Splash! an online social repository to support teenagers with Asperger Syndrome

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ABSTRACT

Asperger syndrome is a pervasive developmental disorder on the higher-functioning end of the Autism Spectrum. Like many of the other Autism Spectrum Disorders (ASDs), people with Asperger's struggle in social situations and using social skills while executing everyday life activities. This is particularly notable during adolescence, when social skills and relationships gain complexity and behavior is expected to become more independent. Given this population's penchant for technology and online resources like *Wikipedia*, we present Splash! an online social repository to support teenagers with Asperger syndrome. This social encyclopedia will contain social etiquette and How Tos that teenagers can access on-demand. This paper will cover existing research related to our work, as well as opportunities they present for improvement; a system description and sample interaction scenario; and an envisioned evaluation plan, before concluding with a critical discussion of the project, lessons learned from working with this special population and opportunities for future research and exploration.

Author Keywords

Autism, Asperger syndrome, social support, teenager, independence, intervention.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

Design, Human Factors.

INTRODUCTION AND MOTIVATION

Asperger syndrome is a pervasive developmental disorder on the higher-functioning end of the Autism Spectrum. Like many of the other Autism Spectrum Disorders (ASDs), people with Asperger's struggle in social situations and using social skills while executing everyday life activities [2]. Repetitive and inflexible patterns of behavior are also a common characteristic of Asperger syndrome, making it particularly difficult for them to generalize knowledge and skills [12] to novel—but similar—experiences outside the learning environment and into the dynamic, fluid situations of real-life. This comfort in predictability and rigidity, and preference towards circumstances with limited social and human components to process, make technology of great appeal to this population. Additionally, there is a culture of dependency [18] and over-protection surrounding the care of people with autism—even for the high-functioning ones with Asperger's—which can be particularly disconcerting for those seeking independence or who are expected to be independent (*e.g.*, adults, maturing teenagers).

Teenagers with Asperger Syndrome

Partnered with the Diploma Support Program for Students with an Autism Spectrum Disorder at a high school in Brampton, Ontario, we have explored the use of a technology-based social interaction and social norm resource for teenagers with Asperger's syndrome. We have gained some preliminary feedback on our project through this partnership and have unearthed a number of rich research opportunities that elicit further exploration.

Our experience with the teenagers in this program corroborates the textbook definition of Asperger syndrome, as the students are high functioning, able to communicate and do well academically, but struggle most in social situations and using social skills while executing everyday life activities. At an age noted for its focus on social development and independence, teenagers with Asperger's present a strong contrast to this because they are socially awkward and exposed to more dependent relationships. At home or in school, these teens are surrounded by knowledgeable, supportive caregivers who typically only permit them to navigate through their world under their strict guidance. The significant amount of time the teens spend working with technology (*e.g.,* desktop computers, laptops, video game consoles), and their preference for technological communication and interaction suggests that an online system would be an appropriate means of effectively reaching this population.

The program offers academic assistance by providing teenagers with Asperger's a safe and supportive learning environment to successfully obtain the Ontario School Diploma. The program also prepares them for the "real world" by teaching life, social and work- and school-ethic skills. Last year, the program piloted a life skills course to teach the teenagers how to interact and behave in social

situations. The intention was to reduce anxiety with these unpredictable situations and provide firsthand experience for when they are on their own. Lessons were taken from a popular textbook [3] and tailored to the interests and needs of the enrolled students. Topics ranged from stress relief and personal hygiene to dating and job interviews. It was a great success from the point of view of the parents, teachers and students. The success and importance of the course highlight both the need for social skills education and the opportunity to explore alternative means (*e.g.*, technological interventions) to amplify the educational impact and quality.

Current Social Resource Inadequacy for Asperger Teens
When teenagers of today are curious about social norms or etiquette they have a few resources available. They can, for example, look online at *Wikipedia* (http://www.wikipedia.com), *eHow* (http://www.ehow.com), forums such as *Yahoo!* Answers (http://answers.yahoo.com) or peruse through the wealth of results returned by search engines like Google (http://www.google.com). They can also look in printed materials such as textbooks or magazines, or ask their family or friends.

