GETTING IN SYNC: EXPLORING AND SUPPORTING PEER INTERACTION IN AN AUTISTIC CHILD WITH INCONSISTENT ACCESS TO SPEECH

BY

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DISSERTATION

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ABSTRACT

Challenges in peer interaction are commonly associated with autism, both within research literature and through first-person accounts. Related intervention studies have tended toward a skills-based approach that emphasizes remediating perceived social deficits in the autistic individual, with most of the literature focusing on children who are classified as "high functioning" due to their verbal skills and/or typical IQ scores. Limitations in this skills-based approach have led to the development of a supports-based approach—based largely on a distributed model of communication—as an alternative way to facilitate peer interactions involving autistic students (Vidal, Robertson, & DeThorne, 2018). This supports-based approach prioritizes egalitarian interactions, participation in shared activities, and flexible access to multimodal communicative resources.

The present mixed methods study was designed to examine the communication profile and peer interactions of John, a 9-year-old autistic child with inconsistent access to speech and concomitant diagnoses of Pediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcal infections (PANDAS) and apraxia. In addition to behavioral assessments of John, data collection included interviews of John and 8 other adult and peer participants as well as 20 video-taped observations during art class. An ABAB design was employed to assess the functional relation between the social supports provided during art class and differences in peer interaction, measured via communicative offers and interpersonal synchrony between John and one of his non-autistic peers.

In regard to key findings, John's speech-language profile was characterized by use of single words, emergent word combinations, some conventional gestures, concomitant language comprehension challenges, and poor intelligibility associated with motor speech impairment.

His sensory-motor profile included fine motor impairments, gross motor strengths, and sensory differences across visual, hearing, and tactile modalities. John's peer interactions at the beginning of the study were relatively limited and characterized as single-turn and non-egalitarian with a prominence of eye gaze. The implementation of social supports during art class was associated with increased peer interactions characterized by increases in shared eye gaze, eye contact, shared activity, turn-taking, and emergent egalitarian interactions. In addition, peers and other adults were noted to adopt routines and strategies introduced by the examiner.

The present study is pioneering in providing a detailed description of the communicative profile and peer interactions of an autistic child with limited speech. It also contributes to the evidence base for use of a supports-based approach to facilitating peer interaction for autistic students in the classroom. Additional considerations for clinical practice and future research are also discussed.

DEDICATION

To John and every child that John represents. Your differences make this world better!

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Although the present document will keep my authorship, it represents the culmination of a hard and collaborative work. Many people have been part of this process, and I cannot be more thankful for the tremendous support that they have provided me to successfully finalize this stage of my life.

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CHAPTER 1: SOCIAL INTERACTION AND SOCIAL SUPPORTS FOR CHILDREN ON THE AUTISM SPECTRUM

Social Interaction involving Autistic Children.

Positive peer interactions are critical for social participation, academic success and social-emotional development (Bauminger, Shulman, & Agam, 2003; Healy, Msetfi, & Gallagher, 2013; Howard, Cohn, & Orsmond, 2006; Humphrey & Lewis, 2008; McLaughlin & Rafferty, 2014). Accordingly, negative peer interactions have been associated with a higher prevalence of affective disorders (e.g., depression and anxiety), social isolation, academic failure, and bullying (Bauminger & Kasari, 2000; Bellini, 2004; Cappadocia, Weiss, & Pepler, 2012; Chamberlain, Kasari, & Rotheram-Fuller, 2007; Guralnick, 1990; Humphrey & Symes, 2010; Symes & Humphrey, 2010; Tantam, 2000; Thompson & Emira, 2011; Van Roekel, Scholte, & Didden, 2010; Wolfberg, Mccracken, & Tuchel, 2008)—all of which have been commonly experienced by autistic individuals[1]. The American Psychological Association lists "persistent deficits in social communication and social interaction across multiple contexts" as a defining feature of autism (APA, 2013, p.50). A review paper on quality of life issues written by autistic scholar, Scott Robertson, stressed that "diverse difficulties and strengths in language, communication, and social interaction constitute a major facet of the disability of autism." He goes on to explain that "challenges in forming and maintaining social relationships" is a likely consequence for autistic individuals (Robertson, 2010).

[1] I have chosen to use identity-first language because this language is preferred by a great portion of autistic individuals (Kapp, Gillespie-Lynch, Sherman, & Hutman, 2013; Kenny et al., 2016). This is consistent with APA's (2013) recommendation that authors should "respect people's preferences; call people what they prefer to be called" (p.72).

Even though challenges in peer interaction has been commonly associated with autism, limited attention has been devoted to autistic individuals with inconsistent access to speech (Kasari et al., 2010; Tager-Flusberg & Kasari, 2013) even though approximately 20-30% of autistic students are described as having limited speech or being minimally verbal (Mawhood, Howlin, & Rutter, 2000; Tager-Flusberg & Kasari, 2013; Turner, Stone, Pozdol, & Coonrod, 2006). In 2010, the National Institutes of Health held a multidisciplinary workshop to examine the state of the empirical knowledge base and to establish future research directions specifically related to autistic population with inconsistent access to speech. Conclusions from this workshop highlighted the need for further research related to understanding specific behavioral profiles (including communication, sensory processing, and motor abilities), developing more suitable assessments, and designing supports that particularly address students considered as not responding to traditional therapeutic programs.

Despite widespread recognition of the need for communication and social interaction support for autistic children, particularly those without ready access to speech, perspectives on what form such practices should take varies. Specifically, tensions have emerged regarding the extent to which autistic people should conform to non-autistic norms of social interaction versus the extent to which society should accept and accommodate the atypical neurology of autistic people (e.g., Bagatell, 2010; Pellicano & Stears, 2011). The upcoming literature review will a) highlight the differences between two different approaches to peer interaction and autistic children and youth, specifically the skills- versus supports-based approach, b) review the literature on sensory-motor differences related to autism, including how such differences may impact peer interactions, and c) introduce my specific research questions and associated methodological decisions.

Approaches to Peer Interaction Including Autistic Children and Youth

Skills-based Approach. Therapeutic programs designed and implemented for autistic children have traditionally framed difficulties with peer interaction as a result of social impairments in the autistic individual (Milton & Moon, 2012; Robertson, 2010; Silberman, 2015; Straus, 2013). The rationale appears to be that if children with autism would behave in a more neurotypical fashion, then peer interactions would be more positive toward them. As stated by Reilly and colleagues (2014), "...If students with autism are viewed by peers as less 'different' and more similar to peers' expectations, these peers are more likely to interact with classmates with autism" (p.227). As a result, interventions have focused on attempting to "normalize" individual's skills—for example working to change the autistic individual's use of eye contact, frequency of initiations and responses, or understanding false beliefs—to make autistic students more similar to their non-autistic peers (e.g., Ozonoff & Miller, 1995; Rao, Beidel, & Murray, 2008; Rogers, 2016; White, Keonig, & Scahill, 2007). Some studies (e.g., Lerner & Mikami, 2012; Lerner, Mikami, & Levine, 2011) have emphasized the distinction between focusing on skill knowledge (i.e., knowing what to do) versus skill performance (i.e., being able to do it), but in either case the emphasis remains on modifying the skills of the autistic individual.

A second feature of skills-based approaches to peer interaction is a tendency to privilege one communicative modality (see Brady et al., 2015), often speech, over others (e.g., Shabani et al., 2002). In other words, outcome measures are often tied to a single modality, such as verbally-initiated questions or requests through AAC devices. This approach seems unnecessarily restrictive as communication is inherently multimodal, and the same communicative functions (e.g., greeting, initiating, responding, informing, and entertaining or sharing delightful experiences) can be accomplished in a variety of ways.

Finally, a skills-based approach tends to promote hierarchical peer interactions in which non-autistic peers assume the role of "experts" and autistic students are seen as "novice" or "unskilled" (DiSalvo & Oswald, 2002; Gates, Kang, & Lerner, 2017; McMahon, Lerner, & Britton, 2013; Rogers, 2000). A paper by DiSalvo and Oswald (2002) highlighted the role of peer-mediated interventions for autistic children as a means for "socially competent" non-autistic peers to "model and reinforce appropriate social behavior" (p.198). Similarly, a review of group-based social skills interventions for autistic youth, McMahon, Lerner, and Britton (2013), noted that non-autistic peers may serve as a social role model for the autistic youth, provide feedback on "inappropriate social behaviors," and promote generalization of skills (p.25). In sum, non-autistic peers are often socialized into therapist-like roles (Gates et al., 2017; Rogers, 2000).

Although elements of a skills-based approach can be found across many studies, I have selected Reilly and colleagues (2014) to illustrate the three key elements of a skills-based approach to peer interaction. Consistent with a focus on individual impairments, this study focused on teaching three autistic adolescents to ask novel peer-directed questions because they were "rarely observed" doing so (p.216). Communication books supported elements of the instructional practices, but the primary dependent variable within the single case experimental design focused on a single modality: participants' spoken production of novel questions to non-autistic peers. Although the first intervention phase focused on examiner use of modeling, role play, verbal prompting, and praise, limitation in the generalization of the effects led to a second peer-mediated phase in which non-autistic peer partners executed the same instructional strategies previously utilized by the clinician. Consistent with establishing a hierarchical dynamic that placed non-autistic peers in authority/expert positions, instructors taught non-autistic peer partners to engage in three primary actions: providing verbal directives (e.g., "Ask

me what kind of movies I like"), corrections (e.g., "Hold on, I wasn't finished"), and praise to autistic participants. Consistent with the positioning of the non-autistic peers as the experts, only the non-autistic peers were asked to judge the "appropriateness" of their partners' interactions. Results from this study showed that all three autistic adolescents increased their use of novel questions directed toward their non-autistic peer.

