CYO Airport Story: A Serious Game Airport Simulation

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ABSTRACT

There is a need for tools/interventions that help autistic (or neurodivergent) individuals to be able to prepare to visit public spaces that cause high levels of stress and anxiety, such as the airport. While there are certain efforts that have gone into making the airport more accessible for neurodiverse populations, such as the addition of dedicated quiet spaces and programs like "Wings for Autism", there is a need for more accessible tools. This need can be partially met through the use of an airport simulation, in allowing individuals to practice going to the airport in a more accessible and cost-efficient manner. *CYO* (Choose Your Own) *Airport story*, a serious game airport simulation, is proposed as one such simulation that could benefit anyone with airport-related anxieties (though it is primarily designed for neurodiverse populations). It incorporates the social model of disability in its design, instead of the more commonly used medical model of disability that uses approaches such as Cognitive Behavioral Therapy (CBT) and exposure therapy, which are controversial when used within the autistic community. Special effort has been made in designing this tool that can serve any individual who would benefit from practicing going to the airport (to ease airport-related anxieties) in a manner that gives the user full agency over its use, and within the simulation itself.

1 INTRODUCTION

CYO Airport Story is an in-progress serious game airport simulation that can be experienced over the web or as a VR application. Initially, the idea was to make this a VR simulation specifically, though through my research, it has become clear that the greater accessibility that comes from having the two options has a greater benefit than achieving full immersion. It should be noted, however, that this paper does focus on the benefits of working with VR specifically. *Unity* [1], a game development environment, and *Blender* [2], a 3D modeling environment, are being used to build this project. *OpenAI*, *ChatGPT*'s available API [3], is also being incorporated to add needed dynamism through text. Further research would aim towards incorporating AI more actively within the environment and character designs through 3D models. (This project will be continued beyond DREAM through a master's project course at Tufts this Spring 2024.)

CYO Airport story is intended to help to ease anxieties related to going to the airport. It is meant as a tool that can facilitate the lives of any individuals that experience airport related anxieties, though it is primarily geared towards autistic populations of all ages and abilities that need to use the airport, either regularly or not. Going to the airport, which is not a routine or easily practiced scenario, can cause a high level of stress among anxiety prone and/or neurodiverse populations [4]. This project further aims to incorporate broader appeal through adopting more game-like features, in both function and aesthetics, so that users will be motivated to return to this tool whenever needed. Based on the evidence gathered from relevant research, it is expected that skills gained while utilizing *CYO Airport Story* should carry over into the real world, and in a safe and cost-efficient manner [5][6].

1.1 Autism and Design Needs

Autism spectrum disorder (ASD) is a developmental disorder that can affect the way that people learn, communicate, and interact. The real and perceived limitations of ASD can often be due to sensory sensitivities or behavioral factors that are often difficult for neurotypical individuals to identify or understand. Autistic individuals are prone to experiencing sensory overload in certain environments and to becoming overwhelmed/stressed when routines or plans are changed. Autism is also a very individualized experience, which is why there is not one generalized approach to successfully working with individuals with autism. For this reason, it is important for family members, care takers, and teachers to have the ability to aid in personalizing learning/coping strategies. This can be achieved through further education and accessibility to tools/interventions. While it is important for communities to become more aware of the needs of neurodiverse populations, and to implement methods that make public spaces more accessible [7], these larger systemic changes can take time.

The airport is one such space that can cause significant barriers for neurodivergent individuals. The crowded, noisy, and rushed nature of the airport environment are only a few examples of what makes this public space a particularly difficult one to navigate, especially for those with sensory sensitivities. Going to the airport can also very often mean having to face disruption in plans due to flight cancellations or interactions with airport staff or fellow travelers, which can be especially difficult for those who rely heavily on planning and consistency. Having to go through security alone comes with several scenarios that any individual can find difficult, such as having ones' personal items (or self) examined. While there have been accessibility efforts made within airports, such as the incorporation of quiet spaces or programs primarily geared towards families, such as "Wings for Autism"/"Wings for All" [8], further

research/design is still needed [9]. In particular, tools or programs that can help individuals prepare for the airport, without having to actually go to the airport, would be especially helpful in terms of accessibility.

