TEACHING COMMUNICATIVE TURN TAKING USING THE IPAD© TO PROMOTE
SOCIAL INTERACTION FOR PRESCHOOL CHILDREN WITH COMPLEX
COMMUNICATION NEEDS AND THEIR PEERS

A Dissertation in
Communication Sciences and Disorders

by
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ABSTRACT

Positive interactions with peers impact future success in many domains, including language development and relationship development. Children with complex communication needs (CCN), especially those with characteristics of autism spectrum disorder (ASD), confront many barriers to successful interactions with peers. These include personal barriers, those specifically related to the individual child, and environmental barriers, or barriers related to the people and objects in the child’s environment. Proximity to children without disabilities alone seems to have little effect on peer interaction, which leaves children with CCN at risk for social isolation. Intervention is needed to support children with CCN who have characteristics of ASD to participate in peer interaction. In this study, a multiple probe across dyads research design was used to evaluate the effects of a peer interaction intervention on the frequency of symbolic communicative turns taken by children with CCN and characteristics of ASD in interactions with peers. Percentage of total turns and joint engagement were also investigated to assess the quality of the interaction. The multicomponent intervention included: (a) provision of a communication app on an iPad as augmentative and alternative communication (AAC) and (b) dyadic turn-taking training. Four of the five participants with CCN met the criteria for completing training within 9 training sessions and increased communicative turn taking with peers in sessions without adult support. The fifth participant showed increased turn taking during training sessions, but this did not result in turn increases during independent sessions with peers. The results from this study provide support for the use of AAC as an environmental support combined with dyadic turn-taking training to promote peer interaction for children with CCN and characteristics of ASD. Results, social validity, clinical implications, and future research directions are discussed.

Keywords: social interaction, peer interaction, augmentative and alternative communication, autism spectrum disorder, mobile technology, intervention
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Chapter 1

Introduction and Review of the Literature

Interactions with same-age peers become important to children starting in preschool and maintain importance throughout life. These interactions form the basis for developing social relationships, which are considered a core dimension of quality of life (King et al., 2003; Lynch et al., 2008; Petry, Maes, & Vlaskamp, 2005; World Health Organization, 2007). Research shows that early peer interactions contribute to social and emotional development as well as academic success (Bukowski, Motzoi, & Meyer, 2009; Vitaro, Boivin, & Bukowski, 2009; Wentzel, 2009). When it comes to peer relationships, both quality and quantity seem to be influential factors shaping children's well-being (Prinstein & Dodge, 2008). Because of this, children who have a hard time interacting with peers, or who have an abundance of negative interactions with peers, are at risk for experiencing loneliness (Asher, Parker, & Walker, 1996).

Children with complex communication needs are children with disabilities for whom oral speech is not sufficient to meet their daily communication needs. These children confront many barriers to social interaction, and observational research has shown that at school, they rarely interact with their classmates without disabilities (Chung, Carter, & Sisco, 2012b). Because challenges with social interaction and communication are a core deficit for children with autism spectrum disorders (ASD), children with CCN who also have characteristics of ASD are especially at risk for difficulties with social interaction and therefore likely to experience loneliness. Intervention is required to support children with CCN who have ASD or characteristics of ASD in social interaction with peers. The current study was designed to investigate the effects of an intervention to promote social interaction between children with CCN who experience the social challenges of ASD and their peers with typical development.
The importance of peer interaction

Peer interaction, the back-and-forth communicative interaction between two individuals, plays an important role in the development of relationships throughout one’s lifetime (Bukowski et al., 2009; Cartledge & Milburn, 1995). Basic social skills learned in the preschool years contribute to the development of complex ones, essential for developing and maintaining relationships, such as sharing and negotiating roles (Kennedy, 2013).

Social relationships provide many benefits; they have been shown to improve mental and physical health (Cohen, 2004; Umberson & Montez, 2010), facilitate the body’s ability to cope with stress (Hartup & Stevens, 1997), and benefit cognitive and language development (Hartup, 1989). Peer interactions provide a place to experiment with language in a way that adult-child interactions do not. Without the scaffolding support provided by adults, children must rely on themselves to get their message across. These interactions become a sort of proving ground for children (Light, 1997; Wilkinson, Heibert, & Remold, 1981). For school-age children, relationships with peers have also been shown to increase academic success. Higher levels of peer acceptance have been correlated with greater academic performance and having peer relationships motivates students to participate in learning activities (Wentzel & Watkins, 2002).

For young children, social interactions with peers are the beginning of the path to developing social relationships. Peer interactions provide a context for young children to learn how to be friends. By gauging peer reactions to their own behavior, children are able to shape their behavior for future interactions, gradually becoming more socially competent (Prizant & Wetherby, 1990). Children who struggle with these foundational peer interactions are at a higher risk for social isolation, depression, and poorer school performance (Brown, Odom, & Buysse, 2002; Bukowski et al., 2009).
Peer interaction for children with CCN

For children with complex communication needs, just as for all children, social relationships play an important role in quality of life (Batorowicz, Campbell, von Tetzchner, King, & Missiuna, 2014). Children with complex communication needs are those for whom spoken language is not sufficient to meet their communication needs. For many children with CCN, this is due to developmental disabilities such as autism, cerebral palsy or Down syndrome, but these communication challenges can also be due to acquired disabilities such as traumatic brain injury. Augmentative and alternative communication (AAC) strategies have the potential to enhance communicative effectiveness for individuals with CCN (Beukelman & Mirenda, 2013). AAC can be any method other than oral speech used to communicate, and can be unaided or aided. Unaided AAC includes gestures and manual signs and can be used in the absence of other individuals or supports. Aided AAC requires the support of equipment and can range from pen and paper to high-tech speech-generating devices (Beukelman & Mirenda, 2013).

Observational research shows that individuals with disabilities and especially individuals who use augmentative and alternative communication (AAC) are at risk for social isolation from peers (Clarke & Kirton, 2003; Cooper, Balandin, & Trembath, 2009). Research suggests that even when children with CCN are included in general education classrooms, peer interaction remains sparse (Carter, Sisco, Brown, Brickham, & Al-Khabbaz, 2008; Chung et al., 2012b). In a descriptive study of the social experiences of 16 elementary and middle school students who use AAC, Chung and colleagues found that the students interacted mainly with the adults in the classroom and less than 11% of their interactions were with peers (Chung et al., 2012b). Peer interaction for children with CCN may be impacted by a variety of both intrinsic and extrinsic factors.
Barriers to peer interaction

Children with complex communication needs

The World Health Organization’s International Classification of Functioning, Disability and Health, Children and Youth Version (ICF-CY; WHO, 2007), characterizes factors that impact participation in life events as either personal or environmental. Personal factors are those related to the individual with a disability such as motor and language skills, personality, and motivation to interact with peers while environmental factors consider the impact of people and objects in the environment (Raghavendra, Bornman, Granlund, & Björck-Åkesson, 2007).

For children with CCN, personal factors can be related to the characteristics of their disability, or their skill in using AAC. For example, children who use AAC often require extra time to compose messages in order to participate in a conversation (Batorowicz et al., 2014; Beukelman & Mirenda, 2013). In a group, this may mean that the conversation has moved on to another topic by the time they are ready to contribute. The attentional demands of AAC create an additional cognitive barrier to social interaction. For individuals who use AAC to participate in a conversation, they must listen to their partner, plan what they are going to say, visually scan their device to find appropriate selections, motor plan to make those selections, and remember their whole message even as they select the composite parts of the message (Smith, McCarthy, Benigno, 2009).

Environmental factors impacting social interaction may be related to the communication partners or to the setting itself. For school-age children who use AAC, peer interaction is facilitated through play and conversation with their classmates. However, even as young as preschool age, children without disabilities are less likely to choose to play and interact with classmates with disabilities (Diamond, Le Furgy, & Blass, 1993). In addition, without explicit
instruction, peers may not have the skills to communicate with a child who uses AAC, as even untrained adult communication partners lack these skills (Kent-Walsh & McNaughton, 2005; Lilienfeld & Alant, 2005) and young children are still learning to manage conversations with skilled communication partners.

Finally, the environment itself can create barriers to social interaction. For example, the almost constant presence of adults near children who use AAC could hinder peer interaction (Carter et al., 2008; Mihaylov et al., 2004; Causton-Theoharis & Malmgren, 2005; Watson, Shakespeare, Cunningham-Burley, & Barnes, 1999). Another oft-documented environmental barrier for children who use AAC is inconsistent access to AAC systems (Chung et al., 2012b). Without access to a consistent communication system, children with CCN may be left with no way to interact with their peers.

**Children with CCN and ASD**

Children with CCN who also have characteristics of autism spectrum disorder including challenges with social communication and restrictive and repetitive behaviors or interests, are likely to be even more at risk for loneliness and isolation from peers. They face the double challenge of inherent difficulty with social interaction that is part of autism spectrum disorders combined with the barriers created by the use of AAC. This combination creates a complex profile of skills and needs (Finke, 2009).

The *Diagnostic and Statistical Manual of Mental Disorders (5th Ed.; DSM-5)* requires impairment in two areas of development for a diagnosis of autism spectrum disorder (ASD): (1) impairments in social communication and interaction and (2) stereotypic and repetitive behaviors (American Psychiatric Association, 2013). Individuals with ASD are a heterogeneous population, and children with ASD have a wide range of skills, needs, and levels of functioning. Despite this
variability, the core deficits in social communication and interaction will affect the lives of children with ASD throughout their lives (National Research Council, 2001).

Characteristic deficits in social communication and social interaction can lead to challenges forming relationships for individuals with ASD (Travis & Sigman, 1998). Studies examining peer relationships for children with disabilities suggest that friendships are more restricted for children with ASD and intellectual disability than for any other students receiving special education services (Wagner, Cadwallader, Garza, & Cameto, 2004; Wagner et al., 2002). Both quantity and quality of interaction are lower for children with ASD than for children without disabilities (Lord & MaGill-Evans, 1995; McGee, Feldman, & Morrier, 1997; Sigman & Ruskin, 1999). Children with CCN who are also affected by the social impairments related to ASD, confront additional personal and environmental barriers to success in social interaction.

Personal barriers that may affect social interaction include difficulty initiating and responding to social interactions, sustaining eye contact, sharing objects and activities, and responding to other’s feelings (Baron-Cohen, 2004; Boyd, Conroy, Asmus, McKenney, & Mancil, 2008). Children with ASD have also been shown to have trouble maintaining a topic during conversation, and therefore may abruptly change topic, confusing peers (Tager-Flusberg & Anderson, 1991). Many children with ASD also have restricted interests and may only want to talk about those specific topics (Rotheram-Fuller & Kasari, 2011). If peers do not share these interests, this lack of flexibility may inhibit social interaction. Finally, motivation to interact with peers can also be a challenge for children with ASD or characteristics of ASD (Drager, Light, & Finke, 2013). Participating in communicative social interaction with peers requires a desire to do so, and if children do not find social interaction rewarding, they may instead choose solitary play.

The environment can also create barriers for children with CCN and characteristics of ASD. Barriers related to communication partners are similar to those listed above for all children with CCN; communication partners, especially when those partners are young children,
may lack the skills known to support communication. Environments in school that typically support social interaction, such as free play time, lunch or recess may not provide the structure or motivating context that individuals with autism spectrum disorders need to be successful, as some evidence suggests that children with autism are more likely to engage in peer interaction when participating in structured, highly preferred activities (Ferrara & Hill, 1980; Koegel, Dyer, & Bell, 1987). Given the personal and environmental barriers to peer interaction confronted by children with CCN, and more specifically by children with CCN who also have characteristics of ASD, it is clear that research is needed to develop and evaluate interventions that support peer interaction.

Peer interaction interventions

State of the science

Instruction for children who use AAC has historically had a narrow focus on expressing needs and requesting items and activities in interaction with adult communication partners (Snell, Chen, & Hoover 2006). This focus does not equip children with CCN to participate in interactions with peers that rely on social communicative competence, the pragmatic skills necessary to carry on conversation, to stay on topic, and to ask partner-focused questions, among other skills (Light & McNaughton, 2014). Because of this, researchers have called for the development of intervention to support these social skills and expand the focus of AAC interventions (Light, Parsons, & Drager, 2002).

Recent reviews of peer interaction research show that developing intervention to support social interaction has become an important focus within special education (e.g. Chung, Carter, & Sisco, 2012a; McConnell, 2002; Nijs & Maes, 2014; Therrien, Light, & Pope, 2016). The
interventions that have been developed to support children with CCN to participate in peer interaction focus on mitigating one or more of the barriers to social interaction. For example, some interventions target the child with CCN by teaching specific skills to enhance social interaction and are referred to as child-specific strategies (Odom, McConnell, & Chandler, 1993; Therrien et al., 2016). Other interventions focus on environmental barriers by either training peer communication partners in strategies to support children with disabilities, referred to as peer-mediated strategies, or by changing the physical environment to encourage social interaction, referred to as environmental arrangement (Odom et al.; Therrien et al.) A large group of interventions includes a combination of these intervention components, therefore addressing multiple barriers in one intervention.

Child-specific interventions aimed to mitigate personal barriers to success in social interaction for children who use AAC. These included interventions that either taught specific social or conversational skills, or taught children strategies to use their AAC systems within a social situation. Only one of the 19 studies in the review by Therrien et al. (2016) focused exclusively on child-specific strategies (Hunt, Alwell, & Goetz, 1988), but 12 of the 19 studies included child-specific components. Two of the three studies with the best evidence (Cosbey & Johnston, 2006; Hughes, Golas, Cosgriff, Brigham, Edwards, & Cashen, 2011) included components focused on teaching the child with CCN either to use AAC within peer interaction or to use specific social skills. Both of these interventions resulted in increases in initiations toward peers, and Hughes et al. also showed increases in peer interactions and responses to peers.

Environment arrangement interventions were those in which interventionists changed something about the physical environment to support social interaction. Studies including environmental arrangement components either provided a new form of AAC or modified an existing AAC system, formed or modified existing peer groups, or established motivating activities. No published studies on peer interaction for children with CCN focus exclusively on
environmental arrangement strategies, but they were often used in conjunction with interventions focusing on either children with CCN or their peers. Of the studies including environmental arrangement components, those with the highest level of evidence (Hughes, Rung, Wehmeyer, Agran, & Copeland, 2000; Hughes et al., 2011) included only provision of AAC, so little is known about the effectiveness of other environmental arrangement strategies.

Teaching children without disabilities the skills needed to support social interaction for children who use AAC is labeled peer-mediated intervention. Typically, these interventions either provide information about AAC or disability to children without disabilities, teach peers social skills to support interaction with children who use AAC, or teach peers to model and prompt AAC use. Of the 19 studies reviewed by Therrien et al. (2016), 17 included peer-mediated components. The most frequently used strategy was teaching peers social skills, such as responding to initiations made using AAC and providing extra time for individuals using AAC to compose a message, to improve the interactions of children who use AAC. Three studies in the review used only peer-mediated components for their peer interaction intervention (Carter & Maxwell, 1998; Chung & Carter, 2013; Trottier, Kamp, & Mirenda, 2011). Of these, the best quality of evidence comes from Chung and Carter who reported mixed results, with only one of the two participants demonstrating gains in peer interaction and initiations. The results for multicomponent interventions that included peer-mediated components with high quality of evidence were typically more consistent at effecting gains across all participants.

Much of the research on supporting social interactions for children who use AAC included multi-component interventions, or those that sought to mitigate the effects of multiple barriers to interaction by including a combination of child-specific, peer-mediated, or environmental arrangement components (Therrien et al., 2016). Although the use of multicomponent packages can make it difficult to tease out the components that have the most
impact, the complexity of social interactions between children with ASD and their peers may require this combination of intervention components (Carter et al., 2010).

Multicomponent interventions generally show better results than single component interventions, which aligns with theoretical views that to improve communication outcomes for individuals with complex communication needs, interventions must consider the individual, the communication partner and the context in which the communication takes place (Light, 1997; Light & McNaughton, 2014; Siegel-Causey & Bashinski, 1997). Of the nineteen studies reviewed, three studies from Therrien et al. (2016) were given the highest rating for quality of evidence, and each had percent non-overlapping data higher than 90%, ranking them as highly effective interventions (Cosbey & Johnston, 2006; Hughes et al., 2000; Hughes et al., 2011). All three of these studies used a combination of intervention components. Although each of the three studies used a different combination of components, all three included peer-mediated strategies. This provides preliminary evidence to support the inclusion of peer training within multicomponent interventions to promote successful social interaction for children who use aided AAC. The success of multicomponent interventions may be due to the fact that the intervention components target each of the potential barriers to interaction.

In the literature on supporting social interaction for individuals with CCN who use AAC, only a few studies include participants with autism spectrum disorder. The systematic review by Therrien et al. (2016) identified only seven studies including children with ASD, and only one (Hughes et al., 2011) with the highest certainty of evidence, signifying rigorous research methods. The participants in that study included middle and high school students with a variety of developmental disabilities, including three participants with ASD. Hughes et al. investigated the effects of a multicomponent intervention, including child-specific, peer-mediated and environmental arrangement components. The results of the study were positive. All participants saw improvements in peer interactions, initiations toward peers, and responses to peers.
these results certainly suggest that the peer interactions of individuals with autism spectrum disorder who use AAC can be improved, the study is limited in that it includes only three participants with ASD between the ages of 16 and 21. For preschool and elementary age children, very little is known about how to increase and improve peer interaction.

Because so few studies include participants with autism who use AAC, when developing interventions for that population, it is important to consult both the literature on children who use AAC and the literature on supporting children with ASD. The literature on improving social skills for children with autism is extensive. Carter, Sisco, Chung, and Stanton-Chapman (2010) identified 83 studies focused on supporting social interaction for school-aged children with autism and many other studies were conducted with preschool-aged children (see reviews by Camargo et al., 2014; McConnell, 2002; and Watkins et al., 2015). This body of literature shows that with intervention, children with ASD are capable of initiating and responding more to peers (e.g., Ganz & Flores, 2008; Jung, Sainato, & Davis, 2008; Mason et al., 2013) and extending the duration of interaction with peers (Kamps et al., 1997; Katz & Girolametto, 2013).

Just as social interaction interventions for children who use AAC can be grouped according to the barriers they attempt to overcome, so can interventions for children with ASD. Reviews of interventions to support social interaction for children with ASD support the use of combination interventions that confront multiple barriers, and many stress the value of peer-mediated intervention (Camargo et al., 2014; Carter et al., 2010; McConnell, 2002; Watkins et al., 2015). Intervention strategies such as modeling, prompting, and reinforcement are frequent elements of both the child-specific and peer-mediated intervention strategies for supporting peer interaction for children with ASD (Camargo et al., 2014; Watkins et al., 2015).
Limitations and gaps in the research

While the evidence from peer interaction studies to support children who use aided AAC does provide some guidance in ways for clinicians and educators to support interaction, there are limitations. First, the evidence for conclusive studies from Therrien et al. (2016) is limited to only 13 participants. With the heterogeneity of the population of individuals who use AAC, a wider variety of interventions meeting the highest standards of research is required to determine whether peer interaction interventions can be successful with all individuals who use AAC. For example, in the group of three studies with the highest level of evidence, only one study included children under the age of 10. In a study published after that review, the intervention in Therrien and Light (2016) focused on preschool children with CCN. However, the results from that study were mixed. Given that preschool is the first opportunity that many children have to consistently interact with peers, more research is needed on how to support preschool children with CCN in interactions with peers. Additionally, participants with ASD who require AAC are minimally represented in the literature. Given that many special education and general education classrooms today include children with a variety of disabilities, including ASD, it is important to investigate interventions that can support peer interaction for children with a variety of skills and challenges. For example, an intervention that promotes peer interaction for all children with CCN regardless of diagnosis would be immensely helpful in classrooms where students with communication challenges have diagnoses of Down syndrome, cerebral palsy, and autism spectrum disorder.

