Teaching social stories through a game based on reduced generalization theory

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***Abstract*—Students with autism appear to learn social stories through electronic screen media better than they do simply reading a story from a book. Using reduced generalization theory, a game was created that uses a social story as a guideline to how the student should play the game. The game then gives the student the ability to put into action what they just heard. This allows the student to immediately try and understand the lesson.**

Keywords—Autism, games,

I. BACKGROUND

One of the key aspects of a person with Autism is that they tend to lack in social skills [14]. One of the more widely used tools to combat this is known as a Social Story. Social stories are short stories whose goal is to impart some social skill by teaching specific component skills [3]. These can usually be chained together to help paint a larger picture. Social skills have been shown to help students with autism perform better in scenarios that they describe [10]. However, students with autism tend to lack the ability to generalize what they learned to contexts other than what is described in the story [13]. In fact, the ability to help students learn to generalize is considered by some to be the holy grail of interventions for students with autism [7].

One reason for this lack of generalization can be found in the theory of Weak Central Coherence. The main idea behind this theory is that people with autism pay attention to specific details as where normally developing peers would focus on the overall meaning of some stimuli [7]. Yet this by itself does not provide any answers on how to help people with autism gain a more thorough understanding. Another theory that provides an answer for this is known as Reduce Generalization Theory. The main idea of this theory is that students with Autism focus on what is unique and special about something but they tend to understand the common features more poorly [8]. One prediction from this theory is that students with autism should perform well on test in which two stimuli are similar to each other. The overarching idea to take from these theories is that to help students with generalization, we should change scenarios slowly so that from one change to another, the change is small enough that the two scenarios are able to be seen as similar. This method is supported by reduced generalization [8] as a way to facilitate generalizing for students with autism.

The problem now becomes using what was just stated, how can we use that to help students with Autism generalize what they learn in social stories? The solution that is being pursued is to create a side scrolling HTML5 Game that presents the social stories to the students in such a way that they will want to participate within the story.

The reasons for using a 2D HTML5 game are many. It has been reported that students with autism have increased learning when learning through games and other screen technology [16]. One reason for this can be seen in the fact that those students are better able to pay attention to a screen because it has a restricted viewing window [3]. This prevents the student from paying attention to the wrong stimuli and helps them focus on the stimuli that we intend. Students have also been shown to participate better in a game type setting because they can be free from the negative feedback they might receive in real life [9]. Those students do better in a world where they can exist in a managed situation [7].This can relieve their anxiety and put those students in a state where they are more likely to learn. Another facet that a game can take advantage of is that you can customize the world you are in. Students with autism have specifically been shown to be more enthusiastically engaged when they can use avatars that are more similar to them [3].

II. TOOLS

The game was created using melonJS, an open source HTML5 game engine based on JavaScript [1]. With melonJS no other libraries have to be included as it can handle everything needed run the code for the game. For tile maps melonJS integrates with Tiled [15]. With Tiled you can take png images that contain sprites and other assets and create a map from that. Piskel was used to create the tiles that makes up maps and edit sprites to create a wider variety of sprites [6]. Piskel is a website that lets you create pixel type images and then export them as a png image. Avatars can be created and have their moment tested for a realistic appearance on the spot instead of having to see what they look like in game. Piskels also shows its value with the ability to create extra resources on the fly. All of these resources are open source and free of charge to use. The game is hosted on Georgia Institute of Technology prism servers.[1]

[1] Game is here [1] http://www.prism.gatech.edu/~cjones343/YourStory/

III. GAME NAME

The name of the game is Your Story. The reason for that is that the game is supposed to help the student be in the avatars shoes and hopefully learn from the avatar's actions

IV. SOCIAL STORIES

Before going into the design of the game, we need to understand the stories behind the levels. Social stories are a tool whose creation is guided by the Carol Gray's guidelines [4]. Carol Gray invented the concept of social stories and she continues to improve their form through her guidelines. The social stories used in the game can be found in table 1.