2   RELATED WORK

Work involving VR, games for entertainment, and serious games are explored as methods for creating tools and interventions to help autistic individuals navigate difficult situations or tasks. Social Stories, both as they are traditionally used and as they have been applied to such tools/interventions, are also explored.

2.1   Use of VR for Autism Tools/Interventions

The use of Virtual Reality (VR) as an intervention tool intended for the autistic community has been an active topic of research since the early 2000s, with its earliest work beginning in the mid 1990s. Both earlier and more recent interventions have primarily focused on themes regarding social situations and a variety of high anxiety scenarios, such as navigating crowded spaces, driving cars, or visiting the airport [5]. In reviewing both early [10] and recent [11] intervention research, it has become clear that many projects primarily adopt the medical model approach, where tools are designed as methods of treatment based on Cognitive Behavioral Therapy (CBT) or forms of exposure therapy. While CBT and exposure therapy have proved quite useful in treating anxieties within neurotypical individuals, recent evidence (including first-hand accounts) [12], [13] has proven that these techniques are not always ideal for neurodiverse populations.

The idea that exposing an autistic person to an environment with loud noises, for example, will eventually lead to that person being able to handle loud noises is not a reasonable expectation, because sensory factors (such as actual physical pain in response to loud noises)

cannot be exposed away [12]. A more ideal approach to this same example would be to assist that individual in finding strategies or tools that can help them face loud environments, such as incorporating the use of breathing exercises or earplugs. These strategies/tools should also be those that the individual has complete control over, as opposed to something that is imposed by another. In response to these more recent realizations, in large part due to self-advocacy efforts from the autistic community, current studies have shifted their focus towards implementing the social model, which puts more emphasis on considerations and support for the individual. This shift in perspective, in combination with simulation qualities found within VR, invites many possibilities for research within this area.

2.2   Use of Serious Games and VR for Autism Tools/Interventions

In parallel to research involving VR as tools/interventions for autism, the use of serious games was also first seen around the early 2000s, as educational tools made primarily for children. Their use has since greatly expanded for all age ranges and for various purposes, such as healthcare, professional training, etc. The main difference between a traditional game and a serious game is that the latter is meant to serve a specific enrichment purpose, outside of pure entertainment. Many traditional game elements can exist within serious games, such as the use of stories and the ability to achieve goals as the result of a built-in system of motivational factors and rewards [14]. Because of the well-documented appeal of games within all age ranges, the use of serious games carries a strong potential for progress and growth within various fields [15]. To date, however, many serious games designed as tools by researchers do not have the same appeal or staying power as those games designed for entertainment, which comes as no surprise [14].

While a serious game VR tool sounds like a natural combination, recent realized VR projects designed as tools for individuals with autism have either simply focused on the linear

progression of tasks or have taken a more passive approach of immersive story telling [16], as opposed to incorporating a more interactive approach. This is surprising, given the immersive strength of VR and its ability to imitate life, which is naturally interactive. Those tools/interventions that are more interactive, unfortunately, tend to lean towards CBT [17] and exposure therapy [18] inspired designs. Within these recent approaches, however, it is noteworthy to find that the use of Social Stories [19], which is a method developed in 1990 by Carol Grey as a way of helping autistic individuals to better understand and prepare for specific events, interactions, customs, etc., have either been directly incorporated or at least referenced within the research.

3 WORK DONE

CYO Airport Story is offered as a path forward in the field of tech-related simulations as tools/interventions for neurodiverse populations. This is based on both early and more recent related work in this area and on further research, including first-hand accounts of neurodivergent individuals, focused on the differences between the medical and social models of disability.