Second, although many studies reviewed by Therrien et al. included provision or modification of AAC as an intervention component, it is unclear whether particular characteristics of AAC are important to social interaction interventions. Seven of the eight studies that provided or modified AAC as part of the intervention used low-tech AAC such as a
communication board or book, while only one study (Chung & Carter, 2013) modified participants’ speech-generating devices to support interaction by providing specific social vocabulary. More research is needed to investigate the impact of type of AAC used and the programmed vocabulary on the peer interactions of children with CCN.

Despite the success of peer-mediated interventions with children with CCN and with children with ASD, there are potential challenges to peer mediated approaches. First, unless peer-mediated interventions can show that they produce generalizable changes in the social interaction skills of children with ASD, the success in social interaction seen in studies will require constant access to trained peers to make a sustained difference in the lives of children with ASD (McConnell, 2002). An additional concern is that many peer-mediated interventions teach peers to see themselves as “helpers,” which establishes a relationship hierarchy instead of promoting equality (Janney & Snell, 1996; Therrien & Light, 2016). Developing relationships in which children have equal status may be better suited for promoting friendship development, as equality is often cited as a critical component of friendship (Bagwell & Schmidt, 2011; Finke, 2016; Newcomb & Bagwell, 1995).

In order to preserve the horizontal relationship between children without disabilities and children with CCN, Therrien and Light (2016), included a dyadic training component, teaching turn taking with the iPad as AAC to both the peer and the child with a disability. The study included two participants with CCN, who both showed some gains in turn-taking during the intervention period. Because neither of the participants in the study by Therrien and Light were diagnosed with ASD, research is needed to determine whether dyadic training would be effective to support children with and without ASD in social interactions. An intervention that is effective with children with CCN and a wide variety of disabilities may be particularly helpful for teachers in inclusive classrooms serving children with a variety of diagnoses with a range of skills and
Further research is needed to determine whether interventions promoting equality in the peer relationship can be successful with a diverse group of children with CCN.

**AAC for social interaction**

To support young children with CCN and characteristics of autism in social interaction with peers, it is essential that participants have both a means of communication, and something about which to communicate. For children with CCN, AAC systems are required to provide that means of communication.

Children without disabilities are able to use a variety of shared modalities to communicate with peers, including gestures, facial expression, and spoken words. To encourage interaction between children, von Tetzchner, Brekke, Sjøthun, and Grindheim (2005) proposed that “a shared means of communication [was] a necessary prerequisite” (p. 86). Children who use AAC are often lacking this shared means of communication. Although AAC is typically considered a customized support for use by one individual, research suggests that conversation partners using AAC to communicate with individuals with CCN has a positive impact on language development for individuals with CCN (Sennott, Light, & McNaughton, 2016). Some studies have tried to capitalize on this by teaching peers without disabilities to model the use of AAC (e.g., Trembath, Balandin, Togher, & Stancliffe, 2009; Trottier et al., 2011). Specifically teaching peers to model AAC use, however, again puts the peer in the role of mini-teacher. One potential way to avoid this is to introduce the high tech AAC as an environmental support within an activity, rather than as an individualized support for the child with CCN, as seen in Therrien and Light (2016). Although this may be a novel use of high tech AAC, preschool teachers and SLPs have often used low-tech AAC in this way. Preschool classrooms, especially inclusive preschool classrooms, are filled with picture symbols used for visual schedules, making activity
choices, and learning the classroom rules (Quill, 1997). Using high-tech AAC in this way could support both the child with a disability and the peer to participate and engage by both (a) decreasing the stigma of AAC and (b) encouraging peers to model use of AAC without explicitly teaching this skill.

Stigma and negative attitudes toward individuals who use AAC are some of the barriers to social interaction for this population (Dada, Horn, Samuels, & Schlosser, 2016; McCarthy & Light, 2005). Research suggests that the use of an iPad as AAC may reduce the stigmatization of individuals with CCN, thus having a positive impact on feelings of isolation (Dada et al., 2016; Hunt, Doering, Maier, & Mintz, 2009; McNaughton & Light, 2013). iPads also have more appeal to children with and without disabilities than typical AAC systems (McNaughton & Light, 2013). With a variety of child-friendly cases and applications, iPads include many of the components for making AAC devices appealing to children: bright colors, personalization, popular themes and characters, and games and music (Light, Drager, & Nemser, 2004; Light, Page, Curran, & Pitkin, 2007).

iPads have successfully been used as AAC for individuals with ASD. Reviews investigating of the use of iPads and other mobile technology devices to support communication for individuals with ASD found that use of the mobile technology as AAC was highly effective in increasing communication skills such as requesting and answering simple questions (Alzrayer, Banda, and Koul, 2014; Lorah, Parnell, Whitby, & Hantula, 2015). Although many parents and professionals support the use of the iPad to support communication (Alzrayer et al., 2014; Clark, Austin, Craike, 2015), research is needed to investigate its use for communication skills beyond requesting. Because children with characteristics of ASD specifically struggle with social interaction, determining whether the iPad can be used as a tool to promote peer interaction should be a focus of future research.
In traditional AAC assessment and intervention, after a device is selected, vocabulary must be selected and organized to promote participation. Research has shown that young children have an easier time locating vocabulary when using visual scene displays than with grid displays (Drager, Light, Speltz, Fallon, & Jeffries, 2003). Symbols in visual scene displays (VSD) derive meaning from both the depiction of the actual object and the relationship between the object and the surrounding environment. This use of contextual vocabulary may reduce metalinguistic and working memory demands for young children (Drager et al., 2003; Light, Drager, McCarthy, et al., 2004). Visual scene displays may also meet a need that is often overlooked in high-tech AAC, that of appeal to children. Light, Drager, and Nemser (2004) argued that early intervention for children who use AAC would be more effective if AAC options were appealing, and that it would be easier for children who use AAC to engage in interactions with peers when using appealing systems. Using VSDs to display and organize vocabulary may provide an experience for both the children with CCN and their peers that is fun and engaging and not unlike many of their experiences with commercially available eBooks and other games developed to engage young children on the iPad or other mobile devices. A final benefit of using VSDs to support social interaction is that VSDs allow for integration of communication modality and the activity.

**Contexts for social interaction**

For beginning communicators, communication typically focuses on their current activity. Because of this, it is important that preschool-age children are engaged in a mutual activity to encourage interaction. In a typical preschool classroom, children engage in a variety of activities that could support communication. Many classrooms are organized around centers (e.g., drama
center, arts & crafts center, literacy center). Traditionally, in most center activities, a child who uses AAC would be forced to choose between playing and communicating (Light, 1997; Light, Collier, & Parnes, 1985). In the literacy center, however, it is possible to embed communication within the activity, so children are not forced to divide their attention. AAC using VSDS can avoid this problem, as photographs of each book page with embedded communicative hot spots can be created. In this way, the activity and the means of communicating are paired in one device, where attention can be focused. In this scenario, children would not be responsible for managing other materials or shifting attention between the activity and the AAC device in order to communicate.

Story reading has been used in research as a context for interventions to support social communication between adults and young children with CCN. In adult-child interactions using storybooks, children with CCN have shown increases in communicative turns, multi-symbol message use, morphological structures, and semantic concepts expressed (Kent-Walsh, Murza, Malani, & Binger, 2015; Sennott et al., 2016). A noted benefit to the storybook context is that it is a familiar routine that provides a common vocabulary. Choosing vocabulary to program on an AAC device can be challenging, as it is hard to know what another person might want to say in a given situation (Beukelman & Mirenda, 2013). While this is still true of the storybook reading context, the books themselves provide a starting point for communication.

**Study objectives and research questions**

Utilizing components that theoretically address all types of barriers to social interaction, this intervention aimed to increase communicative interaction for preschool children with CCN who had characteristics of ASD through provision of the tools and skills necessary for a balanced interaction: an appropriate AAC system, an iPad with the communication app GoTalk NOW
(Attainment Company, 2011), and dyadic training in turn-taking with the iPad. Unlike many peer-training interventions, this training treated the two children as equals, with each playing an essential role in the interaction. In addition to communication skills of the children with CCN, this study also explored peer communication variables and engagement variables across all phases. The primary research question for this study was: What is the effect of this social interaction intervention on the frequency of communicative turns expressed by children with CCN and characteristics of ASD who use AAC in interactions with peers without disabilities? In addition, this study investigated whether turn-taking skills learned during the intervention generalized to the natural context of the preschool classroom with new materials. Finally, the study explored the perceptions of stakeholders (parents, teachers, SLPs, and children) on the intervention and its results.
Chapter 2
Method

Research design

The current study implemented a single subject, multiple probe research design (McReynolds & Kerns, 1983; Richards, Taylor, & Ramasamy, 2014), across one set of three dyads, with a replication across an additional set of two dyads, for a total of five participating dyads. The original design included a replication with three dyads (for a total of six participating dyads), but one participant was unable to continue after consent due to medical issues. The independent variable was a multicomponent intervention including provision of AAC and turn-taking training. The main dependent variable was frequency of symbolic communicative turns for participants with CCN during a 10-min storybook sharing session with a peer. The study involved two main phases, baseline and intervention, with two generalization probes conducted during each phase. Dyads participated in sessions between one and three times per week across three months, with no more than one training and one probe session on any day.

Use of single subject designs affords evaluation of the efficacy of an intervention that includes participants from a heterogeneous population (i.e., children with CCN and children with ASD) because each participant serves as his or her own control (Richards et al., 2014). A multiple probe design across dyads was used to evaluate the effects of the intervention on the frequency of symbolic communicative turns expressed by the child with CCN. This design requires systematic introduction of the intervention with three or more dyads (Richards et al., 2014). A multiple probe design was more practical than a multiple baseline design as it requires periodic
measurements of baseline behavior, instead of daily measurements. This was chosen as an alternative to multiple baseline design to minimize participant boredom and frustration during baseline probes (Richards et al., 2014). Additionally, the repeated measures in a multiple probe design provide information about the process of acquiring skills throughout the study for each dyad (McReynolds & Keams, 1983). Finally, a multiple probe design was more appropriate for this study than designs involving withdrawal or reversal because participants learned behaviors during training that were not expected to return to baseline when training ended (Richards et al., 2014).

Before training occurred for any dyads, a minimum of five baseline phase data points were collected (Kratochwill et al., 2010). Baseline sessions continued until a pattern of behavior for the dependent variable with little variation, and with no evidence of an increasing trend was observed (Kazdin, 2011; McReynolds & Kearns, 1983). Baseline frequency of turns for children with CCN was considered to be stable if the range of frequency from the lowest to highest number of turns over five sessions was no greater than five. Trend was assessed through visual analysis of the data.

Once the first dyad met criteria for transitioning out of baseline, intervention began for that partnership. The second and third dyads remained in baseline. When an intervention effect was established with the first dyad, intervention began with the second dyad, assuming the criteria for ending baseline had been met. An intervention effect was defined as two consecutive data points that were higher than the baseline median by double the baseline median. For example, if the baseline median were 3.5, to show an effect, during intervention there would have to be two consecutive data points over 10.5. This definition of an effect ensured that a definitive change between baseline and intervention performance had occurred when and only when the intervention was provided (Kazdin, 2011). Just as with the second dyad, the third dyad remained in baseline until an intervention effect was established with the second dyad. During the
intervention phase, training sessions occurred a minimum of five times (Dyad E was an exception because of the end of the school calendar) and continued until the criteria to end training had been met.

Participants and setting

Participants were recruited from early childhood centers in Pennsylvania via letters sent home to parents of all children in the classroom. Once three children with autism spectrum disorders and three peers who met the criteria were identified and consent to participate was acquired, the study began. Three additional children with ASD and three peers were recruited using the same method as a replication. However, one child with ASD was unable to participate due to medical problems.

Inclusion criteria

All the children in this study were from English-speaking homes. Participants with complex communication needs met the following criteria: (a) had a diagnosis of ASD or developmental delay with characteristics of autism (challenges with social communication and repetitive and restrictive behaviors or interests), (b) were 3-6 years old, (c) were children for whom speech was not sufficient to meet communication needs, (d) were intentional communicators with emerging symbolic skills, (e) were able to sustain interest in a preferred functional play activity for five minutes, (f) had motor skills sufficient for reaching and touching a 9 x 7 inch screen, (g) had adequate vision and hearing (with or without correction) to engage in
play interactions, and (h) did not have a history of behaviors that presented a safety risk to self or peers.

Children with CCN and characteristics of ASD were chosen for this study because of their risk for later social isolation. Participants were required to have emerging symbolic skills so that they could recognize the hot spots on the iPad with visual scene displays as a possible mode of communication. Sustained interest in an activity, along with motor, vision, and hearing skills were required to participate in the interaction with the peer using the materials without accommodations. Finally, to keep both participants safe during research activities, children with behaviors that could be considered a safety risk were excluded.

Peers without disabilities met the following criteria: (a) were 3-6 years old, (b) were classmates or same-aged (within 1 year) peers of children with complex communication needs, (c) had no history of negative interactions with their partner at school, (d) had at least one common interest with their partner, (e) had adequate vision and hearing (with or without correction) to engage in play interactions, and (f) had no identified disability.

Same-age peers were chosen as partners because they are a natural communication partner for children in preschool and will continue to be possible communication partners throughout the school years. Participants were required to share a common interest so that materials chosen would be appealing to both children and to encourage a positive social interaction (Bauminger & Schulman, 2003).

All policies and procedures instituted by Penn State’s Office for Research Protections were followed in order to ensure proper protection of participants (see Appendix A for IRB approval letter). A parent for each participant provided informed consent to participate before the investigation began (see Appendix B for consent form).
Assessment of participant skills

Parent and teacher report was used to determine: age, diagnosis of disability, vision and hearing status, history of behaviors that might impact safety, participant interests, and history of negative interactions. Parents filled out a demographic questionnaire and interest inventory for all participants (see Appendix C for demographic questionnaire).

Diagnosis of disability

Parents provided information on the demographic questionnaire relating to age at diagnosis, test used, and physician’s name. Parents were asked to provide a copy of the written report documenting the participants’ disability, but this information was only obtained from one of the four participants with a diagnosis of autism spectrum disorder.

Although four of the five participants had been previously diagnosed with autism spectrum disorder, confirming accurate diagnosis is important before measuring the efficacy of a treatment for children with ASD (Matson, Goldin, & Matson, 2014). Researchers in this study used the Childhood Autism Rating Scale (2nd Edition) to confirm diagnosis of ASD or presence of characteristics of ASD according to the DSM-5 criteria. This assessment is often used to distinguish between children with autism spectrum disorders and those with other developmental disabilities. For this specific task, when using a raw score cutoff value of 30, the CARS-2 was shown to correctly identify 87% of the testing sample as either having or not having autism (Schopler, Van Bourgondien, Wellman, & Love, 2010). Although the CARS-2 was developed before the adoption of DSM-5, the assessment is still considered a valid diagnostic tool under the updated criteria (Park & Kim, 2016).
**Language skills**

The online version of the Communication Matrix (Rowland, 2009) was used to determine whether participants met the requirements for intentional communication with emerging symbolic skills. The Communication Matrix is an assessment well-suited for determining intentionality with children with ASD who have minimal speech as it takes into account the various reasons for communicating as well as modalities for communication (Kasari, Brady, Lord, & Tager-Flusberg, 2013). After two 20-minute play interactions and a 30-minute classroom observation, the primary investigator completed the online Communication Matrix for each participant with CCN. To meet the criterion of intentionality, participants had to have at least three mastered skills at Level 3, unconventional communication (pre-symbolic) and to show that participants were capable of understanding symbols, they had to have emerging skills at a minimum level of Level 6, abstract symbols, to participate in this study.

All children with CCN who participated in the study were identified by their SLP as students who required the use of AAC to communicate at school. Parents of participants completed the MacArthur-Bates Communicative Developmental Inventories (CDI; Fenson, Marchman, Thal, Reznick, & Bates, 2006) Words and Gestures form to create a better picture of the expressive communication skills of participants. Although the CDI is normed for children ages 8-37 months, it is often used in research and clinical practice with older children with developmental disabilities (Kasari et al., 2013).

Finally, in order to better describe the language skills of the children participating in this study, the receptive language of each child with CCN was assessed using the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4; Dunn & Dunn, 2004). Kasari et al. (2013) rated the PPVT-4 as well suited for assessing the receptive language of children with ASD who have minimal speech.
**Motor skills**

During the 20-minute play interaction, the primary investigator engaged the participants in at least one interaction using the iPad and a cause-and-effect app to ensure that participants could reach and touch the device. The iPad was placed flat on the table, and to successfully play with the app, participants had to reach and touch a specific 3x2 inch section of the screen. A successful touch involved a touch and release gesture that was not a swipe. In the course of game play, participants had 18 opportunities to touch a specific location. To meet criterion for motor skills, participants had to successfully touch the iPad in 15 of the 18 opportunities (83%).

**Attention**

During a 20-minute observation, the primary investigator followed the child through typical preschool activities. With a stopwatch, she measured duration of attention to the activities when children were participating functionally in an activity. Children had to demonstrate the ability to attend for five minutes in at least one activity during the observation. Functional participation in an activity included engaging with materials in an expected or typical way, for example, turning pages and looking at pictures in a book, or driving cars along the floor. Perseverative activities such as rapidly flipping the pages of a book or spinning a car’s wheels were not counted toward time-spent engaging in activities.

**Pool of potential participants**

A total of seven potential participants with ASD were gathered through collection of parent interest forms. One of these participants did not meet the selection criteria, as she was unable to successfully attend to an activity for five-minutes, and was not able to interact with the
iPad using a touch and release gesture. Additionally, one child who enrolled in the study and met study criteria left school due to health concerns and therefore could not complete the study. The remaining five children with ASD and their peers met all of the above selection criteria and were deemed appropriate for the investigation.

**Participant demographics**

All five children with ASD were male and their ages ranged from 3;9 to 5;10 (years; months) at the start of the study. The parents of all five children identified their child’s race and ethnicity as white, non-Hispanic. Two of the participants with ASD came from low-income families. All five children with ASD were reported by their SLP to use few spoken words or word approximations to communicate at school. Using the CDI (Fenson et al., 2006) Words and Gestures form, parents estimated that the number of words/concepts the children were able to express (across all five children) ranged from 1 to 303 out of a maximum of 396. These children were also involved in other interventions including occupational therapy, physical therapy, speech-language therapy, and applied behavior analysis with discrete trial training (see Table 2-1 for participant descriptions). At home, none of the children used any form of aided AAC, but communicated through gestures, facial expressions, and minimal speech. At school, they all used some forms of low-tech aided AAC, including picture symbols, sentence strips, and communication boards in various contexts.

All five of the peer participants were recruited from Head Start preschools whose classrooms were in the same building as the classrooms for children with ASD. Four of the peer participants were male, and one was female. Peer participants ranged in age from 3;11 to 4;11. Parents of all peer participants reported race and ethnicity as white, non-Hispanic. Four of the five peers came from low-income families. At one of the participating centers, the autism
classroom and the head start classroom combined for center activities at least once a week, and joined for special events regularly. At the other center, students had not interacted prior to this study. Even those children who had participated in activities with children with autism prior to the onset of the study reported not knowing their partner’s name before starting the study.

Table 2-1: Participant descriptions.

