a natural and organic way.
3. In this age of technological and digital proficiency, virtual reality can be used to provide naturalistic social situations.
4. Research conducted using VR on children with ASD, supported the idea that skills learned through virtual reality can be transferred to the real world.
5. Participants showed improvements in contextually appropriate behaviors throughout the entirety of the study.
6. “For one of the early verbal participants whose attention to the VR intervention increased throughout the intervention, a similar increase in use of targeted vocabulary was also noted. Another participant who demonstrated high verbal skills commented on being afraid when flying, which was one of the targeted communication skills. Strategies for helping to create a calmer feeling were modeled. During the real-world experience, one of the participants initially rejected going down the jetway, but then completed the checkpoint when playful verbal cues and partial physical assistance (hand holding) was provided. These are positive indicators for using VR intervention paired with functional communication strategies to facilitate improved air travel experiences”.

Key Article 2

Method

A key article for this topic was sourced and selected. Required article content was copied and highlighted.

- Search Engine: Google
- Key Words Used in Search: air travel and autistic child

Findings

Citation: Traveling By Air with Your Autistic Child - Special Learning Article. (n.d.). Retrieved September 27, 2020, from https://www.special-learning.com/article/traveling_by_air_with_your_autistic_child

Key Content: is reproduced below.

Introduction

Fear of flying, or aerophobia, is a condition in which a person has extreme anxiety any time he or she is forced to travel in an airplane – that is, if he or she can be forced to do so at all. But if you are like many parents who have a child with ASD, you may suffer from a different condition: Fear of flying… with your autistic child. Some parents would rather drive their child halfway across the country than try to deal with the special challenges that airplanes and airports create for a child with autism. The bustling crowds, unfamiliar sounds, TSA officers in uniform and foreboding security machines can be very threatening to children in general and could cause sheer panic in a child with a disorder in the autism spectrum. Nevertheless, traveling by air is something most people need to do at least occasionally. If you are considering flying with your diagnosed child, taking time to prepare in advance can save you enormous stress and anxiety during your journey.

Findings

Plan for Your Trip Ahead of Time

When it comes to traveling with an autistic child, there is much more to preparing for a flight than just booking seat tickets and packing clothes. One of the best ways to begin is to call the airline and tell them you have an autistic child and *ask them* if they are used to having autistic children as passengers and if so, what services they offer for helping children like yours. The chances are very good that the airline's staff knows just what to do and they can aid you from the moment you arrive in the airport.

To start with, most airlines will be happy to provide you and your child with faster check-in and boarding procedures to lessen your child's anxiety by avoiding the long lines you would typically encounter. You could also opt for a flight that leaves at night so your child will fall asleep faster and have smaller crowds to deal with.

Make sure that at least one of the seats you reserve is a window seat. Once you board the plane you can quickly determine if your child likes sitting at the window and looking out of the plane. If the child seems to enjoy it, sitting by the window and watching the view could help distract your child from the loud noise and rumbling that occurs during take-off and landing.

"Immunize" Your Child Prior to the Actual Flight

Any time you expose your autistic child to new events, places, people and sounds it is a good idea to prepare your child for the new experience with a few basic techniques. By pre-exposing your child to many of the things they will see and sounds they will hear through pictures, videos, social stories and field trips, you can significantly reduce the trauma your child will feel when you actually go on your trip.

Use picture cues – if it is the child's first airplane trip, use pictures to introduce your child to what an airplane, airplane crew and airport look like. Familiarize your child with different things, people and equipment he or she might be seeing on the actual day. An example would be showing your child a picture of a flight attendant and informing him or her that a uniformed person like the one in the picture will be helping you with all your needs.

- Use Video Modeling or Role Playing – you can use video modeling or role playing to explain to your child that he or she will be frisked upon entering the airport. Discussing how he or she is expected to react during the frisking and assuring your child that everything will be okay is a good way of easing your child's tension. If you can, go to the airport and record video of the surroundings as much as you are allowed by airport security. Show one of your other children or other anonymous children going through the security system and being frisked, what the airplanes look like as they take off and land, etc.

- Tell Social Stories – social stories are a very helpful way to prepare your child for an airplane voyage. Make sure that you repeat each story numerous times before the actual day of travel until your child feels comfortable with the story and idea. A nice example would be using a social story to tell your child about the ear sensation he or she might feel upon descent of the aircraft. Air pressure in the ears can be equalized by swallowing or chewing, so telling your child a story about the feeling and how it can go away with chewing gum will prepare him for the actual flight.

- Immersion – with regards to the large crowds in an airport, you can start by exposing your child to a small group of people. An example would be taking your child with you to a bank where a number of people are waiting in a line for their turn. Then you can eventually move to a larger group, say the mall or a big restaurant. Gradual exposure will not only prepare your child but also improve your child's social coping skills.

L*oad your Carry-on*

Whether the flight is a short or long one, you should bring plenty of tools to help keep your child distracted. Bring a set of noise-canceling earplugs or an MP3 player to distract your child from loud sounds (but be aware that the airline will likely require turning the player off during take-off and landing). A pair of the darkest sunglasses you can find may also reduce your child's sensitivity to visual stimulation, crowds and warning lights. Bring your child's 'security blanket' or favorite toy; or anything that will serve as a distraction while you are in the air. If your child loves coloring or drawing, a set of new crayons or markers will definitely excite him and keep him busy. You can also ask the airline if they have a kid's pack, which usually contains a coloring book and a set of crayons. Packing your child's favorite snack and drink would also be a good idea. And of course, don't forget to pack *medications for autism* that your child needs to take during the flight. Make sure you have the prescription and other necessary papers needed to carry these medications to avoid any unwanted questioning at the airport.

Have a 'Plan B'

If all else fails and your child begins to show signs of panic, you should have a 'Plan B' ready just in case. One option is to have whatever medication your doctor recommends that will slightly sedate your child during the course of the flight. Common sedatives in this group are Diphenhydramine (Benadryl) or Promethazine (Phenergan), which are over-the-counter antihistamines, but make sure you have consulted your pediatrician regarding which sedative to use and what dose can be safely administered to your child. Do not use a sedative without your pediatrician's approval. Remember that sedating your child should be your *last* option.

With the right preparation, it is possible for your child's airplane trip to be an exciting and joyous event for you and your autistic child, rather than a stressful or traumatizing one.

Summary Statements:

1. Children are triggered by the unique environments they are exposed to during their travel duration, starting from home, through the airport, and inside the airline cabin.

2. Parents of children with ASD typically prepare for their trip by utilizing a variety of strategies. This includes:

a) "immunizing" child prior to flight by exposing them to large crows and public spaces
b) Video modelling or role-playing at home to practice the various airport scenarios that they may happen upon
c) Telling social stories at home, encouraging these open discussions at school and explaining to the child what to expect
d) Carrying the child's favorite toy, or a device like an iPod so that the child is distracted with something that gives them comfort
e) Carrying sensory toys and devices in the carry-on to take out during the flight and keep the child preoccupied
f) And often times medicating the child so that they are sleepy throughout the flight, although this method is least preferred by parents.

Expert Interview 1:

Minutes taken from a phone call with Expert 1 – Faryal.

1. Can you tell me a bit about your work with ASD kids?

- Work as a therapist – worked at a school – one on one therapy in a classroom setting
- Doesn't really matter what age it is – each child is different and may not like compression
- So, age doesn't matter – more cognitive development
- Commonalities include sensory challenges – auditory (feel uncomfortable with loud noises, or high pitch)
- Airplanes and airport create a lot of sounds – noise cancelling headphones (not everyone likes the feeling of air plugs)
- Lights – Glasses that protect them from lights changing – change in lights
- Fans
- Inconsistent moving can be either hypnotizing or it can be fascinating
- Other kids crying can be disturbing emotionally
- Some kids are very hyper-emotional
- Social skills also vary amongst children
- So, when thy work with kids they take their ABC Data behaviour – analyze the data and look at commonalities and why they happen
- Four functions of why behaviour happens – tangibles (access to something), attentions (want to get attention), stimulation (missing something), escape (don't like the environment)
- That's how you figure out how to react to it – figure it the reason and make a plan to prevent in the future

- Based on this they create programs – when it's about to happen – they already know
- This isn't always information that parents may not always

2. What brought you to this field?
3. How do children communicate with you?
- They use symbols for words – speech therapist would know
- PEC board – binders that they have like laminated squares with images that they use
- They use programs on iPad
- Using sign language – have trouble using this because it's also a communication tool
- They use their tone of voice or – there's a hierarchy of communication – 7 levels
- Lowest and most primary form of communication is crying or engagement

4. What types of things work best for your child in terms of rewards and motivation?
- The only way to deal with children, very few children that work without reinforcement
- Tends to be food – easiest thing to use – willing to work a lot for it
- Going to the playroom, playing with friends
- Token boards – working towards the reinforcement
- They keep it very visual
- Visualize the token and where they are

5. Has this diagnosis changed your environment at home?
- Parent involvement is huge
- There's a huge discrepancy because there's so many parents who aren't involved
- They get to foster care – foster parents aren't usually involved
- So many kids get very little care
- Parent encouragement and being on the same page is a huge thing – if kids are refusing to eat anything and they're being helped in school and when it's not reinforced at home, you have to start from scratch when they get back
- Very little expectations at home – parents have to work harder
- Very difficult for parents they can't put in the time – while teachers are getting paid to help them

6. Do changes in routine or transitions to new activities affect your child's behavior?

Expert Interview 2:

1. Does your child have Autism Spectrum Disorder?

   Yes

2. How old is your child?

   24 now

3. Do they have siblings?
4. How old was your child when they were diagnosed with autism?

7 years old

5. What prompted you to get a diagnosis?

   2-8 are the most difficult years, they don't have the ability yet to understand what's happening. A lot of the reactions are immediate, physical and intense. As a parent, you don't know what's going on either cause its new to you.