Although skills-based programs have been successful at developing individual skills in therapeutic settings, two key shortcomings have been identified. First, skills-based programs have shown limited impact on quality of life outcomes, as noted in a myriad of reviews (Bellini, Peters, Benner, & Hopf, 2007; DiSalvo & Oswald, 2002; Finke, 2016; Gates et al., 2017; Kasari, Rotheram-Fuller, Locke, & Gulsrud, 2012; McConnell, 2002; McMahon et al., 2013; Miller, Vernon, Wu, & Russo, 2014; Rhea Paul, 2008; Rao et al., 2008; Rogers, 2000; White et al., 2007). Authors writing about skills-based programs have often attributed limits in generalization to the inherent impairments of autistic children and/or problems with the therapeutic planning (Arnold-Saritepe, Phillips, Mudford, De Rozario, & Taylor, 2009; R. Koegel & Egel, 1979; Lovaas, Koegel, & Schreibman, 1979). However, another possibility is that poor generalization reflects key limitations of the adopted instructional practices and associated theoretical framework (see Finke, 2016; Vidal, Robertson, 2018). Related to this, Finke (2016) in a viewpoint article related to friendship-based outcomes and autism stated that issues in generalization may be attributable to that fact that "interactions with peers in the majority of social skills intervention studies are highly controlled by the researchers (the children are told when, where, and about what topics they should communicate and interact)" (p.656).

A second concern with skills-based programs, especially when focused on normalization and compliance, is the potential social-emotional harm to autistic individuals (Gillespie-Lynch,

Kapp, Brooks, Pickens, & Schwartzman, 2017; Milton & Moon, 2012; Milton & Sims, 2016; Pellicano & Stears, 2011; Sibley, 2015). The normalization agenda of skills-based programs tends to assign autistic individuals an "othered" identity, positioning them as less than and creating pressure to conform to neurotypical standards—a process of trying to blend in that has also been referred to as the camouflage phenomena (Gofman, 2009; Milton & Sims, 2016; Rynkiewicz & Łucka, 2015; Rynkiewicz & Ptaszek, 2013). This pressure to conform to neurotypical standards often fails to value the natural differences, talents, and gifts of autistic individuals and has been associated with negative self-esteem and social isolation (Milton & Sims, 2016; Pellicano & Stears, 2011; Robertson, 2010; Sibley, 2015). This concern underscores the need to prioritize student's dignity, comfort, and self-worth when providing information about non-autistic expectations and mainstream norms. Together, concerns about limited generalizations of the skills-based approach and the potential social-emotional harm associated with it, call for an alternative approach to facilitating peer interactions for autistic children and youth.

Supports-based approach. In contrast to a skills-based approach, Vidal, Robertson et al. (2018) presented key elements of a support-based approach, grounded in a distributed model of communication, as a viable alternative. Distributed models of communication emphasize the role of context in shaping interpersonal dynamics, emphasizing the ways in which communication is situated within activity and distributed across people, resources, and time (DeThorne, Hengst, Fisher, & King, 2014; DeThorne, Hengst, Valentino, & Russell, 2015; Hengst, 2015).

Successful communication is never just about the words being spoken. Consider for example a traffic cop who says "stop." The word contains very different meaning if it is being

shouted and paired with an outstretched hand while standing in the middle of an intersection versus that same traffic cop mumbling "stop" with a smile and downturned eyes as a friend delivers a string of compliments at a cocktail party. The meaning of words and other symbolic gestures are always shaped by the activity (e.g., directing traffic or deflecting a compliment) and co-occurring behavioral phenomenon in other modalities (e.g., eye gaze, facial expression, body positioning, prosodic inflection). In addition, communication is distributed or shared across people, highlighting that meaning is always jointly constructed and often misconstrued (Bauminger, 2002; DeThorne et al., 2014; Kamps, Potucek, Lopez, Kravits, & Kemmerer, 1997). Think of the complexity involved in shaping and interpreting when to end a conversation. There is rarely a verbal imperative to "stop." Instead, communicative partners provide and read a variety of spoken and nonverbal cues (e.g., inflection, proximity) that are shaped in part by the relationship between the people involved. For example, it is likely easier to "read" when a friend or family member is bored within an interaction than an unfamiliar partner. Finally, a distributed model of communication emphasizes how patterns of interpersonal interaction unfold over time on various scales (DeThorne et al., 2014; Hengst, 2015). Interactions are shaped by broad historical contexts (e.g., school policy, legislation) and more specific interpersonal dynamics (e.g., past patterns of interactions across minutes, days, weeks, and years). Using a distributed model of communication as a guiding theoretical framework, Vidal, Robertson, et al. (2018) outlined and illustrated three key elements of a supports-based model for supporting peer interaction for autistic children and youth: focus on shared activities, encourage the flexible use of multiple communicative resources, and promote egalitarian interactions. Each are reviewed briefly here.

Focus on shared activities. Focusing on shared activity encourages the alignment of resources toward common goals and helps attribute meaning to individual behavior (DeThorne et al., 2015; Hengst, 2015; Park, 2010). In particular, literature on autism highlights that shared activities that capitalize on children's interests and strengths are most apt to facilitate peer interaction (Baker, Koegel, & Koegel, 1998; Finke, 2016; L. Koegel, Vernon, Koegel, Koegel, & Paullin, 2012; Lanou, Hough, & Powell, 2012; Vellonen, Kärnä, & Virnes, 2013). For example, Koegel and colleagues (2012) conducted a multiple baseline across participants design to assess the effectiveness of incorporating students' interests on social interaction. For this purpose, three school-age autistic children were included in three regular education classes where they conducted free play activities in two different conditions: existing club activities (baseline) and club activities that capitalized on their specific interests (support phase). Results showed that incorporating activities of interest to autistic children increased social engagement in all three autistic students without any specific skill training (see also Baker, Koegel, & Koegel, 1998).

A second example comes from Vellonen, Kärnä, and Virnes (2013), a qualitative study that designed a weekly program intended to build on the technological skills of four autistic students, age 9-11. The weekly program consisted in four technological workstations (symbol matching, building with bricks, storytelling, and game playing) completed by each student. Findings from the content analysis supported the use of student interests and activities to facilitate engagement, inclusion, and positive peer interactions (see also Lanou et al., 2012).

Encourage the flexible use of multiple communicative resources. A second element of a supports-based framework is to encourage the flexible use of multiple communicative resources. Particularly for autistic children with limited or inconsistent access to speech, the importance of validating and supporting multiple forms of communication is crucial to supporting peer

interaction (Beukelman & Mirenda, 2013; DeThorne et al., 2014, 2015; Fisher & Shogren, 2012; Hengst, 2015; Mirenda & Brown, 2009). Verbal behaviors such as echolalia and non-verbal behaviors such as eye gaze, gestures, vocalizations, prosodic features, and use of objects, including AAC devices, are rich communicative resources utilized by autistic and non-autistic students alike (Beukelman & Mirenda, 2013; DeThorne et al., 2014, 2015; Fisher & Shogren, 2012; Hengst, 2015; Mirenda & Brown, 2009; Prizant & Fields-Meyer, 2006; Sterling et al., 2008; Van Der Geest, Kemner, Erbaten, & Van Engeland, 2002). In their description of autistic sociality based on ethnographic data, Ochs and Solomon (2010) highlighted the essential nature of non-verbal communication for autistic students, including the role of objects in facilitating social interaction, with a focus on shared eye gaze in particular. Specifically, the authors note that "non-face-to-face alignment may optimize social coordination … in ways that face-to-face interaction does not. (p.81)" It is interesting to consider what role objects might play in facilitating non-face-to-face alignment.

Specifically, AAC systems have been described as an essential means of communication for many autistic students (see Mirenda & Brown, 2009). In fact, epidemiological studies have estimated that 10-30% of autistic students rely on AAC systems to successfully communicate (Binger & Light, 2006; Creer, Enderby, Judge, & John, 2016). A case study by DeThorne and colleagues (2015) explored the construct of communicative competence through a distributed model of communication by focusing on the classroom interactions of Aaron, a preschool-age autistic boy and AAC user. The authors utilized interview data, categorical coding of field notes, and discourse analyses of videotaped classroom observations to reveal that communicative offers involving Aaron occurred an estimated once every 2-3 minutes. In addition, results highlighted the importance of flexible multimodality. In particular, AAC, shared eye gaze, and gestures

toward objects frequently mediated interactions.

Promote egalitarian interactions. The third and final element of a supports-based approach to peer interaction as discussed by Vidal, Robertson, et al. (2018) is the importance of socializing peers into egalitarian interactions. Related to this point, Finke (2016) highlighted that clinicians "need to consider the desired outcome of an intervention and how the structure of the relationship created between the children may affect the desired outcome" (p. 659). Traditional peer-mediated interventions for autistic children and youth tend to utilize peers as role models or co-therapists, which creates a hierarchical dynamic that is not fully characteristic of peer friendship (Finke, 2016; Fiske, 1992). Consequently, when working toward the development of egalitarian friendship, clinicians need to work from the premise that *each* partner brings equal value to the interaction and can benefit from individualized support (Vidal, Robertson, et al., 2018). In particular, presumed competence has been described as a key feature of supportive interactions within autistic individuals (DeThorne et al., 2015). Specific to communication, presuming competence refers to the assumption that autistic individuals are interested and able to interact in meaningful ways (cf. Biklen, 1999; Broderick, Mehta-Parekh, & Reid, 2005; Jorgenson, McSheehan, & Sonnenmeier, 2007; Savarese & Savarese, 2010). Unfortunately, peers often bring negative impressions of competencies of students with inconsistent access to speech (Prince, 2010; Savarese & Savarese, 2010) that are shaped in part by ableist attitudes of society at large (Hehir, 2002; Shyman, 2016). Related to this point, in their exploratory study of autistic adults' narratives regarding social and emotional well-being, Milton and Sims (2016) mentioned that interactions involving autistic individuals tend to be characterized by what they called the *double empathy problem*. The authors explained that even when some autistic adults "mentioned difficulties in terms of understanding the intentions of others within social

interactions, it was far more common that a lack of understanding from others was of more difficulty" (p. 527).