<table>
<thead>
<tr>
<th>Name</th>
<th>Age, gender, disability</th>
<th>CARS-2/severity</th>
<th>Comm. Matrixa</th>
<th>PPVT-4 (Form B)b</th>
<th>CDI Words &amp; Gesturesc</th>
<th>Peer, age, gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alex</td>
<td>4;0/M/ ASD</td>
<td>35.5; mild/mod</td>
<td>3/6</td>
<td>51</td>
<td>34</td>
<td>Aaron/ 4;8/M</td>
</tr>
<tr>
<td>Ben</td>
<td>3;9/M/ ASD</td>
<td>30.5; mild/mod</td>
<td>3/6</td>
<td>69</td>
<td>117</td>
<td>Bri/4;8/F</td>
</tr>
<tr>
<td>Carter</td>
<td>5;2/M/ ASD</td>
<td>36.5; mild/mod</td>
<td>3/6</td>
<td>62</td>
<td>120</td>
<td>Chris/ 4;11/M</td>
</tr>
<tr>
<td>Drew</td>
<td>5;3/M/ ASD</td>
<td>43.5; severe</td>
<td>3/7</td>
<td>25</td>
<td>1</td>
<td>David/ 4;8/M</td>
</tr>
<tr>
<td>Eric</td>
<td>3;11/M/DD</td>
<td>28.5; minimal</td>
<td>3/7</td>
<td>55</td>
<td>303</td>
<td>Eli/3;11/M</td>
</tr>
</tbody>
</table>

Note. Ages are in years; months. CARS = Childhood Autism Rating Scale, Comm. = communication, PPVT = Peabody Picture Vocabulary Test, CDI = Communicative Development Inventory, ASD = autism spectrum disorder, DD = developmental disability, mod = moderate.

a first reported level is the highest level with mastered skills, and second is the highest level with emerging skills
b standard score
c maximum score is 396.

Participating dyads

Pseudonyms have been used to identify all the children in this study. The first letter of each pseudonym for the typically developing child corresponds with the first letter of the pseudonym of the child with ASD with whom he or she interacted. Children were paired based on age and shared interest (Bauminger & Schulman, 2003).
**Dyad A: Alex and Aaron**

Alex was four years old at the beginning of the study. His father reported that he was diagnosed with autism spectrum disorder at age two and had no vision and hearing difficulties. His parents provided the report from his original evaluation for ASD, showing that he was assessed between 27 months and 29 months. A screening at 27 months showed signs of autism, and a full evaluation was recommended. Over the course of the next two months, Alex participated in two home visits and one clinic visit for ASD assessment. At the final clinic visit, the Autism Diagnostic Observation Schedule was administered. This assessment combined with two home observations, parent interviews, and a review of past records resulted in a diagnosis of autism spectrum disorder, mild to moderate form. The interventionist and a certified speech-language pathologist (SLP) observed Alex using the CARS-2 assessment protocol (Schopler et al., 2010) to confirm that Alex met the DSM-V criteria for ASD. Alex’s raw score on the CARS-2 (35.5) placed him in the mild-to-moderate autism group, confirming his previous diagnosis.

Alex’s father reported Alex was generally happy and easy-going. Upon first meeting Alex, it was clear that he was interested in others, as he played a hiding game and enjoyed imitating silly behaviors of the primary investigator. At school, he played in the vicinity of peers, but there was minimal back-and-forth interaction. On the playground, Alex was observed to run and climb with other children and spent most of his outside time on the slide.

Alex’s father’s primary concern for Alex was communication. At home, Alex demonstrated the ability to imitate some words, and communicated by bringing items to his family members or pulling family members toward items, but rarely initiated or responded with unprompted speech. Alex’s father completed the CDI (Fenson et al., 2006) Words and Gestures form to document the range of expressive concepts Alex communicated. Of the 396 items in the vocabulary checklist developed for children ages 8-18 months, he reported that Alex was able to
communicate 34. To gain additional information on expressive language, the interventionist and a certified SLP conducted an observation to assess language level using The Communication Matrix (Rowland, 2009) and determined that Alex had mastered seven of the eight areas in Level 3 (unconventional communication) and had emerging skills up to level 6 (abstract symbols). At school, Alex was exposed to a variety of picture symbols used for expressive communication during the school day (primarily during circle and meal times). During these routines, Alex was expected to respond to answer simple wh-questions related to the routine or activity, such as “what is weather bear wearing?” by choosing a picture, then he was prompted to imitate an oral response. His SLP reported that his speech and language goals were related to increasing expressive language and articulation. Pictures were often used within structured activities to prompt oral communication at both the single-word and phrase level. At home, Alex did not use any form of aided AAC, but used a combination of spoken words, facial expressions, and gestures to communicate with his parents and siblings.

A certified SLP also assessed Alex’s receptive language skills using the PPVT-4. His standard score of 51 placed him below the first percentile. Within classroom and home routines, Alex responded appropriately to directions such as “go get your coat,” “come here,” and looked around expectantly when the teacher announced the arrival of new people, for example, “Look, Alex! Katie’s here.” Alex’s SLP reported that he was hard to engage, and required a great deal of prompting to respond, making receptive language testing difficult. Despite this, she reported that he was able to identify objects in pictures and follow routine directions.

During a 20-minute play interaction, the primary investigator engaged Alex in the simple cause and effect app Peek-a-boo Barn (Night & Day Studios, 2014) using the iPad. He expressed enjoyment with smiles and some eye contact, and was able to successfully reach the end of the game (18 turns) using a touch and release gesture with no assistance. Alex was able to maintain
attention within both the iPad activity and various academic center activities (e.g., art, play with small figurines in a toy house) for greater than 5 min.

Alex’s father reported that he had a variety of interests, and enjoyed most activities typical of preschool-age children. He was particularly interested in numbers, letters, painting, and drawing. He enjoyed gross motor play, especially outside on the playground. Favorite videos and TV shows included Thomas and Friends, Disney’s Cars, and The Lorax. These interests aligned well with his peer buddy, Aaron.

Aaron and Alex were paired due to a shared interest in running and playing outside, and interest in vehicles, including cars and trucks. Aaron was a male, age 4;8, who attended preschool in the adjacent head start classroom. Parent and teacher report indicated that he had no difficulties with hearing or vision. He was receiving behavioral support services through the county, but had no identified disability. In the classroom, he was observed to get angry when other children did not agree with his ideas, or when teachers announced transitions and he wanted to continue playing. Aaron had no behavior issues when participating in this study.

**Dyad B: Ben and Bri**

Ben was three years, 11 months old at the beginning of the study. Ben was diagnosed with autism spectrum disorder at age three and had no reported vision and hearing difficulties. Ben’s parents did not provide the written report from his original evaluation for ASD, but they reported that he was diagnosed by a developmental pediatrician at a well-respected diagnostic clinic for ASD. The first author and a certified SLP observed Ben using the CARS-2 assessment protocol (Schopler et al., 2010) to confirm that Ben met the DSM-V criteria for ASD. Ben’s raw score on the CARS-2 (30.5) placed him in the mild-to-moderate autism group, confirming that he meets the DSM-V criteria for ASD.
Ben had two sisters at home and often played in their vicinity, but rarely played with them. Ben’s mom noted that Ben was easy-going and would happily participate in reading activities regardless of book choices, but that he was extremely sensitive to displays of negative emotions from other children and would begin crying when he heard other children scream or cry. This was a major challenge for Ben at school, and his mother reported that he would come home from school crying if any classmate had had a bad day. During classroom observation, the researcher noted that in activities with minimal structure, Ben would often isolate himself and just look around the room. He rarely interacted with pretend play materials and never initiated play with peers. Despite lack of engagement with peers, Ben would smile at and hold hands with familiar adults.

The researcher and a certified SLP conducted an observation to assess language level using The Communication Matrix (Rowland, 2009). Ben had mastered six of the eight areas at level 3 (unconventional communication) and had emerging skills up to level 6 (abstract symbols). Ben was an intentional communicator, and although he often chose non-symbolic communication modes, he was observed to use words and graphic symbols in some contexts. Ben’s mother completed the CDI (Fenson et al., 2006) Words and Gestures form and reported that Ben was able to express 117 of the 396 concepts included in the form. At home, Ben communicated with his parents using single spoken words and gestures. His parents reported that he rarely initiated, and most often communicated in response to a question. Ben’s school speech and language goals were related to articulation and increasing phrase length. The SLP used pictures and sentence strips as cues to promote oral responses. In the classroom, he was observed to imitate words and respond to targeted questions with prompting. He was not observed to initiate communication via any mode with any communication partners (adults or peers).

Ben’s receptive language skills were assessed by a certified SLP using the PPVT-4. Ben’s standard score of 69 placed him in the second percentile, and showed that he had some
receptive difficulties. In classroom observations, Ben was able to follow one-step directions “go get your coat” and “time to line up”. Ben’s SLP reported that he was able to identify many age-appropriate objects in pictures, and knew his colors, shapes, and numbers. She reported that his biggest receptive challenge was one of attention, especially when other students in the classroom were upset.

When the first author engaged Ben with the Peekaboo Barn app (Night & Day Studios, 2014) using the iPad, he was able to successfully reach the end of the game using a touch and release gesture with no assistance or prompting. Ben was able to maintain attention within both the iPad activity and various structured center activities for greater than 5 minutes.

In the investigator’s meeting with Ben’s parents, his mother reported that he was an easy-going child who would have no trouble attending to books for ten minutes or more. She reported that he was interested in animals, building toys, electronic games, and books. She also reported that he enjoyed TV shows and movies such as Lion Guard and Disney’s Cars. Teachers reported that Ben did not enjoy outside time at school, and spent most of his time in the shade, waiting to go back inside. Ben shared an interest in Disney and books with his peer partner, Bri.

Bri’s mother reported that she, like Ben, enjoyed most preschool activities, such as reading books, arts and crafts, building and dramatic play. She also loved Disney movies. Bri was a 4;8 female who attended preschool in the head start classroom. Parent and teacher report indicated that she had no identified disability and no difficulties with hearing or vision. Bri’s teacher reported that she was a sweet girl who sometimes had trouble remaining focused during structured activities. This behavior was not observed during the study.
**Dyad C: Carter and Chris**

Carter was five years and two months old at the beginning of the study. His parents reported that he was diagnosed with autism spectrum disorder at age three and had no vision and hearing difficulties. Carter’s parents did not provide the report from his original evaluation for ASD, but they reported that he was diagnosed at a well-respected local diagnostic clinic for ASD. Results from the CARS-2 assessment protocol (Schopler et al., 2010) confirmed that he met the DSM-V criteria for ASD (scores can be found in Table 2-1). Carter’s raw score on the CARS-2 (36.5) placed him in the mild-to-moderate autism group.

During an initial visit with Carter and his mother at his home, Carter did not engage with the researcher, but spent his time watching short videos on his mother’s phone. During classroom free-play time, Carter was not observed interacting with classroom peers. Teachers reported that he would sometimes initiate interaction with peers in unconventional ways (e.g., touching the peer’s face) and that the peer response was typically to walk away.

Carter’s mother completed the CDI (Fenson et al., 2006) Words and Gestures form and reported that Carter was able to express 120 of the 396 items in the vocabulary checklist. Carter was observed to initiate using spoken words with his mother to request new videos and particular snacks. He did not use an aided AAC system at home, but used a combination of spoken words and gestures to communicate. The interventionist and a certified SLP observed Carter in free play at school and completed the online Communication Matrix (Rowland, 2009). The results showed that Carter had mastered four of the eight areas in Level 3 (unconventional communication) and had emerging skills up to level 6 (abstract symbols).

The same SLP also assessed Carter’s receptive language skills using the PPVT-4. Carter’s standard score of 62 placed him in the first percentile. Although Carter, like his classmates, was observed to follow directions to participate in classroom routines, the test-taking
activity was clearly not preferred as he often tried to stand up, and he rarely looked at the test booklet. His teachers and SLP reported that Carter’s abilities were often masked by avoidance behaviors when the activity was not preferred. His SLP reported that he was able to identify many age-appropriate objects and follow directions. In her analysis, he understood use of objects and knew colors, shapes, letters, and numbers. She reported that he struggled with spatial concepts, negatives, and inferences.

During free play time, the interventionist asked Carter to play with the Peekaboo Barn app (Night & Day Studios, 2014) on the iPad. He was able to successfully reach the end of the game, which required 18 turns using a touch and release gesture with no assistance, showing that he had the motor skills required to participate in the research activities. Carter was able to maintain attention within both the iPad activity and various structured academic center activities for greater than 5 minutes.

Carter’s mother reported that he was interested in vehicles, building toys, TV shows, electronic games, arts and crafts, and books. She also reported that he loved numbers and letters. Carter was paired with his peer buddy, Chris, due to their shared interest in both cars and electronic games. Chris was a 4;11 male who attended preschool in the head start classroom. Although Chris was born 7 weeks premature and received early intervention services up until one year of age, he currently had no identified disability or delays and no difficulties with hearing or vision. Teachers reported that Chris was very kind and always followed directions in class.

**Dyad D: Drew and David**

When the study began, Drew was five years and three months old. His mother reported that he was diagnosed with autism spectrum disorder at age three and had no vision and hearing difficulties. His mother did not provide the report from his original evaluation for ASD, and
information on the assessment could not be verified. The first author and a certified SLP observed Drew using the CARS-2 assessment protocol (Schopler et al., 2010) to confirm that Drew met the DSM-V criteria for ASD and his raw score on the CARS-2 (43.5) placed him in the severe autism group.

At home, Drew did not use a form of aided AAC, although his mother mentioned that she was interested in the possibility of using an iPad with him. His mother reported that Drew usually independently accessed toys and foods that he wanted instead of requesting them. If he was unable to access objects on his own, he would grab her hand to take her there, or cry in frustration. Drew’s mother completed the CDI (Fenson et al., 2006) Words and Gestures form showing that his expressive communication was seriously limited. Of the 396 items in the vocabulary checklist developed for children ages 8-18 months, she reported that Drew was able to express only one symbolically. This likely accurately reflected what he was able to express at home without access to picture symbols and communication boards. In the classroom, Drew’s teacher and SLP used single picture icons, sentence strips, and core word boards to support both receptive and expressive language of all students, so Drew used all of these throughout the school day. For structured activities, Drew occasionally used the LAMP Words for Life App on the iPad. Although much of his communication consisted of responses to specific questions or requests, Drew did initiate with adults at school on occasion. During one session of this research study, which was conducted in the small room typically used for pull-out speech and language therapy, Drew found the “I want _____” sentence strip and added a picture of “candy” and brought it to the interventionist. After observations in the classroom, the first author and a certified SLP completed the online Communication Matrix (Rowland, 2009) and determined that Drew had mastered seven of the eight areas in Level 3 (unconventional communication) and had emerging skills up to level 7 (abstract symbols).
A certified SLP used the PPVT-4 to assess Drew’s receptive language skills. Drew demonstrated a lack of eye contact during the testing session, rarely looking at the test booklet, and had to be redirected to sit down multiple times. Drew’s standard score of 25 placed him below the first percentile, showing that receptive language is a challenge for him. His SLP and classroom teacher reported similar challenges assessing Drew’s receptive skills and noted that he often refused to participate in non-preferred activities. They reported that Drew was able to follow simple directions and label some objects, but that he often refused.

During the classroom observation, the interventionist asked Drew to play the Peekaboo Barn app (Night & Day Studios, 2014) on the iPad. He interacted easily with the iPad, using the appropriate touch and release gesture to advance the game without prompting or assistance. Drew was able to maintain attention within both the iPad activity and various academic center activities for greater than 5 minutes. While in a play center, the interventionist and Drew played together with a doll and doctor kit. Drew used the toy doctor items appropriately to check the baby. Throughout the school day, Drew was observed to follow classroom routines, but protested transitions away from preferred activities, especially sensory activities. When Drew was frustrated or excited, he would repeatedly hit his forehead lightly with the heel of his hand.

Drew’s mother reported that his interests were cars and trucks, superheroes, electronic games, arts and crafts, and books. She also reported that he enjoyed TV shows and movies, such as Finding Nemo and Monsters Inc. His mother also noted that he particularly enjoyed Lightning McQueen books. Drew was paired with David for this study given their common interests in superheroes, vehicles, electronic games, and outdoor play.

David was a 4;8 male who attended preschool in the head start classroom. David had no identified disability and no difficulties with hearing or vision. David was born prematurely, with no lasting effects. David’s mother reported that he enjoyed reading books and using the iPad for early learning activities.
Dyad E: Eric and Eli

Eric was three years and 11 months old at the beginning of the study. His mother reported that he had not been diagnosed with autism spectrum disorder, but that given developmental delays and an older sibling with autism, he was being watched closely by his pediatrician. Many of his behaviors reflected characteristics of autism spectrum disorder and his communication was delayed. Because of this, he was attending a preschool classroom for children with autism. The first author and a certified SLP observed Eric using the CARS-2 assessment protocol (Schopler et al., 2010) to determine level of functioning in areas that are typically impacted by autism spectrum disorders. Eric’s raw score on the CARS-2 (28.5) did not meet the cut off for ASD (a score of 30), but suggested that he demonstrated some characteristics similar to children with ASD. Eric was interested in other children, but interacted with them in unconventional ways, often getting too close to their faces. His oral speech was often echolalic, as he would imitate words he had heard repeatedly. He was observed to flap his hands when excited and to perseverate on commercial labels. For example, during this study, a few of the books had the Disney logo. He would point to it and repeatedly say “Disney”. Eric had no vision and hearing difficulties.

Eric showed signs of being interested in social engagement, often smiling at adults and trying to engage them in singing his favorite song, “Row, row, row your boat.” During the observation, Eric seemed to enjoy active play, such as running and jumping and did not have a difficult time with transitions. He initiated familiar routines with adults, making eye contact, and saying “ready, set, go” before running with an aide. His SLP reported that he rarely interacted with peers during the school day.

Eric was able to use spoken words expressively, but typically required a verbal prompt that he would then imitate. He was also able to label objects when asked “what is this?” Eric’s
mother completed the CDI (Fenson et al., 2006) Words and Gestures form. She noted Eric was able to express 303 of the 396 items on the checklist. Despite this relatively high score, Eric’s SLP reported that he rarely used these spoken words to initiate or comment, or in situations where an oral response was not obligatory. This assessment was confirmed in researcher observations. Eric had the ability to label items in his environment, but had trouble with functional communication. The interventionist and a certified SLP conducted an observation and then completed the online Communication Matrix (Rowland, 2009). Results showed that Eric had mastered skills in all eight categories at level 3 (unconventional communication) and had emerging skills up to level 7 (language). To assess receptive language skills, a certified SLP administered the PPVT-4. Eric’s standard score of 55 placed him below the first percentile for receptive language.

Eric played Peekaboo Barn (Night & Day Studios, 2014) with the interventionist and was able to complete the game independently, showing that he had the motor skills required to participate in the intervention for this study. Eric was able to maintain attention within both the iPad activity and various academic center activities for greater than 5 minutes.

Eric’s reported interests in outdoor active play, electronic games, and vehicles matched well with the interests of a peer named Eli. Eli was a 3;11 male who attended preschool in the head start classroom. Parent and teacher report indicated that he had no identified disability and no difficulties with hearing or vision. Eli was one of the quieter students in his classroom, but enjoyed playing with other children and participating in typical preschool activities.

**Setting and context**

This study took place in two early childcare centers in central Pennsylvania. The children with ASD and the peers were in separate classrooms in each center. The context of the
intervention was sharing books together. The intervention context was meant to reflect what typically occurs in the book center in a preschool classroom, where children sit and look at the pictures in the books, pointing out pictures of interest.

Baseline and intervention sessions took place in a small room with only the investigator and the dyad present. Generalization sessions took place in the reading center within the peer’s classroom as the classrooms for children with ASD did not have a designated reading center. This center had bookshelves separating it from other play areas. Within the reading center, a variety of books were available, and children could sit on comfortable chairs or large beanbags to read.

**Materials**

**Books**

A selection of books was used for each data probe session during baseline and intervention and each training session. All books selected for this study met the following criteria: (a) had illustrations, (b) were appropriate for use in a preschool classroom, as determined by a review of the book list by preschool teachers, and (c) included topics or characters that were of interest to at least one included participant. Illustrations on every page were required to create hot spots for communication. Only books appropriate for preschool children were chosen to better reflect the natural environment where children would have access to books. The language level of the books was not considered because students would not be reading the text. In order to increase motivation to participate, books reflecting the interests of the children were chosen and books were placed into groups of four for each session to provide choice (Koegel, Singh, & Koegel, 2010). The books were placed in four groups of four books each and were rotated.
randomly for use during probe sessions without replacement until all were sampled. A full list of books used in this study can be found in Appendix D.

