Using Interactive Social Story Games to Teach Social Skills to Children with Autism

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ABSTRACT

This paper presents *interactive social stories* (ISS) for teaching social skills to children on the autism spectrum. Using interactive narrative techniques, we enhance the traditional intervention of Social Stories in order to facilitate exploration and potentially promote *stimulus generalization*. Using this approach, we designed a tablet-based ISS game called *FriendStar* to teach 9-13 year old children with autism the social skills of greeting in the school context. The results of our user study show that both health professionals and children with their caregivers reacted positively to *FriendStar*. Most notably, both groups respond favorably to the ability of making mistakes and correcting them in the game.

Keywords

Game for Health; Autism Intervention; Interactive Narrative

INTRODUCTION

Autism is one of the fastest-growing developmental disorders in the U.S. According to the 2012 report of the Autism and Developmental Disability Monitoring Network's (ADDM) 2010 data, 1 in 68 8-year-olds was diagnosed with an Autism Spectrum Disorder (ASD). This new data represents a 78% increase since 2002. Deficits in social communication and reciprocity reflect a key feature of ASD. Such deficits are associated with significant functional impairment and growing public health costs. There is thus a pressing need to understand how to improve the social skills of the youth so that they can better integrate into their family and community.

This paper presents *Interactive Social Stories* (ISS), an approach that expands the existing intervention of Social Stories with interactive narrative techniques of *variability* and *branching structure*. Inspired by the errorless learning design paradigm (Jones and Eayrs 1992), we designed *FriendStar*, a mobile game containing a series of interactive social stories about the social skills of greeting and making new friends in school. Our *key contribution* is to apply these interactive narrative techniques to the relatively new domain of Autism intervention to encourage exploration and potentially better learning outcome.

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Our long-term goal is to further connect interactive narrative research and ASD interventions. A key open problem in the latter is *stimulus generalization*, that is, the transfer of a response, which is learned to one circumstance or a single cue, to similar yet varied stimuli (Cooper et al. 2007). For instance, when a child with ASD learns to greet a specific classmate at school in a social story, how does she know whether this response is appropriate outside that specific circumstance (e.g. her school Principal)? We believe that branching structures and the meaningful variability between interactive stories, along with other interactive narrative technology such as procedural story generation and adaptive personalization, offer the potential to promote stimulus generalization.

In this paper, we discuss our design insights of incorporating branching structure and meaningful variability in the established ASD intervention of Social Stories in the context of *FriendStar*. In our user study of the usability and acceptability of ISS, we evaluated the game with two groups: 1) six children with ASD and their caregivers, and 2) four health professional groups. Results show the participants have a very high willingness to try *FriendStar* as well as a very high level of acceptance of the game from both groups. Most notably, both groups respond favorably to the ability of making mistakes and correcting them in the game, which is not supported by the traditional Social Stories. In terms of the potential effectiveness, the clinician group is more skeptical than the patient group. In our planned future work, we will improve the game based on feedback from this user study and evaluate the effectiveness of *FriendStar* to promote stimulus generalization in the efficacy study.

BACKGROUND

Since its introduction in the early 1990s, the paper-based Social Stories™ have been widely used in schools and homes to teach children with ASD a variety of social skills (Gray and Garand 1993; Reynhout and Carter 2011). These written stories, often accompanied with visuals, describe challenging social situations by omitting irrelevant information and break them down into simple steps. They are designed to help an individual with ASD to understand the entirety of a situation and answer the questions such as who, what, when, where, and why in social situations (Scattone et al. 2002). Below is an example called "Could You Please Repeat That?" used in the Bakersfield City School District in California[1].

> *When other students are talking while my teacher is talking, it is okay to raise my hand, wait to be called on, and then ask the teacher, "Could you please repeat that? I do not understand yet." When I do this, I show the teacher I am trying to listen and understand my school work. This is an intelligent thing to do.[...]*

There have been many efforts to adapt Social Stories into digital media, especially by video and computer graphics, which have been shown to be effective in previous studies (Hagiwara and Myles 1999). Authoring tools such as StoryMaker have been developed for caregivers, educators, and clinicians to create their own Social Stories. While most digital Social Stories remain linear, researchers have looked into interactivity. For instance, the "I can Problem-Solve" program, with the help of human instructors, allows children to choose solutions or