3.1 Proposing *CYO Airport Story*

In reviewing current research involving the design of technology geared towards neurodiverse populations, it became clear that there is merit to turning towards VR technologies [5] [6]. Designs that avoid incorporating CBT or exposure therapy are still needed, however, meaning that designs that support the social model of disability are preferred. It also became clear that the use of serious games (a game whose purpose goes beyond entertainment) as tools/interventions related to healthcare, had great potential [14]. This potential would only increase if these serious games could more fully incorporate those aspects of popular entertainment games, such as aesthetics and motivation design, to increase their staying power

[14][15]. Finally, it became evident that tools/interventions geared towards helping neurodiverse populations visit the airport are needed and are especially lacking for independent adults [7][9].

The design of *CYO Airport Story* is that of a tool for personal use at home and, upon its completion, would ideally be experienced through VR, though the option to navigate the simulation through a webpage will also be available for those individuals who are not comfortable with using (or don't have access to) VR headsets. The game-like nature of this tool, along with the flexibility in selecting the user-experience format, makes the duration and setting of this program/tool quite flexible. When preparing for a trip to the airport, for example, one user may need to turn to using *CYO Airport Story* more regularly when leading up to this trip. While for another user, a single use of *CYO Airport Story* in preparation for a flight might be enough. Given the self-directed nature of this program/tool, individuals would have the agency to implement the use of *CYO Airport Story* themselves as needed, or to simply turn to this tool for fun. Whether the tool is to be used more specifically in preparing for an airport trip or in a more leisurely manner, any use of *CYO Airport Story* should still provide the intended benefits of easing airport-related anxieties through practice [5][6].

3.2 Outlining *CYO Airport Story*

As implied by the title of this project, the users will be able to choose their own adventure, so to speak, as they navigate various locations within an airport. Preceding this specific experience, however, Social Stories will be incorporated as an introduction to *CYO Airport Story*, through the use if AI. Each Social Story will be customized to those needs of the individual user, based on a given user description of their experience of going to the airport as a prompt. Users will be asked to describe what the experience of going to the airport is like for them. The user will have the option to either state this verbally or to type the description through

text. By providing both options, this tool should be accessible to both verbal and non-verbal individuals. Based on clues/tone given through the description, the Social Story will adapt accordingly based on the assumed maturity level of the user. For example, if the user describes traveling with a parent, the story would be more catered to a child. Whereas if the user describes showing their ID at security, the story would be more catered to an adult. To the best of my knowledge, there have not been related projects that focus on customizing experiences to individual users in this manner.

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Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1300.0.29.30)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: /Users/valerie/Desktop/tufts/DREAM/projectDrafts/GetTicket/OpenAIFiles/pyscript_demo/vscode/Ch
eckInSS.py
Please describe what the experience of going to the airport is like for you. Please be as specific as you
can be when describing the things that you like or that you do not like about going to the airport.

Going to the airport means having to talk to people that I don't know and not being able to control very
much.

When it's time to go to the airport, it can feel overwhelming because there are many people there that yo
u don't know. It's not easy to talk to people you don't know, and that's okay. You might feel anxious or
unsure about what to say, but remember that you are not alone in feeling this way.

One way to make the experience less stressful is to prepare ahead of time. You can research and learn abo
ut the airport beforehand, so you know what to expect. Knowing where to go and what to do can bring a sen
se of control and reduce anxiety.

If you're worried about talking to strangers, it can be helpful to have a plan in place. You can write do
wn or practice what you need to say to the airport staff or security personnel. By having your thoughts o
rganized, it can make the interaction smoother and less overwhelming.

Remember that airports are aware of the different needs of their passengers. Many airports have resources
and programs in place to help make your experience more comfortable. They may have designated quiet rooms
or sensory-friendly spaces you can explore if you need a break from the noise and crowds. Exploring these
resources can provide you with a safe space where you can take a moment for yourself.