To make each group of books equally interesting for participants, four book series were chosen, and each book group contained one book from each of the four categories. The four book series were Paw Patrol, Sesame Street, Cars, and Thomas and Friends. Paw Patrol books were chosen because many participants expressed an interest in animals, and the characters in these books are familiar to many preschool-age children. Sesame Street books were chosen as they included themes relating to numbers and letters, which many of the children enjoyed. Cars and Thomas and Friends books each were chosen based on participant interests in vehicles, especially cars, trucks and trains. Each book set then included one Paw Patrol book, one Sesame Street book, one Cars book, and one Thomas and Friends book. For Dyad B, as neither participant expressed an interest in trains, Thomas and Friends books were replaced in each book group by Disney Princess books to take into account the interests of the peer participant in that dyad.

Dyad D showed little improvement in the dependent variable after eight training sessions. Based on an analysis of participant behaviors, a new set of four books was purchased and programmed into the iPad app as VSDs. These books conformed to requirements for books included in the study, and VSDs and hot spots followed all previously described rules. The only difference was that all four books were chosen based on activities that Drew, the participant with ASD found interesting and motivating. During Dyad D’s final two training sessions and final probe session only these books were used.

AAC system

The iPad, as used in this study, provided both a shared means of communication and a shared activity about which to communicate. VSDs of each page of the selected storybooks were
used to access both single word vocabulary and short phrases on the iPad. The iPad application, GoTalk NOW, was chosen because visual scene displays in this application were shown to be quick and easy for adults to program (Caron, Light, & Drager, 2016). Additionally, parents have commonly purchased GoTalk NOW to use to create VSDs for their children with complex communication needs, and it was reported to be the most recommended visual scene display AAC app by SLPs (Caron, Costello, & Shane, 2014). GoTalk NOW allowed for the creation of both grid displays and VSDs, which made it possible to program both a main menu page and VSDs for each page of each book. Both types of displays could be created using digital pictures, which was necessary for making VSDs of each book page. Finally, although GoTalk NOW has a built-in text-to-speech synthesizer, it also allowed for recording digitized speech, which was used in this study, as digitized speech was shown to be easier for preschool-age children to understand than synthesized speech (Drager, Clark-Serpentine, Johnson, & Roeser, 2006).

Members of the research team programmed pages of each book as VSDs, with hot spots containing voice output. Because children could choose among four books during each session, the home page of their communication system on the iPad was a grid display showing the cover of each book in a 2x2 rectangular grid. Members of the research team then programmed one VSD for each page or page spread (two pages) of each book and between one and four communicative hot spots per VSD depending on the content of the book page.

The rules for programming hot spot vocabulary for the current study were changed from Therrien and Light (2016) to more closely approximate the way visual scene displays would be programmed by caregivers, paraprofessionals, classroom teachers, and aides. Each hot spot was programmed with five or fewer words to approximate a maximum of 5-6 morphemes, which aligns with the average MLU for preschool age children (Brown, 1973). Although using short phrases limited the generativity and range of possible messages, using short phrases had the advantage of increasing the intelligibility of the AAC system (Drager et al., 2006). Additionally,
the goal of this intervention was to increase peer interaction, and pre-programming short messages decreased both the operational and linguistic demands of using AAC, allowing the children to communicate ideas more quickly and with less effort.

Each hot spot was to be both fun and functional. For a hot spot to be fun, it had to incorporate either (a) sound effects (e.g., animal noises, snoring, vehicle noises), (b) tone of voice, words or sounds to express strong emotion (e.g., giggling, laughing, crying), (c) silly words (e.g., “uh-oh,” “bummer”), or (d) using character voices (recording something the character in the book might say). These fun strategies were chosen based on the recommendations of children for AAC devices in Light et al. (2007). To be functional, hot spots had to either: (a) ask or answer a question (e.g., “what is that?”), (b) call attention to a part of the picture (e.g., “look at that bug!”), or (c) relate the picture to the child’s experiences (e.g., “I love dogs!”).

**Procedures**

Participants in this study met with the interventionists over a period of three months. Either the author or a second trained interventionist conducted training sessions for all dyads. The trained interventionist was a doctoral student in special education with experience working with children with ASD and research experience in the field of AAC. She was provided with a script and observed the first author in training sessions for one week. She conducted simulated training sessions while being observed by the first author until fidelity to training procedures was over 95% and the first author observed her first two training sessions with participants in this study.

Sessions occurred between one and three times per week, with no more than one session for each dyad per day. All training and probe sessions occurred in a small room adjacent to the
preschool classrooms. Training sessions took between five and twenty minutes, depending on how long it took to complete 10 turns each for the both children in the dyad. Probe sessions were always 10-minutes.

**Baseline probes**

During the baseline condition, no training sessions were conducted, and children met a minimum of one and a maximum of three times per week for data collection probe sessions, during which participants looked at one of the regular sets of four storybooks with their peer partner for 10-minute sessions. The researcher was not involved in these interactions except for providing instructions prior to the session. Data on dependent and collateral measures were taken to establish typical performance in peer interaction prior to intervention. Baseline ended for Dyads A and D after a minimum of five probe sessions during which a stable pattern was evident in the dependent variable. Remaining dyads began intervention once an intervention effect was noted for the previous dyad. The exception to this rule was Dyad E, as Dyad D did not show improvement during intervention probes, so the decision to begin intervention with Dyad E was made given the time constraints of the school year.

**Intervention**

The independent variable for this study was a package intervention with two main components: (a) provision of an iPad with the application GoTalk NOW including VSDs with speech output for storybook pages, and (b) the turn taking training. Each intervention session began with a 10-minute probe, where data were collected on the dependent and collateral
variables for the dyad with no researcher intervention. Each probe was followed by a training session.

**Provision of AAC**

During all intervention sessions (training and data collection probes), participants were provided with the iPad as AAC to support communication. The iPad was turned on and the app GoTalk NOW was running. Participants did not have access to any other apps. At the beginning of each session, participants were shown the home page with a 2x2 grid showing the covers of the four books they could choose for that session. At any point during the session, the children could return to this home page to change books.

**Training sessions**

The goal of the turn-taking training was to teach the child with complex communication needs and the peer to share the iPad during the interaction as a concrete way to teach conversational turn taking. Turn-taking behaviors are often impaired in young children with ASD. Because deficits in social reciprocity are a core aspect of ASD, researchers argue that improving turn taking may reduce the impact of ASD (Yoder & Stone, 2006). Many social interaction interventions for children with CCN also focus on initiating and responding (e.g., Chung & Carter, 2013; Hughes et al., 2011), and in that way, the focus of this training is similar to previous work. During this training, the interventionist provided scaffolding to help children identify opportunities for communicative turns, provided a means for taking a turn, and prompted children to take their turn. Children were also taught to provide enough wait time for their partner to take a turn (see full training script in Appendix E). Prior to the first intervention probe
session, dyads participated in one training session. All subsequent training sessions immediately followed intervention data collection probes.

During each training session, the researcher first showed the main menu screen, composed of a 2x2 grid showing a digital photo of the cover of each of the books in the chosen set. During training, the researcher chose the book to use for the session by selecting the appropriate image and then began the sharing instruction. The sharing training began by telling the children that during book buddy time, they are expected to take one turn and then wait for their friend to take a turn. The researcher then modeled taking a turn and chose one child to go first. Following this model, the children were supported to participate in a back-and-forth interaction in which first one child and then the other took a turn. This cycle was repeated 10 times so that each child had the opportunity to take 10 total turns and each child was required to wait for his partner to take 10 turns. Instruction followed a least-to-most prompting hierarchy until the child was able to successfully take a turn or wait. Least-to-most prompting was chosen instead of most-to-least because it gives children the opportunity to independently perform the expected action before providing as minimal assistance as needed to be successful. This has been shown to expedite acquisition of new skills (Libby, Weiss, Bancroft, and Ahearn, 2008). Least-to-most supports are considered reliable methods for teaching students with disabilities (McLaughlin & Cascella, 2008) and have been used to teach children with ASD requesting, responding to questions, social commenting and appropriate game play (Davis-Temple, Jung, Sainto, 2014; Humphreys, Polick, Howk, Thaxton, Ivancic, 2013; Xin & Leonard, 2014).

Prompts in this study increased according to the acronym “Oh gosh!” where “Oh” signified a zero-prompt or natural cue, “g” signified a gestural prompt, “o” signified an oral prompt, “s” signified a “show” or model prompt, and “h” signified a hand-over-hand prompt. When children were successful, they received contingent positive feedback. For the turn-taking child, the researcher either repeated or expanded on the communication. For example, if the child selected
a hot spot that labeled the picture “dog,” the researcher might have said “Yes! The dog is barking!” For the waiting child, the researcher would intervene with a prompt when the child started reaching toward the iPad instead of waiting. If the child was successful without a prompt, the researcher gave feedback by identifying the behavior, “Nice waiting” and connecting the behavior to the natural reinforcer, “now it’s your turn.” Contingent feedback and reinforcement is a recommended practice to increase communication for children with autism spectrum disorder (Koegel & Koegel, 2006).

The criteria to complete training required each child in the dyad to meet both of the following standards across two consecutive training sessions: (a) successfully take obligatory turns independently (with no prompt) in eight of 10 opportunities, and (b) successfully wait during the partner’s turns in eight of 10 opportunities.

**Generalization**

Dyads A, B, and C participated in two generalization probes during baseline and two during intervention. Dyads D and E completed baseline generalization probes, but due to timing and the end of the school year, did not participate in generalization probes during intervention. Although three or more sessions would clarify the generalization trend, this was not possible due to the logistics of acquiring access to the space during class. Children were only available for research sessions during specific times, and the classroom book center was not always available at those times.

In these sessions, generalization to a new setting and to new books was assessed. During generalization sessions, the dyad was taken to the book center in their classroom. The other children were typically present in the room, but not at the book center. A set of four books was chosen from the classroom to use during generalization sessions. None of these books were used
during training sessions or probe sessions. For generalization sessions during intervention, these same four books were also available on the iPad as VSDs. All other instructions to the children were the same as during data probe sessions.

**Maintenance**

Because of the end of the school year and participants aging out of preschool or moving out of state, it was not possible to collect maintenance data for this study.

**Procedural integrity**

A graduate student in communication sciences and disorders watched videos of both probe sessions (baseline and intervention) and training sessions to compare the interventionists’ behaviors to the procedural checklists as a measure of procedural integrity (see Appendix F for probe session procedural integrity checklist and Appendix G for training session procedural integrity checklist).

**Procedural integrity for probe sessions**

During probe sessions, the interventionist provided instructions to the dyad, and then removed herself from the interaction, only intervening for specific reasons (see probe session script in Appendix H). In addition to completing a checklist to insure correct directions were given to the children, the graduate student coded videos to identify moments when children were misbehaving or seeking attention from the interventionist, and then coded the interventionist response behavior as either following the protocol or not. Procedural integrity was measured on
over 25% of the baseline and intervention probe sessions for each dyad and on 25% of generalization probe sessions. Procedural integrity for probe sessions ranged from 92-100%. All sessions were 100% except for the first baseline session with Dyad D, where Drew was unhappy to be in the small room and frequently attempted to gain the attention of the researcher, resulting in a few interactions between the researcher and the children.

_Procedural integrity for training sessions_

During training sessions, the interventionists used the training script with least-to-most prompting procedures. The graduate student used a checklist was used to measure fidelity to the training procedures (see complete checklist in Appendix H). Procedural integrity was measured on 30% of the training session videos for each dyad and was calculated by dividing the number of steps completed correctly by the total number of steps and multiplying by 100. Fidelity to training procedures overall averaged 99%. For Dyad C, average procedural integrity over training sessions was 99%. For all other dyads, fidelity to training procedures was 100%.

**Measures**

**Dependent and collateral variables**

The dependent variable in this study was the frequency of symbolic communicative turns expressed by the children with complex communication needs during a 10-min interaction with a peer. Collateral variables were the frequency of symbolic communicative turns of the peer and joint engagement for the dyad. Operational definitions of the measures can be found in the “Coding” section below.
A variety of dependent variables have been investigated in the literature on supporting peer interaction for children who use AAC. The most common way to quantify interaction between children with CCN and their peers is to measure the communicative behaviors during interactions (Therrien, Light, & Pope, 2016). Although some studies focus specifically on either initiations or responses, this study focused on turns to report on the full participation of the child with CCN within the interaction.

Peer turns were measured in order to obtain the information necessary to investigate the relationship between peer turns and turns for the individual with CCN. Research shows that adults without disabilities take a majority of turns in interactions with individuals with CCN. To reduce this imbalance, many researchers have focused on training communication partners and have shown that after training, turns are more balanced (Light et al., 1985). Measuring peer turns allowed researchers to determine whether similar patterns exist in child-to-child interactions. If an imbalance was identified, data on peer turns over time would provide evidence for the impact of the intervention on the balance of turns between the two children.

Joint engagement was measured to contribute to an assessment of the quality of the interaction between the two children beyond measures of communication. Joint engagement with peers is often used as a measure of the effectiveness of social interaction interventions for children with ASD (e.g., Kasari, Rotheram-Fuller, Locke, & Gulsrud, 2012; Kretzmann, Shih, & Kasari, 2015) and was used in this study as a way to capture the quality of the interaction.

**Data collection**

All probe and training sessions with participants were videotaped using a small video camera set up on a tripod before the session. To reduce reactivity during probe sessions, the camera was set to record before the session started and although the tape captured the researcher
giving instructions to the children and helping them choose a book, only the 10 minutes after the researcher moved away from the children were coded. For probe sessions, the camera was set up directly in front of the participants who sat side by side with the materials for the session on the table in front of them.

Baseline probe sessions

During baseline probe sessions, each pair of children was taken to a small room with a child-sized table and chairs. A video camera was set up so all interactions between the two children could be captured. Children were provided with the set of four books and given an opportunity to choose among the books throughout the session. Before they began, the researcher gave instructions and reminded the children to share (see probe session script in Appendix E). The researcher told the children that she had work to do, and sat facing slightly away from the children for the remaining 10 min with books or a computer to appear busy.

Training sessions

During training sessions, the video camera was at a 90-degree angle to the participants to better capture the participants and the interventionist sitting across from them. The interventionist took data on prompt level for each turn on paper during the training session using the data collection form (see Appendix I).
Intervention probe sessions

Intervention probe sessions were exactly the same as baseline probe sessions with the exception of the provision of the iPad during sessions in the intervention condition. As in baseline, the researcher gave instructions, reminded the children to share, and then told the children that she had work to do, and sat away from the children for the remaining 10 min prior to training.

Generalization probe sessions

Generalization probe sessions during baseline used the same procedures as baseline probe sessions, and generalization probe sessions during intervention used the same procedures as intervention probe sessions. The differences were: 1) sessions occurred in the book center of the general education classroom, and 2) children chose from the books that were available in the book center. As in all probe sessions, the researcher gave instructions, reminded the children to share, and then told the children that she had work to do, and sat away from the children for the remaining 10 min.

Coding of dependent and collateral variables

Definition of symbolic communicative turn

A symbolic communicative turn was defined as an attempt to interact with a partner using words (either spoken or through speech output from the AAC app), conventional signs, or conventional gestures (e.g., nodding head for ‘yes’). Participants showed intent to communicate either through eye contact or body orientation, as eye contact is challenging for children with
ASD, and increasing eye contact was not a focus of this study. In the absence of eye contact, if a child either turned toward their partner or maintained neutral body orientation, the turn was considered communicative. Turning away from the peer during a turn was considered a signal that the utterance or gesture was not an attempt to interact with the partner. These utterances or gestures were not coded as symbolic communicative turns in this study. A turn was considered complete anytime the other child began communicating, or after two-seconds had passed with no communication (similar to Logan, 2003). The two-second interval began at the end of an utterance. The end was defined as follows: (a) spoken word – the child ceased vocalization; (b) hot spot activation – the spoken output ceased; (c) manual sign or conventional gesture – the child ceased final movement of the sign or gesture.

**Definition of joint engagement**

Joint engagement was defined as an instance when the two participants interacted either with each other, with the same book, or jointly with the iPad. Specifically, participants were considered jointly engaged if: 1) participants were looking at each other, 2) both participants were looking at the same book or the iPad, or 3) one participant was looking at a book or the iPad and the partner was looking at the first participant, except when the first participant’s body orientation was turned away from partner.

**Coding procedures**

Studiocode software (Sportstec Limited, 2015) was used to code videos for dependent and collateral variables directly on the video file. The first author served as both interventionist
and the main coder for this study. Because of this, the primary coder was not blind to the goals of the study or the treatment condition. Attention to the operational definitions and repeated viewings of each probe session video mitigated the risk of bias in coding. During the coding process, videos of each session were viewed a minimum of two times to ensure accuracy in coding. In addition, a second coder who was blind to the goals of the study coded 30% of the baseline and intervention probe sessions and training sessions, and 25% of the generalization probe sessions. A coding window was created a priori, before the study, composed of buttons for each code. Additional buttons took input from the items already coded to calculate percentages for engagement variables (see Figure 2-3 for a screenshot of the coding window).
Event recording was used to code turns for each participant in the dyad. When coding turns, the coder would click a button at the beginning of the turn. A turn would appear on the timeline as a count (e.g., turn 1, turn 2, turn 3), but duration of turn was not taken into account on the timeline.

Figure 2-3: Screenshot of coding window. All buttons with a diamond in the upper left corner could be clicked in real time while watching videos of sessions to code that variable. The three buttons with squares in the upper left corner would populate with calculated percentages in real time for each type of engagement.
Engagement was coded using momentary time sampling interval coding every 10 s for the duration of the 10-min interaction. Every 10 s, the coder documented if each child was engaged or not, and whether the children were jointly engaged for a total of 60 opportunities for each variable in a 10-min interaction. Percent engagement was calculated by dividing the number of times engaged behaviors occurred by the total number of engagement opportunities (see Figure 2-4 for a sample of a coded timeline).

Figure 2-4: Screenshot of StudioCode timeline view. While coding, the video would play in the top window and the timeline below would show coded variables.
Interobserver reliability

The same graduate student who coded for procedural integrity was trained on a selection of the videos from a previous study with similar procedures (Therrien & Light, 2016) until reliability in coding turns and engagement was greater than 80%. Differences were resolved through discussion and clarification of the operational definition of the dependent variable and collateral variables. Once training was complete, the coder viewed and coded a randomly chosen 30% of all baseline probe, intervention probe, and training sessions for this study, and 25% of generalization probe sessions. Reliability was calculated by dividing the number of agreements by the total number of agreements and disagreements and multiplying by 100. For probe sessions, an agreement was defined as an identified communicative turn at the same time (within one second), attributed to the same child. A disagreement occurred anytime one coder identified a turn but the other coder did not. For participants with CCN, average reliability for frequency of turns across phases was 94% (range 83-100). For peer participants, average reliability for frequency of turns across phases was 93% (range 83-100).

Agreement for engagement occurred any time either both coders chose “engaged” or both coders chose “not engaged”. Reliability for engagement was calculated by dividing the number of agreements by the total number of agreements and disagreements and multiplying by 100. Average reliability for engagement across all dyads and phases was 94% (range: 88-98). Table 2-2 presents the average reliability for each dyad and each variable in each phase.

Agreement for prompt level occurred any time both coders chose the same prompt level for a given turn or waiting period. A disagreement was any instance where coders chose a different prompt level for the given turn or waiting period. Reliability for prompt level was calculated by dividing the number of agreements by the total number of agreements and disagreements (40) and multiplying by 100. Average reliability for prompt level during training
sessions was 96% for Dyad A, 94% for Dyad B, 98% for Dyad C, 96% for Dyad D, and 96% for Dyad E. Average reliability across all dyads for prompt level was 96%.

Table 2-2: Average reliability for each coded variable by dyad and phase.

