

Exploration of Videochat for Children with Autism

Sanika Mokashi

Georgia Institute of Technology
Atlanta, GA, USA
sanikamokashi@gmail.com

Svetlana Yarosh

AT&T Research Labs
Florham Park, NJ, USA
lana@research.att.com

Gregory D. Abowd

Georgia Institute of Technology
Atlanta, GA, USA
abowd@gatech.edu

ABSTRACT

Autism is characterized by language delays and difficulties in social interactions. Remote synchronous communication technologies may provide children with autism with new opportunities to practice social interaction when in-person interaction may not be possible. We conducted an empirical investigation, asking children with autism to interact with a teacher using two different videochat prototypes. We found that the teachers were able to engage the children in social interactions using videochat, using certain techniques to draw the children away from distractions or fixations. We describe the effective strategies used by the teachers and discuss opportunities and challenges in using a traditional videoconferencing layout compared to an alternative side-by-side layout.

Author Keywords

Autism, ASD, video-conferencing

ACM Classification Keywords

H.5.2 [Information Interfaces and Presentation]: User Interfaces – *User-centered design*

INTRODUCTION

Children on the autism spectrum frequently struggle with social interactions and communication. An important component of therapy for children with autism is repetition and practice of social skills [2]. As such, these children stand to benefit from increased opportunities for social communication provided by videochat technologies, when in-person communication is unavailable.

Previous work has identified videochat as a potential tool for connecting children with their remote friends (for e.g., [10]) and family members (e.g., [1]). We build on the findings and suggestions of previous work, such as framing the video space by using a play stage (suggested in [11]) and providing a side-by-side video layout (suggested in [10]). This work extends the previous investigation of video-mediated communication with neurotypical children to children with autism.

In this work, we investigate the challenges in supporting video-mediated communication for this unique target audience. We also looked to understand what are effective adult strategies to support

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engagement with children over videochat. Lastly, we wanted to compare the use of a standard videochat layout with an alternative side-by-side layout, suggested by previous work. We begin with a brief overview of the background of autism therapies and related technical work. We then describe the methods of our empirical investigation and our findings from the study.

BACKGROUND

Treatment for Autism: Paradigms and Therapies

Traditional therapies for children with autism focus on developing essential skills through behavior management therapy, where the goal is to reinforce wanted behaviors, and reduce unwanted behaviors [2]. Structured interventions from speech, occupational, and physical therapists are combined to provide positive outcomes for children with autism.

In contrast with these behavioral approaches, the Floortime Model focuses on holistic relationships between the child with autism and their caregivers. Rather than reinforcing skills and isolated behaviors, this therapy focuses on expanding and extending the child's play themes, following the child's lead in supporting play, and creating playful obstacles to encourage problem-solving [5]. This approach is more similar to the kind of interaction that a child with autism may have with family members or friends, rather than the structured intervention of a behavioral therapist. As such, it may lend itself well to the kind of loosely structured interaction that is supported by videochat. In this study, we examine whether a Floortime-inspired interaction is possible between a child and a trusted adult (in this case, teacher) over videochat.

Relevant Technical Interventions

There has been a great deal of previous work examining how neurotypical children can synchronously connect with remote friends and family, including investigations of videochat in the home (e.g., [1]), play over videochat [4], and reading together over distance [8]. However, none of these investigations included participants with autism. There have also been a number of non-video-based technological approaches to help develop social skills in children with autism, including skill-building games (e.g., [7]), storytelling applications (e.g., [6]), virtual peers (e.g., [9]), and even human-robot interaction [3]. However, none of these interventions examined how children with autism may connect synchronously with trusted adults. In this study, we investigated the possible role of videochat technologies in facilitating children in remotely connecting with their teachers.

METHODS

In this section, we describe the conditions, participants, and procedure of our study.