Consistent with the nature of communication as distributed across people, the double empathy problem highlights the need to include non-autistic peers as targets of intervention. Of relevance, a study conducted by Kasari and colleagues (2012) used an experimental group design to directly compare the impact of two different interventions on 30 autistic students, age 6-11 years: a) child-assisted, which focused on direct social skill instruction to autistic students, and b) peer-focused, which taught non-autistic students strategies for identifying and engaging with isolated students on the playground. In short, the peer-focused intervention led to greater decreases in isolation and more friendship nominations for autistic students (see also Pierce & Schreibman, 1995, 1997 for related findings). To summarize, programs or interventions to support egalitarian friendship involving autistic children and youth need to value autistic sociality, directing supports and designing outcome variables toward the dyad rather than the individual autistic child. In addition, recognition of autistic sociality, the importance of presumed competence, and the role of the double empathy problem, suggest that supporting adults can play a key role as an interpreter of sorts within peer interactions (see Vidal, Ernat, & DeThorne, 2018).

To the best of my knowledge, Vidal (2016) was the first study to explicitly apply all three elements of a supports-based approach to facilitating peer interactions involving an autistic child. The proof of concept study focused on Aaron, an autistic boy, and four of his non-autistic classmates in a combined 2nd/3rd-grade classroom. Aaron was a 7-year-old AAC user with limited spoken communication. Specifically, his mother reported via updated McArthur Bates Communication Development Inventory (CDI; a standardized vocabulary checklist; Fenson et

al., 2006) that he used 13 spoken words, understood 253 words, and had a repertoire of 18 gestures. Consistent with the importance of alignment of communicative partners within the activity, an Activity-based Music Program (AMP) was designed based on the shared musical interest of all child participants, who worked together toward the development of a final performance to share with the larger class. The clinician supported peer interactions using five key strategies that focused on dyads rather than individual skills: direct prompting, scaffolding, and positive reinforcement (all aimed at peer interaction), as well as behavioral interpretation, and environmental arrangement. See Table 1 for operationalized definitions and examples of each strategy (see also Vidal, Ernat, et al., 2018 for a follow-up study focused on illustrating the use of behavioral interpretation). The dependent variable, communicative offers drew on DeThorne et al. (2015), and was defined as "possible communicative initiations, defined through a combination of at least two simultaneous behaviors (verbal and nonverbal or two nonverbal) directed toward another, whether intentional or otherwise" (Vidal, 2016, p. 34). Consistent with the distributed model, a communicative offer could be initiated either by Aaron toward a peer or from a peer toward Aaron. Note that communication offers were also inherently multimodal, allowing the clinician and children flexibility in how messages were communicated. On the topic of multimodality, the musical program also foregrounded nonverbal forms of communication through the focus on making music and using conducting gestures, and it explicitly incorporated multiple forms of AAC. This proof-of-concept mixed methods study used an experimental multiple baseline across participants design to document the increased frequency of communicative offers found in three of the four dyads. Unfortunately, data collection had to be discontinued prematurely due to the close of the school year, and quantitative evidence of generalization was limited. However, qualitative analyses of the interview data from adult and

child participants revealed positive changes in peer interactions, and adult participants reported in their final interviews that children broadened their understanding of what communication was.

In addition to highlighting the feasibility and promise of the supports-based approach, the Vidal (2016) study shaped the current research project in two key ways. First, Aaron's comorbid diagnoses of autism and childhood apraxia of speech (CAS) spurred my interest in autistic children with limited speech, their communication profile, and the nature of their peer interactions, which are largely underrepresented in the current literature. Second, findings from Vidal (2016) together with the literature reviewed here have shaped my interest in looking for a means to measure interpersonal peer dynamics. Although the dependent variable from my prior study, communicative offers, accommodated flexible multimodality, it still focused primarily on the behaviors of an individual (as directed toward another individual) rather than capturing interpersonal dynamics directly. Consequently, I began to read literature on the topic of interpersonal synchrony as a possible means to measure the distributed nature of peer interaction. Based on this literature, I will provide a working definition of interpersonal synchrony, including its biological underpinnings, and highlight its positioning as a central tenet of sociality. Together such evidence underscores the importance of studying interpersonal synchrony in autistic children.

Interpersonal Synchrony

Definition. Interpersonal synchrony—also called social entrainment or interpersonal coordination—has been defined as the coupling of behaviors across individuals by a mutual adaptation of their own rhythmic patterns (Condon & Ogston, 1966, 1967; Gill, 2012; Phillips-Silver, Aktipis, & A. Bryant, 2010; Semin & Cacciopo, 2008). This means that two or more different individuals with autonomous rhythms coordinate and couple at some specific period of

time confining themselves to a common phase (Clayton, Sager, & Will, 2004). For example, Chartrand and Bargh (1999) examined the relation between behavior matching and perception of fluid interactions of 72 students from an introductory psychology class using a between-group design. The experimental group was instructed to imitate behaviors of participants while the control group engaged in natural interactions. Results indicated that the use of mimicry during interactions increased participants' liking of one another and made the social exchange smoother. Interpersonal synchrony has also been widely observed in neuro-typical communication practices (see Giles, Coupland, & Coupland, 1991). For instance, Levitan and Hirschberg (2011) examined the amount of synchronization of four dimensions: intensity, pitch, voice quality, and speaking rate during dyadic spontaneous conversations of 13 adults (six females and seven males). For this purpose, dyads participated by playing three computer games that required verbal communication between participants (dyads were separated by a curtain to avoid the use of non-verbal communication). By mean of statistical analysis, results showed synchrony between participants in the four assessed dimensions.

Similar to the idea that communication is situated within activities (DeThorne et al., 2014; Hengst, 2015), interpersonal synchrony is viewed as contextually dependent and tied to a common goal (Gill, 2012; Phillips-Silver et al., 2010; Semin & Cacciopo, 2008). Gill (2012) states that "mutual and interpersonal synchrony requires us to have the goal to communicate or perform an activity together" (p. 121). The construct of interpersonal synchrony also corresponds well with the distributed model of communication in that it is inherently distributed across people. Each participant contributes to synchrony, either intentionally or unintentionally, even if one individual rhythm may dominate over the other (Bluedorn, 2002; Phillips-Silver et al., 2010). Even when only one person is speaking, the other communicative partner is

continually providing feedback (e.g., gestures, eye gaze) that may or may not be directly related to the spoken message (Bavelas, Coates, & Johnson, 2000; Condon & Ogston, 1967). Responses are also implicit, mimicking aspects of posture, intonation, and gesture that are provided almost simultaneously with what the speaker is saying and doing (Bavelas et al., 2000; Condon & Ogston, 1967).

Given that synchrony can take so many different forms, it is also consistent with communication as a multimodal construct. For example, several studies have shown that there is a synchrony process that unfolds when two individuals engage in a conversation, and this process occurs across different levels such as kinesics, paralinguistic, lexical, and phonetics (Brennan, 1996; Levitan & Hirschberg, 2011; Pardo, 2006; Shockley, Santana, & Fowler, 2003). Essentially, interpersonal synchrony involves the alignment of multimodal resources across people (Phillips-Silver et al., 2010; Semin & Cacciopo, 2008). It is worth noting that even though interpersonal synchrony is multimodal in nature, there remains a tendency within the literature to examine it in a modality-centric fashion (Borrie, Lubold, & Pon-Barry, 2015; Brennan, 1996; Pardo, 2006), a point I will return to when reviewing the literature on synchrony and autism.

Finally, interpersonal synchrony can also be understood as distributed across time in two ways. First, interpersonal synchrony often occurs within a relatively short period of time (i.e., couple seconds). Accordingly, even slight delays in an individual's reactions could disrupt interpersonal synchrony (c.f. Condon & Ogston, 1966; Gill, 2012). Second, interpersonal synchrony is an extended process unfolding over time and shaped by participants' history of interactions. For example, individuals who have interacted before tend to synchronize more often and more quickly (Bernieri, Reznick, & Rosenthal, 1988; Louwerse, Dale, Bard, & Jeuniaux,

2012). Conversely, an individuals' history of disruptions and unsuccessful interpersonal coupling are also likely to shape present-day interactions.

Biological underpinnings of interpersonal synchrony. Our understanding of interpersonal synchrony extends from behavioral observations to neuropsychological studies. Whereas traditional cognitive models of imitation have portrayed perception and action as distinct processes (e.g., Hommel & Prinz, 1997; Simon, 1990), the ideomotor model of imitation conceives perception and action as associated processes that share a representational organization (Iacoboni, 2009). This ideomotor model of imitation is consistent with neuroscientific evidence of the mirror neuron system (Iacoboni, 2009), a set of neurons that activate when an individual performs a specified action or perceives another person performing that action (Gazzola & Keysers, 2009; Iacoboni et al., 1999; Giacomo Rizzolatti, 2005). For example, observing someone biting and chewing an apple bilaterally activates Brodmann areas 6 and 44 and unilaterally activate area 45 in the right hemisphere. Those are the same areas that are activated when actually biting and chewing an apple (see Buccino et al., 2001 for more detailed description). In fact, mirror neurons in humans have been associated with brain areas 44 and 6 (Giacomo Rizzolatti & Craighero, 2004), the same areas that have been described as active participants during language and speech processes (Grodzinsky, 2000; Meister, Wilson, Deblieck, Wu, & Iacoboni, 2007). Given the link between observed action and motor activation, mirror neurons have been presented as a fundamental neurological component of human imitation (Iacoboni et al., 1999; Meltzoff & Moore, 1977), which is the behavioral mechanism that underlies social synchrony.