1. accessed at http://bcsd.com/autism/classroom/sstory/repeat/ on Feb. 7, 2015

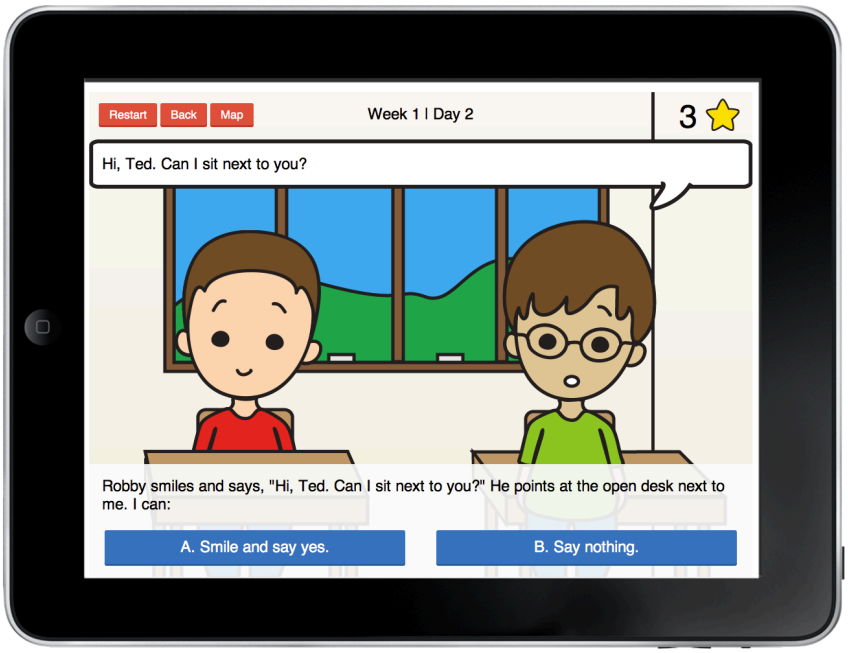

Figure 1: Screenshot from *FriendStar*

propose novel ones to problem situations (Bernard-Opitz et al. 2001). The Refl-ex system, paired with its authoring tool, aims to help children with high-functioning ASD through obstacle-based branching (Boujarwah et al. 2011).

A number of projects use digital approaches to social skill training for youth with Autism (Kandalaft et al. 2013; Tartaro and Cassell 2008; Ulgado et al. 2013). However, very little research has been conducted on promoting the *stimulus or response generalization* using Social Story-based or other narrative-based interventions. Our project is among the first to extend Social Stories with branching structures and variability, commonly used in modern computer games, to target users' exploration and potentially stimulus generalization.

INTERACTIVE SOCIAL STORIES AND *FriendStar*

We designed and developed an interactive social story mobile game called *FriendStar*, focusing on teaching the social skill of greeting and making new friends in school. As a team of digital media designers and Autism clinicians, our goal is to explore a new way of modeling social skills in a fluid and flexible manner so that children can learn, test and adjust specific social skills, including their generalizations, in a less threatening environment than the real world. As some of the design reflections have been described briefly in our prior work (Zhu et al. 2014), this paper presents our evaluation results.

Our target audience is children with ASD between the age of 9 and 13. They can play the ISS game either with caregivers or on their own. Following traditional social stories, the user plays himself and the story is told from his first person perspective, with vocabulary at the third grade reading level. The interface is designed to be simple, with two options at a given time (Fig. 1). To increase character identification and potentially knowledge acquisition, the user can customize the player character's name, skin tone, hair style, clothing, and the