6. How does your child communicate with you?
7. How does your child best communicate with others?
8. Does your child have any sensory needs that I should be aware of?
9. If yes, what type of sensitivity does the student have?
10. What activities does your child like?
11. What are their symptoms?
12. What are their triggers?
13. How do they deal with the triggers?
14. What is your role in reducing the symptoms?
15. What therapy has made the most difference?
16. What are your child's areas of strength?
17. What types of things work best for your child in terms of rewards and motivation?
18. Has this diagnosis changed your environment at home? If so, how?
19. Do changes in routine or transitions to new activities affect your child's behavior?
20. How often do you travel?
21. How frequently do you travel by air?
22. What are some of the challenges of air travel with a child with ASD?

    Waiting in line, being at the airport, going to the bathroom, loud noises, no concept of authority, what you have to do when, no understanding of the urgency of how things have to go for security reasons, she didn't know you could call the airlines until about 5 or 6, she would just pick him up and carry him, it was very stressful.

23. How do you prepare for your air travels?

    They used to prepare him, by telling him what's going to happen, walk him through the process so he's prepared but that was when he was much older. Its good if you have a travel buddy because you really need someone there for support (one to deal with the child and the other to deal with the airline process). When he was younger, she could take him into the bathroom with her, but as he got older, she couldn't do it. If they had family bathrooms, for when they got older, that would be so helpful.

24. Do you notify/plan with the airlines ahead of time?

she didn't always know you could call the airlines, but she used to call airport authority tell them it's a super stressful experience, they told her you could go through special line for security, move you to front of line, as he got bigger they used to do boarding. After she contacted airlines and they directed to the right person, it was really a turning point for her. Before then, it was super stressful.

25. What does that process look like?
26. What behaviors related to autism spectrum disorder do you most commonly see during your air travels?
27. Are there triggers for these behaviours?
28. In your experience, what are the best ways to cope with these challenges and get your child back on task?

    She remembers chasing him through an airport and having to sit on him because he was having a tantrum about pushing carts and pushing carts into things. She remembers saying "this is not ok" and if you don't stop, shell have to call security. There was a stage where he was much older like 6-9 and he understood but he was bigger, she was much more definite about what's allowed, what's expected, what will get you in trouble. She was clear with him about his behaviours and it wasn't always successful, she doesn't enjoy talking about it that much and they were both learning and it's a bit traumatic for them because no kid is perfect. Sometimes candy works, sometimes money, sometimes toys, sometimes treats or books or toys work as motivation. From the parent's perspective it's about flexibility and foresight because as he got older and they got better at it, they were able to plan for those difficulties and anticipate them. It got better when both partners could travel together. A big thing for him in terms of triggers were crowds. They started travelling with carryon instead of big luggage, so they didn't have to go through to huge crowds.

29. What are some travel essentials that you pack for the flight?
30. What are some challenges you have faced travelling by air?
31. How has your experience been with other passengers?
32. How has your experience been with airline staff?

    They used to tell her to remove the headset, put him in his seat, put the seatbelt on, but it would be stressful for him and they wouldn't understand at take-off. His sensitivities are noise, especially not understanding that when you were landing, the air pressure would panic him because he didn't understand it.

33. How would you improve the overall experience of travelling with a child with autism?

There should be training, there should be some shorthand, she would have to be explaining to other people. Kids have tantrums and no one would understand. Later on, when he was able to understand time and concepts, they would do the preparation by showing pictures and talk about where they were and what would happen next. Seating could be improved in airlines, she would tell him to stop but it would escalation, and you're trying to avoid escalation, so it's a fine line, in terms of seating, it's better for them to sit at bulkhead but they're not allowed. A lot of airports now have announcements only have boarding near boarding gates,

Topic Justification

User Primary, Secondary, Tertiary *indicate a minimum of 10 items*	**Product** Benchmarked Products *indicate a minimum of 10 items*	**Environment** *indicate a minimum of 10 items*
Child with autism (primary) Children between the ages of 5-8 years. - Sensory overload - New environment - Behavioural challenges - Speech and language difficulties - Anxiety from environment changes - Limited food/dietary options - Large crowds, noise, and long lines - "disruptive" or "suspicious" behaviour gets flagged	Wings for Autism - Tedious process - A full-day event - There is a waitlist to sign up – priority given to "first-timers" - Specific schedules that may not fit into family's availability	Home - Cannot simulate airplane experience at home - More comfortable - Predictable behaviour - Toys/devices/sensory tools to soothe and calm - Consistent environment/discipline
Parent(s) (primary) Either one or both parents - Preparation before travel date - Packing all essentials for autistic child in carry-on - Educating child about air travel prior to flight - Informing airline staff about travel plans - Working with health practitioner to plan all necessary medications - Anticipating any change of behaviour in child	Zoobears Medical ID - Provides a solution for just one aspect of air travel with an ASD affected child - Is removable - Child may not always want to wear one - visibility	Practitioner's Office - cannot simulate airplane environment - change in crowds affect behaviour
Siblings (primary) - Unpredictable behaviour displayed by autistic sibling - Meticulous planning and preparation - Feelings of neglect	Visual Reminders on Clothing - They are removable - Low visibility - Child may not want to wear one - They provide a solution for one aspect of air travel - Don't provide a solution for in-seat care	School/Educational Institution - Consistent environment/discipline - Predictability that doesn't exist outside of school and home - Access to resource tools

Doctor/Pediatrician/Health Practitioner (secondary) - Working with parents to ensure safe travels - Medication/health care revision - Updates from parents in case of emergency	Favorite Item (toy, iPod, string) - They can get misplaced or list - A child can get bored or lose interest - Does it need to be charged? - Can it be put in carry-on? - Needs to go through security which causes anxiety - Does it pass air travel restrictions? -	Check-in at Airport - Large crowds - Unwanted attention from public - Unpredictable behaviour from others - Long waits - Security issues
Pilots (secondary) - Ensuring safety of child as well as other passengers - Creating safe environment - Undergoing whatever "training" is required to handle security issues	Practicing Vacation Scenarios - Not always predictable - Varying response based on the spectrum - Doesn't provide a solution for in-flight care	Pre-boarding - Large crowds - Unwanted attention from public - Unpredictable behaviour from others - Long waits - Security issues
Air Stewards (secondary) - Ensuring comfort of child, parents and other passengers - Providing appropriate environment to child - Inadequate training - Complaints/concerns - Security issues	Use of Video Modelling or Roleplaying - Variable response based on the spectrum your child falls on - Doesn't provide full experience	Security - Large crowds - Unwanted attention from public - Unpredictable behaviour from others - Taking toys/items to run through security - Long waits - Security issues
Other Passengers (secondary) - Security concerns - Difficult travel experience - Personal family challenges -	Tell Social Stories - Provides a solution for just one aspect of air travel with an ASD affected child - Unpredictable response based on the spectrum of the child - Doesn't provide full experience - Not always soothing	Inside Airplane - Small spaces - Unwanted attention from public - Unpredictable behaviour from others - Long waits - Security issues - Not enough motion - Overwhelming passenger requests - Loud noises (engines, cargo loading, PA system) - Lack of seat choices
Security (TSA) (tertiary) - Security concerns - Inadequate training to deal with ASD - Application of policy regarding ASD and disabilities	Immersion - Can lead to behavioural aggression in public spaces - Overwhelming for the child with the added pressure of public's attention - Long-process - Requires significant effort from parents	Airplane Seat - Small, crowded space - Unwanted attention from public - Unpredictable behaviour from others - Lack of motion - Long wait times before take-off - Loud noises (engines, cargo loading, PA system)
Airport Staff (tertiary) - Security concerns - Inadequate training to deal with ASD - Application of policy regarding ASD and disabilities	Sedation through medication - Not popular method amongst parents and practitioners - Judgement	Airplane Bathrooms - Small - Long wait times often - Unpleasant smells

	- Medication along with jet lag has significant effects on child's behaviour and body - Difficult to administer in public -	- Loud noises (pressure from flushing) - Lack of options
Ground Crew (tertiary) - Takes a while to load/unload cargo - Time constraints – affects child's behaviour	Sensory Toys (Foam Rocker Board, Chewlery, Soft Sippy Cup) - Expensive - Difficult to carry-on - Taking through security - Limited space on airline - Multiple devices	Cockpit - Loud noises (engines, cargo loading, PA system) - Small, crowded space - Invoke fear/anxiety - Sensory overload

Appendix B – User Research

User Profile

IMAGE	DEMOGRAPHIC INFORMATION
 Figure 8-80 – Altogether Autism TakiWatanga. Retrieved from https://www.altogetherautism.org.nz/autism-and-the-support-of-siblings/	Age: 5-9 Gender: Male Ethnicity: Caucasian Family Income: Uncertain Education Level: Kindergarten - Grade II Sibling Relations: Brothers
 Figure 8-81 – USA Today. Retrieved from https://www.usatoday.com/story/travel/flights/2013/04/17/flying-with-autism-airport-program-helps-affected-children/2088367/	Age: 5-8 Gender: Mixed Ethnicity: Caucasian Family Income: Uncertain Education Level: Kindergarten – Grade II Sibling Relations: Mixed

 Figure 8-82 – Autism Speaks. Retrieved from https://www.autismspeaks.org/blog/tips-holiday-travel	Age: 5-6 Gender: Male Ethnicity: Caucasian Family Income: Uncertain Education Level: Grade I Sibling Relations: Unknown

Literature Search for Demographic Data

A literature search was conducted on the Humber Library Search Engine as well as Google to collect vital statistical information regarding the target demographic. The following search terms were used:

- "Autism Demographics"
- "Autistic Children Demographics"
- "Autism Travel Challenges Statistics"
- "Autism Travel Survey"
- "Autism Challenges Survey"

Findings.