Table I. Social stories

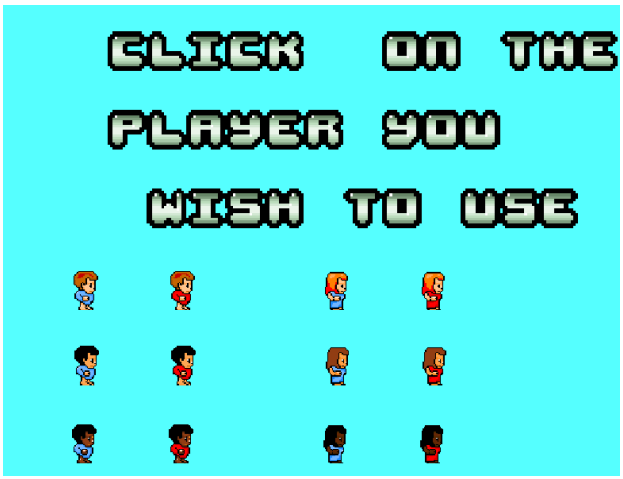
Title	**Story**
Collect them All!	I enjoy collecting things. One time I collected rocks. I had many rocks around my room. Mommy walked on the rocks and hurt her foot. Then I put all of my rocks in a box to keep them together. Now I cannot lose my rocks. I know where all of my rocks are. That makes me happy.
Jumping around!	Jumping is fun! I like to jump around when I am excited. Jumping makes me feel good. I like to jump everywhere. Sometimes jumping on things breaks them. Jumping on people can hurt them. Mommy gets sad when I jump on things and break them. People get angry when I jump on them and hurt them. It is okay to jump on the ground or on my trampoline.

The first story in the game is the collection story. The goal of this story is to show that it is ok for the students to enjoy collecting items, but that they should take care of them. The story does not say that collecting is bad but it points them in the right direction of how to take care of their collection. There are a few reason for why can be a good skill for the student. One is so that the student will know where their items are. That can relieve any stress that might arise if the student starts to think that some of their items are missing. The other reason for this skill is that it can also make sure that the student, and potentially their parents, do not walk on whatever the students collect. This can prevent pain and could help the student not get in trouble with their parents. One reason for using a collection story is that people with autism tend to collect items [11]. Since this does not usually tend to boarder on life threatening hoarding, this was appropriate to use as motivation for the student to play. Another thing that is considered in the design of the game is to build on the lessons learned from one story to the next. The use of collecting continues to be used throughout the rest of the game as a mechanism to keep the student engaged and to hopefully make them want to play again.

The second story in the game is a social story about Jumping on people. Students with autism often times find themselves moving around in ways that same age peers do not. One action that many students with autism find themselves doing is jumping. Since there is a danger with jumping in the wrong place or at the wrong time, this was a good skill to teach. The gist of the story is that the student will jump. Notice that the story does not tell the student to not jump. Trying to completely restrict the student from certain actions usually does not help the student to reach the goal of the story. The story tries to positively guide the student to understand when and where they should jump. Players are clearly guided to not jump on others as it may hurt them. However, the story does give them viable option of jumping around on the ground or on the trampoline. Notice in both of these stories the student is never scolded for wanting to do something. The patient and overall positive tone leads to better engagement with the student.

V. DESIGN

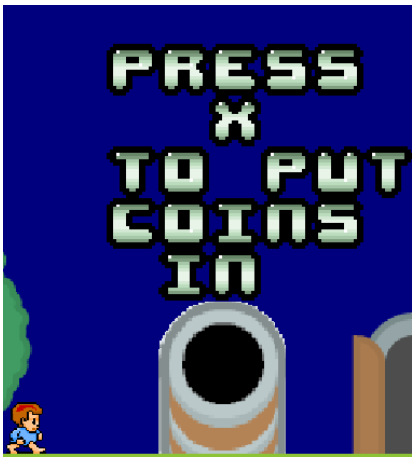
Having seen the social stories, we can now move on to understanding the game's design. First we need to give an overview of the screen flow. Upon starting the game the player will see generic melonJS load screen. The load screen was not within the scope of this project. After the game loads the player will then be taken to a screen with twelve different playable characters to choose from.