Mirror neuron functioning aligns with the distributed model of communication in a number of ways. First, the mirror neuron system has been found to be modulated by context

(Cook, Press, Dickinson, & Heyes, 2010; Fogassi et al., 2005; H. Heyes, 2010; Umilta et al., 2001). Specifically, different patterns of activation are observed in mirror neurons according to the activity that is conducted (Fogassi et al., 2005; Umilta et al., 2001). Second, activation of mirror neuron is multimodal (Gallese, 2007; H. Heyes, 2010; Kohler et al., 2002). In addition to vision-action interaction—which are the most commonly-described modalities tied to mirror neuron functioning (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996; G. Rizzolatti, Fadiga, & Gallese, 1996)—other sensory systems (i.e., auditory, visual, tactile/vestibular) have also been observed to activate the mirror neuron system during individual and interpersonal synchrony processes (Kohler et al., 2002; Semin & Cacciopo, 2008). Finally, the mirror neuron system is modulated by experience, which connects to developmental processes over time. It has been found that the repetitive exposure to observed actions and/or the repetitive performance of a specific action will strengthen or reverse the activation patterns of the mirror neuron system (Calvo-Merino, Glasser, Grezes, Passingham, & Haggard, 2005; Catmur et al., 2008; Catmur, Walsh, & Heyes, 2007; Ferrari et al., 2005; C. Heyes, Bird, Johnson, & Haggard, 2005).

Interpersonal synchrony as a central tenet of sociality. Consistent with its biological underpinnings, several authors have described interpersonal synchrony as an essential process for the development of relationships and social-emotional well-being (Condon & Ogston, 1966; Gill, 2012). Interpersonal synchrony has been described as a crucial element for human sociality since it increases the interpersonal rapport and the perception of being connected (Bernieri et al., 1988; Chartrand & Bargh, 1999; Lakin & Chartrand, 2003; Miles, Nind, & Macrae, 2009). Studies in non-disabled adults have pointed out that interpersonal synchrony increases affiliation of one another and makes social exchanges smoother (Chartrand & Bargh, 1999; Hove & Risen, 2009; Lakin & Chartrand, 2003). Additional research examining mother-child interactions have

revealed an association between interpersonal synchrony and the development of secure attachment, self-regulation, and empathy during childhood (Feldman, 2007; Isabella, Belsky, & von Eye, 1989). Although these findings are limited by their correlative nature and their focus on adult-child interactions, such results suggest that interpersonal synchrony may offer a powerful window into understanding and supporting peer interactions across both neurotypical and autistic children.

Interpersonal synchrony and social interaction in autistic children. To the best of my knowledge, there have been only three published articles that directly studied interpersonal synchrony involving autistic individuals, and none of them focused explicitly on communication. In addition, all three studies explored adult-child interactions and tended to attribute observed differences in synchrony to deficits in the autistic individuals (Fitzpatrick et al., 2016; Fitzpatrick, Diorio, Richardson, & Schmidt, 2013; Marsh et al., 2013).

Marsh and colleagues (2013) explored synchrony between eight autistic children (46-103 months old) and their parents as compared to 15 non-autistic children (33-98 months old) in an experimental group design using a rocking chair paradigm. Specifically, children were placed in their own rocking chair while their parents read a storybook and rocked in a different nearby chair according to a specified tempo. The authors reported that autistic children showed less in-phase rocking with their parents (i.e., less synchronized) than non-autistic children and suggested that such synchrony difficulties could help explain some of the social challenges experienced by autistic individuals. It is interesting to note that even though interpersonal synchrony by definition is a bidirectional process, this study was designed to examine the phenomenon unilaterally (see Koehne, Hatri, Cacioppo, & Dziobek, 2016), thereby ignoring/controlling the role of one's partner.

The second and third available studies on interpersonal synchrony and autism approach synchrony as a bidirectional process. Fitzpatrick and colleagues (2013) conducted an experimental group study to assess the impact of interpersonal social coordination on social difficulties experiences by autistic individuals. For this purpose, 11 autistic school-age children (10 males and 1 female) and seven non-autistic school-age children (4 males and 3 females) completed tests of cognitive social coordination abilities (i.e., joint attention, theory of mind, intentionality, and helping and cooperation) and social motor coordination and movement abilities (i.e., imitation, social synchronization, and motor coordination). Particularly relevant for the present study was the social synchronization tasks in which the experimenter asked for child imitation and then, conducted five activities together: tap cylinders with a hammer, tap a drum with fingers, tap their own left shoulder with fingers, tap their own right shoulder with fingers, and tap center chest with fingers. Results showed lower synchronization between the autistic individuals and the examiner.

Fitzpatrick and colleagues (2016) used an experimental group design to assess social motor coordination between nine autistic adolescents (8 males and 1 female) and their parents and 9 non-autistic adolescents (7 males and 2 females) and their parents within a laboratory setting. Using a pendulum coordination paradigm in which autistic students and their parents were asked to sit in a chair next to each other facing the same direction while holding a pendulum. Once in this position, participants were asked to engage in three different social coordination tasks: spontaneous adult-adolescent synchrony, intentional adult-adolescent synchrony within an in-phase pattern (i.e., pendulums in the same position at the same time), and intentional adult-adolescent synchrony within an anti-phase pattern (i.e., pendulums in opposite

positions at the same time). Results indicated that adult-autistic adolescent dyads synchronized less often than adult-non-autistic adolescent dyads.

Together these three studies highlight synchrony differences involving autistic children/youth within the context of adult interaction within laboratory settings. However, further research is needed to explore interpersonal synchrony involving autistic children and their peers within naturalistic settings, such as classroom interactions. Such work seems particularly interesting given the significant number of autistic children with significant sensory-motor differences, which are likely to be an influential factor in the interpersonal synchronization process.

Autistic Students with Sensory-Motor Impairments

An important and significantly underdeveloped area of study is the nature of peer interactions in autistic children with comorbid sensory-motor impairments. Both "stereotyped or repetitive motor movements" and "hyper- or hypo-reactivity to sensory input" are listed as examples of restricted, repetitive patterns of behavior, which is one of the core diagnostic features of autism (APA, 2013, p.50). The DSM-V also specifies that "motor deficits are often present, including odd gait, clumsiness, and other abnormal motor signs" as well as "self-injury" such as head banging and biting the wrist (p. 55). Particularly relevant to the present study, literature has implicated sensory-motor differences as an influential factor in shaping peer interaction within the autistic population (Costa & Lampreia, 2012; Donnellan, Hill, & Leary, 2012).

Motor impairments. Regarding the nature of associated motor impairments, studies have suggested both gross and fine motor delays (Couture et al., 2009; Ming, Brimacombe, & Wagner, 2007; Provost, Lopez, & Heimerl, 2007), motor coordination and planning issues (Ming

et al., 2007; Mostofsky et al., 2006; Vernazza-Martin et al., 2005; Wiemer, Schatz, Lincoln, Ballantyne, & Trauner, 2001), perceptual-motor integration challenges (Müller, Cauich, Rubio, Mizuno, & Courchesne, 2004; Vanvuchelen, Roeyers, & De Weerdt, 2007; Wiemer et al., 2001); hypotonia (Ming et al., 2007), toe walking (Ming et al., 2007), and postural control issues (Kohen-Raz, Volkmar, & Cohen, 1992; Minshew, Sung, Jones, & Furman, 2004) associated with autism. More specific to communication, autistic children with limited speech often demonstrate difficulties in oral-motor skills (e.g., Adams, 1998; Gernsbacher et al., 2007), including speech sound imitation (e.g., Bernard-Opitz, Sriram, & Sapuan, 1999; Hailpern, Karahalios, DeThorne, & Halle, 2010), inconsistent access to speech (Kasari, Brady, Lord, & Tager-Flusberg, 2013; Mawhood et al., 2000; Tager-Flusberg & Kasari, 2013; Turner et al., 2006), and unusual prosody (Donnellan et al., 2012; McCann & Peppé, 2003; R Paul, Augustyn, Klin, & Volkmar, 2005; Robledo, Donnellan, & Strandt-Conroy, 2012)

Motor skills have been described as an influential factor in the development of peer interactions in disabled and non-disabled children (Ariane, P, & J, 2007; Iverson, 2010; Leonard, 2016; Wagner, Bös, Jascenoka, Jekauc, & Petermann, 2012). Specifically, for autistic individuals, a few studies have reported a significant association between motor and social development (Hsu et al., 2004; Leonard, 2016; Sipes, Matson, & Horovitz, 2011). For example, Sipes, Matson, & Horovitz (2011) conducted a between group study comparing motor skills and social interactions in 810 autistic students (17-36) and 810 non-autistic students (17-36 months). Using Baby and Infant Screening for Children with autism Trait, part 1 (BISCUIT-Part 1; Matson, Boisjoli, & J., 2007) and the Battelle Developmental Inventory–Second Edition (BDI-II; Newborg, 2005), results showed that autistic children presented more motor difficulties than

non-autistic children. Additionally, gross motor skills difficulties were significantly associated with social challenges.

Another study conducted by Hsu et al. (2004) used a between group design to examine the association of motor skills development and social functioning in 32 preschool-age autistic children divided into subgroups based on the personal social functioning domain from the Chinese Child Developmental Inventory (CDI; Hsu et al., 1978). The same measure was used to assess seven other functioning domains: gross motor (GM), fine motor (FM), expressive language (EL), concept comprehension (CC), social comprehension (SC), self-help (SH), and general development (GD). Results showed that "motor, speech, and self-help functions in autism with high social function were better than those in autism with low social function" (p.754).