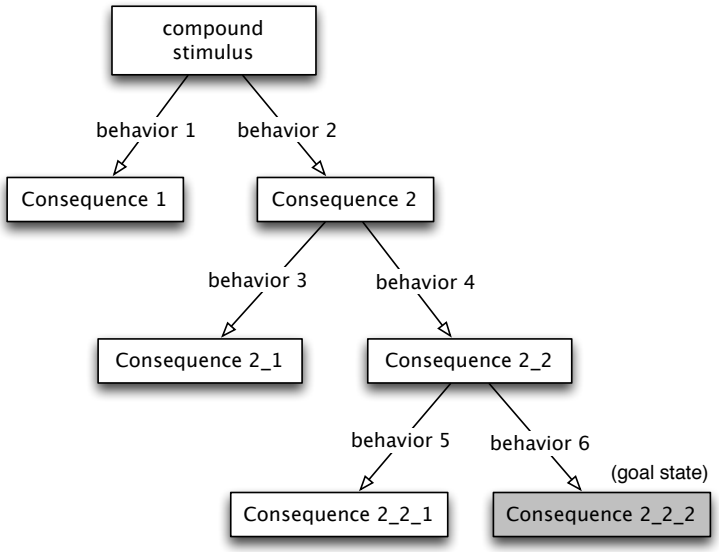

Figure 2: A Branching ISS Structure in *FriendStar*

school he attends. Since ASD is 5 times more common among boys, the main character of this current prototype is male due to limited scope. To avoid over-stimulation, we chose to include only necessary visual information. All characters are drawn in the simplistic *chibi* style with child-like body proportions. Similarly, only relevant environmental information (i.e., that conveys the context of the location) is included.

The narrative component of *FriendStar* is developed in conjunction with clinicians who have extensive experience with traditional social stories and working with children with ASD. The main setting of the game is the first three weeks (in-game time) of the new school year. Each week corresponds to a main learning module. In Week 1, the user practices how to greet the same person in different contexts, i.e., generalize over context. In Week 2, he practices greeting skills with different people in the same location, i.e., generalize over people. In Week 3, the user will encounter new combinations of person and location for further practice. It also allows us to measure how much he has formed a generalized understanding of greeting (generalization over people vs generalization over context) based on examples shown in the first two weeks.

A week is further divided into five days. Each day contains a self-contained interactive social story, wherein the user can practice how to greet a particular person in a particular context. A team of clinicians who have extensive experiences with children with ASD and Social Stories development designed the content. The branching story structure of Day 1 in Week 1 is shown in Fig. 2. For example, the compound stimulus in this particular story is "My name is ... and I go to .... School. My first day at the school is scary. There are many adults and kids I do not know.// The Hallway is loud and busy. I am not sure how to get to class.// When I do not know how to find my class, I can: A. Stand to the side and wait till everyone leaves. B. Find anther student and ask for help.//" Each "//" indicates a separate screen with different images. Option A represents "behavior 1" in Fig. 2, and Option B is "behavior 2."

Once a social situation, or compound stimulus in behavior science terms, is setup in the first scene, the users are given the option of two behaviors (actions). Each behavior leads to a different consequence. The consequences for the user's choices mimic those of real life, including positive and negative social feedback, increasing generalizability by using common stimuli between gameplay and the real world. This technique is similar to the increased social interactions via common stimuli findings (Petursdottir et al. 2007). We chose two options as it is sufficient to test our ISS model. In this example, the user needs to select three correct actions in a row. Inspired by the errorless learning design paradigm (Jones and Eayrs 1992), the user cannot move to the next day unless he reaches the current day's goal state.

Every time a correct behavior is chosen, it is reinforced through sound and animation of the star (top right corner of Fig. 1). We chose the star representation mainly because it is easily transferrable to the real world. A caregiver could use a physical paper star that resembles the one in *Friendstar* and reward a child when she transfers the in-game behaviors to the real world. In some stories, we incorporate "recover" behaviors that can correct early mistakes to model the complexity of social situation.

PRELIMINARY USER STUDY

We conducted a preliminary user study to evaluate the usability and acceptability of *Friend-Star* with two groups of people: 1) children with ASD (age 9 - 13) along with their caregivers and 2) health professionals, such as behavior analysts and school psychologists, who worked closely with school settings with children diagnosed with ASD.

Methodology

In the study with the child-parent pairs, the children first did a short reading test (a story of 267 words) to make sure they were at the appropriate reading level. Each child was then given *FriendStar* on a tablet or a laptop and was asked to spend up to an hour playing with the mobile game. The parents sat beside their children while testing, and a research staff sat to the side for observation. After they completed the game, each pair of children and their parents was asked to complete a standard intervention acceptability measure consisting of 15 items called - Intervention Rating Profile (IRP-15). These 15 questions are on a 6-point Likert scale and they are listed in Table 1. The research staff also asked them a series of questions about their impressions of the ISS game. Our ratings Key are: 1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = slightly agree, 5 = agree, 6 = strongly agree.

For the health professionals group, each clinician was asked to complete IRP-15 surveys after interacting with *FriendStar* for 30 minutes. They then participated in a focus group to discuss their impressions.