The content from these sources is often not coherent, unstructured or cluttered with unnecessary information. These means typically require that the individual know precisely what they are looking for in order to find it, but that is not always the case. Even when information about the desired topic is found, many resources focus on a best-case scenario and do so at a very high level. Information in these resources often make many social assumptions are made about the reader and leave questions of what to do when the situation goes astray unanswered. For example, a resource might instruct you to 'hail a cab to the airport' but not indicate how to precisely do this (*e.g.*, walk outside to a busy street corner and whistle or raise your hand up at a passing cab car whose 'occupied' light is not on) or what to do if there are no cabs out at that hour (*e.g.*, call the company directly). While information about social norms and etiquette is plentiful in both online and human resources, it is widely and thinly distributed, and the credibility of the source is unknown; there is no one, go-to resource for social norms and interactions. Learning through experience is a powerful educational means, but it is often fraught with unnecessary frustration and anxiety-causing failures, causing some to completely avoid socially unfamiliar situations.

Given these problems and the penchant and comfort with technological systems that people with Asperger Syndrome have, we present Splash!, an online repository of social norm and interaction resources, targeted specifically at teenagers with Asperger's who face high social development demands, and independence desires and expectations typical of this developmental phase.

The remainder of this paper will cover existing projects and research related to our work and the differences between them, as well as opportunities for improvement; a system description and sample interaction scenario; and an envisioned evaluation plan, before concluding with a critical discussion of the project, lessons learned from working with this special population and opportunities for future research and exploration.

BACKGROUND AND RELATED WORK
Teenagers with Asperger's face the same teenage social pressures, yet are at a disadvantage due to their social awkwardness they have trouble adapting to social situations when something does not go according to plan. There is a substantial amount research being done regarding helping autistics with their social skills. However, the work is focused on different facets of learning social skills as described in the following sections.

Current Social Skills Education Methods for Autistics
Storytelling
A popular approach amongst children are portraying social interaction through social stories and comic strips in order to showcase conflict resolution and managing disagreement [1, 16, 33]. This approach allows the students to interpret and understand potentially challenging situations that they might encounter in the future and how to prepare for them. For the most part social stories have been written by the children, there is some research currently being done in Georgia Tech that is looking to create Flash representations of the paper based stories [15]. However, there is little research that proves if they are actually effective in the long run. In addition, virtual peers have been created and evaluated as in intervention for children with autism [31]. The goal of virtual peers is to foster a less overwhelming social environment for a child with autism to develop their social skills by interacting with a computerized peer whose facial expressions are controlled. While these techniques may be somewhat suitable for children, they fall short when it comes to teenagers.

In-Situ Social Awareness
As a means of self-evaluation Weilde et al observed how autistics correlate during peer discussion groups discussing their social expectations and experiences [34]. Even with monthly meetings it is unknown if they are an effective means of changing behavior thus there is a necessary lack of empirical proof. However, stems an interesting research stream to support the claim that interacting with your peers and discussing your issues is an effective medium for self-evaluation. This is an interesting area as autistics normally do not have many friends, thus this allows them to be potentially develop friendships. One weakness is that the groups are tailored to what the adolescents want to focus on, thus there is a lot of information that potentially does uncovered.

In contrast Channon et al observe how autistics perform problem solving in real-life-type situations [8]. By presenting real-life scenarios with video and comparing the

results of autistics and typically developing adolescents, the researchers concluded that autistics had the most trouble with social appropriateness [8]. This study does provide a sense as to what situations are more problematic for the autistic population; however, how these scenarios affect behavior change when actually in the social situation was not observed. Since the videos being shown were not available elsewhere, and the peer groups are on a weekly basis, however, when adolescents need on-demand information, these approaches are somewhat inflexible. Peer groups are found online yet are not live, and there are many videos online about social situations, however, they are not explicitly categorized as to what is socially appropriate and what is not.

Toys and Games
There is a substantial body of work which is carried by the University of Hertfordshire that is looking into how robotics can aid social interaction. This research group states that children (and potentially adults, as well) adapt to their robot toys and mimic their actions, thus fostering engagement with their toy [10, 11, 20, 27]. These studies have been carried out on young children, but being attached to a robotic toy is not really appropriate for teenagers. There has also been some work done showing how LEGO® can be used to improve social competence amongst autistics [21].