The findings from the data collected have been summarized according to all the categories being observed: Age, Gender, Ethnicity, Family Income, Education Level, and Sibling Relations.

Gender: As seen in the graphs shown below, ASD disproportionately affects males over females. For every 1 girl, about 4.3 boys were affected by ASD.

Prevalence of Autism Spectrum Disorder (ASD) in 8-year-olds (2014)				
Data Courtesy of CDC				
		Prevalence	Percent	About 1 in every "x" children
	Overall	16.8 per 1,000	1.7%	1 in 59
Sex	Boys	26.6 per 1,000	2.7%	1 in 38
	Girls	6.6 per 1,000	0.7%	1 in 152
Race/Ethnicity	White	17.2 per 1,000	1.7%	1 in 58
	Black	16.0 per 1,000	1.6%	1 in 63
	Asian/Pacific Islander	13.5 per 1,000	1.4%	1 in 74
	Hispanic*	14.0 per 1,000	1.4%	1 in 71

Figure 8-83- National Institute of Mental Health. [Image] (2016) Retrieved from https://www.nimh.nih.gov/health/statistics/autism-spectrum-disorder-asd.shtml

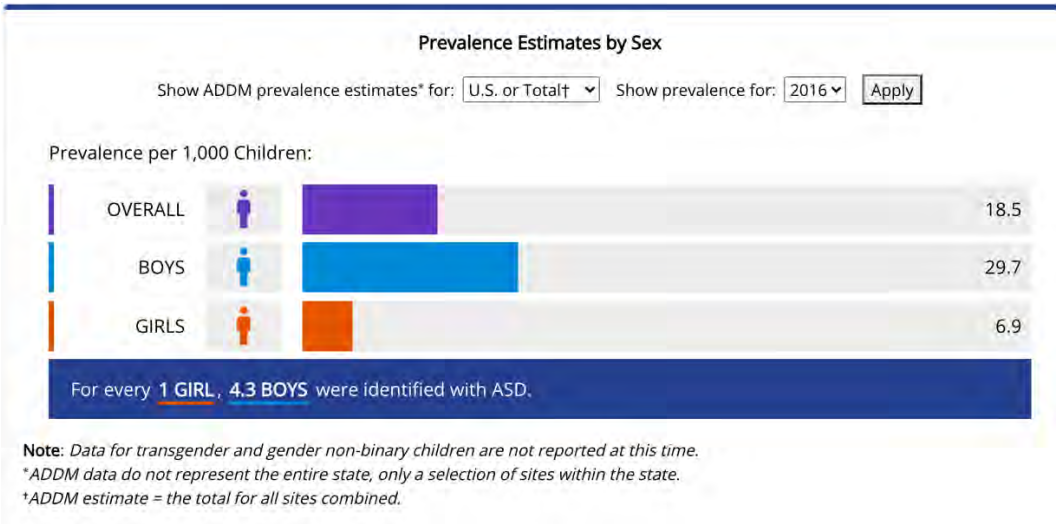


Figure8-841 -Reported Prevalence Varies By Sex. [Image] (2016) Retrieved from https://www.cdc.gov/ncbddd/autism/data/index.html

Age: The discussion of age when conducting this particular research is two-fold: the first is the age of the child upon receiving a diagnosis, and secondly, the average age of children with ASD. The average age of diagnosis was 3.1 years, for children with ASD, and as seen in the table below, the age by which they receive the diagnosis was declining. This shows an improvement in that children are receiving their diagnosis earlier, creating an opportunity to optimize prognosis through treatment and resources.

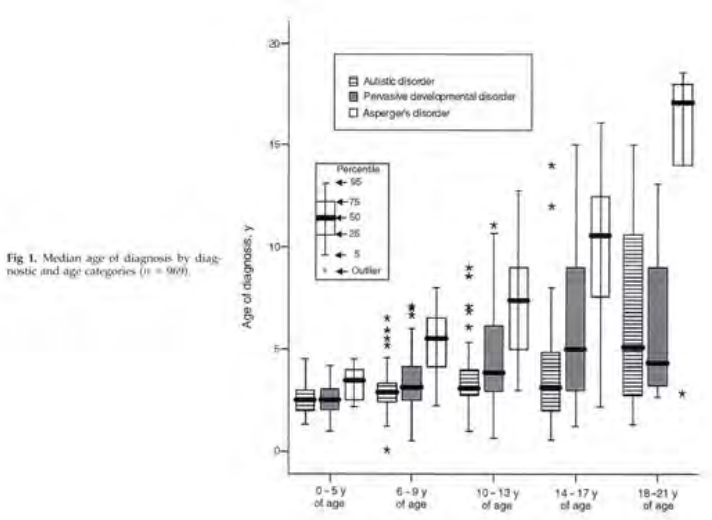


Fig 1. Median age of diagnosis by diagnostic and age categories (n = 969).

Figure 8-85 – *Factors Associated with Age of Diagnosis Among Children with Autism Spectrum Disorders. [Image] (2005) Retrieved from https://link.gale.com/apps/doc/A140304285/AONE?u=humber&sid=AONE&xid=45623097*

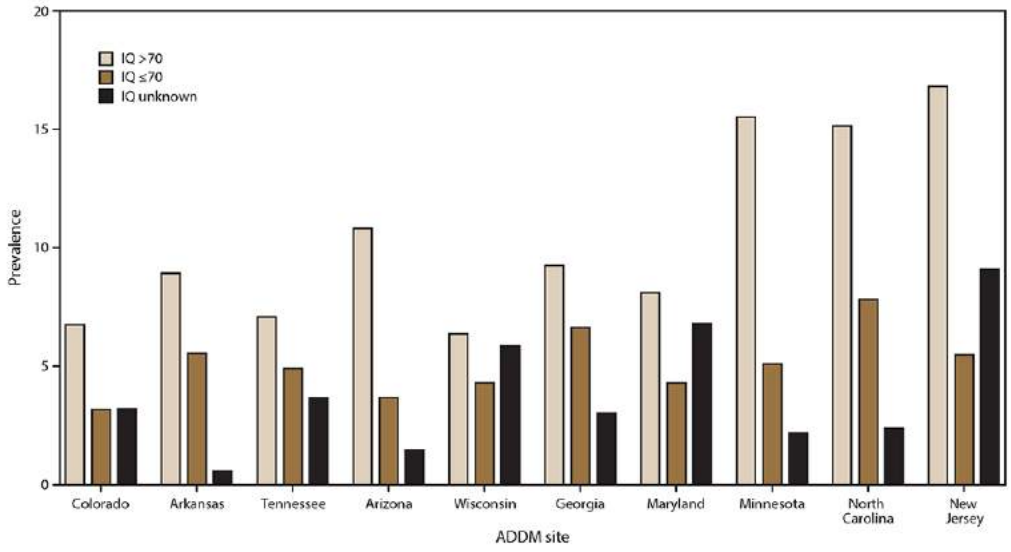


Figure 8-86 – Prevalence of ASD. [Image] (2016) Retrieved from https://www.cdc.gov/mmwr/volumes/69/ss/ss6904a1.htm#F1_down

Race and Ethnicity. Again, it is obvious that ASD affects non-Hispanic White children more than any other race or ethnicity. Second in prevalence, are non-Hispanic Black children with about 18 per thousand children being diagnosed with ASD.

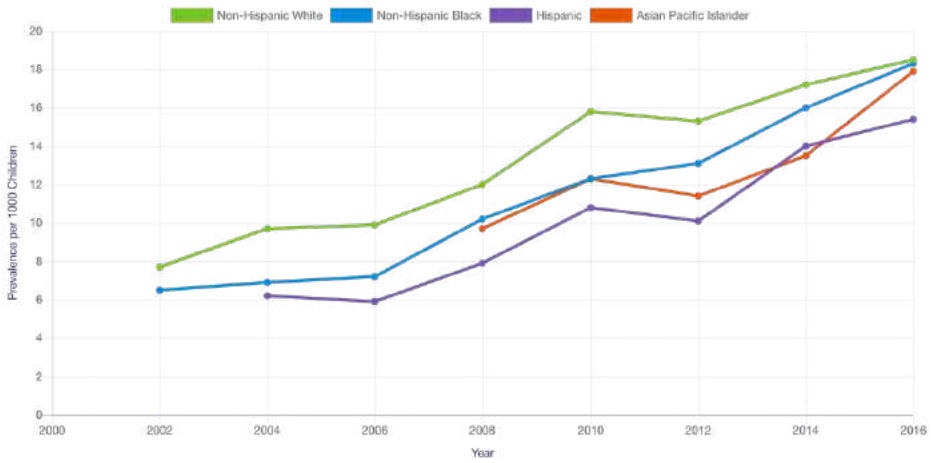


Figure 2-87- Prevalence Estimates by Race/Ethnicity. [Image] (2016) Retrieved from https://www.cdc.gov/ncbddd/autism/data/index.html

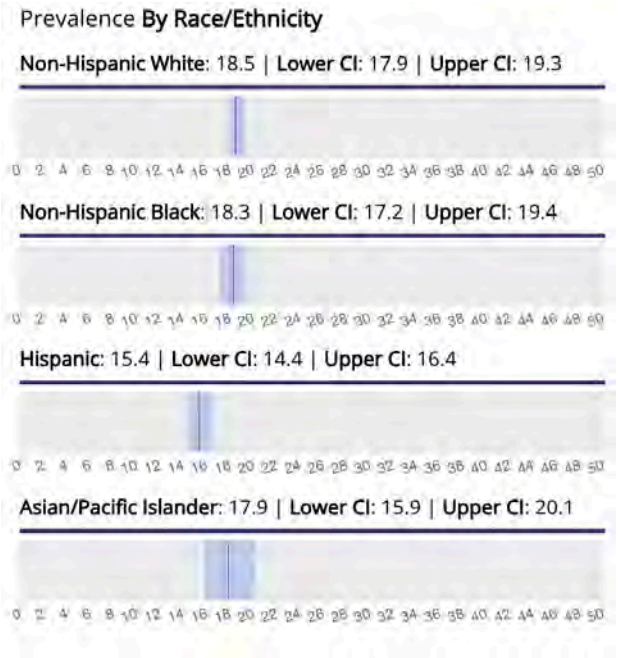


Figure 8-89 – ASD Prevalence. [Image] (2016) https://www.cdc.gov/ncbddd/autism/data/index.html#explore

Education. Statistics surrounding education so that about 11% of children experiencing ASD required special education services in 2016 (in the United States).