<table>
<thead>
<tr>
<th>Dyad</th>
<th>Turns for child with ASD</th>
<th>Peer Turns</th>
<th>Joint Engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bl</td>
<td>Int</td>
<td>Gen</td>
</tr>
<tr>
<td>A</td>
<td>100</td>
<td>86</td>
<td>87</td>
</tr>
<tr>
<td>B</td>
<td>93</td>
<td>83</td>
<td>100</td>
</tr>
<tr>
<td>C</td>
<td>100</td>
<td>83</td>
<td>91</td>
</tr>
<tr>
<td>D</td>
<td>100</td>
<td>96</td>
<td>100</td>
</tr>
<tr>
<td>E</td>
<td>100</td>
<td>87</td>
<td>100</td>
</tr>
</tbody>
</table>

Note. All numbers are percentages. ASD = autism spectrum disorder, Bl = baseline average, Int = intervention average, Gen = generalization average.

Data analysis

To determine the effect of the intervention on the symbolic communicative turns of the children with ASD, all data on the frequency of symbolic communicative turns of participants with ASD were graphed separately for each dyad across each phase. The effect of intervention on the frequency of symbolic communicative turns was determined by visual comparison of baseline values to intervention values in regard to level, trend, and variability (McReynolds & Kearns, 1983).

In addition to visual analysis, Tau-U was chosen as the effect size measure. Although there has been debate over the best statistical procedures to calculate effect size for single-case research, much support has recently been given to the nonparametric effect size measure Tau-U (Camargo et al., 2015). Non-overlap measures such as non-overlap of all pairs (NAP) and percent of non-overlapping data (PND) have been criticized for not controlling for positive baseline trend. Tau-U can address this limitation by providing a measure involving both level
and trend (Parker, Vannest, Davis, & Sauber, 2011). As compared to PND, Tau-U often reports a more modest effect. Calculation of Tau-U requires pair-wise comparisons of each data point both within and across phases. Tau-U scores can be interpreted using the following criteria: 65% or lower, a weak or small effect; between 66% and 92%, a medium to high effect; and 93% to 100%, a large or strong effect (Parker & Vannest, 2009). For this study, Tau-U and 90% confidence intervals were calculated using the Tau-U online calculator (Vannest, Parker, & Gonen, 2011) for communicative turns with each partner.

To determine generalized effects, two comparisons were made. The first compared level of generalization data points during baseline to those during intervention. This comparison investigated the impact of the intervention on turns and engagement in the generalization context. The second compared level of data points during intervention data probes to those during generalization data probes during the intervention phase. This comparison investigated the extent to which skills learned in one context generalized to a new one.

Social validity

As part of this study, the validity of goals, methods and outcomes (Wolf, 1978) of the intervention was assessed for the indirect consumers: the teachers, SLPs, and parents of the participating children (as recommended in Schlosser, 1999). Four teachers, three parents, and one SLP agreed to participate. They were sent a questionnaire via email once the study was complete. In addition to questions about goals and methods, the questionnaire included links to password protected video clips of baseline and intervention sessions. Participants were asked to comment on what they noticed, liked, and wanted to see improved in each video (see Appendix J for the complete questionnaire). Each participant was sent four 2-3 minute video clips; two from baseline and two from intervention. These 2-3 minute samples were chosen at random. Videos
were assigned to adult participants according to the following rules: (a) parent participants were provided with one video of their child’s dyad in both baseline and intervention. The second set of videos was randomly chosen among the other participants in their child’s class, and (b) teacher and SLP participant videos were chosen at random from among the students in their class. Participants first watched both baseline videos, and then the intervention videos. The presence of the iPad was clear in the intervention videos, so adult social validity participants were not blind to which videos represented the intervention condition.

Peers in each dyad were asked yes/no questions relating to their participation in the study. They were provided with picture symbols for “yes”, “no” and “maybe”. The pictures were explained and then children responded to a set of seven questions about the study (see Appendix K for peer social validity procedures).

1 LAMP Words for Life is a trademark of the Prentke Romich Company (PRC), 1022 Heyl Road Wooster, OH 44691, USA.
Chapter 3

Results

The following data pertaining to the participants are presented below: (a) training session data, (b) frequency of symbolic communicative turns expressed by the children with ASD and generalization of turns, (c) frequency of symbolic communicative turns expressed by the peer, and (d) joint engagement for the dyads. Finally, the results of the child social validity interview and adult social validity questionnaire are presented.

Training sessions

Training session data report the number of independent turns taken by each child and also the number of partner turns for which the child successfully waited. For each of these variables, both children in the dyad had 10 opportunities. Criteria for completing training included each individual child in the dyad independently taking 80% of his own turns and also independently waiting for his partner to take turns 80% of the time across two consecutive sessions. Four of the five peers reached 80% success in both turn taking and waiting in two sessions, and only one child with CCN also met criteria in that short time. Table 3-1 shows the frequency of independent turns and waiting for each child across training sessions.
Dyad A

With the exception of training session three, Alex steadily increased the number of independent turns from zero during the first training session to 10 during the last three sessions. Interestingly, during session seven, his first time independently taking 10 turns, he also had more trouble waiting for his partner, and that skill, which had been at 10 for the previous three sessions decreased to only seven of 10 opportunities. He reached criterion for both skills during session 9, after a total of 103 min of training. For his peer buddy Aaron, both turn taking and waiting skills were over the 80% criterion through all sessions, except during session six, when waiting decreased to seven of ten opportunities.

Table 3-1: Training data for participating children.

<table>
<thead>
<tr>
<th>Day</th>
<th>Alex</th>
<th>Aaron</th>
<th>Ben</th>
<th>Bri</th>
<th>Carter</th>
<th>Chris</th>
<th>Drew</th>
<th>David</th>
<th>Eric</th>
<th>Eli</th>
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<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>10</td>
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</tbody>
</table>

Note. T = turn taking, W = waiting. Typical instructional time for training sessions was less than 10 minutes.
Dyad B

Over the first five training sessions, Ben’s number of independent turns was variable, ranging from zero to seven. After initial variability in both waiting and turn taking, Ben met criterion for completing training during session 7, after 91 min of training. For Ben’s partner, Bri, both turn taking and waiting skills were over the 80% criterion through all sessions.

Dyad C

Carter also had variable performance in turn taking over the first few sessions, and was able to take 10 of 10 turns independently during session two, but dropped to five of ten at the following session. He met criterion after 76 min of training during session 5. Carter was consistently successful waiting for his turn and met the 80% criterion for this skill during every training session. Carter’s partner, Chris, was over 80% for both turn taking and waiting in all training sessions.

Dyad D

Although Drew never met criterion for turn taking during the training sessions, his performance was increasing slowly through his nine training sessions. He increased from taking only one independent turn during the first session to taking five during session eight. Drew consistently met criterion for waiting, rarely reaching for the iPad when it was David’s turn. After the first session, Drew’s partner, David, was above 80% for both turn taking and waiting for the remaining training sessions. Due to the end of the school year, training sessions were discontinued before Drew met criterion. At the end of the study, Dyad D had received a total of 100 minutes of training.
Dyad E

Eric and his peer partner, Eli, met criterion for both turn taking and waiting after two sessions, and remained successful in over 80% of opportunities for turn taking and waiting during all four training sessions. The total training time for Dyad E was 24 min; because neither child required much prompting to be successful, training sessions for Dyad E averaged only 6 min. Due to the end of the school year, Eric and Eli did not complete five training sessions.

**Frequency of symbolic communicative turns**

The primary dependent variable for this study was the frequency of symbolic communicative turns for the children with CCN in interaction with peers without disabilities. This section presents the results for the independent performance of all children with CCN in interactions with peers with no prompting.

Dyad A

Alex, a four-year-old boy with ASD, took very few communicative turns during baseline with his peer, Aaron. Frequency of turns for Alex ranged from 0 to 5 turns during baseline sessions, and increased to between 7 and 28 turns ($M = 16$) during intervention. There was an increase in level between baseline and intervention phases (average gain: +13 turns). Baseline performance was stable, with little variability and no trend. During intervention, variability increased. Frequency of turns generally increased over the first three intervention sessions, followed by decreasing numbers over the next three sessions, and then a final increase for two more sessions. Frequency of turns in all intervention sessions exceeded the highest frequency from baseline. The Tau-U effect size for communicative turns from Alex was calculated as 0.94.
(90% CI [0.4, 1.5]), indicating a strong effect (Parker & Vannest, 2009). During generalization probes, the frequency of turns for this dyad increased by an average of 6.5 turns between the baseline and intervention generalization probes. The average frequency of turns during the intervention generalization probes (9.5 turns), however, was lower than the intervention mean of 16 turns.

**Dyad B**

Ben, a three-year-old diagnosed with ASD, took between 2 and 11 communicative turns during 10-min baseline sessions with his peer, Bri. During intervention sessions, he took between 14 and 26 turns ($M = 20$) per session. There was an increase in level between baseline and intervention phases (average gain: +14.5 turns). Baseline performance was stable, with little variability and no trend. An overall increasing trend was present in intervention data, although from session to session frequency varied. The Tau-U effect size for communicative turns from Ben was 0.97 (90% CI [0.4, 1.5]), indicating a strong effect (Parker & Vannest, 2009). The frequency of turns for Ben increased by an average of 12 turns between the baseline and intervention generalization probes. The average frequency of turns during the intervention generalization probes (12.5 turns) was lower than the intervention mean of 20 turns.

**Dyad C**

Carter was a five-year-old boy with ASD. In interactions with his peer partner, Chris, Carter took a maximum of 1 turn during 10-min baseline sessions, but in the majority of sessions took no turns. During intervention sessions, Carter’s frequency of turn taking increased to between 4 and 45 turns ($M = 25.8$). There was an increase in level between baseline and
intervention phases (average gain: +25.6 turns). Baseline performance was stable, with little variability. During intervention, frequency was variable with an overall increasing trend. The Tau-U effect size for communicative turns from Carter was calculated as 0.93 (90% CI [0.30, 1.5]), indicating a strong effect (Parker & Vannest, 2009). The frequency of turns for this dyad increased by an average of 16 turns between the baseline and intervention generalization probes. During the first generalization probe during the intervention phase, Carter took only one turn, showing no increase from baseline. However, at the second generalization session, Carter took 32 turns. Because of the large difference in the number of turns between generalization sessions during intervention, an average of generalization performance would be misleading. Carter taking only one turn during the first intervention generalization probe was similar to his frequency of turns during baseline generalization probes. During his second generalization session during the intervention phase, however, he took 32 turns, which was notably higher.
Figure 3-1: Frequency of symbolic communicative turns for the children with ASD in Dyads A-C. The asterisk indicates that the criteria for ending training were met during the training session following this probe.
Dyad D

Five-year-old Drew had a diagnosis of ASD, and took no turns during baseline with his peer partner, David. During intervention sessions, Drew took between 0 and 14 turns ($M = 3.25$) per 10-min session. There was a slight increase in level between baseline and intervention phases (average gain: +3.25 turns). Performance was variable, however, with Drew taking zero turns in four of eight intervention sessions. Drew increased to 14 turns in the first session after the start of intervention, but dropped back to zero during the second session. When intervention sessions 6 and 7 both resulted in zero turns, a new set of books was chosen based on his specific areas of interest, and after one training with the new books, his turns increased to four. The Tau-U effect size for communicative turns from Drew was calculated as 0.5 (90% CI [0.06, 1]), indicating a weak effect (Parker & Vannest, 2009).

Dyad E

Eric, who had a diagnosis of developmental delay, but was being monitored as he had an older sibling with ASD, was three years, eleven months old during the study. During baseline sessions with his peer partner, Eli, Eric took between 0 and 3 communicative turns. Eric’s frequency of turns increased to between 17 and 42 turns ($M = 31.3$) per 10-min session during intervention. There was an increase in level between baseline and intervention phases (average gain: +29.3 turns). Baseline performance was relatively stable, with a slight decreasing trend. In intervention, this dyad was only able to complete four training sessions and four probe sessions due to the summer break. A stable pattern of turn taking was not established during this time period. The first two sessions were stable with an increase during the third session, but a decrease in the fourth. The Tau-U effect size for communicative turns from Eric was calculated
as 1.00 (90% CI [0.4, 1.6]), indicating a strong effect (Parker & Vannest, 2009). Again, due to summer break, this dyad did not participate in any generalization sessions after intervention.

Figure 3-2: Frequency of symbolic communicative turns for the children with ASD in Dyads D and E. The asterisk indicates that the criteria for ending training were met during the training session following this probe. Drew did not meet the criteria, so there is no asterisk for Dyad D.
Frequency of peer turns

Overall, the peers in this study took more turns during intervention than in baseline sessions. In both baseline and intervention, most peers took more turns than the children with CCN, although the balance of turns was typically closer to 50% during intervention, suggesting a more balanced exchange.

Dyad A

Aaron, Alex’s peer buddy, took between four and 24 turns during 10-min baseline sessions ($M = 14$) and between 15 and 70 turns during intervention ($M = 41.9$). Despite this increase, there was no increase in the turn imbalance within the dyad. During baseline, Aaron took an average of 87% of the total turns within the dyad, and during intervention, he took an average of 71%.

Dyad B

Ben’s peer buddy, Bri also increased frequency of turns between baseline and intervention. During baseline, she took between two and 31 turns per session ($M = 11.5$). During intervention, she took between 26 and 62 turns ($M = 35.7$). For this dyad, the increase in turn frequency had no impact on the balance of turns, with Bri taking an average of 62% of the turns in baseline and 63% in intervention.
Dyad C

Carter’s peer buddy, Chris took between zero and 3 turns during 10-min baseline sessions ($M = 1.6$). In one baseline session, neither child took any turns during the entire 10-minute session. Chris increased the frequency of his turn taking during intervention, and took between 5 and 32 turns during those 10-min sessions ($M = 14.3$). For this dyad, the balance of turns shifted such that the child with CCN, Carter, took more turns than the peer, Chris, during intervention sessions. The imbalance in turns decreased during intervention. During baseline, Chris took 88% of the total turns, and during intervention he took 38%.
Figure 3.3: Frequency of symbolic communicative turns taken by both children in Dyads A, B, and C.
Dyad D

David, Drew’s peer buddy, took between zero and 8 turns during baseline sessions ($M = 2$). Like many of the peers, his turn taking increased during intervention, when he took between 11 and 68 turns ($M = 38.3$). Calculating percentage of turns for this dyad was challenging, as Drew took no turns at all during baseline, and David took no turns during three baseline sessions. Of the total turns taken during baseline sessions, David took 100% of them. Even though Drew continued to take very few turns during intervention ($M = 3.25$), taking any turns was an improvement and resulted in a decrease in turn imbalance. During intervention, David took 89% of the total turns.

Dyad E

Eric’s peer buddy, Eli, took between zero and 9 turns during 10-min baseline sessions ($M = 4.1$). During intervention probe sessions, Eli took between 51 and 68 turns ($M = 60.0$). As seen in Dyad B, the balance of turns for this dyad remained about the same between baseline and intervention despite increases in frequency of turns by the peer. Eli took an average of 64% of turns during baseline and an average of 66% during intervention.
Figure 3-4: Frequency of symbolic communicative turns taken by both children in Dyads D and E.
Engagement

There was an average increase in joint engagement between baseline and intervention for all five dyads (see Figure 3-5 for a comparison of average engagement across phases). Engagement was variable from session to session, but average joint engagement was higher during intervention sessions than during baseline sessions for all dyads.

![Figure 3-5: Comparison of average joint engagement for baseline and intervention phases for all dyads.](image)

**Dyad A**

During baseline sessions, Alex and Aaron were engaged jointly for an average of 26% of intervals (range: 5%-48%). During the intervention phase, the level of engagement increased on average, but was accompanied by an increase in variability. During intervention sessions, they were jointly engaged for an average of 45% of intervals (range: 10%-75%).
Dyad B

Ben and Bri were jointly engaged for an average of 29% of intervals during baseline sessions (range: 20%-38%). Their engagement had little variability, but an increasing trend during baseline. During the intervention phase, they were jointly engaged for an average of 53% of intervals (range: 27%-55%). Joint engagement was high during the first two sessions after introduction to the iPad and turn-taking training, but decreased over the next two. This decreasing trend was followed by an increasing trend for the next two sessions.

Dyad C

During baseline, Carter and Chris were engaged jointly for an average of 10% of intervals. Their engagement was stable through baseline, ranging from 7% to 12% over five sessions. There was an immediate increase in engagement for two sessions after the introduction of intervention, followed by a decrease to just above baseline levels for two sessions. The final two sessions saw engagement rise and fall again. On average, they were jointly engaged for 27% of intervals during intervention sessions (range: 17%-37%).
Figure 3-6: Percent intervals with joint engagement for Dyads A, B, and C at baseline and during intervention.
**Dyad D**

During baseline, Drew and David were engaged jointly for an average of 9% of intervals (range: 2%-18%). Their engagement varied through baseline, but variability increased after the introduction of the independent variable. Joint engagement during the intervention phase ranged from 2% to 52%. It was at its highest the first session after the introduction of the independent variable, then increased and decreased variably for the remainder of intervention. Average joint engagement during the intervention phase was 21%.

**Dyad E**

During baseline, Eric and Eli were engaged jointly for an average of 23% of intervals (range 8%-47%). Through the baseline phase, engagement decreased for the pair. The first session after the introduction of the independent variable, engagement was at its highest (52%) but decreased through most of the intervention phase as well. During intervention sessions, average joint engagement for Dyad E was 34% (range: 15%-52%).
Figure 3-7: Percent intervals with joint engagement for Dyads D and E during baseline and intervention.
Social validity

The peers who participated in the study each answered six questions to assess social validity, all of which could be answered with either “yes,” “no,” or “maybe,” either with an oral response or by pointing to a picture. Four of five children answered “yes” when asked if they had fun looking at books with their buddy, and three of five answered “yes” when asked if they enjoyed looking at books on the iPad with their buddy. Four of five peers said they liked using the iPad at book buddies.

Four of five peers said that the iPad helped them talk to their buddy and three of five said that the iPad helped their buddy talk to them. Finally, although four of five peers said they liked reading with their buddy, only one of five answered, “yes” to “I want to keep reading with my buddy.”

Four teachers, three parents, and one SLP completed the online social validity questionnaire (see Appendix L for full results of survey). All eight participants agreed that social interaction was an important part of what happens in school. Even though children with ASD in both childcare centers were in separate classrooms from the children without disabilities, all eight participants agreed that interaction between children with and without disabilities at school was important. All eight participants again agreed that interaction skills such as turn taking should be taught at school.

Participants answered three open ended questions about each sample video: (1) What do you notice about the interaction between the two students, (2) what do you like about their interaction, and (3) what would you like to see change in the way they interact?

Each participant viewed two sample baseline videos. Of the 16 responses to question one for baseline, 13 noted that the students either did not interact at all, or did not interact much. When responding to question two, participants noted that the children were willing to sit next to
each other and share materials, and two noted that they liked the few attempts to interact. For question number three about what they would like to see changed, 7 responses mentioned that they would like to see more interaction; five responses mentioned they would like to see them looking at the books together instead of looking at separate books; five responses mentioned wanting to see more eye contact, and five wanted to see them talk to each other more; two responses mentioned that they should help each other, and one response noted that a desire to see the children smile at each other.

Each participant then viewed two sample intervention videos. Of the 16 responses to question one, five noted that the children interacted more often; two mentioned that they shared more, and three noted increases in turn taking. Two mentioned that the children still did not seem to interact much and another two noted that the children were finding it challenging to share the iPad. When asked to describe what they liked about the interaction in the intervention videos, six participants noted that the peers without disabilities put more effort into engaging the children with ASD. In response to question three, four participants mentioned wanting to see even more turn taking and sharing, and another four wanted to see the peer comment on the story using spoken words. Three mentioned wanting to see more eye contact and one wanted to see more enjoyment in the activity. Two participants wanted to see a greater variety of interaction and noted that the interactions seemed repetitive.