The work being done with social games is targeted on a user working directly with an application and lack the face-to-face communication [5]. Typically non-technological solutions have included board games, skits, and card games to simulate social situations. Yet these approaches have been shown to be inflexible and uninteresting. There are a number of single user computer games to aid with social skills which focus on memorization of facial expressions and emotions [5, 24, 32]. Yet memorization lacks flexibility and generalization. There has been work done as well into collaborative play (SIDES) using tabletops to foster social interaction. SIDES provides a motivation supportive experience where teenagers can practice social and group work skills in group therapy sessions [25]. This is expensive technology that is mostly used in therapy sessions.

Virtual reality has also been explored to provide virtual collaborative environments shared features between the virtual and real world facilitates generalization. Also can practice skills safely without real world consequences [6, 28] Video games have been proven to aid some children with social skills as they provide a safe place individuals can visit frequently [9, 17, 19], yet computers cannot accurately represent nuances of human social behavior. Also some virtual environments are quite inflexible, as they require a lot of control over the experience and require a lot of pre-programming for each student.

Pervasive Intervention
The previous two categories have looked at how to teach social skills through some sort of mediated approach.

Pervasive interventions look to provide a bit more independence for the teenager while trying to learn social skills on the fly. There is research being done on the Handy Interactive Persuasive Diary (HIPD) which is an interactive calendar with configurable abilities and knowledge about situations where the user is able to adapt a new behavior or attitude [26]. The researchers claim that without HIPD the individual will be socially isolated and incapable to interact with others, thus the goal of the HIPD is to warn the user of a difficult situation that is likely to arise and offer to guide him through it [26]. There has also been work done into how the use of a PDA can improve the independence of teenagers with Asperger's [14, 23]. Along the same lines comes wearable computing, the wearable technology focuses on in-situ training to provide an environment that is as realistic and natural as possible. These systems allow exploration of social interactions to gain insights on expressions in a fun, easy-to-use way to promote infrequent learning sessions outside the classroom. These wearable systems allow adolescents to systemize, quantify and reflect on their social interactions, encouraging self-evaluation practices [13, 22].

Research Opportunities
There are a few holes within the current work. Most of the work is tailored for therapeutic purposes or educational for children of young ages. However, teenagers have a different set of needs than children do. They would have already been through the therapy sessions and been taught social stories, but now require more independence and not being told what to do. Since the internet is very popular amongst Asperger teenagers for researching and looking up information, our social repository will provide a place for these adolescents to look up information about social situations and norms when they please, without having to be monitored by an adult, teacher, or caregiver. The adolescent will be able to look up the information they deem is important and learn about a particular social situation. Ideally this self-motivation to look up a social situation will prompt the adolescent to apply what they have learned when in the real world. According to Bandura motivation is a cognitive three step process were former experiences are reflected upon, there is a certain expected result, and evaluation of own performance in order to reach desired goal [4]. Thus this online repository can serve as a means for adolescents to reflect and evaluate how they will achieve their desired goal in a specific situation, which prior research has not explored.

SYSTEM DESCRIPTION
We propose Splash! an online, social encyclopedia that contains social etiquette and How Tos on topics related to social interaction and other life skills. To our knowledge, there is no one place that categorizes and organizes social etiquette and norms for either the general population or for people with autism. Similar web communities include *WikiHow* (http://www.wikihow.com) and *eHow* (http://www.ehow.com), but neither has the level of detail

and breadth of social topics covered to meet the needs to these students.

Interacting with the students, we found that one of their favorite websites is the free-content, collaborative encyclopedia project, *Wikipedia*. Though we did not have the foresight to ask them why they like it so much, we imagine the authoritative nature of the content, breadth of topics covered, straightforward writing style, and the simple site design and layout contribute to its appeal. Further research in an online forum and social network for people with Asperger Syndrome (http://www.WrongPlanet.net) revealed a thread that began with "Wikipedia has got to be an aspie heaven." Another discussant replied, stating:

> *"Wikipedia is like a drug to me... I can just go on there and start looking up anything and never stop. I seriously get addicted to looking up information. Its great that many articles get really in depth too."*

And another commented that:

> *"Wikipedia is like a quick way to build up a human encyclopedia in yourself, especially those with a high rote memory (like me and many other ASDs). It is also a good way to get interested in new things by surfing the page by page by page."*

These discussions highlight the value and educational potential of an online encyclopedia to people with Asperger syndrome. Recognizing the resistance to change and learning new systems that are characteristic of all Autism Spectrum Disorders [2], we sought to model Splash! on existing, widely-used technological resources like *Wikipedia*.