Two Alternative Layouts

Figure 1 shows the two prototypes we used during the study, which differed in the layout of the videochat windows. The first prototype used a standard window layout, showing a big view of the remote participant and a small view of the local one. We implemented this condition using Skype. The second prototype used an alternative layout for play over videochat that was suggested (but not implemented) by Yarosh et al. [10]. This layout shows the participants the same size and side-by-side on the screen and both participants see the exact same view. The side-by-side layout aims to make it easier for the child to understand what is visible to the other person and to interact by gesturing towards the shared edge of the video. For example, the child is shown on the left-hand side and the teacher is shown on the right hand side of the screen, when viewed by either of them. If the teacher puts his hand up to the left side of their video frame, the child can match this motion to perform a simulated “high five.” This alternative layout was implemented using the TokBox API [12]. In order to keep the child from accidentally hitting the keyboard and to provide a guide for what is visible to the teacher, both conditions employed a physical structure called a PlayStage (developed and validated in [11]).



Figure 1. (A) Standard videochat layout. (B) Side-by-side videochat layout.

Participants

16 children and 12 teachers were recruited from a small private school that specializes in educating children with autism and other communication social difficulties using the Floortime Model. Some teachers took part in multiple sessions, to make sure that each child used the system with a familiar adult. For four of the youngest children, there was one teacher present in the room with them and another who was videochatting with the child. Children had the option to volunteer for the study after we received parental consent via a note sent home with each child. Their ages ranged from 5.5 to 17 ($M=12.34$, $SD=4.04$). Only two were girls, due to boys having a higher risk for autism (4.3:1 ratio). 7 out of 16 had previous experience using videochat at home, but none used it regularly.

Procedure

Each child was excused from regular activities for 20 minutes to join one of their teachers and us at the school’s library. Each child and teacher was shown demo videos describing the two proto-

types. They could decide what kinds of toys or props (if any) they wanted to use during the study sessions. Each child used prototype 1 for 5-7 min and then prototype 2 for 5-7 min (counterbalanced for order). We conducted post-study interviews with the children and teachers to understand their preferences, what the teachers thought the children enjoyed and other aspects of communication.

The lead author coded videos of each session for the kind of activities that the teachers and children engaged in (see description in the results) and for the children’s measure of engagement and social behavior derived from Functional Emotional Developmental Levels for children with autism as defined by ICDL [13] (summarized in Table 1).

Table 1. Functional Emotional Development Levels coded.

Measures of Child's Engagement and Social Behavior	
Shared Attention	Child's ability to regulate his or her attention and enter into a state of shared attention with another person. Measured on a scale of 1 to 5.
Engagement	Child's ability to engage in relationships, including depth and range of warmth and pleasure. Measured on a scale of 1 to 5.
Intent	Child's ability to enter into purposeful two-way communication. Measured on a scale of 1 to 5.

FINDINGS

We discuss the overall characteristics of the videochat interaction observed between teachers and children with autism, outline the differences between the standard and side-by-side layouts, and describe the strategies used by teachers to engage children in the videochat interaction.

Overall Interaction Observed

We found that video conferencing as a tool has a lot of potential and the teachers were able to engage the children and keep them from getting distracted in spite of the limitations of the medium. The overall average level of shared attention was 3.81 ($SD=0.69$), the average level of engagement was 3.20 ($SD=0.80$), and the average level of ability to communicate intent was 3.25 ($SD=1.02$) as coded based on ICDL guidelines. However, videochat did not work for every child. Child #13 became agitated during the first session and had to stop participating. Children #3 and #4 struggled with communicating intent and staying engaged in the interaction, with sessions receiving codes between 1 and 2.25 on those scales. Excluding these three children from the analysis, the other participants were on average successful in maintaining shared attention ($M=4.02$, $SD=0.50$), staying engaged ($M=3.38$, $SD=0.71$), and communicating intent ($M=3.61$, $SD=0.52$). So, videochat was not compelling to every child, but it was a viable medium for social interaction for the majority of the children in the study.

We observed and coded for four major types of interactions over videochat. The most common types of interaction observed were narrative and pretend play, which included telling stories about or pretending to be toys or imaginary characters. For example, in one of the sessions, the child and the teacher reenacted the story of the three little pigs:

Child #12: I'll huff, and I'll puff, and I'll blow your house down! [Blows; then bends sideways to show he has fallen. When the teacher did not respond instantly...]