After viewing all videos, the eight participants answered questions about the outcomes of the intervention. Six of the eight participants agreed that the intervention had a positive effect on the communication between the two children, that the intervention had a positive effect on engagement, that they would support use of this intervention in the classroom, and that they would recommend the intervention to others. The two participants who didn’t feel that the intervention had increased communication were either a parent or teacher of the participants in Dyad D, and their responses likely reflect the lack of intervention effect for that dyad.
Chapter 4

Discussion

The goal of this study was to provide children with both the tools and the skills needed to participate in a balanced communicative interaction, where both children were responsible for the success of the interaction. During training, children in participating dyads were introduced to an AAC system to support communication within a shared activity, and taught to use that system for communicative turn taking. Four of the five participating dyads met criterion for ending training after fewer than 10 training sessions (range 24-103 min) and the children with CCN in those four dyads all expressed more symbolic communicative turns after participating in training sessions than they had during baseline. The fifth dyad was unable to reach criterion before the end of this study, but was showing improvements in training. For three of the five dyads, the balance of turns between the two children improved, even when the peers took more turns during intervention. For the remaining two dyads, the turn balance remained the same, with the peers taking around 60% of the total turns for those dyads. Average joint engagement increased across phases for all participating dyads. Variability in joint engagement from session to session was high, and additional research to identify the factors that play a role in joint engagement is needed. Findings from social validity questionnaires showed that all adult stakeholders believed social interaction was an important part of early childhood education. All parents and three of the four teachers reported that the intervention made a positive impact on the communication and engagement of the participants. In the remainder of this chapter, the key findings of this study will be discussed, along with how this study contributes to the literature on promoting peer interaction for children with CCN. Finally, clinical implications, limitations, and future research suggestions will be presented.
Key findings

Increases in frequency of turns

The primary research question for this study was whether this multicomponent intervention would be effective at increasing the frequency of symbolic communicative turns for children with CCN who had characteristics of ASD. For the children with CCN in Dyads A, B, and C, this intervention was successful at increasing frequency of turn taking. Experimental control was maintained through a staggered baseline and systematic application of the independent variable; a functional relationship between the intervention and the increases in frequency of turns for participants with CCN was established. Drew, the child with CCN in Dyad D, did not meet the criterion for turn taking within the time limits of this study. During training sessions, he and his partner were both successful with waiting, and Drew was showing improvement in turn taking, but the school year ended before he met all of the criteria for completing training. Because of the coming end of the school year, intervention began with Dyad E before an effect was established with Dyad D. Eli’s turn taking increased between baseline and intervention. This section will provide an examination of the overall effectiveness of the intervention followed by an exploration of the possible factors contributing to the lack of effect for Dyad D.

Overall effectiveness of the intervention

Average gains for the five participants with CCN ranged from 3 to 25 turns during 10-min sessions, which was a gain of between 0.3 and 2.5 turns per minute. This outcome is encouraging as very few studies present compelling interventions to support peer interaction for preschool-age children with CCN and characteristics of autism. The social validity questionnaire
responses (see Appendix L) for stakeholders who viewed selections of videos from the first three dyads indicated that all adult stakeholders believed the intervention played a role in increasing both communication and engagement for the dyads and all would recommend this intervention to other children, while social validity responses for Dyads D & E were less positive.

Results from this study extend the literature in a few ways. First, this study provides additional support to the assertions of Therrien and Light (2016) that the use of multi-component interventions can be a successful way to promote social interaction for preschool children who use AAC. This study extends those findings to children with characteristics of ASD, for whom challenges in social interaction are a part of the diagnosis. This intervention sought to mitigate the personal barriers related to disability by teaching children with CCN communicative turn taking. Environmental barriers relating to both communication partners and the physical environment were also addressed by training peers in turn taking and providing AAC to support communication. This multicomponent intervention was effective at increasing independent communicative turns for four of the five included participants. Two previous studies of peer interaction for preschool children with CCN also measured communicative acts (Therrien & Light, 2016; Trembath et al., 2009). In the study by Trembath et al., preschool-age participants with autism spectrum disorder increased communicative acts by 0.2-1.1 acts per minute. In Therrien and Light, participants with CCN who did not have characteristics of ASD increased communicative acts by 1.1-4.7 turns per minute. While the participants in this study overall had smaller gains than those seen in Therrien and Light (2016), the four participants who showed increases in frequency of turns had gains that were greater than those seen in Trembath et al.

The participants in the study by Trembath et al. were children with CCN who had been diagnosed with autism, and therefore were similar to the participants in this study. The intervention in Trembath et al. included both peer-mediated and environmental arrangement components. It may be that the slightly larger gains in communication seen in this current study
are due to the child-specific components that were present in the current study but missing from the study by Trembath et al. Given the social challenges common to individuals with ASD, it is not surprising that children with ASD would be better supported when explicitly taught skills to support social interaction. Another possible explanation for the difference in gains seen between the two studies is the AAC system used in each. First, in the study by Trembath et al., the AAC system was a light-tech speech-generating device (SGD) with a grid layout and eight symbols. The programmed vocabulary words were: yes, good, don’t, no, more, I want, help, and finish. While these core words may be useful in a variety of settings, they may not be engaging to young children and include few of the characteristics of AAC recommended for young children (Light et al., 2007). Finally, the AAC system in the study by Trembath et al. was not embedded in the activity, meaning that, when playing, the children had to choose between using their hands to continue to play, or using their hands to activate the SGD and communicate. Given this choice, many young children will choose to play instead (Light, 1997).

Although the training was implemented differently in this study, the major components and goals were similar to Therrien and Light (2016). One participant in the study by Therrien and Light demonstrated gains of 2.9 to 5 turns per minute as a result of intervention. Given that challenges with social interaction are associated with ASD, it is not surprising that participants in this study had smaller gains than those demonstrated in Therrien and Light. The positive results for four of the five participants in the current study lend additional support to the principles behind the intervention, and show that those principles also apply when the intervention targets communication outcomes with children with characteristics of ASD. Developing interventions that effectively support social interaction for a diverse group of children is ideal because children with a variety of disabilities are often educated together within their general education classroom, and teachers are likely to choose interventions that can be effective for the majority of the class.
Like many multicomponent interventions to support social interaction, this intervention included a peer-mediated component, providing additional support to the benefits of training peers within social interaction intervention packages. This study, like Therrien and Light (2016), shows that it is possible to conduct a peer training without establishing a power imbalance in the relationship, such as in cases where peers are taught to prompt AAC use for children with CCN (Chung & Carter, 2013; Hughes et al., 2000, 2011; Trottier et al., 2011). The intervention in this study taught the children with CCN and peers interaction skills (turn taking and waiting) together, and neither child was considered the helper or the receiver of help. The training data for this study suggest that the peers were capable of both taking turns and waiting after initial training instructions with little to no adult support. However, a number of intervention sessions were required before each child in the dyad was able to successfully take turns and wait independently without the presence of the interventionist.

The results of this study also suggest that providing appropriate AAC as an environmental support may be effective at supporting social communication for children with CCN who also have characteristics of ASD. Although the use of the iPad and other mobile technology as AAC for children with ASD has been investigated in previous research (Alzrayer et al., 2014; Lorah et al., 2015), no previous studies have investigated the effect of using the iPad as AAC to promote peer interaction for this population. As theorized by McNaughton and Light (2013), the appeal of the iPad may have made it an ideal tool for encouraging joint participation between the peer and child with CCN in this intervention.

Because the intervention was provided as a package, it is impossible to tease out the relative importance of the components. Further examination of the results of the intervention lends support to the following ideas: (a) provision of AAC may have been responsible for early increases in frequency of communication while (b) the turn-taking training may have been responsible for later gains and continued maintenance of frequency of turns. An examination of
the results from both training and probe sessions support these assertions. Because children in the dyads had only received one training session prior to their first intervention probe session, and for four of the five participants with CCN, their turn taking did not meet criterion, it is unlikely that increases in communication seen in the first few intervention probes were due to training. Instead it is likely that the appeal, ease of use, and novelty of AAC in this study was enough to make a change in turn taking for some of the participants with CCN without training in turn taking. It is interesting to note that some participants did not demonstrate this initial increase, and that this increase was not maintained. The participants with CCN in Dyads A, B, and C each saw a dip in performance after an initial increase. This aligns with research showing that provision of AAC alone is not enough to support communication outcomes for individuals with CCN (Beukelman & Mirenda, 2013). As the dyads participated in more training sessions, and their independent turn-taking skills increased, the frequency of turns in probes increased again following the initial drop. It is more difficult to see the impact of the individual components in the results for Dyad E. For this dyad, criteria for completing training were met after only two training sessions, and yet Eric still demonstrated a decrease in turns after the first few intervention sessions. Unfortunately, because of the end of the school year, intervention could not continue to see if his performance would have increased later similar to that seen in Dyads A-C. Additionally, because of time limitations, the lasting effect of achieving criterion in training is unclear. It is possible that increases in independent turn taking would stay stable or continue to improve. It is also possible that participants would need continued support to maintain the increased frequency of turn taking. Future research should plan for continued probe sessions once criterion for training has been met to examine the lasting effects of the intervention.
Examination of the results for Dyad D

A variety of factors may have contributed to the lack of intervention effect for Dyad D. One factor that may have impacted success was time spent in training. Drew and his partner, David, participated in nine training sessions, and their training sessions lasted an average of 11 minutes. The total training time for Dyad D was slightly over an hour and a half spread across a period of seven weeks. Increasing the total time in training may have been beneficial for this Dyad, as the frequency of independent turns Drew took during those training sessions was increasing over the final three sessions. In addition to total time, increasing the intensity of intervention may have had a greater effect for Drew. Due to scheduling in Drew’s school, he participated in a maximum of two training sessions per week.

This limited total time and intensity combined with the relative severity of Drew’s autism symptoms likely played a role in the lack of effect for Drew. Drew was the only participant in this study whose score on the CARS-2 (Schopler et al., 2010) placed him in the severe autism category, and he also had the lowest score on the PPVT-4 and the CDI (Fenson et al., 2006). Increased autism severity could result in less social motivation and interest in peers and more restricted interests, meaning that the barriers to overcome were even greater for Drew and he may have required more time and intensity of training to learn the turn-taking skill.

Additionally, in many sessions, it seemed that lack of motivation might have played a role in Drew’s low levels of turn taking. To address this concern, additional books specifically targeting Drew’s interests were added toward the end of the study; an increase in the frequency of Drew’s attempted turn taking was observed with this change. In his final intervention probe session, Drew more frequently reached toward the iPad to take turns. This frequent reaching is not represented in the data because he was unsuccessful activating the hot spots due to his peer partner’s interference. Unfortunately, the time limitations of the study did not allow enough
sessions after the addition of these high interest books to determine the impact of these books on his turn taking.

Environmental factors may also have impacted Drew’s performance. Drew’s partner, David, was highly interested in using the iPad and, without an adult in proximity, was often unwilling to share the iPad. In a few sessions, Drew would reach for the iPad to participate in the interaction and David would push his hand away. If this happened early in the session, this behavior often resulted in Drew turning away and disengaging, or simply picking up one of the books on the table and flipping through the pages. Additional feedback or support to help the peer share the iPad may have been helpful for this dyad.

Generalization of turn taking

This study also investigated whether turn taking would generalize to new books and to a new context, the classroom book center. The data from generalization sessions in this study are promising, but need to be investigated further. Only the first three dyads completed generalization sessions during intervention. For all three of the participants with CCN, the frequency of turn taking during intervention generalization probes was equal to or higher than during baseline generalization probes. Frequency of turns varied across the two generalization sessions during intervention, however. For Dyads A and C, frequency of turns during the second generalization session during intervention was higher than during the first, and similar to the frequency seen in other intervention probes. For Dyad B, frequency of turns during generalization probes during intervention was lower than in typical intervention sessions and decreased from the first session to the next. Because there was no time to complete generalization sessions during intervention for Dyads D and E, it is unclear whether increased frequency of turns would have been evident for those dyads.
Generalization sessions occurred throughout the intervention phase making it possible that the lower frequency of turns was related to the fact that for some probes, the dyads had not yet reached criterion in training. Future research should consider additional generalization sessions after participants have met criterion for completing training to determine whether learned communication skills generalize to new books in the book center environment. Additionally, the lack of a consistent effect for generalization data suggest that future research should consider conducting training and probe sessions in the classroom to encourage children to use the skills learned during intervention in the natural environment.

**Frequency of peer turns**

Peer turns were measured to investigate the relationship between the frequency of peer turns and the frequency of turns for the individual with CCN. The rate of communication during baseline for peers in this study was low with average frequency of turns ranging from one to 14 during a 10-min period. Once intervention began, all peers increased the frequency of their turns, and average frequency in intervention ranged from 14 to 60 turns in a 10-min period. Across all five dyads, this increase in frequency did not negatively impact the balance of turns in the interaction. In fact, for three of the five dyads, the ratio of peer turns to turns for participants with CCN moved closer to 0.5 and for the other two dyads, that ratio was essentially unchanged between baseline and intervention.

These results suggest that the intervention encouraged peers to take more frequent turns, but without taking on a more dominant role in the interaction. This ability to maintain a balance in turns is essential, as research with adults who use AAC shows that conversation partners tend to dominate conversations (Light et al., 1985). Teaching children to share the conversational
space more equally may result in more opportunities for communication for children with ASD who use AAC.

**Engagement**

In addition to communicative turns, this study also investigated joint engagement for each dyad. Because both quantity and quality of interaction are important to relationship development (Prinstein & Dodge, 2008), the goal of measuring engagement was to capture one aspect of the quality of the interaction. The data suggest that the intervention may have a positive impact on joint engagement for participants. Average joint engagement increased between baseline and intervention for all participating dyads. Joint engagement skills at ages three and four have been shown to be an indicator of later quality of friendships (Freeman, Gulsrud, & Kasari, 2015). The increases in joint engagement across all dyads were expected based on the use of a single iPad to facilitate interaction. Although all four books were still present on the table, the iPad became a central focus due to its visual appeal and the auditory appeal created by the speech output from the hot spots. The training may also have encouraged more joint engagement, as each child became more aware that the other was taking a turn.

The average increases in engagement are promising, but there was significant variability in the joint engagement data across intervention sessions. This variability could be due to a variety of factors. One possibility is the materials. If the chosen book was not equally interesting to the two participants, one participant may have been less engaged, and less likely to participate enthusiastically in that interaction. Another possible explanation for the variability is the changing environment from which the children were taken to participate in the sessions. Children were participating in a variety of activities during the time allotted for research. Sometimes they were eager to leave the classroom for the research. Other times, they were more reluctant. Many
of the participants did not want to leave outdoor playtime, and this may have contributed to reduced engagement on those days. Finally, personal factors related to the participants could play a role in engagement. Over the course of the study, students were sometimes sick or overtired. At other times, participants were looking forward to vacations, or had just returned from vacation. Sometimes, research sessions were delayed because students had been misbehaving and needed a break. All of these personal factors could contribute to variability in engagement with peers.

**Clinical implications**

Findings from this study suggest several implications for educators and SLPs who work with young children with complex communication needs. First, given the importance of peer interaction, peers should be considered a primary communication partner for children with CCN in the preschool classroom. Because peer interaction is unlikely to occur frequently without some intervention to mitigate barriers, teachers and SLPs should consider the barriers that are most likely to impact peer interaction for a given student and provide support to students to overcome those barriers.

Second, peers can be included in intervention without playing the role of helper. Preschool age children are all learning the skills necessary to participate in interactions with peers. Providing intervention targeted at supporting students with CCN can also positively impact the social behaviors of peers in the environment. In this study, it was important for both children in the dyad to learn to communicate more with each other, while also learning the turn-taking and waiting skills required to maintain a balanced interaction, where neither dominates the conversation.

This intervention package would be relatively simple to implement in the typical preschool classroom. The technology used is commercially available and inexpensive compared
to traditional AAC systems. Because the training focused on a concept that is already commonly introduced in preschool classrooms, taking turns, preschool teachers and aides would likely be comfortable teaching those skills. In addition, the training is efficient. For four of the five dyads in this study, criterion was met with less than 1.5 hr of instructional time. Just as in Therrien and Light (2016), the novelty of the current intervention was the use of the iPad as an environmental support to promote communicative turn taking. This study provides additional support to the effectiveness of this intervention in supporting conversational turn taking for preschool age children with disabilities and suggests that implementing the intervention with students in an inclusive preschool classroom may be an effective way to increase social communication for many children with complex communication needs.

**Limitations and future research**

This study contributes to the field by enhancing our understanding of the attributes of technology and type of training that can support peer interaction for children with CCN and characteristics of ASD; however, there are some limitations to consider.

The populations of children with CCN and children with ASD are heterogeneous, and this study only included five participants. External validity, or the extent to which the results from a study apply to participants other than those involved in the study, is one limitation of single-subject research, though external validity is enhanced by replication (Horner et al., 2005). Future research should investigate whether this intervention can successfully promote peer interaction for a variety of participants with CCN.

Another limitation of the design was that the investigator was also the primary coder. While knowing the hypothesis could bias the results, utilizing a second coder for reliability mitigates this risk. The second coder in this study was blind to the goals of the study, but could
not be blind as to which videos occurred after intervention due to the presence of the iPad. Reliability on a random 30% of baseline and intervention videos was high ($M = 93\%$) lending credibility to the results of this intervention.

Additionally, the lack of success with one of the dyads indicates that future research is necessary to determine what characteristics contribute to successfully increasing turn taking through this intervention, and what additional supports are necessary so that children who do not benefit from this intervention can be more successful in social interaction with peers.

The timing of this study and limitations in availability of the dyads meant that it was not possible to collect maintenance data so the lasting effects of this intervention for children with CCN and characteristics of ASD remain unknown. To establish lasting effects of the intervention, future research should plan for collecting both short- and long-term maintenance data on all participants.

Another limitation of this study is that it did not occur within an inclusive preschool classroom. Instead the participants from the study were from separate, but adjacent classrooms, and had limited interaction before the start of this study. Researchers argue that if the goal is truly to encourage relationship development based on the increase in social interaction, partners should be children that are well-liked and ideally the partnerships should reflect mutual choice (McConnell, 2002; Werebe & Baudonniere, 1988). Because of the separation of classrooms, that was not possible for this study; however, future research should consider inclusion criteria for peers based on their relationship with the child with CCN.

Additionally, this study took place in a room separate from the preschool classroom. As a first-step in determining the effectiveness and feasibility of the intervention, controlling the setting and minimizing distractions in this way was desirable; however, future research should determine whether this intervention could be effective if implemented within the classroom. With the mixed results for generalization probes, it is essential to determine whether this
intervention could be implemented without pullout training to support use of skills in the natural environment. Ecological validity could be further enhanced by investigating the feasibility of training teachers, paraprofessionals, or other preschool staff to implement the intervention.

The results of this study suggest that engagement may be positively impacted by the intervention, but the variability seen in joint engagement from session to session means that future research is needed to understand the many factors impacting engagement within social interaction activities.

By using a dyadic training that made both children equally responsible for the success of the interaction, this study confronted the problem of imbalance in relationships; however, it did not investigate ways to confront another criticism of peer-mediated approaches, that of generalization to untrained peers. While peer training may result in increased social interaction, unless research shows that peer training produces changes in social interaction behaviors of children with CCN such that the behaviors generalize to untrained peers, positive interactions for children with CCN will always rely on the presence of trained peers (McConnell, 2002). The first step toward ensuring that children with CCN always have access to trained peers may be to train all peers as part of a classroom experience. It is possible that this intervention could be successfully used within the classroom to teach all members of the class the turn-taking skills taught to the dyads in this study. Future research should investigate whether teaching these skills at the classroom level could have a similar positive impact on peer interaction for children with CCN. Additionally, future research should investigate whether, once turn-taking skills are learned, children with CCN are more likely to participate in communicative turn taking exchanges with untrained peers.