For our initial prototype, content will be chosen and developed based on feedback from the members of the program, drawing explicitly from existing textbooks and resources used my many caregivers and educators [3, 7]. The goal is to show social information in a way that students relate to so that they will deem the information important on their own and hopefully apply it to real life situations. This system will also promote independence in the students so that they take the initiative to look up the social interaction norms that interest them, without the need of an adult intervention.

System Requirements
Users
We are targeting Splash! at teenagers with Asperger's who are in need of social education and support. While our idea could expand to non-teenage users with or without Asperger's, we are focusing on this group because of the high level of social pressure at this age and the imminent need for independence as their high school graduation approaches.

Task
To convey information on social norms and etiquette in a very explicit, concise manner.

Context
The system is an online application that may be used in the classroom, at home or any other internet-accessible location. We imagine the students will most likely use it in a desktop environment because that is the most easily available platform and one that the students are already comfortable with. The decision to design a web-based system means the users will be able to look up what they want to about social norms at any time (instead of being restricted to classroom instruction or machine-specific situations). The usefulness of Splash! in these different contexts has not yet been researched, but it is something we will examine in the future.

System Features
In this section we outline some of the main system design and features, many of which are visually highlighted in Figure 1.

Search Functionality
Many interventions have found that autistics can be taught typical, specific social skills, but they struggle with generalizing this to other, similar situations [12]. We will support this need in our search functionality. When the user searches for a social situation, the system will return similar entries to try to capture the true essence of what the user is hoping to find or may need to know. The suggestion of similar situations may serve as a clue to when the skill may be needed again and the various contexts where this skill is used.

Figure 1. Two different approaches to information presentation for the main entry content. The screenshot on the left is the more traditional approach that has minimal distractions and extraneous information, standardized page layout, and an integration of multimedia resources, with an emphasis on detailed, cookbook-like explanations and behavioral procedures to match typical, scripted learning methods. The design scheme on the right uses a widget-based approach that minimizes the amount text presented to the user and categorizes content into playful modules. It is not known which may be more appropriate for our target population.
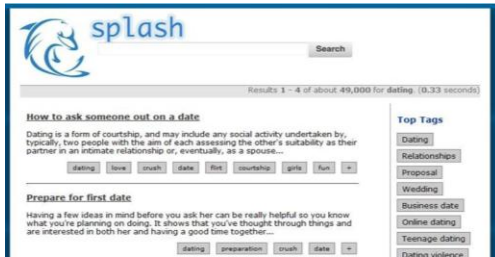
Information Architecture

Motivated by the finding that "the influence of categories are optional for autistics, but are mandatory for nonautistics" [29], we designed a non-categorical information architecture by utilizing a tag-based information architecture, much like is found on the social bookmarking website, Delicious (http://www.delicious.com, Figure 2). Tags provide a way for users to apply their own categorization words to an entry and a dynamic, diverse set of words or adjectives to describe a specific entry. These tags can also be used to support generalization, whereby certain social situations that are similar in nature will have similar tags to allow the user to connect entries together. Entries also contain lists of links to similar concepts and situations. Similarly, search results (see above, *Search Functionality*) will be clustered together to connect topics together that may otherwise have not been associated. These features all support the goal of generalizing concepts and skills across social situations and domains.

Information Presentation

Entries are presented in similar fashion to *Wikipedia* (*e.g.*, minimal distractions and extraneous information, standardized page layout, inclusion of multimedia resources), with an emphasis on detailed, cookbook-like explanations and behavioral procedures to match their typical, scripted learning methods. It is not clear what information layout or media is ideal to support learning in this community, so we are exploring different means to present the information.