Results

In our study, we recruited 6 children-parent pairs from an after-school social skills training program and 4 health professional including 2 behavior analysts and 2 school psychologists. Among them, one children-parent pair was disqualified because the child was older than our target demographic. The rest 5 children (3 males and 2 females) were ages 12 - 13 years,

spanning 6th to 8th grades. Caregivers included 3 mothers, a father, and a grandmother, spanning ages 38 - 65 years. All children were previously identified with high-functioning ASD. All participating clinicians had experience with children with ASD (5 - 11 years direct experience).

Intervention Rating Profile Results

Overall, all of the participants showed a positive opinion of *FriendStar*. Detailed results are summarized in Table 1 and below are some highlights. All 10 participants (we count each child-parent pair as one) felt that *FriendStar* was acceptable for the target behavior, greetings and making friends at school. 10 out of 10 would recommend *FriendStar* to others, would be willing to use it at home or in the classroom, and felt that it was a fair and beneficial treatment that would not have any negative side effects.

In addition, 9 out of 10 participants reported that they thought *FriendStar* would prove effective, and liked the procedures used to teach children. 9 out of 10 participants also believed that *FriendStar* was a good way to teach social skills and a "reasonable" and "suitable" intervention for social skill deficits. The child-parent group also had very positive reactions towards the game. For all 15 questions, the mean of their answers were within the agree range. Except for the severity of their children's behavior, they lean heavily towards "agree" than "slightly agree."

Health professionals' opinions were more skeptical. They were evenly split about whether *FriendStar* resembles interventions they are currently using. Although 3 out of 4 professionals noted that *FriendStar* was likely to prove effective in changing social skills, their mode rating was "slightly agree" for this question and the mean professional rating fell between the "slightly agree' and "slightly disagree" range (3.75 out of 6). Further feedback showed that the health professionals were more skeptical about *FriendStar*'s ability to help teach other behaviors besides greeting based on mean rating scores (3.25, in the disagree range) or to be appropriate for a variety of children (3.5, in the disagree - slightly agree range). The main reason is the lack of efficacy data.

Comments from Children-Parent Pairs

From our semi-structured interviews, the comments from the children-parents group confirmed their positive reaction demonstrated in the IRP-15 surveys. All children and parents said that they liked the look of the game, the story, the star rewards and the ability to customize their own avatars. They specifically mentioned that they liked the characters because there were "not too many details." Parents liked that *FriendStar* was "short", "relatable", "showed kids how to act appropriately" and "made wrong answers obvious". The children commented that they liked the "cartoons", "learning how to start a conversation" and "learning a better way to act after making a mistake." The last comment suggests that our initial design goal was met for this group of children. By extending the linear story format, ISS are more flexible to show what possible mistakes could be and give children the opportunity to try something else afterwards.

Among the things they did not like, the only comment we got was that some children and parents felt the game was "too long." Our game telemetry data show that the longest it took

the children in our study to finish the game was 9 minutes. We believe that the comment referred more to the repetitive nature of the ISS each day for 15 days. For the future iteration of the project, we plan to make the story progression from one day to the next more distinguishable and hence reduce the repetitive feeling. Echoing the last comment, this group told us that they would like to have "a wider variety of topics", "add topics about the weekend [in addition to the school days], too". Some suggested that we expand the current number of choices (two) to three. Others proposed we "add a mini game" within *FriendStar*. One parent noted that they wished the child could lose points as well as gain them.

Comments from Clinicians

From the health professional group, there are a number of things they expressed positive feedback. Some mentioned that they liked the "ipad format", "opportunities to correct mistakes," and the "use of scripts to teach appropriate verbal behavior." Other liked the choice of realistic settings. They believed these elements would promote generalization across settings and practice. The game was described by the professionals as "attractive", "engaging". Notice that the ability of making mistakes and correcting them was mentioned independently by this group as well as the children-parents group.

Under the things they dislike, the health professionals list: the "lack of girl [player] character", "ability to make mistakes over and over" (i.e. to keep choosing wrong option rather than be forced into right answer), and limited number of topics and contexts. They suggested that we provide prompts or a voice over, such as "let me give you a hint," to guide child to correct answer, when the game detects that the player is repeating the same mistakes too many times.