(a) Selection of useable sprites

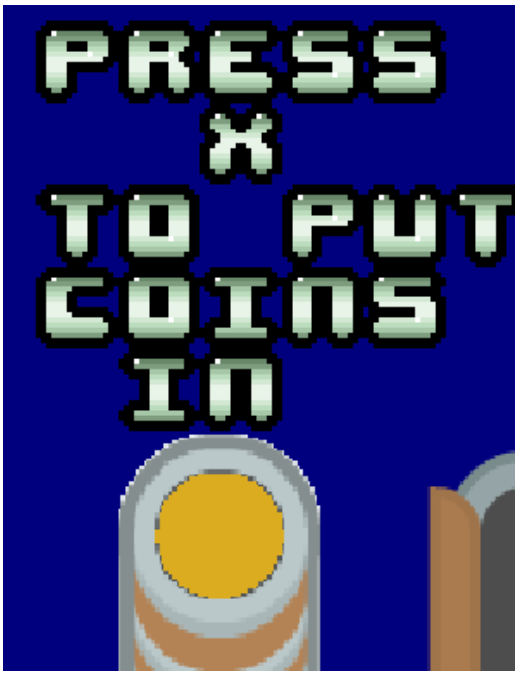
The reason for having multiple characters has already been alluded to in the fact that students with autism showed an increased enthusiasm for learning when they were using avatars that more closely resembled them. The goal for this game was to at least have three males and three females, each with a progressively darker skin tone. Without allowing the customization of avatars, this was an easy way to attempt to allow different looking avatars to be used. The base sprites used here and for the rest of the game were created by Phillip Lessen [12].

After a player has chosen their character, they will then see the collection stage. The collection stage is a simple stage that introduces the concept of collecting to the player. As soon as the player starts a reading of the collection social story plays for them. While the story is being read the player can move around and collect the coins that act as the collectable item. Coins also give the student one point on their score. After moving a bit the player will see instructions that tell them where to put their coins after they are done collecting them.



(b) Barrel with instructions

As you can see, it gives them guidance on what key to press. The barrel, the door, and the trees used here and throughout the game were created by Kenney [2]. Once the student presses the x button, the barrel then becomes filled with gold.



(c) The barrel is now colored as if it is filled with items

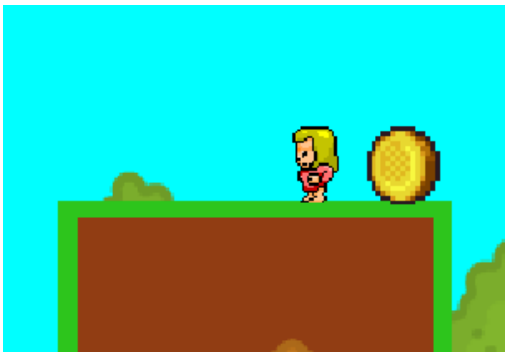
One thing to note here is that you cannot leave while the story is still being read. This prevents the player from being able to run through the game without playing correctly. The player also has to put their coins away before they can leave. This is to reinforce that it is important to store your collectables so that you know where they are.

After the collection level the player will come to the jumping social story. The jumping levels start differently in that the player starts out inside. Another thing to note is that the jumping story is a platformer type stage. The first place the player will come to is a house. It is in this house that the student will be read the jumping social story. Similar to the collection level, you cannot leave the room until the story is done being read. Once it is, the player can leave. The player will not be read the social story again once they leave that first room.

Before talking about the specifics of the jumping level we need to talk about the overall structure of the levels for the jumping story. The levels have been designed with reduced generalization theory in mind. There are four levels for the jumping story each one different than the other. The first level is simply outside of the avatar's house with child sprites appearing throughout the stage. The second level is similar to the first except it has adults instead of children and

it also has a slightly different set of tiles used to design the platforms. The third level shifts to school and the playground. When outside, the player will see an adult who represents the teacher along with children. The final level is also outside on a playground except it has children and adults on the playground at the same time. To finish the jumping social story portion of the game you have to finish all four levels. However that is not all of the levels. One of the points of the jumping story is that jumping on others is not desirable. If a player jumps on the sprite of another child or an adult, they then have to start over keeping none of their progress. The player does not have something analogous to lives as we did not want the player to get the idea that jumping on other people is ok. However, we did not want to then give the student the same exact stage should they mess up. Instead there are different versions of each level. We call these the sublevels of each level. Each sublevel has the same overall feel as the level before it but the player cannot simply take the same path. This should force the student to reevaluate their decisions every time hopefully helping to increase the effectively of the lesson. To summarize, there are four jumping story levels each with four sublevels for a total of 16 different maps for the jumping story. Further development on the game would also follow this same type of pattern.