One possibility is to convey a traditional style entry that has integrated information from multiple mediums such as text,
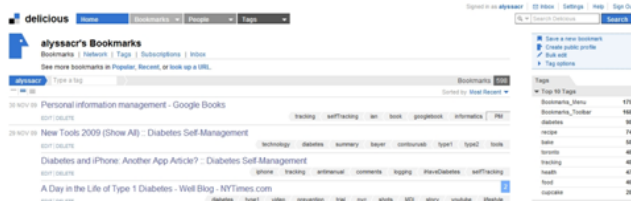
video, images, *etc*. Another possibility is a more modular approach of utilizing widgets. A widget, as seen on the Apple Dashboard or iGoogle, provides a way to showcase one specific area of focus and separate it from other content or functions. Using widgets provides the user with the majority of different focus areas without having the user scan for what they are looking for. This may be beneficial for those users whom are overwhelmed with reading long paragraphs of text. Figure 3 illustrates examples of traditional and widget-based information presentation.
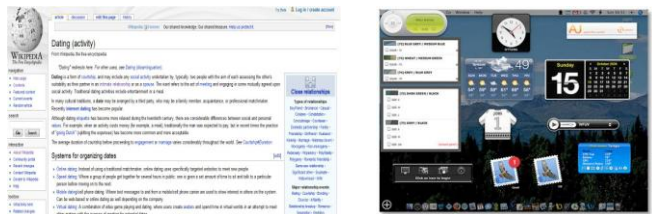
Typical Use Case

Edward has a crush on Bella, but he does not know what to do to get to know her better and has anxiety about approaching her. He knows about this thing called "dating" but he is not sure what that really means or how to do it. Thus Edward goes online and searches our system for tips on dating. Edward is able to click through different entries and their related topics to see what he should say and how he should react upon an awkward or unexpected event. He references them multiple times before approaching Bella to be sure he understands both generally and specifically what dating is and how he might need to act. Eventually Edward builds up his confidence and understanding of dating, so he feels more prepared to approach Bella. He puts his new knowledge to use and asks Bella on a date, who eagerly agrees and the two fall madly in love. Edward lives happily ever after with Bella, thanks to the tips and knowledge he initially gained from our system.

ENVISIONED EVALUATION PLAN

Continuing the partnership with the high school students in the Diploma Support Program for Students with an Autism Spectrum Disorder, we envision a comparative, deployment intervention evaluation of Splash! that would include not only system design and interaction evaluation, but also overall efficacy of our goal of teaching social norms and etiquette to teenagers with Asperger syndrome.

Using the topic of friendship and 'getting to know someone new' from the current textbook [3] used for the program's social living skills course, we would compare the efficacy of the traditional classroom lesson plan and educational setting to one supplemented by Splash!.

(a)

(b)

Figure 2. The information architecture of Splash!, as illustrated in the search results page (a), takes much inspiration from the social bookmarking site Delicious (b) with respect to using a user-contributed, flexible, tag-based labeling system that encourages generalization and association between similar social skills.

(a)

(b)

Figure 3. Current information presentation schemes that influenced the Splash! system design. (a) *Wikipedia* is an example of a traditional, integrated information presentation. (b) The Apple Dashboard is an example of a widget-based information display, whereby specific functions or pieces of information are featured in graphical modules.

All students will receive the same classroom instruction and any additional resources (including online or human knowledge), but only one group will have access to Splash! For both groups, the task after the lesson is complete (approximately two 1-hour sessions) will be to ask a friend to the movies at least once over the following two weeks

Specifically, we choose the topic of friendship and asking a friend to go to the movies because it is a skill that can be generalized to other situations (*e.g.*, asking someone out on a date), and that combines and builds upon a number of different social skills (*e.g.*, conversation starting and/or interrupting, telephone calling).

The students will be broken into two, equal-sized groups of 5-10 people with Asperger's, as evenly distributed by grade level and gender as possible. While there are significant differences in personalities, aptitudes and degree of syndrome severity, these variations are expected as a natural part of research for this population and will not be independently controlled for. Only one group will have access to Splash! throughout the experiment. They will not be required to use Splash! for a minimum amount of time or frequency after their brief tutorial of the system.

Both qualitative and quantitative measures will be used in this evaluation. For the Splash! group, we will solicit qualitative feedback on the different information presentations (*i.e.*, widget or traditional) and multimedia formats (*e.g.*, video, text-to-speech audio), the tagging infrastructure and other system features, and suggestions for improvement and future applications. Both groups will describe their memory of the task and what additional resources (if any) they consulted.

Quantitative measurements of anxiety, confidence and knowledge of the topic before and after the intervention, as well as after completing the task will be compared between both groups. We will track the web activity of the Splash! group (*e.g.*, time spent viewing page, queried terms, links selected and relationship to queried term and exit entry) to gain a better understanding of the interaction behavior of the students with the system. Assuming permission was granted, we will also log the overall web activity of both groups to gain an understanding of their baseline internet activity and sites visited. Of course, the question of whether or not the task was completed successfully will also be accounted for in both groups' quantitative analysis.