Going to the airport may feel challenging, but with a little preparation and self-care, you can navigate
the experience with more confidence. Remember that it's okay to feel anxious, and you are not alone.
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Social Story generated by custom chatbot. (created using *OpenAI* and Python)

Following the introductory Social Story, which is in keeping with the design of traditional video games that contain an overall story that sets the individual challenges/scenes within the game (such as saving Princess Peach in various Super Mario games) [20], the user will have to navigate through 4 "scenes" within the airport simulation. Those are the ticketing/bag drop area, the security area, the path from security to the gate area, and the appropriate gate waiting area. To avoid a design that leans towards exposure therapy, the users

will enter each space with certain tools available to them to help them work through their

required tasks within each scene, such as earplugs, sunglasses, the green sunflower lanyard [21],

etc. The use of tools is also very much in keeping with the design of traditional video games,

where users are either given or can collect items/tools for use. Through the incorporation of

tools, furthermore, each scene would match a standard expectation level of noise, crowds, and

interactions comparable to real-life airports. The user could then cater their own experience by

using these tools. With this design, a user who experiences physical pain caused by loud noises

(as described in an earlier example), could simply use the earplugs to experience the simulation

at a lower noise level, instead of being expected to manage repeated exposure to loud noises.

Initial Earplugs, Sunglasses, and Sunflower Lanyard tool designs. (created using *Photoshop*)

Within the ticketing/bag drop area, users will need to choose to stand in line or to go to a

kiosk in order get their tickets. They will then need to drop off their bag. These are the two tasks

to complete before moving on to the security area scene. In the security area, as is true in real

airports, there are less choices. Here, the challenge will be in finding ways to appropriately

navigate this space, based on the line chosen and on any interactions that may occur between the

user and the non-player characters (NPCs). The security scene tasks will be complete once the

user makes it through security and collects their belongings. The next scene will involve finding

the path to the gate area. The challenge here will be in properly navigating the airport to find the

appropriate gate in time, meaning that there will be more opportunities for choices/variability within this scene. Once the user locates their gate, the task for this scene will be complete. The final scene will be the waiting area at the user's gate. The challenge here will involve finding a space to wait and making sure to be ready at the gate once boarding begins.

Outside of the actual tasks that the users will need to complete in each scene, which is comparable to traditional video games where a user might need to collect coins or perform a given series of tasks, there will be further challenges. While the use of challenges can be used in traditional video games as ways to encourage further motivation to play [15], in this serious game, the challenges are those that exist in real life. These real-life challenges will come in the form of time restraints (or of unexpected changes of schedule) and from the interactions (whether expected or unexpected) with NPCs. The task of designing the various NPCs, and all the possible interactions that can occur within an airport, could be incredibly daunting. With the more recent accessibility to tools such as *OpenAI*, however, it is now possible to program NPCs to take on certain characteristics and roles. This way, when approached, NPCs can provide a unique response to every interaction. The hope will be that because these built in challenges are experienced within a game-like setting, that they can have a similar motivational factor as those challenges found within entertainment games [22][23].

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Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1300.0.29.30)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: /Users/valerie/Desktop/tufts/DREAM/projectDrafts/GetTicket/OpenAIFiles/pyscript_demo/vscode/Tic
ketAgent.py
Next?

Hello!

Hello! How may I assist you today?

I need to print my tickets and check a bag.

Of course! I can help you with both of those. May I see your e-ticket or booking confirmation, please? And
how many bags will you be checking in?

Here you go. I will only be checking one heavy bag.

Thank you for providing your e-ticket. I will print your boarding pass shortly. As for your bag, could you
please place it on the scale so we can determine if it meets the weight limit?

Ok. No problem.

Thank you for your cooperation. It seems that your bag exceeds the weight limit for a standard checked bag
. However, we do offer the option to pay for overweight baggage. Would you like to proceed with that?

I guess I don't have a choice do I? Things are so expensive at the airport.