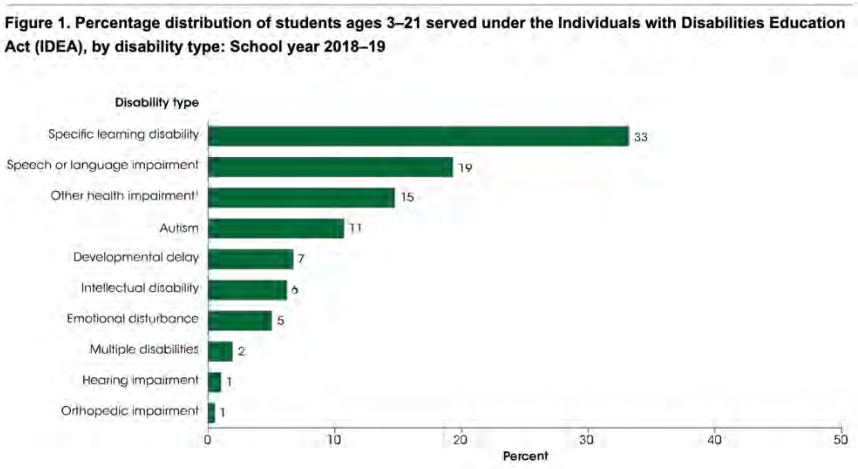


Figure 8-90 – National Centre for Education Statistics. [Image] (2016) Retrieved from https://nces.ed.gov/programs/coe/indicator_cgg.asp

Income: Statistics regarding income show that children whose family lived below the poverty line, received their ASD diagnosis later than children whose family income was higher.

	%	Age Diagnosed Mean (SD)
Total	--	3.1 (1.7)
Demographics		
Male	86	3.0 (1.6)
Female	14	3.4 (1.9)
2 5 y of age	40	2.7 (0.8)
6-9 y of age	26	2.9 (1.1)
10-13 y of age	22	3.4 (1.5)
14-17 y of age	9	3.9 (3.0)
18-21 y of age	3	6.9 (5.4)
White	82	3.1 (1.6)
Black	10	3.0 (2.4)
Asian/Pacific lslander	3	2.8 (0.7)
Native American	2	4.7 (4.8)
Latino	3	3.3 (1.1)
Adopted	3	3.5 (1.3)
Rural	22	3.5 (2.2)
Suburban	54	2.9 (1.1)
Urban	24	3.2 (2.2)
Income		
Below poverty level	15	3.6 (2.8)
From poverty level to 100% above	18	3.2 (1.9)
>100% above	67	3.0 (1.3)
Symptoms		
Does not respond when called	85	3.0 (1.6)
Self-injurious	47	3.0 (1.4)
Severe language deficits	90	3.0 (1.7)
Oversensitive to pain	16	3.3 (2.0)
Aggressive to others	49	3.0 (1.4)
Insists on sameness	72	3.1 (1.6)
Lack of eye contact	87	3.1 (1.7)
Sustained odd play	72	3.0 (1.4)
Echolalia	58	3.4 (1.9)
Hand flapping	68	2.9 (1.4)
Toe walking	52	3.0 (1.8)
Spins self	41	3.0 (1.3)
Other clinical features		
Mental retardation	30	3.3 (2.1)
Hearing impairment	3	4.1 (3.2)
Seizures	10	3.2 (1.6)
Health system interactions		
1 primary care physician before diagnosis	34	2.9 (1.0)
2 primary care physicians before diagnosis	39	3.2 (2.0)
3 prirnary care physicians before diagnosis	16	3.3 (2.1)
[less than or equal to] 4 primary care physicians before diagnosis	11	3.2 (1.2)
In response to concerns about development, the primary care physician		
Conducted developmental tesis	12	3.1 (1.3)
Referred to a specialist	34	3.0 (1.6)

Figure 8-91 – Factors Associated with Age of Diagnosis Among Children with Autism Spectrum Disorders. [Image] (2005) Retrieved from https://link.gale.com/apps/doc/A140304285/AONE?u=humber&sid=AONE&xid=45623097

Discussion / Conclusions

Based on the Google Image Search, as well as the compilation of statistical data from primary sources, it is ascertained that ASD is commonly diagnosed in children of Caucasian background. It is also analyzed that children as young as two years old are being diagnosed with ASD, in fact, there is a significant onset of ASD that is being diagnosed earlier than previous years. It is also known that children from Kindergarten all the way to high school are taking

advantage of special education programs. Similarly, children whose family income is greater than median, have an earlier diagnosis rate than children whose families live below the poverty line. None of this data is surprising, in fact, both the Google Image Search as well as the statistical data collected confirm the same findings.

Appendix C – Product Research

Benefits Table

Key Benefits of Comparable Products	
Keyword	***Frequency***
Comfort	11
Style	9
Ease	7
Efficiency	6
Fun	4

Features Table

Key Features of Comparable Products	
Keyword	***Frequency***
Frame	11
Fork	9
Seat	7
Tires	6
Suspension	4

Appendix D: Analysis

Empathy Map

Thesis Topic: *How might we improve air travel for children with Autism Spectrum Disorder?*

***Objective of the user observation**:*
To determine the main pain points of the user while as they pack for a trip, enter the airport, check-in at the counter, go through security, boarding as well as spending time within the aircraft once seated.

User (individual or group):
The primary user is a child with ASD, aged 2-8 years. The secondary users are the parents or guardians travelling with the child, the siblings if they have any and the tertiary users are airport as well as airline staff, and other passengers.

User Background:
The primary user is a child with ASD, he is now an adult and is 28 years old. He frequently travelled with his parents, one of whom was stationed in another city which was a few hours away by flight. This meant frequent air travels to see the parents before the child was even diagnosed with ASD.

Method:

Interview

The goal with this interview was to speak with the mother of a child with ASD, to gather her experiences and perspective on the challenges that may arise during air travel. This was accomplished through a set of questions directed at the parent and recorded and later transcribed.

Recording Techniques Used

The interview was done on zoom and recorded, later transcribed on the Ottr app.

Results:

The expected results include a detailed conversation with the parent of a child with ASD, outlining their experiences travelling by air and the challenges that came up.

Analysis:

The Empathy Map

The Empathy Map insights into generates insights into Pains,

and possible solutions which make the task easier, more productive, or more enjoyable?

Result

Transcript

"Shown below is a sample of the transcript taken from the interview with the user.
The transcription was generated from Ottr.ai."

Unknown Speaker 0:01
Okay, so we're recording and I'm just gonna put it here on my phone by the speaker on my computer. Good.

Unknown Speaker 0:08
Perfect. Well, thank you so much. I apologize.

Unknown Speaker 0:11
No worries.

Unknown Speaker 0:13
All right. Well, thank you so much

Unknown Speaker 0:16
for taking the time out to speak with me today. No worries, I'll give you a bit of background about maybe why I'm doing this and what I'm looking for. So I'm, I mentioned to you in the email, I'm a fourth year industrial design student at Humber College. And were completing our thesis in our final senior year. And my thesis is on air travel and how to improve air travel for children with ASD. Okay, and so I'm trying to reach out to parents, and really my target age group is between the ages of two and eight, but I'm looking to speak to really, anybody who might even fall outside of my Adrian, because they were at 1.2 to eight. Yeah,

Unknown Speaker 0:58

I have. Well, I have, um, I have a lot of experience with this. So with air travel with my son, and I can talk if it would be helpful more about that. Those times between two and eight. Yeah, traveling with him.