CONCLUSIONS AND FUTURE DIRECTIONS
Even in its nascent form, Splash! and the concept of an online social interaction and etiquette repository have a number of limitations. We will critically discuss those below, followed by our own lessons learned working with this population and future research opportunities to explore.

System Critique and Limitations
Appropriate Social Content Selection
Our initial prototype obtained content about social behaviors from the students' life skills textbook [3], as well as internet resources like *wikiHow* and *Wikipedia*. We manually edited the text to make it better match the needs of the students and the information presentation of the system. Even after this slow process, we do not know if the content we highlighted will be sufficient or useful to the teens, and whether or not our chosen level of detail will be comparably sufficient and useful across different topics. The idea of a 'correct' social behavior for a given context is not well-established (*e.g.*, should a man always hold open the door for a woman), so trying to either cover all the possibilities or select only the most common one is challenging. User feedback on the specific entry might alleviate some of this concern, but not entirely. Though Splash! is intended to provide guidelines for social situations, we do have to be very careful with the responsibility that might be given to the system as a social 'authority.' Additionally, we will have to face copyright and content-sharing issues, were we to deploy the system in the wild and continue to use traditional educational materials.

There has also been some concern expressed about whether a system like Splash! is insulting to people with Asperger's because it assumes that they lack 'common sense' and basic social knowledge that even neurotypicals struggle with. Selection of appropriate social content will require balancing these contrasting philosophies and determining what, for example, is the most suitable level of detail.

Moving from Research Prototype to Deployment
On top of selecting appropriate social content resources, developing a system (automatic or manual) to evaluate resource quality and then format the content appropriately is not a trivial task, especially given the quantity of social topics that would need to be covered. The situation becomes even more nuanced when considering multimedia content (*e.g.*, from sources like *YouTube*).

Lessons from Working with Teenagers with Asperger's
Working directly with the Asperger teenagers proved to be a great learning experience for the types of behaviors and evaluation methods researchers should use. Questions and discussions should be highly structured and not open-ended. Probing about 'big picture' or hypothetical situations resulted in confusion and off-topic comments. This was prone to happen even in concrete discussions (*e.g.*, questioning researchers about how their project will be graded or arguing that data collected will not be statistically representative, instead of answering the question). We also observed some teens insist on expressing their opinion or shifting the topic back to an un-related or previously mentioned point, distracting from the rhythm and goals of the discussion. These strong opinions and quick judgments need to be filtered and not overemphasized during analysis; they may also limit the reach and credibility of both the researcher's goals and the system itself. Patience and the ability to not take criticism personally are two other important skills to use when working with people with Asperger's

Future Directions

User Contribution, Networking and Interaction
In the future, we imagine Splash! will support an online community to make comments on the entries, including personal experiences and improvements to the entry, as well as to suggest and, perhaps, write new content. Community feedback can occur in the form of photos, text or video to encourage users to learn from each other. The success and vibrancy of online communities supported by people with autism has already been demonstrated through sites like Wrong Planet.net. Some students expressed concern with not being 'experts' in any social domain and hesitancy authoring content on their own, but whether or not they will feel inclined to participate in the community through commenting is not clear; we still believe it to be an important feature for future use of the system.

Additional Evaluation Studies
While not included in this initial study design, a comparison to gender- and age-matched, neurotypical students would be interesting to explore for any behavior, performance, learning-style or preference differences, as well as the usefulness of Splash! as a mobile, *in situ* resource.

Even without addressing these limitations and exploring these new research directions, we believe Splash! will help inform people with ASD about what to do in specific social situations and how to react when those situations change. For the teenage students, our goal is to provide an online support system that will accomplish similar goals as their school program, but will do so in a more comprehensive and accessible manner that promotes independence and generalization of social skills.

Ultimately, through our research with Splash! we hope to contribute to helping with this long-standing problem as described by one parent: "There are so many deficits that kids with autism have. The school district takes care of your academic skills. The regional center takes care of your self-help and behavioral skills. But one of the huge deficits in autism is social … and nobody seems to be taking care of that" [30].

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