They further recommended to better utilize *FriendStar* in the setting with professional therapists, we should provide guidelines for how to use it in classroom/ home/ therapeutic setting. Specifically, how would therapist reinforce concepts in *FriendStar* with in vivo learning? Some suggested that we add a pause button to allow therapist teach and reinforce these concepts. Another suggestion was to allow therapists to chose what level of agency each child may have (e.g., how many choices the child can have and how much room she can have to make mistakes) so that it can be more personalized to individual children. A couple of people also mentioned that we give the therapists more control over the star reward system so that they can adjust it based on the specific child. For example, some clinician mentioned that they would like the game to only give out a star when the child chooses the correct behavior in the first try. In other cases, it might be more appropriate if they could disable the reward system altogether.

Discussion

Overall, the children showed engagement exploring what was available to them in *FriendStar* during the study. Most notably, some expressed aloud that they tried out what they suspected were the "incorrect" choice because it was the choice they would make in real life, and wanted to see the consequences of both choices. It shows encouraging engagement indicating that the children were paying attention to the behavior-consequence relationship being modeled and that they feel comfortable exploring different options, a necessary condition for the intervention. However, some children's attention seemed to diminish towards

the end, indicating the importance of keeping the content as short as possible while still maintaining enough content to be effective. Feedback from the study will be used to re-adjust the stories in *FriendStar* to further balance simplicity and engagement.

We have spent significant amount effort developing the character customization tool, given the importance of identification in traditional Social Stories. In our study, most children spent some time with customization, some using their own name and some enjoying making up a character, which we did not intend. One girl explored all the different hair customization options in search of a female character design. Although she did not hesitate to continue playing when she did not find one, this suggests further development is needed in the next stage. In addition, further research on the impact of using a fictional character in social stories instead of the child with ASD needs to be further investigated.

CONCLUSION AND FUTURE WORK

In summary, we presented a new framework of interactive social stories. The ISS game *FriendStar* extends the traditional Social Stories, through branching structure and variability from interactive storytelling, by allowing the child to explore different behaviors and obverse the consequences of their choices. In our user study, patients and their parents indicated a very high willingness to try *FriendStar*, and confidence that it would teach the target greeting behavior. Professionals also indicated a high degree of willingness to try, but were less confident in their prediction of the likely effectiveness of changing behavior. Overall, both groups reacted positively to the game. Most notably, both groups mentioned the ability for the children to make mistakes and learn better behaviors through the game was one of the best things about the game. Based on the feedback, we plan to revise the story towards a more appropriate level of abstraction to keep the succinctness required by our target group while offering enough details to engage them. We also plan to add more personalization options.

Our next step is an efficacy study to evaluate the effectiveness of ISS on promoting patients' stimulus generalization of social skills. We plan to compare *FriendStar* with a similar set of stories in the form of traditional linear social stories, and evaluate the mastery level of the greeting social skills by children under the two different interventions respectively.

Another direction to make ISS more accessible is to make the creation process easier for caregivers and health professionals. On-going research in computational narrative such as story generation and personalization offers a promising direction.

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Questions	C-P M	C-P SD	HP M	HP SD
1. This would be an acceptable intervention for a child's problem behavior.	5	1.00	5	.00
2. Most teachers would find this intervention appropriate for behavior problems in addition to the one described.	5	0.71	3.25	1.5
3. This intervention should prove effective in changing a child's problem behavior.	4.8	0.84	3.75	.50
4. I would suggest this intervention to other teachers.	4.8	0.84	4.5	.58
5. The child's behavior is severe enough to warrant use of this intervention.	4.2	1.48	NA	
6. Most teachers would find this intervention suitable for behavior problem described.	4.4	1.14	5	0.00
7. I would be willing to use this intervention in the classroom setting.	4.6	0.89	4.75	0.96
8. This intervention would not result in negative side-effects for the child.	5.2	0.84	4.75	0.96
9. This intervention would be appropriate for a variety of children.	5	1.00	3.5	1.29
10. This intervention is consistent with those I have used in classroom settings.	NA		3.5	1.29
11. The intervention was a fair way to handle the child's problem behavior.	5	1.00	5	0.00
12. This intervention is reasonable for the problem behavior described.	4.8	1.30	5	0.82
13. I liked the procedures used in this intervention.	5	1.00	4.25	0.96
14. This intervention is a good way to handle this child's behavior.	4.8	1.30	NA	
15. Overall, this intervention would be beneficial for a child.	5	1.00	4.5	0.58

Table 1: Results of the Intervention Rating Profile survey for children-parents (C-P) and health professionals (HP). *(Ratings Key: 1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = slightly agree, 5 = agree, 6 = strongly agree)*