Unknown Speaker 1:15
Yeah. Okay. Yeah, no, that would be great. So maybe you can just kind of talk to your experience. Sorry. Yeah,

Unknown Speaker 1:24
absolutely. So my son is 24. And he has autism, he was diagnosed when he was about seven. And we always wanted to our philosophy with him was to try to push things as far as we could, even if it was uncomfortable. And, and it was a very difficult time. So I would say between two and eight, would be probably the most difficult years. Because they don't have the ability yet really to understand what's happening. And so a lot of the reactions are immediate and physical, and intense. And as parents, you've never gone through it before. So it's a surprise for both of you, it's like what's going on here. So a lot of the things I think of my time traveling with Henry is, before I contacted the airlines, and after I contacted the airlines. So in the beginning when he was small enough, um, I would just so things like waiting in line, and possible, and going on with everybody else boarding using the bathrooms. Just generally being in the airport environment with the loud, you know, the boarding calls and everything. Yeah, resonating through the airport. No, he had no concept of, of authority, for example, or what you have to do when so there was no, no understanding for him of the urgency of how things have to go for security reasons. And at that age. So say to, until I realized I could call the airlines, maybe till he was five or six, I would just pick them up and leave the line or, or hold them, you know, carrying more. It was very, very stressful. And then I, I don't know how I realized that I could call the airline. And I think I just called them and said I'm I can't remember whether it was the airport authority or the I think it was I think it was the Toronto Airport Authority with the first people I call and said, I'm, I'm traveling with my son, and it's a really, it's been a super stressful experience. And I'm just wondering if there's anything, you know, we could do to make it less stressful for him. And they were the first people who told me, for example, that you could go through a special line for security. And you could just tell people and they would, you know, put a move you to the front of the line or help you through a situation. Same with pre boarding as he got bigger, you know, that's more after but but before then, so after I contacted the airlines, and they would say well, you go to this person and you tell them are you and they'll help you and I and that to me was a turning point.

Unknown Speaker 5:00
Before then it was

Unknown Speaker 5:04
super, super stressful. Some of the things we did were, you know, we sort of tried to prepare him wrong, which, which is more after a little later, right? When he could understand a bit more. So we would we would say, Okay, so this is what's going to happen, we're going to go to the airport, we're going to do this, we're going to do that. So this is more of an older age. way. But if you want me to focus mainly on that younger age,

Unknown Speaker 5:34
certainly

Unknown Speaker 5:37
being very,

Unknown Speaker 5:38
yeah, whatever your I mean, I'm interested in knowing

Unknown Speaker 5:41
all right, well, I'll just meet at those beginning ages, you, you have to be and I was often at that when he was younger, traveling by myself. My husband was busy working, and we would go, we lived in Halifax for four years. So Henry, and I would fly back back and forth, and my husband would drive or write Henry and I would take family vacations with my family, and I would have to fly with him alone. And it's really good if people can, for example, have a buddy to travel with, because you really need two people. One to deal with what needs to be done, and one to manage the child with autism. And when you're on your own. It's so it's really hard. So but adding in that element of I can approach people at the airport. Um, that had never occurred to me. And it changed everything. For me. It changed everything. And then the bathrooms, I mean, it just in terms, it was very, you know, when he was younger, I could take him into the bathroom with me. But then as he got older, I couldn't, you know, people would start, you know, got very uncomfortable with that. And so I would have to wait outside the bathroom door at the airports and it was really stressful. Like, yeah, because you just never know, right? And so he would have to go in and I would wait and wait and wait. And yeah, I would have to ask people that, could you? Could you please go check if because I couldn't go in. And sometimes I just say like, Henry, are you in there? And so that, you know, I often thought that if they had family bathrooms at airports,

Unknown Speaker 7:35
right? Um,

Unknown Speaker 7:37
you know, for when they got older. That would be really good. Right? The big thing when he was younger was the airline. The air steward the air, I can't remember what they're called down not stewardesses. Air. Sorry, the words leaving there, but you know, the air because

Unknown Speaker 7:55
the air hostess Yeah,

Unknown Speaker 7:56
I don't know, anyway, but they used to insist that I, you know, I had to take off his headsets and his ear protectors and also put them in his seat, which I, when he was really little, it's like, I really need to just hold on to them. And they would say, No, he has to go in his seat, and put on the seatbelt, and take off the headsets. And, and that was really stressful for Ray, because a lot of his sensitivities are, are noise. So and that just was very common for him. So that was always an issue. It was stressful. And I'm not understanding, you know, when you came down from a flight,

the air pressure that your thing? Yeah, that was very hard. He would get quite panicky about that, because he didn't understand it. Yeah, so but we were really. So those early years were very, very difficult until I reached out to the airport staff. And, and some of them were better than others. I feel now that perhaps it's in a piece of the training that should be in place. A shorthand because often I would have to explain.

Unknown Speaker 9:17
Right, like,

Unknown Speaker 9:20
I just needed a shorthand, you know, to say, yeah, look, I'm having a really hard time here. Can we just come in? You know? Absolutely. Because they, they will have tantrums. They will, you know, they really just didn't understand and

Unknown Speaker 9:37
yeah,

Unknown Speaker 9:39
it was very hard. So later on, you know, when he was able to sort of understand concepts and a little bit more about time and was able to talk with us, we would do the you know, the preparation and pictures and this is what's going to happen and and then each stage through the journey, we would, we would, you know, talk about where we were and what was going to happen next. And, and, and we would, you know, bring things for him for his ears, but those moments are still very stressful even. Even now that he's ready, or he gets get panicky about that. Yeah,

Unknown Speaker 10:20
yeah. Um, so.

Unknown Speaker 10:25
Yeah, so so I'll stop there, and you can maybe have given me questions about what I'm saying.

Unknown Speaker 10:32
Yeah, so I guess, um, you know, just going to further on some of the stuff you were talking about? Yeah. Um, I would maybe just ask you a few more questions like, what do you think was the best way to cope with the challenges that you just mentioned? And how did you kind of recenter

Unknown Speaker 10:54
Penry? Well, when he was younger, it was,

Unknown Speaker 10:59
I mean, I remember listen to chasing him through an airport. And he, he and having to actually sit on him in the airport, because he was having a tantrum about, he wanted to push carts, and he was pushing the carts and banging into people, and oriented things, right. And this isn't, you know, he was younger, but still big enough, too big that I couldn't just grab them hold on to it.

Yeah. And I remember saying, If you don't, you know, it's also personal. But I remember saying, you know, if you don't, this is not okay. And then if you don't stop, I'm gonna have to call a security guard, because this is not allowed. There was a period where he was little where he didn't understand. And I could just physically guide him, you know, pick him up, carry him go to someplace different. But then when he was that middle age, where it was a little too big, like six to eight, nine, where he was really tough. And I started being very definite about what is allowed, what is expected, what is unexpected, what is what will get you in trouble. As an adult, you are not allowed to do this, this is what will happen. And I was quite straightforward with him about his behaviors. And society. And it wasn't always successful. But like, but over time, it was successful. Like, it's extremely, it's almost like a traumatic experience. And I I don't, I don't like, I don't enjoy talking about it that much. Because we were learning, and he was learning. And there are no perfect ways there are, every child is different. And you can have your picture cards and your, you know, headsets and your coloring books. And you know, every day you're trying new things, every day, your things are working, things are not working, you're going with things you're coming back to things. So sometimes stickers work, sometimes candy works, sometimes money works as motivation, depending on different things. Sometimes, you know, we'll get a treat, or we can look at this book or play this game. Really, it's about from the parents perspective. It's about flexibility and, and foresight. I mean, as he got older, and we got better at it. And we were able to sort of anticipate difficulties and plan for those and it certainly helped when my husband and I could travel together. Like it would be like okay, I'm gonna do this. You're gonna stay with him. And a big you know, a big part for Henry was crowds. A lot of triggers, you know, in an airport, it's like a triggers trigger Central. Yeah. So, you know, we started traveling with carry on luggage rather than big suitcases. So we could just be so we could just not avoid the lineup for luggage. Avoid the lineup getting your stuff, right. Yeah. So we so we sort of adapted and seating on airplanes. You know, I think that would be a big improvement. Yeah, like we never when you're sitting in those little seats, sometimes he would start you know, banging on the back of a seat or, you know, doing things that I mean, I can tell him to stop but sometimes it would ask, right, so you have to avoid. You have there's a fine line. You're trying to avoid escalation in those situations that are extremely uncomfortable after a while teaching at the same time, the proper way to behave. But I always thought that, you know, sitting in the bulkhead would have been, you know, ideal for us because, yeah, there's more space, you don't have to worry about upsetting other people. Yeah. Um, so in terms of improvements, I was thinking, you know, the the seating arrangements, oftentimes we would be like, well, I'm sorry, you can't sit together and it's like, wait, you don't understand.

Unknown Speaker 15:27
Yeah, we have to sit together.

Unknown Speaker 15:30
Yeah, of course. Yeah.

Unknown Speaker 15:32
So, um, yeah, but often, you know, seating, bathrooms, the noise in airports. I know. There's lots of airports now where they have I think Barcelona Helsinki, where they have silent airports. Where, where the the announcements are only happening near the boarding gates? Hmm. Yeah, you really noticed that when you're in a quieter?

Unknown Speaker 15:59
Yes.

Unknown Speaker 16:00
Yeah. So does that.

Unknown Speaker 16:03
Does that answer?

Unknown Speaker 16:06
Yeah. Sorry, your voice is actually cutting a little bit. It's just kind of going in and out. So I got your last sentence. I wasn't sure if you. I wasn't sure what you said last right now?

Unknown Speaker 16:20
Oh, um, well, it'll be on the recording.

Unknown Speaker 16:24
Yeah.

Unknown Speaker 16:26
Well, what? We were talking about the bulkheads.

Unknown Speaker 16:30
Oh, no, no, I meant no, I got that. I. I just might like, I didn't know what you were asking if there were any other.

Unknown Speaker 16:36
Oh, yeah. Just Just something. Yeah. If you just have Is there anything else that I that? I haven't mentioned that or that you'd grab more information about? Or?

Unknown Speaker 16:45
No, I think you you covered a lot. And I really do appreciate you talking about this. I know. You know, it's sometimes difficult to explain to people that probably don't understand how challenging these things can be. What you know, others kind of don't realize, you know, for them, it's not the same experience. I really do appreciate. Oh, yeah.

Unknown Speaker 17:09
Talking about that. No problem at all.