Sensory differences. In addition to motor challenges, sensory differences of autistic individuals have been described from the early days of diagnosis (Kanner, 1943), but they have received increasing attention in the last three decades (Cesaroni & Garber, 1991; Courchesne, 1997; Donnellan et al., 2012; Grandin, 2000; Jones, Quigney, & Huws, 2003; Kientz & Dunn, 1997; Tomchek & Dunn, 2007). Sensory differences in autistic individuals have an incidence of 30-80%, and they are characterized by processing and modulation challenges (Baranek, David, Poe, Stone, & Watson, 2005; Dawson & Watling, 2000). Particularly for sensory processing disorders, impairments have been described primarily in hearing, visual, and tactile modalities (Baranek, Foster, & Berkson, 1997; Kientz & Dunn, 1997; Sinclair, 2010; Tomchek & Dunn, 2007; Watling, Deitz, & White, 2001). Associated with sensory processing challenges, sensory modulation difficulties have included three different issues: over-responsivity (i.e., exaggerated, rapid onset and/ or prolonged reactions to sensory stimulation; Ben-Sasson, Fluss, Hen, &

Cermak, 2008, p.2), under-responsivity to sensory stimulation (i.e., "unawareness or slow response to sensory input"; Ben-Sasson et al., 2009, p.2), and sensory seeking (i.e., "craving of, and interest in sensory experiences that are prolonged or intense"; Ben-Sasson et al., 2009, p.2). From these three modulation difficulties, under-responsivity has been the most frequently associated with autistic individuals (A. Adamson, O'Hare, & Graham, 2006; Baranek et al., 2005; Ben-Sasson et al., 2008; Rogers & Ozonoff, 2005). However, studies that include first-person perspectives have described fluctuation between different sensory issues depending on the context (Costa & Lampreia, 2012; Donnellan et al., 2012; O'Neill & Jones, 1997). For example, Grandin and Scariano (1986) described how the same stimuli (noise) can be unnoticed when an activity of particular interest is conducted (e.g., spinning a coin) and can be overwhelming in a different context (i.e., social interaction).

Under-responsiveness and broad sensory processing difficulties have been correlated negatively with measures of social interaction in autistic children (Baranek et al., 2013; Hilton, Graver, & LaVesser, 2007; Hilton, Harper, Kueker, Lang, & Abbachi, 2010). For example, Hilton et al. (2007) used a bivariate correlational design to assess the association of sensory processing and social competence of 36 school-age autistic children with an IQ of at least 70. Using the Social Responsiveness Scale (SRS, Constantino et al., 2003) and the Sensory Profile (SP, Dunn, 1999), the authors found a strong correlation between sensory processing and social competence.

Comorbidities. The great variability of sensory-motor profiles in autistic students could be explained in part by comorbidities with other developmental and medical conditions. Many developmental and medical conditions such as ADHD, seizure disorders, and sleep disorders have been described in autistic children, which could help explain some of their sensory-motor

differences (e.g., Bauman, 2010; Mazzone, Ruta, & Reale, 2012). Of particular interest for this study are the potential comorbidity with Childhood Apraxia of Speech (CAS) and Pediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcal infections (PANDAS) (Mazzone et al., 2012; T. K. Murphy, Gerardi, & Leckman, 2014; Shriberg, Potter, & Strand, 2011; Swedo et al., 1998)

Childhood Apraxia of Speech. CAS is a neurological motor disorder that affects coordination of spatiotemporal parameters of speech production without neuromuscular impairment (ASHA, 2007a). Specifically, this disorder–also called *developmental apraxia of speech and developmental verbal dyspraxia* (ASHA, 2007; Forrest, 2003)--is characterized by motor speech planning difficulties which are evident through "three segmental and supra-segmental features: inconsistent errors on consonants and vowels in repeated productions of syllables or words, lengthened and disrupted co-articulatory transitions between sounds and syllables, and inappropriate prosody, especially in the realization of lexical or phrasal stress" (ASHA, 2007ab; Forrest, 2003). The development, diagnostic age, and severity of the resulting speech impairment vary depending on each case. CAS can be considered either a congenital, acquired, or a developmental disorder, and it ranges from mild articulation difficulties to limited ability to use speech at all (ASHA, 2007a; Shriberg et al., 1997). In addition to speech production, children with CAS commonly experience difficulties in other areas, such as fine motor control, reading, writing, and social communication (e.g., Lewis et al., 2004; McCormack, McLeod, McAllister, & Harrison, 2009; Moriarty & Gillon, 2006; Teverovsky, Bickel, & Feldman, 2009).

Empirical reports of diagnostic comorbidity between autism and childhood apraxia of speech are scarce, include experimental limitations, and have provided contradictory results.

Specifically, Shriberg et al. (2011) examined the speech in 46 children with ASD. According to their inclusionary criteria, all participants had to be fluent in language production as demonstrated by a conversational sample with a mean length of utterance of at least 3.0, and words that were >70% intelligible; most participants scored within the normative range on cognitive and language measures. Based on acoustic analyses comparing speech samples between the participants with ASD as compared to 15 unmatched individuals with CAS, the researchers concluded that CAS was not a prevalent concomitant disorder in persons with verbal ASD. Despite its sophisticated acoustic analyses, conclusions from this study are limited by the lack of experimental matching between groups and the exclusion of participants with significant speech-language impairments. Specifically, autistic children most likely to be impacted by CAS would have be excluded due to the inclusionary criteria of the study.

In contrast, a small but provocative study by Tierney et al. (2015) focused on the diagnostic accuracy of an autism assessment in 30 children with communication delays, including those with CAS. Of the 11 children, age 2-4 years, who met diagnostic criteria for ASD, 63.6% also met criteria for CAS. Of the 19 children who met criteria for CAS, 36.8% also met criteria for ASD. The study's intriguing findings received a substantial amount of press, including being one of the top 10 research findings of 2015 highlighted by Autism Speaks. However, findings were based on a relatively small number of participants, and it relied on a measure that is not commonly-employed for diagnosing ASD.

Pediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcal infections. Another condition with significant sensory-motor differences associated with autism is PANDAS, an autoimmune disorder with low prevalence characterized by a sudden onset of obsessive compulsive disorder and tic disorders during childhood or adolescence associated with

a group A β-hemolytic streptococcal (GABHS) infection (Murphy, Gerardi, & Leckman, 2014; Swedo et al., 1998). Concomitant symptoms include emotional lability, deterioration of some cognitive functions (e.g., visual-spatial, attention, and reading abilities), and bedtime fears (Swedo et al., 1998). Regarding motor development, children affected by PANDAS have been described as showing adventitious movements, motor and vocal tics, motoric hyperactivity, impulsivity, distractibility, fidgeting movements, and handwriting difficulties (M. Murphy & Pichichero, 2002; Swedo et al., 1998, 2004). Sensory difficulties have been broadly described as sensory defensiveness (Swedo et al., 1998). Several comorbid diagnoses such as ADHD, avoidant disorder, depression, anxiety, and eating disorders that are commonly considered comorbid with autism are also described as frequently comorbid with PANDAS (Swedo et al., 1998; Murphy et al., 2002).

During the last years, increasing literature has focused on exploring the relation between autoimmune issues and autism. In particular, two articles have discussed the association between PANDAS and autism (Cosford, 2009; Jyonouchi, Geng, Ruby, & Zimmerman-Bier, 2005). The first study was conducted by Jyonouchi and colleagues (2005). Using a between group design, the authors compared immune functioning in 177 autistic children on the under-restricted or elimination diet (age 1-10 years), 30 non-autistic children with non-allergic food hypersensitivity on the under-restricted or elimination diet (1-7), and 13 non-autistic children without any dietary restriction (1-8). Specifically, proinflammatory (TNF-a, IL-1b, IL-6, and IL-12) and counter-regulatory (IL-1ra, IL-10, and sTNFRII) cytokines were assessed to measure innate immune response. Results revealed immune response abnormalities in autistic children with positive indicators of gastrointestinal dysfunction. Although not directly addressed by the research questions, but relevant for the present study, participants' demographic descriptions revealed that

clinical features of PANDAS were reported in 7.0% of autistic children with gastrointestinal symptoms and in 6.9% of autistic children without gastrointestinal symptoms. None of the non-autistic children revealed clinical features of PANDAS.

A second study conducted by Cosford (2009) described the case of Child A, a 5-year-old boy with autistic traits, symptoms and serology consistent with PANDAS, but without history of streptococcal infection. Laboratory measures evidenced "colonic dysbiosis with overgrowth of streptococcal and enterococcal species," which suggested autoimmune responses caused by gastrointestinal infections (p.39). Provided supplementation of probiotics and dietary modifications showed behavioral improvements based on parent reports. Of particular interest was Child A's behavioral description, including social communication and motor difficulties. Regarding communication, Child A showed expressive and receptive communication impairments (age-equivalence: 2:1 according to Vineland-II). Expressive communication was characterized by "unintelligible jargon and frequent repetition of words and sentences" and a restricted consonant repertoire. Receptive communication was characterized by limited understanding of "2 stage commands" and "lack of understanding of abstract questions" (p.40). Based on results from the Childhood Autism Rating Scale (CARS), Child A faced challenges in interacting with peers and adults who were not familiar. The author described that he preferred "to play alone and often withdr[ew] into his own space" (p. 40). Finally, motor difficulties were characterized by delayed development of locomotor and fine motor skills (equivalence range: 2 to 2 ½ years).

By and large, emergent literature has provided descriptions of autistic children with sensory-motor impairments; emergent literature has also related these sensory-motor impairments to some comorbid conditions such as CAS and PANDAS. However, research in

understanding the communication profiles of this population and how best to support their peer interactions is still needed. Previous literature on autism tends to view challenges in peer interaction as a byproduct of the autistic children's social skill deficits. Concomitant sensory-motor challenges have been largely ignored, especially in relation to the peer interactions of autistic children with limited speech. Consequently, therapeutic programs have been designed from a skills-based approach focused on developing normative social skills for autistic individuals with ready access to speech, but there remains limited evidence for changes in quality of life outcomes and concerns regarding social-emotional harm from skills-based approach has been reported. An alternative approach to support peer interactions involving autistic children is a supports-based approach that draws explicitly on the distributed model of communication (DeThorne et la., 2014; Hengst, 2015) and states that therapeutic programs should focus on shared activities, encourage multimodal communicative resources, and support egalitarian interactions (Vidal et al., 2018). Nonetheless, intervention studies that align explicitly and consistently with this model are scarce. Accordingly, my dissertation is aimed at utilizing a supports-based approach to examine the peer interactions of John[2], a school-age autistic child with limited speech, during art class activities. For this purpose, I have developed the following research questions:

1) What is the nature of John's communication profile?
2) What is the frequency and nature of peer interactions between John and his non-autistic peers during art class?
3) How does direct support for peer interaction shape the frequency and nature of peer interaction between John and two of his non-autistic peers during art class?