In addition to investigating the impact of implementing this intervention within the classroom, future research should consider expanding beyond the storybook context. Social interaction is likely to occur in a variety of settings, such as dramatic play, building with blocks,
or arts & crafts. Determining how to provide AAC to support interaction in those contexts, where it is more challenging to embed the AAC within the activity should be a priority for future research into increasing social interaction for preschool-age children.

Finally, investigating the impact of intervention on the social interactions of preschoolers is important in that it may provide a foundation for building social skills throughout life. However, it is clear from research on older children and adults who use AAC that there are many older individuals using AAC who would benefit from social interaction interventions. Determining the barriers to interaction that exist at different developmental stages, and therefore, which supports are necessary for supporting older individuals who use AAC in social interaction should be a future research priority.

**Conclusion**

Social interaction has a variety of developmental benefits. Children with characteristics of ASD who use AAC confront both intrinsic and extrinsic barriers to successful interactions with peers. Interventions to support social interaction and relationship development are essential. Many of the most successful social interaction interventions, both with children with CCN and children with ASD utilize a multi-component intervention, and incorporate the use of peer-mediated strategies. Although these approaches have been shown to be successful, the peer-mediated component may actually have a negative impact on friendship development as it may establish an unequal relationship between the two children (Therrien et al., 2016; Carter & Brock, 2016). Findings from this study suggest that it is possible to make positive changes to social interaction for children with CCN who have characteristics of ASD. This intervention sought to promote a relationship in which both children played an equal role in the interaction. This
“horizontal” quality of the relationship is purported to be a defining quality of friendship (Bagwell & Schmidt, 2011; Finke, 2016). Additionally, this study provided an iPad, an AAC system that was child-friendly and appealing (McNaughton & Light, 2013), to support communicative interaction. The use of AAC as a universal support provided a concrete way for the children to share the conversational space and the programmed VSDs provided an efficient way to access vocabulary for conversation (Drager et al., 2003). The success of this intervention contributes to the literature on promoting social interaction for young children with CCN.
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Appendix A

IRB Approval Letter

**APPROVAL OF SUBMISSION**

**Date:** November 10, 2014

**From:** Joyel Moeller, IRB Analyst

**To:** Michelle Therrien

<table>
<thead>
<tr>
<th>Type of Submission:</th>
<th>Initial Study</th>
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<tbody>
<tr>
<td>Title of Study:</td>
<td>A peer-mediated approach to increasing social interaction between preschoolers with complex communication needs and their peers using visual scene displays</td>
</tr>
<tr>
<td>Principal Investigator:</td>
<td>Michelle Therrien</td>
</tr>
<tr>
<td>Study ID:</td>
<td>STUDY00001258</td>
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<tr>
<td>Submission ID:</td>
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<tr>
<td>Funding:</td>
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| Documents Approved: | • Social Interaction for young children with CCNs - Consent Form (10-10-14_v1), Category: Consent Form  
• Social Interaction for young children with CCNs (11-06-14-v3), Category: IRB Protocol  
• Social Interaction for young children with CCNs - Parent Letter (10-10-14_v1), Category: Recruitment Materials  
• Social Interaction for young children with CCNs - Therapist Letter (10-10-14_v1), Category: Recruitment Materials |
| Review Level:       | Expedited |

On 11/10/2014, the IRB approved the above-referenced Initial Study. This approval is effective through 11/9/2015 inclusive. You must submit a continuing review form with all required explanations for this study at least 45 days before the study’s approval end date. You can submit a continuing review by navigating to the active study and clicking ‘Create Modification / CR’.

If continuing review approval is not granted before 11/9/2015, approval of this study expires on that date. To document consent, use the consent documents that were approved and stamped by the IRB. Go to the Documents tab to download them.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB
Library within CATS IRB (http://irb.psu.edu). These requirements include, but are not limited to:

- Documenting consent
- Requesting modification(s)
- Requesting continuing review
- Closing a study
- Reporting new information about a study
- Registering an applicable clinical trial
- Maintaining research records

This correspondence should be maintained with your records.
Appendix B

Consent to Participate

CONSENT FOR RESEARCH
The Pennsylvania State University

Title of Project: Effects of a social interaction intervention on the balance of turns between preschool children with complex communication needs and their peers

Principal Investigator: Michelle Therrien, M.A.

Address: Department of Communication Sciences and Disorders
308G Ford Building, University Park, PA 16802

Telephone Numbers: Weekdays: 8:00 a.m. to 5:00 p.m. (971) 227-9928

Subject's Printed Name: ____________________________________________

We are asking you to be in a research study.

Whether or not you take part is up to you. You can choose not to take part. You can agree to take part and later change your mind. Your decision will not be held against you. This form gives you information about the research. Please ask questions about anything that is unclear to you and take your time to make your choice.

Some of the people who are eligible to take part in this research study may not be able to give consent because they are less than 18 years of age (a minor). Instead we will ask their parent(s)/guardian(s) to give permission for their participation in the study, and we may ask them to agree (give assent) to take part. Throughout the consent form, “you” always refers to the person who takes part in the research study.

1. Why is this research study being done?
This research is being done to find out if special photo-based apps can help support social interaction. We are asking you to be in this research because we are hoping to learn about beginning communicators: very young children who have complex needs that may make talking difficult for getting what they want or need, asking and answering questions, or making friends to play with and hang out together.

2. What will happen in this research study?
To be a part of this study, you (child with complex communication needs) must:

• Be from an English-speaking home, or have been enrolled in an English speaking school for at least one full year.
• Have a diagnosis of an autism spectrum disorder or developmental delay
• 3-7 years old and a student in an early childhood or Kindergarten classroom
• have speech that is not sufficient to meet communication needs
• demonstrate the ability to engage with a preferred activity for five minutes
• have motor skills sufficient for reaching and touching a 9 x 7 inch screen
• have adequate vision (with or without correction) and hearing to engage in typical play interactions
• not engage in challenging behaviors that present a safety risk to self or others.

OR

To be a part of this study, you (peer) must be from an English-speaking home and:
• 3-7 years old and a student in an early childhood or kindergarten classroom
• classmate or same-aged peer of child with complex-communication needs
• have adequate vision (with or without correction) and hearing to engage in typical play interactions
• have no identified disability

During our first visit, we will ask a few brief screening questions to get a sense of your communication skills, and your preferences/interests. You do not to answer any questions, or do anything, that you do not wish to.

After the screening visit, if you are eligible to continue in the research, the researcher will visit your classroom for one 15-20 minute observation. For participants with disabilities, a member of the research team will administer a assessments to measure language and social skills. These assessment may take 1-2 hours to complete, and will be completed over several days to avoid fatigue. This assessment is for research purposes only and cannot be used to justify special services or medical treatment. If this assessment has been used by the school in the last three months, the score from that assessment will be used for the study and you will not need to be reassessed.

Members of your educational team (parents, teachers, therapists, aides, etc…) will provide information about your skills and abilities in the classroom, your preferences and prior interactions with classmates.

Then, over a few weeks, you will meet with the researcher and one of your classmates to do play activities (such as reading books, playing with toys or games, or listening to music), and have chances to use a video communication software on a Tablet. It is important to know:
• You do not have to answer any questions or do anything that you do not wish to. You can choose to stop at any time, and that will be fine.
• We will take pictures during the sessions, and all of these sessions will be videotaped so that we can learn about the use of the iPad app and how you’ve learned strategies for social interaction. Your face will probably be visible on the photos and videos, and your name will likely be used.

Page 2 of 8
• We will review the videos carefully for how many turns you take and how many times you use the touch screen.
• We keep everything (like the photos, videos and all the information we learn from them), very carefully protected.

Short clips from the collected videos will be shared with members of the educational team and parents of participants to gather opinions about the results of the study.

Once the sessions are all done, we will use what we have learned to teach teachers and therapists ways to help children interact. We will talk about what happens to photos and videos after the sessions are done in a separate, optional section at the end of this consent.

3. What are the risks and possible discomforts from being in this research study?

No part of this research has risks any more than playing and doing school activities like reading or using a touch-screen Tablet with apps. You do not have to answer any questions or do anything that you do not wish to. You can choose to stop at any time, and that will be fine.

There is a low risk of loss of confidentiality if your information or your identity is obtained by someone other than the investigators, but precautions will be taken to prevent this from happening.

4. What are the possible benefits from being in this research study?

4a. What are the possible benefits to you?
You will have the chance to see and use communication software on an iPad. You will be trained in strategies to use when playing and talking with another child.

4b. What are the possible benefits to others?
You will help us to learn how to better support young children who have complex needs in talking and playing with peers.

5. What other options are available instead of being in this research study?

The iPad application we are using in this study is commercially available, and you may choose to purchase it and use it yourself outside of this study. The combination of training and use of the application will only be used in this study.

You may choose not to be in this research study.

6. How long will I take part in this research study?

If you agree to take part, it will take you about 15-30 minutes per session, depending on how you are feeling, to complete this research study. There will be between 8 and 25 sessions over 5 to 20 weeks.

7. How will you protect my privacy and confidentiality if I decide to take part in this research study?
Efforts will be made to limit the use and sharing of your personal research information to people who have a need to review this information.

- A list that matches your name with your code number will be kept in a locked file or password protected file with the Principal Investigator.
- Any data and research records will be labeled with letter-number codes and the date of the session and will be kept in password-protected university on-line storage, on password protected external hard drives, or in locked file cabinets.

In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared depending upon permissions granted below in the optional section at the end.

We will do our best to keep your participation in this research study confidential to the extent permitted by law. However, it is possible that other people may find out about your participation in this research study. For example, the following people/groups may check and copy records about this research.

- The Office for Human Research Protections in the U. S. Department of Health and Human Services
- The Institutional Review Board (a committee that reviews and approves research studies) and
- The Office for Research Protections.

Some of these records could contain information that personally identifies you. Reasonable efforts will be made to keep the personal information in your research record private. However, absolute confidentiality cannot be guaranteed.

8. What are the costs of taking part in this research study?
There are no costs to participate in the study. We will do everything we can to arrange sessions at a time which is convenient for you.

9. Will I be paid to take part in this research study?
You will not receive any payment or compensation for being in this research study.

10. Who is paying for this research study?
The institution and investigators are not receiving any funds to support this research study.

11. What are my rights if I take part in this research study?
Taking part in this research study is voluntary.
- You do not have to be in this research.
- If you choose to be in this research, you have the right to stop at any time.
- If you decide not to be in this research or if you decide to stop at a later date, there will be no penalty or loss of benefits to which you are entitled.
12. If I have questions or concerns about this research study, whom should I call?
Please contact the head of the research study (principal investigator), Michelle Therrien at 971-227-9928 or by email at mct168@psu.edu if you:

- Have any questions, complaints or concerns about the research.
- Believe you may have been harmed by being in the research study.

You may also contact the Office for Research Protections at (814) 865-1775, ORProtections@psu.edu if you:

- Have questions regarding your rights as a person in a research study.
- Have concerns or general questions about the research.
- You may also call this number if you cannot reach the research team or wish to talk to someone else about any concerns related to the research.

**INFORMED CONSENT AND AUTHORIZATION TO TAKE PART IN RESEARCH**

**Signature of Person Obtaining Informed Consent**

Your signature below means that you have explained the research to the subject or subject representative and have answered any questions he/she has about the research.

<table>
<thead>
<tr>
<th>Signature of person who explained this research</th>
<th>Date</th>
<th>Time</th>
<th>Printed Name</th>
</tr>
</thead>
</table>

(Only approved investigators for this research may explain the research and obtain informed consent.)

**Signature of Person Giving Informed Consent and Authorization**

Before making the decision about being in this research you should have:

- Discussed this research study with an investigator,
- Read the information in this form, and
- Had the opportunity to ask any questions you may have.

Your signature below means that you have received this information, have asked the questions you currently have about the research and those questions have been answered. You will receive a copy of the signed and dated form to keep for future reference.

**Signature of Parent(s)/Guardian for Child**

By signing this consent form, you indicate that you permit your child to be in this research and agree to allow his/her information to be used and shared as described above.

<table>
<thead>
<tr>
<th>Signature of Parent/Guardian</th>
<th>Date</th>
<th>Time</th>
<th>Printed Name</th>
</tr>
</thead>
</table>

*By signing below, I give permission for the researcher to contact my child’s educational team to gather information to support my child’s participation in this research project.*
<table>
<thead>
<tr>
<th>Signature of Parent/Guardian</th>
<th>Date</th>
<th>Time</th>
<th>Printed Name</th>
</tr>
</thead>
</table>

Version Date: 2/2/2016
Optional part(s) of the study
In addition to the main activities of the study, there are additional considerations related to the research.

The use of photographs and video is a critical part of this research, which means that names and faces are likely to be recognizable. For the purpose of the study, we have outlined the steps we will take to preserve confidentiality and privacy to the greatest extent possible. Please consider how we may use this footage relative to discussions about what we have learned (for example, in publications or presentations, or for educational and training purposes), and whether or not we may keep these for future research (for example, if we wish to re-examine the footage to learn additional information about the software and its use than we are now able to predict).

You can be in the main part of the research without agreeing to these optional parts.

Publications/Presentations

_____ I give permission for my recordings to be archived for use in publications/presentations.

_____ I do not give permission for my recordings to be archived for use in publications/presentations. The recordings will be destroyed on 5/31/2020.

Educational/Training Purposes

_____ I give permission for my recordings to be archived for educational and training purposes.

_____ I do not give permission for my recordings to be archived for educational and training purposes. The recordings will be destroyed on 5/31/2020.

Other Research

_____ I give permission for my recordings to be archived for research purposes outside of the present study (e.g., as stimulus materials in future investigations).

_____ I do not give permission for my recordings to be archived for research purposes outside of the present study. The recordings will be destroyed on 5/31/2020.

Signature of Person Obtaining Informed Consent

Your signature below means that you have explained the optional part(s) to the research to the subject or subject representative and have answered any questions he/she has about the research.
Version Date: 2/2/2016

Signature of person who explained this research  Date  Time  Printed Name

Signature of Parent(s)/Guardian for Child

By signing this consent form, you indicate that you have read the information written above and have indicated your choices for the optional part(s) of the research study.

Signature of Parent/Guardian  Date  Time  Printed Name
Appendix C

Demographic Questionnaire

Demographic Info and Interest Inventory

Directions: Please answer each question to the best of your ability and return this form to the lead investigator. All information provided will be kept strictly confidential. Thank you.

Child’s Information

Child’s Name: ____________________________________________

Child’s preschool/daycare: ______________________________________

Child’s Date of Birth ______________

Child’s Gender (circle one) □ Male □ Female

Child’s Race & Ethnicity □ Caucasian □ Native American
(Circle all that apply) □ African □ Hawaiian
 □ Asian □ Pacific Islander
 □ Hispanic/Latino □ Other

Information about autism or developmental delay diagnosis

Name of doctor giving diagnosis: ______________________________________

Age at diagnosis: __________________________

Instrument used? ADOS ADI-R other: __________________________

Are you willing to provide a copy of the report? Y N
Other relevant medical history
- any significant illnesses?
- hearing/vision concerns?
- notable birth information? (premature? low birth weight? NICU stay?)
- experience with early intervention services?

Does your child receive special education or related services through the IU?  □ Yes  □ No

If yes, please list the types of services he/she receives:

Interests

Check the items that hold interest for your child and in the space on the right, comment on favorites in that category. (For example, if your child loves cats, write that next to animals. If they are particularly interested in fire trucks, write that next to vehicles)

___ animals
___ vehicles
___ music
___ books
___ TV shows/movies
___ cartoon characters
___ superheroes
___ sports
___ arts & crafts
___ building toys (e.g. Legos)
___ electronic games (iPad, videogames)
___ dress up or dramatic play
___ outdoor/active play

If any of your child’s favorite interests, toys, or play activities were not listed above, please provide more information:

Please list your child’s favorite books or authors:

Can you recommend any strategies to help your child engage with books for ten minutes? Would you anticipate your child having trouble with this?
Family Information

Caregiver(s) relationship to child: ________________________________

Parent(s)/Caregiver(s) highest level of education:

<table>
<thead>
<tr>
<th></th>
<th>Parent 1</th>
<th>Parent 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High School</td>
<td>Some College</td>
</tr>
<tr>
<td></td>
<td>High School</td>
<td>Some College</td>
</tr>
</tbody>
</table>

Family Income

- □ < 20,000 per year
- □ 20 to 40,000 per year
- □ 40 to 60,000 per year
- □ 60 to 80,000 per year
- □ 80 to 100,000 per year
- □ 100,000+ per year

Please list sibling (if any) names and ages

Name_________________________________________ Age________

Name_________________________________________ Age________

Name_________________________________________ Age________

Name_________________________________________ Age________
Appendix D

Book List

Disney Princess:
Frozen
Brave
The Princess and the Frog
The Perfect Tea Party - Andrea Posner-Sanchez

Disney Cars/Planes:
Cars
Firefighters - Frank Berrios
Planes - Klay Hall
Tractor Trouble - Frank Berrios

Thomas and Friends:
Tale of the Brave - Rev. W. Awdry
May the Best Engine Win
The Birthday Express - Rev. W. Awdry
Thomas' 1-2-3 Book - Rev. W. Awdry

Paw Patrol
The Itty Bitty Kitty Rescue
Pirate Pups!
Puppy Birthday to You!
Ice Team

Sesame Street
Just one you!
I love you just like this
My name is Elmo - Constance Allen
Elmo's 1-2-3

Extra Books for Dyad D
Batman – Billy Wrecks
Captain America – Billy Wrecks
Monsters, Inc.
Finding Dory: Dory’s Sea of Wonders
Appendix E

Training Session Script

1. Say “Let’s look at books on the iPad together! Let’s read <Book title>.”
   (Researcher choose book from group of 4 by selecting the icon so children can see)
2. Say “Take one turn, then WAIT for your friend to take a turn”
3. Say “When the iPad is on your placemat, it’s your turn. When it’s on your friend’s placement, you can wait and listen.”
4. Say “Watch me! It’s my turn!” Place iPad on placemat and model touching a hot spot on the iPad.
5. Say “Now it’s your turn, so I pass the iPad to your placemat”

Teaching Turn-Taking with the iPad – Prompt Levels – “Oh GOSH”

<table>
<thead>
<tr>
<th>Turn-Taking Child</th>
<th>Waiting Child</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 0: No prompt (Natural cue only)</strong></td>
<td><strong>NC: place iPad on placemat and wait</strong></td>
</tr>
<tr>
<td></td>
<td><strong>If child takes appropriate turn, respond contingently (e.g., repeat or expand utterance)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>If child does something inappropriate, go to level 4: model</strong></td>
</tr>
<tr>
<td></td>
<td><strong>If child does nothing after 5 seconds, go to level 1: gestural prompt</strong></td>
</tr>
<tr>
<td><strong>Level 1: Gestural Prompt</strong></td>
<td><strong>NC: place iPad on partner’s placemat</strong></td>
</tr>
<tr>
<td></td>
<td><strong>If child waits appropriately, give positive feedback and highlight natural consequence (“Nice job waiting! Now it’s your turn!”)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>If child reaches toward the iPad, go to level 1: gestural prompt.</strong></td>
</tr>
<tr>
<td><strong>Level 2: Oral prompt</strong></td>
<td><strong>If child reaches toward the iPad, place hand at eye level, palm facing toward the child in a “stop” gesture</strong></td>
</tr>
<tr>
<td></td>
<td><strong>If child waits appropriately, give positive feedback and highlight natural consequence (“Nice job waiting! Now it’s your turn!”)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>If child continues to reach toward or touches the iPad, go to level 3: oral prompt.</strong></td>
</tr>
<tr>
<td><strong>Level 1: Oral prompt</strong></td>
<td><strong>If child continues to reach for iPad, look at child and say, “wait!”</strong></td>
</tr>
<tr>
<td></td>
<td><strong>If child waits appropriately, give positive feedback and highlight natural</strong></td>
</tr>
<tr>
<td>Level 3: “Show”</td>
<td>Level 4: Hand-over-hand</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>If child hasn’t taken a turn after the gestural and oral prompt, model turn taking (as in original model), and look at child expectantly.</td>
<td>Say, “let’s do it together”, and gently guide the child’s hand to touch a hot spot.</td>
</tr>
<tr>
<td>If child takes appropriate turn, respond contingently (e.g., repeat or expand utterance)</td>
<td>Gently place your hands on top of child’s hands, resting on the table.</td>
</tr>
<tr>
<td>If child does something inappropriate or does nothing, move to level 4.</td>
<td></td>
</tr>
</tbody>
</table>

- If child does something inappropriate or does nothing, go to level 4: model consequence (“Nice job waiting! Now it’s your turn!”)
- If child continues to reach toward or touches the iPad, go to level 4: model consequence (“Nice job waiting! Now it’s your turn!”)
- Because modeling “waiting” is the equivalent of doing nothing, during the modeling phase, narrate “waiting”.
- “Look at me. I’m waiting for <name> to take a turn. I am quiet. I am looking at the iPad and listening to what <name> is saying!”
- If child waits appropriately, give positive feedback and highlight natural consequence (“Nice job waiting! Now it’s your turn!”)
- If child continues to reach toward or touches the iPad, move to level 4.