Child #12: Fall down! Together with me!

Conversation, without elements of play, was observed with eight of the children, particularly older ones. Three of the children chose to engage in schoolwork activities during the session, such as playing with a balancing scale and blocks to do a math activity. Social play is defined as playful action that involves interaction between both of the participants. Outside of narrative play, social play was observed in three of the sessions, for example making faces at each other. Overall, there were a variety of activities that children and teachers successfully adapted to videochat during the sessions observed.

Many children with autism have sensory issues related to over or under stimulation of certain senses. Some children dealt with it, for example, by using headphones instead of leaving the speaker on during videochat sessions. We observed that sound levels, ambient light and screen brightness had to be adjusted for many children. It will be useful for videochat system design to take into consideration such varied requirements and also provide remote adults the capability to easily configure settings on the child's side.

Comparing Standard Versus Side-By-Side Layouts

One of the goals of this study was to understand the tradeoffs in using each of the two video layout prototypes studied. Table 2 shows the preferences and engagement levels of the children in the two conditions. Seven out of the 15 children preferred the standard layout, seven preferred side-by-side, and one child had no preference. The engagement scores do not show any substantial difference. It seems that the two layouts performed equally well at meeting the children's needs. However, children did express reasons for liking one layout over another in the interviews.

Two of the common reasons given by the children for preferring the standard layout included less distraction (as they did not need to focus on two faces at the same time) and they could avoid looking at their own face, which made some children self-conscious. A common reason for preferring the side-by-side layout was the way it supported novel types of play—such as toys virtually interacting with each other or high-fiving each other. One of the children also mentioned a sense of being in the same place as the other person in the side-by-side condition: *"I really liked seeing us virtually together like that."*

Table 2. Preferences and interaction scores, by condition.

Condition	Preferred by Child	Preferred by Teacher	Avg. Shared Attention	Avg. Engagement	Avg. Intent
Standard	7/15 = 46%	11/15 = 73%	3.86	3.18	3.29
Side-by-Side	7/15 = 46%	4/15 = 27%	3.75	3.21	3.21

In 11 out of 15 sessions, the teachers preferred the standard layout. Two of the teachers mentioned liking it because it was more familiar and it was also disconcerting to see themselves on the screen. On the other hand, one of the teachers mentioned, *"I found the side-by-side layout much more natural, I always disliked the PIP nature of videochat"* Teachers' opinions were more evenly split when describing which layout they thought was better for engaging the child: in 6 cases, they thought standard was better; in 4

cases, they thought side-by-side was better; and in 5 cases, the two layouts were considered equivalent (refer Figure 2). Some teachers thought that the preference depended on the task:

It was a lot of fun when our dinosaurs fought with each other. But for just talking, [the standard layout] was better.

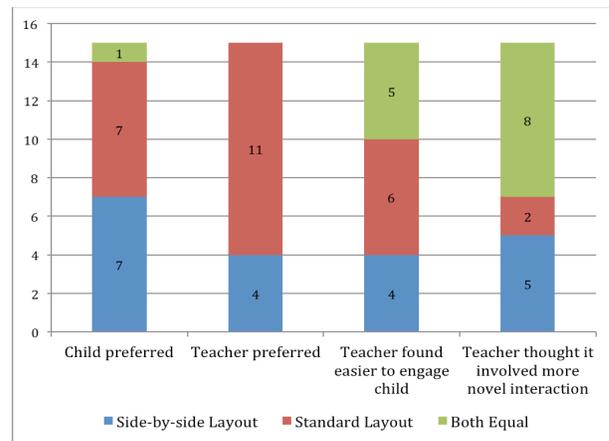


Figure 2. Distribution of preference based on preferences, ability to engage the child and novelty of interaction

Overall, it seems that the two layouts were functionally similar but each might be better for some users and some activities. This suggests that providing both layouts and letting the user choose might be the most beneficial.

Teacher Strategies

One of the goals of this study was to understand how experienced caregivers would structure a videochat activity to keep the child engaged. All the teachers were trained in the use of Floortime Therapy and used it on a daily basis with the children in this school. In this section, we describe the Floortime strategies teachers used and how these were adapted to the videochat medium.