[2] Pseudonyms were used for participants to protect their confidentiality. Pseudonyms were picked based on parents or participants' preferences.

Methodologies Suited to my Research Questions.

Research paradigm: Pragmatism. Pragmatism has been selected as the research paradigm to design and conduct the present study given its practical, flexible, and holistic approach. Unlike positivism and constructivism, pragmatism does not view reality versus human experience as a dualism. Pragmatism is a research paradigm with a flexible and practical view of the research methods, which allows the combination of distinct aspects of the existent research paradigms according to their utility to answer the research questions (Creswell & Clark, 2007). Ontologically, pragmatism acknowledges that reality is a social construction, which is complex and has multiple interpretations (Creswell & Clark, 2007), thereby allowing us to study the complexities of social interaction from multiple perspectives. At the same time, the field of communication sciences and disorders privileges experimental data founded in positivist truths for establishing and documenting evidence-based practices. Consequently, pragmatism aligns with my intent to study the nature of John's communication profile and his peer interactions from varied actors and contexts (the "what" and the "how"), while also allowing me to collect experimental data that speaks in part to the "if" and "why" of potential changes in peer interactions with the provision of social supports. Specifically, this research paradigm focuses on the practical application of research to solve specific issues and make changes in people lives (Creswell & Clark, 2007; Kalolo, 2015).

Research design: Case study. Particularly for this research project, I have opted to use an instrumental case study to explore peer interactions between a school-age autistic child with limited speech and two of his classmates during art class activities. Accordingly, cases studies are focused on attaining a deep understanding of a specific issue or phenomenon, which in this situation is John's communication profile and associated peer interactions (Stake, 2006).

Although varied in nature, cases studies have four shared features (Kazdin, 2011). First, case studies are characterized by the exhaustive study of the case which is considered the unit of analysis. Second, information gathered, analyzed, and reported is thoroughly reviewed to construct rich descriptions. Third, special attention is put on the "complexity and nuances of the case (e.g., contexts, influence of other people)" (Kazdin, 2011, p.4). Fourth, usually analysis of the information is made in a retrospective way. Instrumental cases studies often have been used to describe particular characteristics of autistic individuals (e.g., Kanner, 1943) and novel interventions to support their development and social participation (e.g., Robins, Dautenhahn, & Dickerson, 2009; Theodorou & Nind, 2010; Wimpory, Chadwick, & Nash, 1995).

Research inquiry: Mixed methods. Though case studies often rely on qualitative methods, they can integrate a quantitative approach as well (Gerring, 2006; Stake, 1995). Given the nature of my questions, the present instrumental case study used a convergent mixed methods approach (Creswell, 2014) that combined a qualitative/interpretative case study and a single case experimental design. Specifically, qualitative methods that incorporated behavioral assessments, interview data, and classroom-based observations allowed me to collect the most rich and meaningful description of John's communication profile (Q1), while also addressing the complex nature of his peer interactions in the naturalistic classroom environment (Q2 & Q3). Qualitative research is well-suited to describing and understanding a social phenomenon and its complex interactions in its natural setting (Brantlinger, Jimenez, Klingner, Pugach, & Richardson, 2005; Creswell, 2014; Damico & Simmons-Mackie, 2003). Even though carrying out research in natural settings brings higher variability of the data and less control of the variables and object of study, it allows a richer understanding of the complexities and nuances of the studied phenomenon (Guba & Lincoln, 1985; Stake, 1995). Such aspects are relevant when studying

social interaction because this phenomenon has a direct interdependency with the context where it occurs (Bronfenbrenner & Morris, 1998; DeThorne et al., 2014; Hengst, 2015). For the purpose of the present study, the distributed model of communication was used to view the context in terms of activity, people, multimodal resources, and time. Importantly, qualitative methods also serve as a preferred methodology to incorporate the voice and perspective of traditionally marginalized populations, such as disabled individuals, and when recognizing the need to question investigator assumptions and biases (Brantlinger et al., 2005; Guba & Lincoln, 1985).

At the same time, the implementation of a single case experimental design allowed me to address the third research question about the direct causal impact of the social supports provided. Originally associated with behaviorism, single case experimental design is a "rigorous, scientific methodology used to define basic principles of behavior" (Horner et al., 2005, p.165). Unlike other quantitative designs that require a great number of participants, single subject design has been devised to assess functional relationships (i.e., causal relationships) between a therapeutic or educational program (i.e., the independent variable is actively manipulated) and a specified behavior (i.e., the dependent variable). Single case experimental design has been very popular in studying low prevalence neurodevelopmental differences, such as autism, in which obtaining adequate numbers for experimental group design is not always feasible (Horner et al., 2005). Unlike most quantitative designs that rely on parametric assumptions such as having a normal distribution, single subject design is interested in understanding the performance of one specific individual; thereby allowing one to focus on the theoretical significance and social validity of the variables rather than the statistical properties. Another relevant characteristic of the single case design is the flexibility that it provides, such as modification of procedures as needed based on

the context. Such flexibility is especially critical when working within naturalistic settings such as the classroom (Horner et al., 2005).

In sum, although mixed methods studies are intensive in terms of resources and time, mixed method research allowed me to have a holistic, extensive, and enriched comprehension of a specific phenomenon, which cannot be achieved through one specific approach (Creswell, 2014; Johnson & Onwuegbuzie, 2004). Specifically, the mixed method of inquiry provided the best fit for my goal of studying the complex phenomenon of peer interaction involving a highly unique case that was intended to answer meaningful questions of both a descriptive and experimental nature.

CHAPTER 2: METHODS

Design

This dissertation used an instrumental case study to examine peer interactions involving John, a 9-year-old autistic child. For this purpose, the study used a convergent mixed methodology, which incorporated ethnographic methods and elements of single-case experimental design (see Figure 1 for a summary of employed methods). Specifically, this research study made use of interviews and video-observations to illustrate interpersonal dynamics and to assess the influence of specified supports (Brantlinger et al., 2005; Hengst, Devanga, & Mosier, 2015). In addition, video-observations were analyzed within an ABAB design to assess the functional relation of provided social support and the frequency and synchrony of communicative offers with one of John's classmates (Horner et al., 2005; Kazdin, 2011). This project was approved through the University of Illinois Research Board (see Appendix A).

Research Team

My background. My interest in social supports can be traced to my professional background working as a speech-language pathologist (SLP) for four years in Chile. During this period, I developed an interest in the development of children with neurodevelopmental communication disabilities, an area that was not covered extensively during my professional training. Because of this, I decided to pursue two academic degrees that would complement my professional background and improve my ability to evaluate and provide evidence-based practices for children with neurodevelopmental communication disabilities. First, I obtained a master's in biological sciences with a major in neuroscience. This program provided a greater understanding of the neurobiological basis of the social communication development and its related disabilities. Second, my current Ph.D. program in Speech and Hearing Science has

strengthed my ability to design and implement intervention studies related to supports for social communication in children with communication disabilities.

Research collaborators. For this study, my research team included my primary research mentor, Dr. Laura DeThorne, and 10 research assistants. Dr. DeThorne was an associate professor of Speech and Hearing Science (University of Illinois at Urbana-Champaign) and a certified SLP with over a decade of experience supporting children with communication disabilities. Over the past few years, Dr. DeThorne has worked at bridging medical and social models of disability, with a focus on autism, CAS, and AAC. Additionally, Dr. DeThorne's expertise on single subject experimental design was relevant for the development of the methods chapter of this research study. Nine of the research assistants of this project were undergraduate students majoring in speech and hearing science. All of them had prior experience working with data collection, transcription, and/or behavioral coding. A tenth research assistant was a second-year master's student majoring in speech-language pathology. She assisted me with the primary participant's assessment. She had more than five years of experience working in the lab. In addition to my research team, I collaborated with an autistic scholar in the development of a supports-based approach to peer interaction of autistic students that was employed during this study (Vidal, Robertson, et al., 2018).

Dissertation committee members. In addition to Dr. DeThorne, dissertation committee members encompassed three professors from the Department of Speech & Hearing Science: Dr. Cynthia Johnson, Dr. Laura Hahn, and Dr. Julie Hengst. At the time of the study, Dr. Johnson served as an Associate professor, Director of Graduate Studies, and certified SLP with approximately 38 years of research expertise related to school-age language disabilities and speech sound disorders. Dr. Hahn was an Assistant professor with relevant expertise in social-

ecological models of human development, with an interest in communication and children with neurodevelopmental disorders. Finally, Dr. Hengst, an Associate professor and certified SLP, offered critical theoretical expertise in a distributed model of communication and ethnographic methods and brought 20 years of clinical expertise focused on therapeutic programs for adults with neurogenic communication disorders.

The Case

The specified social phenomenon under investigation was peer interaction involving autistic children using a distributed model of communication (Stake, 1995, 2006). The case selected to exemplify this phenomenon was John, an autistic child with limited speech, and his non-autistic classmates in a 3rd grade general education art class.

Setting. The art class was located at a Midwestern public elementary school, referred to here by the pseudonym Raywood Elementary, which based on the published state report card data included 426 students — 52.3% of whom were "receiving public aid, living in substitute care, or were eligible to receive free or reduced-price lunches." In terms of disability, 13% of the students were reported by the same source as having an Individualized Education Program (IEP), and 12% of students with an IEP were identified as autistic. In terms of the educational placement for students with an IEP at Raywood, 2% received instruction and services in a different facility for the whole day, 13% participated for less than 40% of time in a general education classroom, 15% participated for 40-79% of the time, and 70% participated for 80% or more of the time in a general education class.