Unknown Speaker 17:11
Yeah, and I think just pushing ahead, just just not giving up like, yeah, yeah, there's this whole thing with autism now. You know, what there has been over the years only everything has to stay the same and be predictable stuff. But you also have to prepare your child to be a person in the world and you know, with Henry now, I mean, we've we fly we flown from to Europe four

times. There back we, you know, he's he has become a traveler. Yeah. And he's even got his own. He's started a YouTube video.

Unknown Speaker 17:51
Okay. Yeah.

Unknown Speaker 17:52
I don't know. Have you seen that?

Unknown Speaker 17:54
No, I Well, I believe it was I forget her name, but I was speaking to. But she mentioned Henry's YouTube and I pulled it up and I haven't gotten around to watch Yeah, videos, but that was definitely on my Yeah,

Unknown Speaker 18:07
yeah. Let's do

Unknown Speaker 18:08
well, when you watch them you if you do, and it would be very interesting for you to do so I think for your project. But he he's come a long way. Yeah. And and you know, you don't you don't see that. You don't people don't know. Yeah, what goes into that. And a lot of it is perseverance and just not just keeping flexible, keeping strict constantly thinking of strategies and anticipating problems and reaching out more, I think, yeah, at the beginning, you're so confused, and you're so scared, and you don't know what's going on. And, but as you as you mature as a parent, and you start to reach out and realize you can't do it by yourself, you know? Yeah, so

Unknown Speaker 19:04
yeah, those No, absolutely. Yeah, absolutely. Um, I think it's, it's really commendable, you know, that you've that he's been able to, you know, navigate life through an environment that isn't always conducive to or for children with ASD. No, no, not at all.

Unknown Speaker 19:26
Not at all.

Unknown Speaker 19:27
Yeah, it's challenging in so many ways, but

Unknown Speaker 19:30
a lot of new things, a lot of any, any improvements that you would make in an airport, you know, designer would be would benefit many, many people.

Unknown Speaker 19:39
Yeah, yeah, of course. Absolutely. And I think you know, with COVID, and, you know, this recent virus, pandemic, I think we're starting to see just how I'm doing different I guess things can be in an airport and these areas that have been impacted so deeply. I mean, air travel is

probably something that we won't ever you know, see Same again. I mean, there's so many things that we used to do that has just changed. And I think these changes are probably going to be for the better because out of this change will come. You know, this new kind of experience that I hope incorporates all of these challenges that, you know, children with ASD face, maybe other. You know, accessibility issues that Yeah, the airport doesn't take into account. Yeah. And there's so many through different stages of your travel process.

Unknown Speaker 20:31
Yeah. Especially for people, you know, in wheelchairs and

Unknown Speaker 20:34
yeah, you know, bathroom accessible. Yeah, just I think the aircraft itself and how small it is. It's just not Yeah, it's not the best experience I can't imagine. Well, it's

Unknown Speaker 20:47
not the best experience if you don't have disability. Yeah.

Unknown Speaker 20:51
Absolutely. And add on a layer of fat. So it's, it's definitely more complicated. Yeah. Yeah. Absolutely. Well, I don't think I have any other questions. I think you've you've covered everything that I was kind of hoping to ask you. Okay.

Unknown Speaker 21:10
I'm just checking it out. I was just talking to my husband. Before and things yeah, things that we could remember that. Yeah. So the main things were the family, you know, the bathrooms, and be able to identify him. Even when you book your tickets, because they'll say Do you have any disabilities? Right are any issues and there's never a place for autism? It's it's always, you know, other types of disabilities? More namely, physical disabilities, they don't have anything for mental disabilities. Yeah, seating. Yeah, training for airport stuff, I think. And sound reduction headsets, you know, being aware of the, the need, because if your child is traveling with their parent, you know, they're safe.

Unknown Speaker 21:59
Yeah, I guess one more question I have for you was, what was your experience? Like with other passengers? Has there ever been an instance where you felt constable? Oh, for

Unknown Speaker 22:09
sure. Oh, for sure. Oh, it's, it's it's constant. And, you know, people don't understand. And so you, you often have to explain, and it's humiliating, right. So right. Um, but some people are fantastic. Like, you know, right away someone has experience with autism, they know right away, right. So, and same with stops at an airport. They know. But But people, for people who don't know, it's not that super, it's not that, you know, it's very uncomfortable. So it was pushing in line, or if he's, you know, getting upset, or if he's banging on a seed and, and I'm trying my best sweating trying to make him distract him? Or, you know, redirect him or, yeah, it's not easy. And you're very much on your own in many ways, as a family. It's a very isolating experience, in many ways. Because people just do not understand. Like, even your own family members, like

Christmas time, and you know, all these kind of high stress things, right? And you don't quite get, they don't quite get it. So. And so. Sure. I mean, you but you'd be you get used to being isolated. and looked at Kind of, yeah, and

Unknown Speaker 23:42
that's Yeah, you just get used to that.

Unknown Speaker 23:46
Kinda

Unknown Speaker 23:49
kind of.

Unknown Speaker 23:52
I wonder, I mean, I wonder if it's almost did you find that it was more helpful to let people around, you know, that you're traveling with Henry

Unknown Speaker 24:00
Well, it's a fine line, it's a fine line, because you have to consider the dignity, his dignity. And of course, and as he got older, more and more so.

Unknown Speaker 24:12
And you also

Unknown Speaker 24:15
you don't want to just tell everybody, you know, you want it you you want to try to make it work and be as cool as possible, you know, like, you know, this is gonna happen and as positive as possible. Like you always start with your heart is full of positive energy and you're gonna do a thing and, and then those that when the incidents come up, they're heartbreaking. It's It is literally heartbreaking. Because you can have plans, you can have all your stuff with you, you can, you know, be doing your very best and then sometimes things just the wheels fall off the wagon and describe like, Oh, here we go. And and Yeah, you know, sometimes you will do that. Yeah, you will, you will reach out and tell people and

Unknown Speaker 25:06
yeah, I hope that we come to a point where people kind of develop a little more understanding and you don't need to always have to explain. Yeah,

Unknown Speaker 25:14
well, you know, now the world is becoming more

Unknown Speaker 25:18
inclusive. And I mean, you'll have to watch even if you can just watch the trailer of Henry's video. It's, it's very it's very much a combination of many years of of, of love and effort. Yeah.

Unknown Speaker 25:35

Ah, I'm actually pulling it up right now. And that'll be that'll be my, my thing for today is just watching. watching his videos. Um, I think I'm gonna learn a lot. Just kind of.

Unknown Speaker 25:49
Yeah. And if you want to speak to him, you can. If you ever do, he's, he's, he's, he's a great, great talker. And he just sometimes doesn't get facts, right numbers and stuff. So I could I could help with that. Yeah, yeah.

Unknown Speaker 26:05
Yeah, that would be great. Well, I really do appreciate you talking to me today.

Unknown Speaker 26:11
No worries. Talking about

Unknown Speaker 26:12
your experiences. Yeah, I thank you so much.

Unknown Speaker 26:15
Well, if you think of anything else you'd like,

Unknown Speaker 26:18
you know, I wish I'd asked her this or I don't understand

Unknown Speaker 26:23
a specific thing. When you're doing your thing, just let me know. And I'll, I'll send you this. The recording through we transfer? Sure. Yeah. So you basically just click on it and open it and download it. And that seems to be the best way.

Unknown Speaker 26:39
Yeah, that would be great. Thank you so much. I'll keep you posted on my thesis. So if you're interested in kind of knowing the outcome, and maybe reading the report together, or seeing the final product, I would love to send that over to some

Unknown Speaker 26:53
Sure. Yeah, share them be great. So and I'll send you got the forms, right?

Unknown Speaker 27:00
I did. Yes. Okay. I send you those sent you. Perfect. Thank you so much, Captain. It was really nice to talk to

Unknown Speaker 27:06
you. Okay, good. I hope I didn't overwhelm you with information or no,

Unknown Speaker 27:10
no, not at all. I learned a lot and I'm so thankful that you that you shared your experiences.

Unknown Speaker 27:16
Okay. All right. Well, I'll send this to you now this this this requirement. Okay, perfect. Yes. Great. Best of luck with your project. Thank you so much. Okay, take care. Bye bye.

User Observation: Youtube

Results

Transcript

"Shown below is a sample of the transcript taken from the user observation.
The transcription was generated from Otter.

So I'm just sitting down to do a user observation for a YouTube video titled airplanes and autism. And the idea is to essentially do a walkthrough of the video and try and pinpoint some things that stand out.

As well as the points in the journey where expectations are not met, perhaps some unnecessary touch points or interactions, as well as some low points or points of friction. We're going to be doing this by going through the different major stages of the actual journey of this child that has ASD traveling by air with their family. And in addition to this, we're going to be identifying some high points or some points where expectations are met or they've exceeded.

Once someone with intellectual disabilities travels, things can go very, very wrong. This is how we made it through security.

She is super nervous super upset, even me okay.

An Oregon family traveling with a 15 year old girl with autism was kicked off United Airlines Flight this week.

People of determination how we in the UAE refer to people with disabilities might find themselves stressed.

Okay, so this video, I guess, the person that's narrating This is the Father. And this is probably a personal blog, and they're going to take us through their journey with their child. But they start this video off playing some news clips of families and children with ASD that have experienced some low points in their travel journey and have either gotten kicked off in airplane for exhibiting some autism symptoms, or they've experienced other challenges with passengers and air airline staff. And now we'll continue playing the clip and you'll hear some narration from the video.