The sprites that the player can run into vary. The game chooses from a bank of sprites at random for each instance. Each sprite is also placed carefully so that the player has a small chance of accidentally being punished by the game. One can easily imagine a player missing a jump and falling to the ground in a level. By carefully placing sprites, the chance of the player accidentally landing on a sprite has been diminished as best possible. The last thing a person with autism would need is to be blamed for doing something wrong when in reality they did nothing wrong. That could easily harm the progress that a player could make. Behind almost every sprite sits a coin.



(d) Sprite with coin behind her

The reason for this is it gives the student the ability to, when seeing a sprite, think about their next action. The player can simply move by the student simulating walking around them or they can jump over the student sprite. The best action would be to walk by the student so as to not risk landing on the other sprite. Again, this acts as a mechanism to give the student a goal at each sprite of looking back at the lesson from the social story and it gives them a chance to realize that they should not jump on the sprite.

At the end of each jumping level the player is presented with the same barrel they had at the end of the collection level. The player has to put their coins away before they can move on. At this point the player is now building upon previous lessons learned. When the student leaves each level, the have their current score moved to a total score and the score is set back to zero. The total score never changes even if the student messes up at a further level.

The last few design choices worth mentioning are related to music. When considering the music for the game, the emotional state of the student needs to be considered. If the music is too upbeat the student might start to get overly excited and stop paying attention to the game. However if the music is really boring the student may also not focus on the game. The original project plan included music being created for the game but that part of the project was not able to be completed. As a stand-in for that the song Sweden [5] from the Minecraft soundtrack was chosen. The music was chosen because it is soothing and engaging but it does not drive the student to the excitement level you might experience fighting a boss battle in a role playing game.

VI. Discussion and Future Plans

One way that this game's effectiveness could be improved would be through graphics. Right now the first two levels are serviceable. However, the two playground levels bring trouble. To create the feel of a playground a parallaxing background of a playground would have helped. With that, the playground levels could have been more similar in form to the other levels so that where was less differentiation between the game levels themselves. However, without a quality background the playground stages were made with the platforms representing the playground itself. While this is somewhat successful, one choice made was to create the ladder of a slide with blocks instead of something representing a ladder that a student may actually climb up with. With the lack of graphics the differentiation between the levels is higher than was originally intended. The question from that might be, what is considered not differentiated enough?

One way to start on the road to answering that question could be the test the game with students. To also assist with this we could gather various data on each player and see if certain changes in the game help the student perform better. With these changes we could fine tune the game to be also be more effective at teaching the lesson. However, none of this has as much meaning without seeing real world results. At some point these same students would have to be tested in a real world setting to see if they have truly learned the lesson. Eventually we could see if the student

experiences any gains in social skills in a real world setting and take that as feedback to again fine-tune the game.

Without that feedback, certain design choices were made that may or may not work out. The collection social story uses rocks as its collectible item but for the game we went with a coin. Another choice that had to be deals with the coloring of tiles, sprites, and backgrounds. With more feedback we could create a game that is friendlier to those who might get sensory overload with certain colors.

Once we really understand a quality aesthetic that works for students with Autism, we can then move to create other social stories. The goal of the game was never to make every stage a platforming stage. However, platforming itself has many easy uses. One could make a story about head butting, keeping hands to oneself, and many other physical actions that can be easily represented with a base in platforming.

VII. CONCLUSION

This game lives in fairly uncharted waters. The hope of this game is that even if it in itself does not lead to any great discoveries that perhaps more games can be created in a similar vein. It is clear that students with autism enjoy games and electronic screen media so taking advantage of that is a must. Without engaging them at some level that they understand you will lose them.

Even if the reduced generalization theory approach bears little fruit, the approach of integrating social stories with games in this manner should still bear fruit. Helping those whose life experience is vastly different than ours can help us as a society and in the end help that person live a vastly higher quality of life.

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