At the time of this study, art class at Raywood Elementary was considered one of three "specials," 45-minute classes taught by a specialized instructor outside of the children's homeroom. It alternated with the other specials (physical education, music) and was taught every third day. The class was conducted in a 39x42-foot classroom with cabinets and shelves where

materials and children's art work were stored. The classroom contained 7 rectangular tables, each with room for 4-6 stools. Each group table was differentiated by a different color mobile dangling overhead. Our observations focused on the "green table" delineated by the green origami mobile, where target participants were invited to sit together each class (see Figure 1 for visualization of physical space).

According to the school website and the art teacher, the 3rd grade class where the primary participant was included had a project-based curriculum grounded in situated cognition and constructivism (Bell, 2010; Krajcik & Blumenfeld, 2006). As a main project for this 3rd-grade class, the art teacher reported that she jointly worked with the head general education teacher to develop a "tile sculptural mural" based on the Titanic. For this purpose, students made tiles, decorated them, and glazed them. During her final interview, the teacher reported that the project lasted longer than she was expecting (~1.5 semester). Accordingly, she decided to "take breaks" with the students from the project and work some days on parallel activities which were based on the 3rd grade district curriculum. Parallel activities that were conducted during the study included designing Christmas cards, drawing self-portraits, and landscapes (see Figure 3 for some examples of activities conducted in the art class).

I selected art class for this project for three key reasons. First, specials, such as art class, are a common setting of educational inclusion in public school (cf., Malley, 2014). Second, the arrangement of the physical space and the focus on a project-based curriculum was consistent with the theoretical framework used to support peer interaction. Third, the art teacher was supportive of our involvement and wanted to support student diversity in her classroom. She explicitly mentioned that she was interested in communication development through aesthetics.

Sampling and participants. Participants of this study included: an autistic child who served as the primary participant, five non-autistic peers who interacted with the primary participant during art class, and three adults who provided instruction or care and interacted directly with the primary participant. Participants were selected through a combination of convenience and purposeful sampling specified below (Creswell & Clark, 2007; Etikan, Musa, Alkassim, 2016; Patton, 2002).

Primary participant. The primary participant of this study was, John[3], a Caucasian boy, age 9 years and 8 months. John lived at home with his parents and brother. John's family identified as Hebrew, immigrating to the United States from India 6 years prior. Although Alison, John's mother, stated that they used Hebrew at home, she reported that she addressed John 100% in English because they had always lived in countries where English was the primary language.

I had a prior connection with John's family since he participated in my mentor's, Dr. DeThorne, previous study about comorbidity of childhood apraxia of speech (CAS) and autism, and his mother, Alison, had agreed to be contacted about additional study opportunities. I recruited John for the present study given that his sensory-motor profile was not well represented in the literature on autism and peer interaction, and Alison had expressed an explicit interest in a study that supported peer interaction at school.[4] Alison reported that she enrolled John in a public-school part of the day in order to help him "relate with peers."

At the time of this study, John was homeschooled in the mornings by his mother, with a focus on math and literacy. At the start of the study, John received both applied behavioral

[3] For primary and secondary participants pseudonyms have been used to protect their confidentiality.
[4] Five other child participants from our prior research were approached for our study: one family was initially interested but did not follow-up with consent procedures, three families wanted to participate but were impeded by school permission procedures, and one whose data was collected but has not yet been analyzed.

analysis (ABA) and speech therapy at home, and he attended Raywood Elementary in the afternoons. John's primary placement within Raywood was a special education "life skills" classroom, and according to John's paraprofessional, John also received pull-out social work, occupational therapy, and speech-language pathology services at school. At the beginning of the study, John participated in 45 minutes per day in the 3rd grade general education specials classes, such as art. During the middle of the study, John's paraprofessional, Joe, reported that John's individual education program (IEP) was modified to reduce his time in art and music class from 45 to 20 minutes, because "he couldn't stay engaged the whole time."

Developmental history. Alison reported that John's earliest development met expectations, and "he reached all the milestones" until 14 months when his behavior changed abruptly. Specifically, she wrote in an email to Dr. DeThorne that John's first symptom was crying, which was described by Alison occurring "day and night." She shared that his sleep patterns also were disrupted: "he stopped sleeping at night." She added: "He was chewing extensively on everything, on his hand and the pacifier, and crying. (He) stopped eating the foods that he ate before (…); my son stopped laughing." In addition, she mentioned that John started to "obsessively" watch commercials and stopped paying attention to others.

Alison expressed that she was concerned at this point about John; however, professionals that she visited in India told her that it was part of "his painful teeth," and it was part of normal development. However, when John was 18 months old she decided to take him for an evaluation in India with a multidisciplinary team after seeing that "John stopped walking on the shiny floor," and instead, he started to run and spin. It was during this evaluation, when John was t2 years old, that he received a diagnosis of autism.

After his autism diagnosis, Alison mentioned that John continued crying and having difficulty sleeping. Alison reported that a critical moment in shaping her perception of John's behavior came when his grandmother gave him a "pain killer," which appeared to ease his discomfort. This led her to stop viewing his behavior as "… annoying" or "just sensory" as it had been presented to her by others. She reflected, "What does it mean just sensory? Pain is also sensory." From this situation, Alison looked for additional causes that might explain John's symptomatology, which led her to suspect an autoimmune disorder with low prevalence known as PANDAS (Murphy et al., 2014: Swedo et al., 1998). According to Alison's narrative, John presented with "all the symptoms" of PANDAS during his early development, and she was able to confirm her suspicion through a blood test conducted at a Midwestern clinic in the United States. Alison also reported that while in the United States, John was diagnosed with apraxia by a developmental pediatrician at a local hospital.

During her final interview, Alison mentioned that service provision for John had been challenging. While she lived in India, she mostly received parent consultation. John started to receive direct support since he and his family arrived in the US 5 years prior to the initiation of this study (2013), including speech-language pathology, occupational therapy, and ABA. ABA therapy was implemented for 4 years, and it was discontinued by Alison in the midst of this study, because she did not find it useful. Alison reported that John's mood and behavior improved dramatically after stopping ABA. Because of difficulties finding appropriate supports for John, Alison has come to view herself as his main teacher/therapist. Formally trained as a psychologist, Alison refers to herself as the "case manager of the household."

John's interests and abilities. Many participants noted that John liked physical activities, such as jumping, playing ball, and running around. Specifically, when I asked John if he liked to

jump during his initial interview, he nodded and said, "yes." He also said yes when asked if he liked school and art class. His paraprofessional, Joe, reported that John liked to paint, work with clay, and feel the texture of materials. I observed John frequently seeking out the sink within the art classroom, and his paraprofessional noted that John liked to play with the hairdryer in one particular bathroom. When asked about his strengths, Alison mentioned that John is "very smart," and he has "very good potential." One of his classmates, María, described John as a "really nice and generous" person. She also said: "John can do a lot of things (…) he can play with clay."

Secondary child participants. Non-autistic peers were recruited in two phases. In the first, the head teacher of the 3rd grade class selected Ethan and María from John's classmates, because they demonstrated consistent attendance and were considered receptive to interactions with John. Both families provided signed consent and a completed demographics form, and the children assented to participation. Ethan was a White/Caucasian, age 8;7, who came from a monolingual (English-speaking) family. His parent reported an income of approximately $150,000/year. When I asked Ethan what kind of activities he enjoyed during recess, Ethan responded, "I normally play around with my computer." When asked to tell me about art, he also shared that he liked art class. María was a White /Caucasian girl, age 9:2, who came from a monolingual (English-speaking) family. The item asking about family socioeconomic level on the demographic form was left blank. María stated that she liked to read, ride bikes, and learn. She also mentioned, "I like to…play outside, I like to run around." To the best of my knowledge, neither Ethan or María received special education supports.

The second phase of peer recruitment focused on additional peers, or incidental participants, who began to migrate to John's art table during the initial supports phase. I invited

these peers to participate in the study in order to encourage naturalistic interactions as they unfolded and collect additional data. Three of these incidental participants returned signed consent forms. Although the incidental participants were not included in behavioral coding given the experimental nature of the design, they were invited to complete a brief written interview to provide contextual information about the provided social supports. See Table 2 for a summary of all child participants.

Secondary adult participants. Table 2 also includes an overview of the three secondary adult participants recruited for this study based on their daily interactions with John at home or school: John's mother (Alison), John's paraprofessional (Joe), and John's Art Teacher (Leila). In addition to these three adults, we invited John's school-based speech-language pathologist to participate, but she declined without providing a particular reason. Each participating adult completed a consent form that included a demographic survey.

Alison. Alison identified as a White 47-year-old woman with a college degree in psychology. She was born in Poland, grew up in France, and spent much of her life in South Africa, Israel, and Hungary before moving to India where her sons were born. She could speak both Hebrew and English. During her initial interview, Alison reported that she played different roles in John's life: mother, primary caregiver, teacher, and main play partner. During her final interview she shared a history of frustration in trying to identify the source of John's medical challenges and the most appropriate forms of education and related supports. She noted that her son's potential is often underestimated and shared that the ABA therapist had told her that John was not teachable because he was not motivated. During her initial interview, Alison mentioned that her goals for John are "to be willing to relate with peers (…) [and to] learn to read and write."

Joe. Joe identified as a White 27-year-old man who had served as John's paraprofessional since the beginning of the school year (5 months), though he said he had known John for 2 years. Joe was a native English speaker and identified as belonging to the "working class." Joe had a degree in sociology and served as a head high school track and cross-country coach. Related to autism, he mentioned that he had received training for 2 years "to run discreet trial programs." However, he specifically mentioned that the school district had not provided any specific training to work with autistic students. "I've been doing my best to learn on the fly," he said. Joe went with John to every class that he has at school. He mentioned that he supported John in different aspects including academic and social areas. However, Joe mentioned in the initial interview that "the reason that I'm usually with him during the day anyways is because he has a tendency to run away from people." He mentioned that he has really enjoyed working with John. Regarding goals that the school has for John in terms of social interaction, Joe stated: "the big reason that he (John) comes especially in the afternoon is so that he can get the time with peers at … specials."