And this is their natural way of reacting. They mean no harm Salama and I have a beautiful child, Abdullah, who is on the autism spectrum. And I would never want this situation to happen to him or any other child when they're traveling. So what can be done? How can we all prepare to avoid situations like this? Earlier today, the family and I took a trip from above to Bahrain to

show you how let's start at the beginning. I just wanted to double check with you that the dpma code has been finalized for Abdullah's ticket.

Okay, so at this point, the father is or has introduced to us that his child has autism. And they'll be traveling from abudhabi to Bahrain. And and the video starts off with the father's speaking to airport staff and I did some research on the dpma code. He mentions the dpma code, which is essentially the disabled passenger with intellectual or developmental disability needing assistance. And you can use this code to book flights for passengers with autism Down syndrome and other neat special needs. So he's chatting with the airline staff making sure that they're aware of the child's special needs and that they're booking all flights under this Specific DNA code. So he's doing what he can to prepare the airline stuff and let them know that they are traveling and that this specific air travel will will require certain needs for the child. And I think what we're missing from this blog is, you know, the parents typically introducing the child to the idea of air travel. And that, of course, depending on the spectrum that you're on the spectrum that your child falls on and how serious their needs are, and maybe what they what the family does to prepare them but this in this blog, they probably did that off off video.

I'm nervous.

Leave to the airport in about an hour. I have no idea what to expect but what I do know is what we learned on this video has the potential to change a lot of life.

For me that So here we go. Put your game away. Come on. We're gonna go on the on the plane

in 2008 The International Airport For Association introduced a code called d p and a we Can be used with travel agents and airlines to alert Boom when a passenger has no intellectual or developmental abilities and needs Systems

So At this point The father is essentially explaining what dpma co is and that they're utilizing that For their travel plans, you can see in the video that they've packed very light and that kind of speaks to the nature of their trip, but Through our research, we found that a have parents when traveling with a child that has ASD tend to pack light the Don't like Traveling with luck. That has to be checked in because that adds one extra step that might, you know, present other challenges for the child and for the parents and so whatever that they can take away Add them on flight and store in cabin. It's easy for them and they To do that so that they can exit the plane quicker and move on to the next stage of their journey.

Wow

So when you're booking your next flight with an airline or a travel agent, and you use this code, it allows you to list requirements that you will have when you travel. Since getting to the airport, everything has been super.

So through this dpma code you're allowed to, or you're able to tell the airline staff and the airport staff what your child's needs are and a list of your requirements. So the process is made

a lot smoother for you. And you're not having to go to the airport and run around coordinating with different authorities to arrange the services that you need for your travel.

When we got to guest Information Services, they knew exactly about the code, where to go. We checked in using the dpma code. Right. Awesome. Thank you so much.

So I'm pausing the video here and I just want to mention that the DPN a code you can tell makes it very easy for parents and families traveling with you children that have ASD because the process is more efficient. parents know what to expect. They know what to do and then when they get to the airport, and they're With the appropriate authorities, the authorities also know exactly what to do under the DPP. On a cold, so It makes that stage of the travel journey a lot easier and smoother for both the parents and the families and most importantly, the child that has ASD

just services as soon as We told them that we've used the dpma code they told us to check in from counter seven Six to eight. So when you look up the first thing you see from counters eight to 76 are the they are the family checking. They're already dedicated for family. And that's what we've been assigned to when you use the dpma code, whether you're a full family or not We have Abdullah book under the dpma. With the defendant book, you have the requirements and everything. That's okay. Okay.

Do you want to be bored first To the to the to the aircraft.

Yeah, I mean if that's possible and possible

As a family, we're going to be together right? Yeah,

no problem.

All these aren't getting together.

So I'm pausing the video again to mention Not the airport staff upon check in, is asking the family if they'd like to board first and that there'll be boarding together and they'll also be seated in the plane together. And I don't know if this is something that's offered. Just through or under the DPN a code or a standard procedure to ask a family but I'm I'm certain that because They're traveling under the dpma code. This is something that they offer the fam To make it easier for them, they don't have to wait in line. They don't have to wait through a crowd. A busy crowd they can they can board the plane and be seated and the child doesn't have to be exposed to situations that may aggravate their behavior. I'm going to repeat play the video

You're supposed to get quick access onto the flight. So they'll bring it to the front of the queue if necessary. Make sure you get on the bus. First we're going to board as a family sit together as a Family anyway tend to get on the bus.

Good pausing the video To know that the children in the video Right now they're very humped. They're at ease. They're playing the pair have handed them so Paper To play with and so think that there coloring on You can tell that Because they're not In the crowded in environment

Children are a lot more comfortable with where they are. So far there are no other obvious changes in their behavior that may be on set by ASD You

Put in the deep end code, we put a list of requirements, one of those requirements were that we all got to sit on the same row. And we all got to board as a family, sometimes they split you up. And that can be a source of stress for a child on the autism spectrum. So we just want to keep things as normal as possible it to have catered to that. And we're here, all comfortable ported to hamdulillah. Another thing an airline can do is keep the seat next to you for as long as possible to keep it empty until the plane is completely boarded. That gives you a better chance to have that little extra space.

So at this point, the family is seated. And as the Father pointed out, they were first to board and so they're all seated together. And because of the dpma code, they try and keep the seats that are in that same row empty for as long as possible so that the family is more comfortable and the child is more comfortable. And another thing I'm noting is that they're sitting on the absolute front row, so there's nobody in front of them besides that, that barrier wall. So there's a lot more room for the child.

And there's nobody sitting in front of them. And the child is very happy, he's comfortable. He's looking out the window, he's playing with his mom, there doesn't seem to be any point of stress at this stage of the journey. Now back to the video, sure that the passenger is comfortable, and that you have that space to take care of them. If they're stressed out if they feel anxious. This is really important. You just need that little bit of space, something that's all

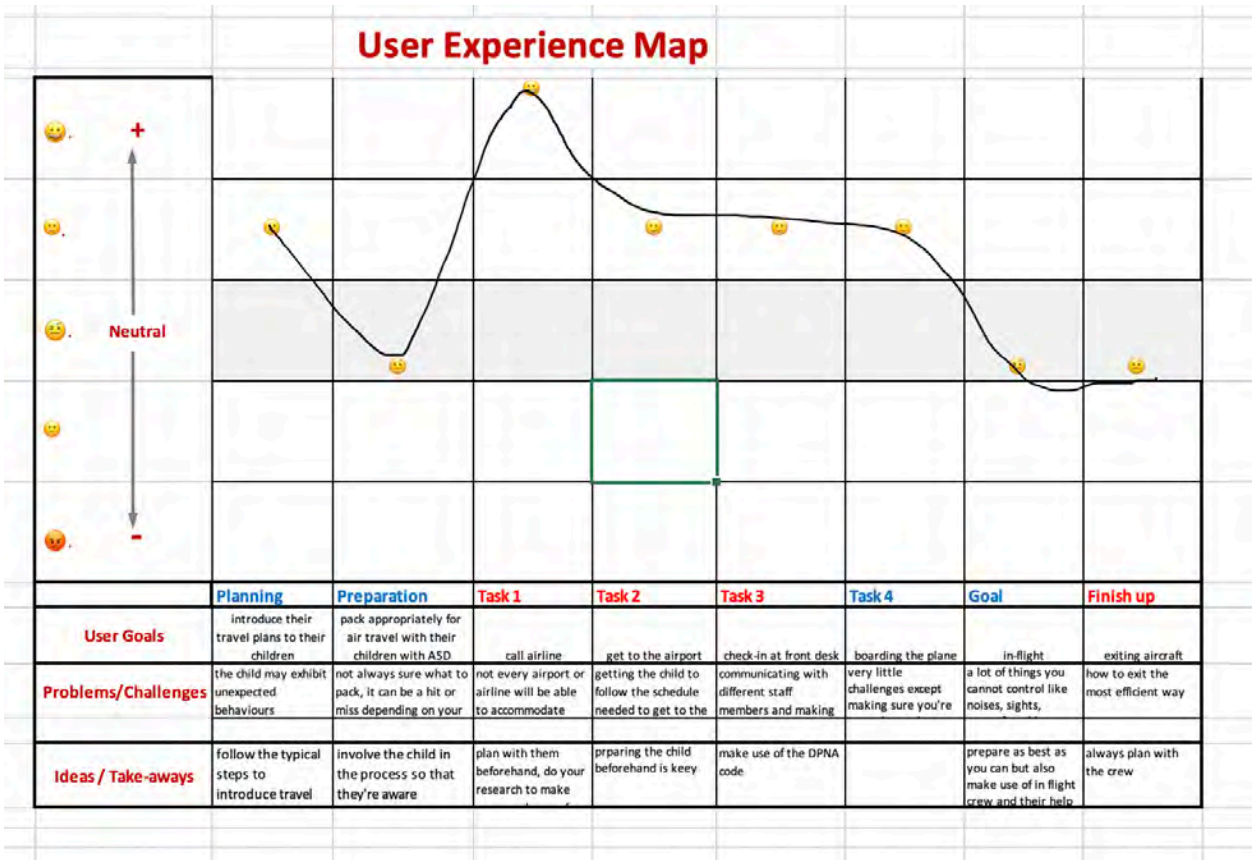
20 minutes to landing and it's been like this.

I mean, everything's been comfortable. They've checked in on up double a couple times. Pretty cool. Everything's just been really good. That's like a parent's dream.