The first aspect that characterizes Floortime therapy is the use of exaggerated affect to draw the child into the conversation, especially when a child gets distracted. Teachers were able to successfully do this over videochat. For example, child #7 got distracted and got up to walk towards the door. At this point, teacher F said very animatedly *"Come back! I miss you!"* and the child came back near the laptop. The standard layout seemed the preferred layout for conveying this emotion. As teacher G mentioned:

It was a lot easier for teacher H to woo child #8 during [standard video-conferencing]. He was a lot more responsive to her efforts at engaging him using affect.

However, we saw examples of the use of exaggerated affect in using the side-by-side layout, as well:

*Child #12: I'm angry [makes angry face]
 Teacher B: I'm angry too [makes angry face]
 Teacher B: I'm sad [makes sad face]
 Child #12: I'm sad [makes a sad face]*

In this case, Teacher B said:

He was a lot more engaged when it was side-by-side. I think it was because when we were imitating each other, he could see himself as well.

Overall, videochat did seem to lend itself well to the emotional exaggeration component of Floortime.

The second important aspect of Floortime therapy is following the child's lead in playing. Teachers would encourage the child to place something in front of the camera and then ask or comment about it. For example, when a child put on a cowboy hat for the teacher, she initiated him into the interaction by starting a discussion about Texas and cowboys.

The final aspect of Floortime therapy is creating playful obstacles for the child to encourage problem solving. A typical example in a face-to-face Floortime session would be a teacher blocking the path of a child's toy truck to encourage the child to interact socially to solve the problem. Since such a physical interaction wasn't possible over video-chat, the teachers improvised. For example, a teacher introduced a social obstacle after a child suggested that their toy dinosaurs should go to the park: "*But my dinosaur doesn't want to go to the park!*" and she walked the toy off the screen. The child responded by saying, "*Ok, then lets [take the dinosaurs to] go grab ice-cream instead.*" So, while not all obstacles were possible over videochat, the teachers were able to improvise situations that did work remotely.

Other strategies successfully used by the teachers were unique to the medium of videochat. The teachers incorporated affordances of the limited view into game play. For example, child #8 and his teacher pretended to magically make each other invisible and hid outside the view of the camera:

Teacher H: Abracadabra kazam kazoom! [Hides out of the view of the webcam]

Child #8: [Laughing] Come back! Now make me invisible.

Teacher H: Ok, let me concentrate. Abracadabra, kazam kazoom! Make [child #8] invisible!!

[Child #8 hides out of the view of the webcam]

The teachers were also sensitive to the type of interaction with toys that would work best with each layout. The standard layout was better for gesturing towards the child, while the side-by-side was better for engaging in play between toys. For example, in the standard layout, teacher B brought the dinosaur up close to the camera so that it took up the entire space and said to child #3, "*Arrrrr! My dinosaur is looking at you! He wants to talk to you*". In the side-by-side session, their dinosaurs played with each other. "*Look out! My dinosaur is charging at yours!*" said the teacher, as their dinosaurs pretend interacted.

When designing videochat systems for grandparents or relatives who are not trained in Floortime or other such techniques, some of these strategies could be incorporated into the system to enable richer communication. As an example, this could be done via a virtual agent as shown in the work by Raffle et al. [8] where they used Elmo not only to engage the child but also to scaffold adult behavior.

CONCLUSION

Videochat has the potential to provide opportunities for social interaction especially when a collocated partner is unavailable. As this could be particularly valuable for children with autism, we investigated how children with autism and trusted caregivers (in this case, teachers) use video-conferencing to interact in a con-

trolled setting. Through this exploratory study, we found that video-mediated communication is possible between children and trusted caregivers, such as teachers. The teachers could successfully adapt various Floortime strategies to keep the children engaged. We also investigated alternate layouts and found that there were trade-offs between different layouts depending on type of activity attempted and individual preferences. Future work investigating interaction with other trusted adults such as grandparents, other alternative layouts, scaffolding techniques, and customization needs of each particular child may make this kind of interaction more viable outside of a controlled environment.

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