- If child does something inappropriate or does nothing, move to level 4.
Appendix F

Procedural Integrity Checklist – Probe Sessions

Date:
Dyad:

**General:**
1. Reads Intro Script:  Y     N
2. Tells children that she is going to do her work:  Y     N
3. Reminds children to share: Y     N

For every child attention-seeking behavior (child calling to researcher, child arguing with partner, child standing up and leaving table) OR incidence of researcher interacting with dyad, was the intervention and appropriate response given the rules for intervening?

<table>
<thead>
<tr>
<th>Incident #</th>
<th>Appropriate response?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Y  N</td>
</tr>
<tr>
<td>2</td>
<td>Y  N</td>
</tr>
<tr>
<td>3</td>
<td>Y  N</td>
</tr>
<tr>
<td>4</td>
<td>Y  N</td>
</tr>
<tr>
<td>5</td>
<td>Y  N</td>
</tr>
<tr>
<td>6</td>
<td>Y  N</td>
</tr>
<tr>
<td>7</td>
<td>Y  N</td>
</tr>
<tr>
<td>8</td>
<td>Y  N</td>
</tr>
<tr>
<td>9</td>
<td>Y  N</td>
</tr>
<tr>
<td>10</td>
<td>Y  N</td>
</tr>
</tbody>
</table>

Fidelity = number of Y’s / (3+total # of incidents) = __________
Appendix G

Procedural Integrity Checklist – Training Sessions

Date:
Dyad:

General:
1. Reads Intro Script: Y N
2. Provides Model: Y N
3. Provides 10 iPad turns to each child? Y N
4. Gives each child 10 opportunities to WAIT? Y N

For analyzing turns, please circle to specify who the TT is for odd & even turns:
Child w/ASD: odd even
Peer: odd even

<table>
<thead>
<tr>
<th>Turn Number</th>
<th>Least-to-most for TT?</th>
<th>Highest Prompt for TT?</th>
<th>Least-to-most for W?</th>
<th>Highest Prompt for W?</th>
<th>Feedback?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>2</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>3</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>4</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>5</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>6</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>7</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>8</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>9</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>10</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>11</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>12</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td>13</td>
<td>Y N</td>
<td>Oh G O S H</td>
<td>Y N</td>
<td>Oh G O S</td>
<td>Y N</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>N</td>
<td>Oh G O S H</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
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<td>14</td>
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<td>17</td>
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<td>18</td>
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<td>19</td>
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<tr>
<td>20</td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

Scoring:
Procedural Integrity: Number of Y’s: ____________ / 64 = ____________ %
Appendix H

Probe Session Script

1. Say “Book buddy Time!”

2. Say: “Here are the books. Let’s pick one” (read book titles one by one. Help children choose a book by consensus. If one child has a preference, ask if the other child agrees. If not, suggest another book. If children can’t agree, suggest that they start with one and then read the other.)

3. Say “You picked <book title>. When you’re done, you can pick a new one.” Move the pile of books over so that they can be reached, but are not in the way.

4. Say: “Please stay together at the table. I’ll be over here doing my work. Remember to share!”

5. Set a timer for 10 minutes

6. Researcher should stay out of intervention as much as possible. Can intervene to:
   - prevent harm to others
   - prevent destruction of property (e.g., ripped books, thrown iPads)
   - help with navigation of device or reaching materials (choosing a new book for example)
   - respond to a bathroom request
   - prevent children from leaving the assigned area
### Appendix I

**Training Data Collection Form**

<table>
<thead>
<tr>
<th>Turn # &amp; role</th>
<th>Name(s)</th>
<th>Prompt(s)</th>
<th>Turn # &amp; role</th>
<th>Name(s)</th>
<th>Prompt(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - TT</td>
<td>Oh G O S H</td>
<td>1 - W</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 - W</td>
<td>Oh G O S H</td>
<td>2 - TT</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 - TT</td>
<td>Oh G O S H</td>
<td>3 - W</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 - W</td>
<td>Oh G O S H</td>
<td>4 - TT</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 - TT</td>
<td>Oh G O S H</td>
<td>5 - W</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 - W</td>
<td>Oh G O S H</td>
<td>6 - TT</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 - TT</td>
<td>Oh G O S H</td>
<td>7 - W</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 - W</td>
<td>Oh G O S H</td>
<td>8 - TT</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 - TT</td>
<td>Oh G O S H</td>
<td>9 - W</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
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<tr>
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<td>10 - TT</td>
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<td>11 - W</td>
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<td>12 - TT</td>
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<td></td>
</tr>
<tr>
<td>13 - TT</td>
<td>Oh G O S H</td>
<td>13 - W</td>
<td>Oh G O S H</td>
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<td>Oh G O S H</td>
<td>14 - TT</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 - TT</td>
<td>Oh G O S H</td>
<td>15 - W</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 - W</td>
<td>Oh G O S H</td>
<td>16 - TT</td>
<td>Oh G O S H</td>
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</tr>
<tr>
<td>17 - TT</td>
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<td>Oh G O S H</td>
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</tr>
<tr>
<td>18 - W</td>
<td>Oh G O S H</td>
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<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 - TT</td>
<td>Oh G O S H</td>
<td>19 - W</td>
<td>Oh G O S H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 - W</td>
<td>Oh G O S H</td>
<td>20 - TT</td>
<td>Oh G O S H</td>
<td></td>
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**Notes:**
Appendix J

Social Validity Procedures – Adults

Social Validity

Survey for parents, teachers and SLPs of children in Penn State’s social interaction research study

My relationship to the participating students is

- Parent
- Teacher
- SLP
- Teacher Aide
- Other: 

Social interaction is an important part of what happens at school.

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ Strongly Agree

It is important for children with and without disabilities to interact at school.

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ Strongly Agree

Interaction skills such as turn taking should be taught in school.

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ Strongly Agree
View video 1a. What do you notice about the interaction between the two students?

View video 1a. What do you like about their interaction?

View video 1a. What would you like to see change in the way they interact?

View video 2a. What do you notice about the interaction between the two students?
View video 2a. What do you like about their interaction?

View video 2a. What would you like to see change in the way they interact?

View video 1b. What do you notice about the interaction between the two students?

View video 1b. What do you like about their interaction?
View video 1b. What would you like to see change in the way they interact?

View video 2b. What do you notice about the interaction between the two students?

View video 2b. What do you like about their interaction?

View video 2b. What would you like to see change in the way they interact?
After viewing ALL videos: This intervention had a positive impact on communication between the two children.

1 2 3 4 5

strongly disagree ○ ○ ○ ○ ○ strongly agree

After viewing ALL videos: This intervention had a positive impact on the students’ engagement.

1 2 3 4 5

strongly disagree ○ ○ ○ ○ ○ strongly agree

After viewing ALL videos: I would support the use of this intervention in the classroom.

1 2 3 4 5

strongly disagree ○ ○ ○ ○ ○ strongly agree

After viewing ALL videos: I would recommend a program like this to other children with autism spectrum disorders and their peers.

1 2 3 4 5

strongly disagree ○ ○ ○ ○ ○ strongly agree
Social Validity Procedures – Peers

Social Validity for Children: Researcher will read the following statements to all of the peers and present 4X6 card with three pictures corresponding to “yes,” “no,” and “maybe” for students to respond. Researcher will record response in a spreadsheet.

Step 1: Making sure children understand icons
I am going to ask you some questions about “book buddies,” but first I want to show you some pictures.

This picture means “yes!” (Researcher mimics gesture by exaggerating smile and showing “thumbs up”) You can point to this picture when you agree with what I say. Let’s practice. It’s my turn. If I say “<name of researcher> is so cool!” I definitely agree with that, so I point to the picture. Now it’s your turn. If I say “<child’s name> is super awesome” do you agree? If yes, you point to the picture. Great job!

This picture means “no!” (Researcher mimics icon by scowling and giving a “thumbs down”) You can point to this picture when you do NOT agree with what I say. Let’s practice. It’s my turn “<name of researcher> is mean”. No WAY! I do NOT agree with that, so I point to the No! picture. Now it’s your turn. If I say “<child’s name> loves <food item parents/teachers have mentioned as a strong dislike>” do you agree? NO WAY! So you point to this No! picture.
I have one more picture. This picture means “I’m not sure” or “maybe”. (Researcher mimics picture by saying “hmmm…I’m not sure” and placing fingers to chin) You can point to this picture when you are not sure or when you want to say “maybe”. Let’s practice. It’s my turn “<name of researcher> is going swimming today”. Hmm…I’d like to go swimming, but I’m not sure I have time…so I’m NOT SURE. I’ll point to this picture. Now it’s your turn. If I say “<researcher’s name> is coming tomorrow”, you’re not sure, so you would say “I’m not sure”

**Step 2: Give social validity statements and record answers**

1. I had fun with my buddy when we looked at books together
2. I had fun with my buddy when we looked at the iPad together
3. I like using the iPad at book buddies.
4. The iPad helps me talk to my buddy.
5. The iPad helped my buddy talk to me.
6. I like reading with my buddy.
7. I want to keep reading with my buddy.
Appendix L

Full Results - Social Validity Questionnaire

Table L1. Responses to questions with a likert scale.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Participant Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1 (A&amp;B)</td>
</tr>
<tr>
<td>Q1. Social interaction is an important part of what happens at school.</td>
<td>5</td>
</tr>
<tr>
<td>Q2. It is important for children with and without disabilities to interact at school.</td>
<td>5</td>
</tr>
<tr>
<td>Q3. Interaction skills such as turn taking should be taught in school.</td>
<td>5</td>
</tr>
<tr>
<td>Q4. This intervention had a positive impact on communication between the two children.</td>
<td>5</td>
</tr>
<tr>
<td>Q5. This intervention had a positive impact on the students’ engagement.</td>
<td>5</td>
</tr>
<tr>
<td>Q6. I would support the use of this intervention in the classroom.</td>
<td>5</td>
</tr>
<tr>
<td>Q7. I would recommend a program like this to other children with ASD and their peers.</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: A response of 1 indicated strong disagreement, while a response of 5 indicated strong agreement. P = parent, T = teacher, SLP = speech-language pathologist. The letters A-E indicate which dyads these stakeholders watched videos of in order to answer the questions.
Table L2. Full responses to open-ended questions from social validity questionnaire

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline Q1. What do you notice about the interaction between the two students?</strong></td>
<td></td>
</tr>
</tbody>
</table>
| T1         | • At first Aaron was interested and initiated interaction with Alex. Once he did not get feedback from Alex he basically ignored Alex.  
• Very little interaction all |
| P1         | • They interact with the books a lot, but there is not much interaction between the students.  
• The boy has minimal interest in interacting with the girl. The girl seems to get bored with this lack of interaction. |
| T2         | • There is no interaction between them.  
• During this video there is no interaction between them at all. They both didn't even open the books just looked at the fronts and slid them around. At one point Ben turned his back towards Bri like she wasn't even there. |
| P2         | • There was no interaction.  
• Very little interaction |
| P3         | • They seemed interested but didn't understand.  
• There was none. They seemed focused in the book. |
| T3         | • They spent their time looking at their own book, Eric seemed more interested in Eli and/or his book than Eli did in Eric. Eli rarely actually looked at his book.  
• They never looked at each other or showed any interest or concern in the others books or behaviors. |
| T4         | • The students are not interacting. They do not look at each other. They sometimes look at each other's books.  
• The students were not interacting. They sat beside each other. |
| SLP        | • They have no interaction with each other.  
• Again there is no interaction although David does look at Drew several times. |
| **Baseline Q2. What do you like about their interaction?** |
| T1         | • I liked that Aaron willingly shared the books with Alex.  
• They shared the materials. |
| P1         | • They didn't seem to fight over the books and passed them back and forth at some points.  
• The two seem to take turns with the books fairly well. |
| T2         | • I liked that Alex remained sitting beside Aaron. I liked that Alex remained sitting beside Aaron. I liked Aaron's attempt to get Alex to interact with him.  
• I liked that they shared the books. |
| P2         | • There was no interaction.  
• He tried to interact by putting his book on top of hers |
| P3         | • They were interested in the books.  
• They had no interaction. |
| T3         | • They were comfortable being beside each other and seemed comfortable in having their own book but not interacting.  
• They were content to be near each other |
| T4         | • They tolerate being in close proximity to each other.  
• The typical child did not react negatively to his peer's self-injurious behavior. |
SLP
- There is no interaction.
- They are not interacting therefore there is nothing to like about the video.

Baseline Q3. What would you like to see change in the way they interact?

T1
- I would like to see the two boys looking at the books together and interacting.
- I would like to see them talk to each other and look at or point at pictures in the book together.

P1
- I’d like to see them make eye contact and talk with each other
- I’d like to see them make eye contact and talk with each other

T2
- I would like to see interaction happening between them.
- I would like to see them interact with one another even if it is looking at the same book together.

P2
- I would like them to interact more.
- More interaction

P3
- Read to each other to help each other understand.
- Helping each other out

T3
- I kept wondering if they would attempt to show each other anything from their own book but I was comfortable in just having them be so close to each other with no competition for anything and no feeling of having to "force" an interaction.
- For their age, I think their interactions were acceptable - these clips were "honest" and "real time" with regards to their interest in each other at the time - I don't think there's any reason to prompt or expect anything other than their honest interactions

T4
- I would like to see them comment to one another, pointing out items of interest and I would like to see them make eye contact briefly.
- I would like to see them comment to each other. I would like to see smiles and eye contact shared between them.

SLP
- I would like to see that they at least acknowledge that each other is even in the room.
- I would like to see them look at one another and talk about the books they are looking at.

Intervention Q1. What do you notice about the interaction between the two students?

T1
- They did interact! They both shared and took turns with the computer. Neither child tried to resist giving up the computer when it was the other child's turn.
- When Ben showed no interest in interacting, Bri verbally and physically engaged him.

P1
- They both seem focused on the tablet and look to each other for a reaction. They are interacting much more than in the first video.
- When the focus of attention was the tablet, they were able to interact.

T2
- There was some interaction and it increased by the last clip, where they were interacting not so much with the ipad but socially imitating one another.
- I noticed Ben really did not have an interest in interacting with Bri. She did get his attention a few times where he actually made eye contact with her.

P2
- The girl took charge of the interaction
- There was no interaction

P3
- They seemed to be okay taking turns and even when it was Eric’s turn he still let the other child help out.
- Drew did not want to share with his peer.
| T3 | • They were patient in sharing the computer, Eric was more verbal than Eli as far as repeating what was said on the computer, Eric spent more time holding a book than interacting physically with the computer.  
• There was a great deal of interaction - mostly physical, although never "rough," but comments were made by each of the boys as they attempted to share.  

| T4 | • They are both looking at the same story.  
• The boys were both interested in the same toy. I saw some turn taking facilitated by the typically developing peer.  

| SLP | • They still are not interacting with each other but seem to enjoy the stories on the iPad. Eric often likes to repeat what he hears from devices or words and pictures he recognizes. The other child still does not try to speak with or gain Eric's attention.  
• They both were interested in the iPad but not in playing with each other, although David was able to speak to Drew.  

| **Intervention Q2. What do you like about their interaction?** |  

| T1 | • I liked that they verbally had fun turn taking and saying "achoo" they even mimicked body movements. When Alex said "more achoo" Aaron started saying achoo again.  
• I liked that Bri initiated the interaction and did not give up. She placed Ben's hand on the computer. Ben remained engaged for the "turn".  

| P1 | • At times both offered the tablet to each other. They each took actions then looked to the other for a reaction. The seemed to genuinely care how the other was feeling at certain times.  
• I like that now the girl has a way to engage the boy's attention using the tablet. They were both able to share reactions to the sounds and pictures.  

| T2 | • Aaron tried at the beginning to engage Alex by prompting him hand over hand. Alex allowed him to do it. Loved the interaction and eye contact at the end.  
• I liked that they followed the rules and waited their turn when it was on the other person's placemat. Really liked how Bri tried so hard to get Ben to interact with her.  

| P2 | • That the girl forced the interaction.  
• There was no interaction.  

| P3 | • They were able to help each other out and have patience taking turns.  
• Even though Drew doesn't want to share David doesn't complain.  

| T3 | • That they were patient and shared and, while not really interacting with each other personally, they had the computer to create a common interest.  
• They really seemed to be trying to share, one boy made verbal comments regarding "time to share" and although the other boy seemed unhappy, he never reacted in a physical way or sought out the adult who was nearby  

| T4 | • They are tolerating each other's presence. The student with the disability does not seem to be pushing his way into using the iPad. He is tolerating the other student's use of the technology.  
• I like that there was a shared interest. I like that there was emerging turn taking happening which seemed to be understood (although not respected) by both boys. I like that the typically developing peer talked to his peer.  

| SLP | • They are still not interacting with each other but seem happier to be play with the iPad rather than just looking at books.  
• I liked that David knew he should share with Drew and that he was not
afraid to play and touch the iPad even though Drew did not want him to have a turn.

**Intervention Q3. What would you like to see change in the way they interact?**

| T1 | • More interaction, not so repetitive. More meaningful exchanges.  
   | • Bri engaging Ben in more turn taking throughout the activity. |
|-----|-------------------------------------------------------------------|
| P1  | • I'd like to hear them say a word or two to each other about they saw on the tablet.  
   | • There is still very limited eye contact and interaction between the students outside of the sounds from the tablet. |
| T2  | • It was very repetitive interaction, imitating same thing over and over. Would like to see the interactions be less repetitive.  
   | • Would like to see Ben become more aware of Bri and interact with her. |
| P2  | • The boy interacted more with the girl  
   | • More interaction |
| P3  | • Nothing |
| T3  | • I thought it was nice just to see them share time and a "toy" - even without any communication.  
   | • if they knew each other better or had more time to spend together, maybe there would be more communication regarding taking turns. |
| T4  | • In my opinion, Eric is echoing the iPad just like he echoes everyone. I don’t think he is making many spontaneous comments (except maybe labeling fire truck). I would like to see the other student use his voice to comment to Eric instead of making the same repetitive comments, especially since Eric quickly memorizes phrases and repeats them without meaning. Touching a button does not appear to hold the same meaning as spontaneously pointing out something cool to a friend. I would like to see the boys look at each other briefly as they share.  
   | • I wish that David's comments weren’t all so directive. I would like to hear him make comments to Drew that reflected a shared interest (Hey, look at that!) rather than only playing a teacher role (telling him that it was his turn). David looked at Drew but not in a shared interest way. I would like to see joint eye contact over the enjoyment of a shared activity instead of fighting over a turn. |
| SLP | • I would love to see them enjoy each other's company and take turns with the device.  
   | • I would like to see more communication and interaction with each other rather than with the iPad. I would love to see Drew understand that he should share with his friend and pass the iPad to give David a turn. |
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Selected Presentations