So I'm pausing the video here to expand on what this father is saying there's still is nobody seated next to them the children are still very comfortable, they're happy they're playing. There seems to be no stress in this environment.

before lunch we have landed safe and sound And we use that code and it made a huge difference in how we felt when we were flying because The airline were aware and that gave us so much peace of mind. company culture Travelport, Digg research and others 200 and 50 million flights that they booked in two Thousand 18 The code was only used 4000 times That's like zero points. 00001 5% or so The like that and that to me is sad because You're seeing these situations happen around The world But the solution exists What needs to happen is we all To be restored And You think awareness about For me, the biggest concern is The code exists DPNA exist. We all can use it. But airlines are not required to They don't have to do anything. But that's why or awareness and raising the issue It's so important As a father Apparently using this code has changed the way we travel and it's been To change the way we try For the rest of our lives For the rest of Abdullah's life Because when it comes to inclusive travel, we are all responsible. Mahatma Gandhi famously said Be the change you wish to see in this world and that is what needs to be done. The responsibility lies on All of us that is one real change is made Much love

God bless you So the video has ended. Now I'm going to pause it And just end on the note that this fall There was mentioned About the code existing It's not you As often As Perhaps a could be maybe family aren't aware Have it And because you airlines are not rigged wired to do anything to accommodate maybe needs to be more awareness right?



	Planning	Preparation	Task 1	Task 2	Task 3	Task 4	Goal	Finish up
User Goals	introduce their travel plans to their children	pack appropriately for air travel with their children with ASD	call airline	get to the airport	check-in at front desk	boarding the plane	in-flight	exiting aircraft
Problems/Challenges	the child may exhibit unexpected behaviours	not always sure what to pack, it can be a hit or miss depending on your	not every airport or airline will be able to accommodate	getting the child to follow the schedule needed to get to the	communicating with different staff members and making	very little challenges except making sure you're	a lot of things you cannot control like noises, sights,	how to exit the most efficient way
Ideas / Take-aways	follow the typical steps to introduce travel	involve the child in the process so that they're aware	plan with them beforehand, do your research to make	prparing the child beforehand is keey	make use of the DPNA code		prepare as best as you can but also make use of in flight crew and their help	always plan with the crew

Figure 8 -91 User Experience Map

Appendix E: CAD Development

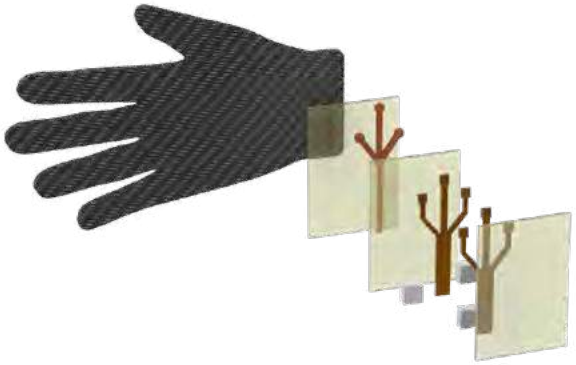


Figure 8 -92 CAD For Senso

Figure 8 -93 CAD For Hand Pump

Figure 8-94 CAD With Hood Down

Appendix F: Approval Forms

TCPS 2: CPRE Certificate of Completion


PANEL ON RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE

Certificate of Completion

This document certifies that

Incia Khalid

has completed the Tri-Council Policy Statement:
Ethical Conduct for Research Involving Humans
Course on Research Ethics (TCPS 2: CORE)

Date of Issue: 2 October, 2020

Signed Topic Approval Form

IDSN 4002
SENIOR LEVEL THESIS ONE

Humber ITAL / Faculty of Applied Sciences & Applied Technology
Bachelor of Industrial Design / FALL 2020
Catherine Chong / Sandro Zaccolo

FTA-4 THESIS TOPIC APPROVAL (TEMPLATE)
This project/assignment constitutes 5% of total mark for the course

Start: Week #4 / Sep-28
Due: **Week #5 / Oct-05**

THESIS TOPIC APPROVAL:

Student Name:	Incia Khalid
Topic Title:	How might we improve air travel for children with Autism Spectrum Disorder?

Abstract

In recent years, there has been a rise in air travel as the preferred mode of long-distance transportation for both business and leisure. However, airlines are ill-equipped to accommodate the needs of children with Autism Spectrum Disorder, creating an unenjoyable experience for the child, the family and other passengers. For children with Autism Spectrum Disorder, the entire process from packing to reaching final destination is riddled with stress and anxiety. From the moment a child is introduced to the idea of travelling, there are many environmental checkpoints that can trigger the child and induce a change in behavior. This may occur at home, at the airport check-in counter, through security lines, boarding and finally inside the airplane. These triggers can be large crowds, unpredictable behavior of others, intimidating machines, loud noises and small spaces within the cabin. This thesis proposes an in-depth study of these various environments and aims to collect data by conducting observational studies, as well as interviews and surveys in compliance with the Research Ethics Board. The objective is to compile a detailed analysis of this data and enhance the physical, auditory and visual air travel experience for children with ASD. To understand the feasibility of this concept, a one-to-one scale buck will be developed to aid in the evaluation of ergonomics, human factors and full-bodies human interaction design. This will lead to a developed solution that enhances the air travel experience for children with ASD and provides a deeper understanding of the ways in which air travel can be made more accessible.

Student Signature(s): Incia Khalid	**Instructor Signature(s):** Catherine Chong, Sandro Zaccolo
Date: 10 / 15 / 2020	**Date:** 18 Oct. 2020

Chong, Kappen, Thomson, Zaccolo

Thesis Design Approval Form

IDSN 4502
SENIOR LEVEL THESIS TWO

Humber ITAL / Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / WINTER 2021
Catherine Chong / Sandro Zaccolo

CRITICAL MILESTONES: APPROVAL FOR CAD DEVELOPMENT & MODEL FABRICATION

Student Name:	**Incia Khalid**
Topic / Thesis Title:	**Adaptive & Sensory Friendly Clothing For Children With ASD**

THESIS DESIGN APPROVAL FORM

Thesis design is approved to proceed for the following:	[X] **CAD Design and Development Phase**
Comment:	Initial CAD progress well as of week #7/March 1st, continue with detailing and refinement.

Thesis design is approved to proceed for the following:	[X] **Model Fabrication Including Rapid Prototyping and Model Building Phase**
Comment:	Design development progress well as of week #7/March 1st, once CAD is completed, can move forward to model fabrication from week #9 onward.

Instructor Signature(s):	Catherine Chong Sandro Zaccolo
Date:	10th March 2021

1

Chong, Kappen, Thomson, Zaccolo

Appendix G: Advisor Meetings and Agreement Forms

IDSN 4002 /4502
SENIOR LEVEL THESIS ONE & THESIS TWO

HUMBER
Faculty of Applied Sciences & Technology
Bachelor of Industrial Design /

INFORMATION LETTER

Conditions of Participation

I understand that I am free to withdraw from the study at any time without any consequences.

I understand that my participation in this study is confidential. (i.e. the researcher will know but will not disclose my identity)

My identity will be masked.

I understand that the data from this study may be published.

☑ **I have read the information presented above and I understand this agreement. I voluntarily agree to take part in this study.**

Catherine MacKenzie — Participant's Name
Catherine MacKenzie — Participant's Signature
Oct 26, 2020 — Date

Project Information

Thank you very much for your time and help in making this study possible. If you have any queries or wish to know more about this Senior Level Thesis project, please contact me at the followings:

Phone: (905) 510 9093
Email: Incia.khalid@mail.utoronto.ca

My supervisors are:

Prof. Catherine Chong, **catherine.chong@humber.ca**
Prof. Sandro Zaccolo, **sandro.zaccolo@humber.ca**

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HUMBER

Faculty of Applied Sciences & Technology

Bachelor of Industrial Design / [illegible]

IDSN 4002 /4502

SENIOR LEVEL THESIS ONE & THESIS TWO

PARTICIPANT INFORMED CONSENT FORM

Research Study Topic: How might we improve air travel for children with Autism Spectrum Disorder?

Investigator: Incia Khalid – 905 510 9093 – Incia.khalid@mail.utoronto.ca

Courses: IDSN 4002 & IDSN 4502

I, Catherine MacKenzie *(First Name/Last Name)*, have carefully read the Information Letter for the project on air travel for children with ASD, led by Incia Khalid. A member of the research team has explained the project to me and has answered all of my questions about it. I understand that if I have additional questions about the project, I can contact Incia Khalid at any time during the project.

I understand that my participation is voluntary and give my consent freely in voice recording, photography and/or videotaping; with the proviso that my identity will be blurred in reports and publications.

Consent for Publication: Add a (X) mark in one of the columns for each activity

ACTIVITY		YES	NO
Publication	I give consent for publication in the Humber Library Digital Repository which is an open access portal available to the public	☒	☐
Review	I give consent for review by the Professor	☒	☐

Privacy

All data gathered is stored anonymously and kept confidential. Only the principle investigator /researcher, Incia Khalid and Prof. Catherine Chong or Prof. Sandro Zaccolo may access and analyze the data. All published data will be coded, so that visual data is not identifiable. Pseudonyms will be used to quote a participant (subject) and data would be aggregated.

I also understand that I may decline or withdraw from participation at any time, without negative consequences.

I understand that I can verify the ethical approval of this study, or raise any concerns I may have by contacting the Humber Research Ethics Board, Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, **Lydia.Boyko@humber.ca** or Incia Khalid at Incia.khalid@mail.utoronto.ca

Verification of having read the Informed Consent Form:

☑ I have read the Informed Consent Form.

My signature below verifies that I have read this document and give consent to the use of the data from questionnaires and interviews in research report, publications (if any) and presentations with the proviso that my identity will not be disclosed. I have received a copy of the Information Letter, and that I agree to participate in the research project as it has been described in the Information Letter.

Catherine MacKenzie	Catherine MacKenzie	Oct. 26, 2020
Participant's Name	Participant's Signature	Date

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