I understand that airport expenses can add up. However, to ensure the safety and comfort of all passengers
, airlines have specific weight limits for checked baggage. If you prefer to avoid the additional charges,
you may consider distributing some items into your carry-on bag or removing non-essential items. This way,
you can bring your checked bag within the weight limit. Is there anything else I can assist you with?

Did you happen to catch the football game last night?

I apologize for not being able to assist with that specific topic. However, I'm here to help with any ques
tions or concerns you may have regarding airports, traveling, tickets, or luggage. Is there anything else
I can assist you with related to that?
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Ticket agent chatbot test. (created using *OpenAI* and Python)

4 RESULTS & DISCUSSION

There is confidence in this design for *CYO Airport Story*, due to the design of currently popular games that are used by people of all ages, which can focus on basic daily tasks within worlds designed with relatively free range. Some examples of such games are *Animal Crossing* [24], *Roblox* [25], and *Sneaky Sasquatch* [26], to name a few. These games provide a world (or worlds) that users can navigate to complete a list of given tasks or to complete tasks of their choice, with the benefit of rewards. The rewards come through checking off to-do lists and being able to move forward within the game, or by gaining the advantage of being able to collect money or valuable items. The games each have their own set of challenges, which makes achieving these rewards more appealing. In the games *Octodad: Dadliest Catch* [27] and

Untitled Goose Game [28], for example, where players focus on completing a given list of simple tasks, the reward is a result of facing the challenges that come from the physical limitations of being either a floppy octopus with too many "arms" and a demanding family or a mischievous small goose with no arms. In *CYO Airport Story*, the reward will be in completing the tasks required in each scene, and within a given timeframe, which will allow users to move forward through each of the 4 scenes. Initially, there were discussions about potentially adding more reward layers through points, to show that users "improve" by relying less and less on the given tools, such as the previously mentioned earplugs. For the moment, this idea has been put aside, as to avoid creating a potentially unintentional CBT approach.

4.1 Non-Player Character Design

The visual design of the NPCs themselves is not a straightforward task. While *CYO Airport Story* is an airport simulation, the question of how real to design the characters is complex. There are two things to consider here. The first being, if this is an airport simulation intended for use by individuals with airport-related anxieties, perhaps aiming for realism within both the space and the NPCs is not a wise choice. It is possible that there is an opportunity to design this airport simulation to feel safer than an actual airport through the look of the NPCs. The second consideration is that of the uncanny valley theory, where a rendition of something very close to human can sometimes elicit negative reactions [29]. It is possible that aiming for reality in the design of characters within a VR simulation will be too off-putting or distracting for the users, when deliberately designing a less realistic character can be more appealing, while still maintaining a sense of immersion [30]. Perhaps the ideal character design for *CYO Airport Story* is one of dollhouse dolls. It is a believable design because dolls tend to be simpler than the environments that they inhabit. In this way, the realistic looking interior of the airport against the

doll-like features of the characters can remain a believable scenario, since achieving immersion through VR does not always mean that one should imitate life exactly but can instead be achieved through consistency within the virtual world presented [31].

Initial peg doll NPC character designs. (created using *Blender*)

So far, the NPCs have been designed to resemble wooden peg dolls, which are a widely recognized design. This also satisfied the need to create an initially simple 3D design (due to time constraints) that could be easily adapted to include a variety of characters, through skin/hair/clothing color, hairstyles, etc. The final NPC design will ultimately be decided based on participant responses to a Tufts IRB approved study that I will be conducting at the beginning of the Spring 2024 semester. The study will involve a participant survey regarding airport-related anxieties and coping strategies, followed by a preview of *CYO Airport Story* in its current state. The study will end in a survey regarding the current design of *CYO Airport Story*, along with NPC character design feedback. This means that a couple more character designs will need to be created before this study takes place. One design will be created using a currently available AI 3D modeling program called *Masterpiece X* [32], which generates 3D models based on a series of prompts. The other will be a more complex 3D design created using *Blender*. Moving

forward, *Stable Diffusion*'s AI add on for *Blender* [33] will be explored, to add more control when designing a 3D model with the assistance of AI.
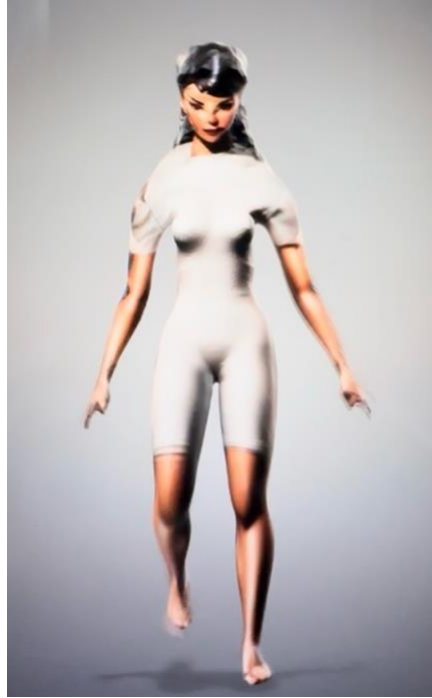
Initial AI generated character.
(created using *Masterpiece X*)

4.2   Current State of *CYO Airport Story*

Currently, *CYO Airport Story* has the ticketing/bag drop scene fully modeled. The goal is to fully develop this scene first, before moving on to the remaining 3 scenes. The decision to work in this manner was made because there will be enough similarities between scenes that when all aspects are solved and developed, completing the remaining scenes will be much more efficient. The ticketing/bag drop scene also has its first NPCs incorporated into the scene. A chatbot has been created that gives a personalized social story in response to a prompt and an initial NPC chatbot has been created that can respond in the way that an airport ticketing agent would. Further chatbots need to be created to serve as various airport staff and as fellow passengers with varied "personalities". The ticketing kiosks in this scene also need to be

programmed with a simple interaction that will result in printing a ticket.

Views of current iteration of *CYO Airport Story*. (created using *Unity*)

4.3   Beyond *CYO Airport Story*

With the various options within each scene and the potential variation in challenges incorporated in this serious game, through time management and NPC interactions, *CYO Airport Story* should provide enough variability within each simulation session where users can continue to effectively use this tool as a method to practice going to the airport [14][15]. Moving forward, an even stronger iteration of *CYO Airport Story* could involve a game where every time the simulation is run, the airport itself also changes. This way, the idea of practicing going to the airport can be more generalized, as opposed to becoming specific to the one airport depicted in the simulation. This could be especially useful for those individuals who might take the simulation more literally and would have difficulty generalizing the skills learned as being

applicable to airports in general. Or perhaps instead of focusing on achieving a generic airport, a specific airport could be identified, and the airport simulation could then resemble that particular airport. Incorporating more variability based on user maturity/age is another way in which this project could be expanded. Perhaps the physical and "personality" designs assigned to the NPCs (through AI) should be adapted, based on the age of the given user, for example [14]. These would be larger undertakings, and ones that would be worth investigating, once the first iteration of *CYO Airport Story* is completed.

5   CONCLUSION

Due to sensory sensitivities and limitations experienced by neurodivergent individuals, public spaces, such as airports, can be especially difficult for certain populations to manage and can create high levels of stress and anxiety. Further programs are needed to help make these places more inclusive, including social model-based designs in tools/interventions for autism. Technologies, such as VR and AI, carry a strong potential for research in this area. The use of serious games, in combination with VR, have an even greater potential for the creation of tools/interventions that carry a broader appeal, due to the success of entertainment-based games. This is important, if users are to actively use these tools/interventions enough for them to become beneficial. It is also important that these tools/interventions provide users with full agency when implemented. This should serve to ensure that researchers are not (even unintentionally) creating designs that trend towards CBT or exposure therapy practices for autistic populations, which are not ideal and often controversial approaches.

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