Leila. Leila, the head art teacher, was a 60-year-old woman who chose not to identify with a specific racial category. She was an English native speaker who identified as belonging to the "middle class." She had a master's degree in teaching language to speakers of other languages (TESOL) and a master's in arts. She had 20 years of experience as a teacher of English as a foreign language and 10 years teaching visual arts with a focus on language and social development. This was Leila's first year teaching at this school, and she had not met John beforehand. She said, "I didn't know him (John) at all before that. (..) I didn't really get a big introduction uh before he came in. So, he started coming in with uh his assistant." Regarding John's academic goals, Leila mentioned that she did not have access to John's IEP. Consequently, she was not aware of John's academic goals. However, when I asked her about

what goals she had for John, Leila reported: "I would hope that uhm, that he can interact with the students (…) and I'd like to see, uh, my for myself, investigate how the other students are interacting with him."

Data Collection

Data collection included initial behavioral assessments, semi-structured interviews and weekly videotaped observations during art class activities in order to gain information about all participants and to illustrate John's patterns of peer interaction both with and without provided support. The procedures used for each data source are described as follow.

Initial behavioral assessments. For the purpose of this study, we examined John's communication profile through parent report measures completed by John's mother and school report measures completed by John's paraprofessional. In addition, we drew on speech-language assessment data collected in association with John's participation in a prior study from the same lab one year prior. Specifically, the current study included parent completion of the MacArthur-Bates CDI: Words *(*Fenson et al., 2006), the Intelligibility in Context Scale (ICS; McLeod, Harrison, & McCormack, 2012), the Nordic Orofacial Test-Screening Interview (NOT-S; Bakke et al., 2007), and The Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07; Wilson et al., 2009). In addition, Joe completed the Sensory Processing Measure (SPM ™; Miller-Kuhaneck, Henry, Glennon, & Mu, 2007) and the Vineland Adaptive Behavior teacher form, Third Edition (Vineland-III; Sparrow, Sparrow, Cicchetti, & Balla, 2016). Results from the prior speech-language assessment, completed one year prior to the current study included the Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003) completed by John's mother, and a 20-minute language sample obtained from John and Alison's

interaction during free play in a sensory room (i.e., swinging and jumping on a trampoline) and book reading activities. Table 3 provides an overview of all assessment measures.

Interviews. Semi-structured interviews were conducted with each primary and secondary participant at the beginning and the end of the study. Interview questions were informed by ethnographic interviewing techniques offered by Westby, Burda, and Mehta (2003), and questions regarding social supports were designed based on the interpersonal support checklist provided in the SCERTS model by Prizant, Wetherby, Rubin, Laurent, and Rydell (2006). Questions focused on John's communication profile and development, nature and frequency of his peer interactions, and participant expectations about provided social supports (see Appendix B). Interviews of the adult participants ranged from 26-40 minutes and were scheduled at a location of convenience for the participants either in person or over the phone. All interviews were video-recorded via camcorder, with the exception of Alison's, which were audio-recorded only, according to her preference.

Child interviews ranged from 4-21 minutes, and all of them took place at the children's school. Child interviews focused on participant interests, patterns of peer interactions with one another, and perceptions of provided support (Appendix B). The interviews with John specifically included access to his AAC device and adapted questions consistent with recommended accommodations for individuals with complex communication needs (Greathead et al., 2016; Harrington, Foster, Rodger, & Ashburner, 2014; Prizant et al., 2006). In addition, Joe (paraprofessional) was present to assist with interpretation as needed.

All final interviews also included video-elicitation techniques—also called stimulated recall (Lyle, 2003)—in which participants watched 3-4 salient examples (ranging from 16 to 48 seconds each) of observed peer interaction during art class activities to prompt first-person

perspectives (Henry & Fetters, 2012). Specifically, I selected video clips that were discussed during lab meetings as characteristic examples of peer interactions during baseline and support phases (see Appendix C for video clips descriptions). Incidental peers participated only in a formal written interview at the end of the study to address why they decided to join the table, their experiences at the art table, and their insights about the provided support (see Appendix B). Informal follow-up questions were also employed with all participants as needed and interspersed throughout data collection to gather information about specific interactions or supports. For example, I was able to ask María and two other incidental peers why they decided on some days not to join our group at the art table.

Videotaped observations. In addition to semi-structured interviews, we conducted weekly videotaped observations once to twice per week, approximately 15-30 minutes each, for a total of 20 sessions. To help reduce the potential reactivity of participants to the cameras, faux recording were implemented two weeks before the study began (Pirie, 1996; Ratcliff, 2003).Video-recording consistently included two cameras, a Canon Camcorder (model # VIXIA HF R800) and a Sony camcorder (model # HDR-TD30V), each set on a tripod near two different corners of the table in order to capture the faces and torsos of the primary and secondary child participants during interactions. In addition, a Flip Ultra video camera was on hand as back up in case one of the primary cameras failed to operate; this happened on one occasion. To improve the sound quality of video-recordings, a clip-on omnidirectional microphone (Movo LV1 Lavalier) was connected to the Canon Camcorder, and it was worn by the primary participant beginning at the first support phase. At the same time, a conference omnidirectional microphone (Fokey 360) connected to the Sony camcorder was placed on the table (see figure 2). Because

multiple videos were recorded from each session, video-recordings were synchronized through OpenShot video editor and uploaded into ELAN prior to coding.

Phases of Data Collection. Consistent with an ABAB single case design, the videotaped observations were conceptualized in four major phases: two phases of baseline alternated with two phases of social support. Initial interviews were conducted during the first baseline phase, while final interviews were conducted at the end of the second social supports phase.

Baseline phases. Baseline phases consisted of video-recorded observations of peer interaction during art class. During this period John, María, and Ethan were instructed by the teacher to work at the same table, but without any explicit support by the examiner. Data collection for this phase was conducted until stability in the primary dependent variable (i.e., communicative offers) was established via visual inspection (see quantitative analysis). In addition to gathering information for quantitative analysis, this phase was used to obtain detailed descriptions regarding the nature of peer interactions (see qualitative analysis). The first baseline phase included seven sessions (ranging in length from 21-34 minutes) and the second baseline phase included four sessions (ranging in length from 16-21 minutes).

Social support phase. Social supports consisted of four explicit clinician strategies implemented by me during art class activities. These strategies (direct prompt for peer interaction, scaffolding peer interaction, behavioral interpretation, and environmental arrangement) were used in my early research project and were described as relevant elements to promote successful peer interactions (see Table 1 for a detailed description; Vidal, 2016). Consistent with single case experimental design, data collection for this phase was conducted until changes in mean and trend (see quantitative analysis) were consistently demonstrated with a minimum of three data points (i.e., sessions). Once an effect was observed for the primary

dependent variable, social support was withdrawn, and I returned to the baseline phase (see figure 4 for scheme design). Whereas the initial support phase focused on the implementation of strategies within the ongoing art activities, limited positive effects and the perception that the specified art activity (i.e., drawing self-portraits) was particularly challenging for John, led me to add one to two alternative activities within the allotted art time. Alternative activities were intended to capitalize specifically on John's motor strengths and interests, for example playing catch with a small ball, hand games (e.g., hand slap game), and games with dice. The first intervention phase included six sessions (19-32 minutes), with the alternative activities beginning at session 4, and the second intervention phase included three sessions (19-23 minutes), all of which included alternative activities.

Supports Fidelity

To better characterize the nature of provided supports and offer an indicator of the fidelity procedures often used in single case experimental designs, three undergraduate research assistants reviewed all video-recorded sessions and recorded the number of strategies used by the clinician during each session. Training for this coding was conducted with the three research assistants who practiced coding clinician strategies implemented in a previous project until they reached 80% of agreement between them (~ 2 months). For baseline, it was expected that I would use no more than one strategy in total per session. Accordingly, the clinician was successful in avoiding use of any specified support strategy throughout all baseline sessions. In the case of the social support phases, it was expected that I would use a minimum rate of 6 clinician strategies/10 minutes per session based on dosage values reported in Vidal (2016). The clinician met the minimum criteria for 100% of the support sessions, using an average of 9 clinician strategies per 10 minutes (range 6 -16).

Quantitative Measure

For this study, I used one primary dependent variable and one secondary dependent variable for the single case experimental design. The primary dependent variable was frequency of communicative offers and the secondary dependent variable was number of positive synchrony indicators associated with each communicative offer. Both dependent variables were operationalized as follows:

Communicative offers. Consistent with prior work (DeThorne et al., 2015; Vidal, 2016), communicative offers were conceptualized as a necessary, but not sufficient aspect of social interaction. It was defined as two or more simultaneous intentional or unintentional behaviors directed toward another, including but not limited to eye contact, sharing objects, gestures, proxemics elements (e.g., getting closer to a peer), and spoken information (cf., Fisher, Shogren, & Halle, 2013; Kamps et al., 1997; Uvnäs-Moberg, 1998; Vaughn, Vollenweider, Bost, Azria-Evans, & Snider, 2003). In the case of a chain of communicative offers, a new communicative offer was coded when a pause of at least 3 seconds divided it from the previous one or when a new communicative partner entered or a current partner exited the interaction. Given that our focus was on interaction rather than individual skills, the frequency of communicative offers was collapsed within a dyad without differentiation regarding who initiated the offer (i.e., communicative offers are specific to the dyad, not the individual).

Communicative offers for each peer dyad (John-Ethan, John-Maria) were coded through review of the video-recorded observations during art class activities across baseline and social support phases. Although we originally intended to use a combination of communicative offers between John-Ethan and John-María as the primary dependent variable, we focused primarily on the John-Ethan dyad for two reasons. First, we were somewhat concerned that communicative

offers between the two dyads might be negatively correlated given the time constraint of the sessions, and second, because María chose not to sit at the same table as John for most sessions during the first support phase. Three undergraduate research assistants coded all sessions of this project using ELAN. Training included iterative coding and review of the same practice sessions until coding reached 85% agreement using the frequency ratio method (Kazdin, 2011).

Interpersonal Synchrony. In an attempt to capture the nature of multimodal interaction in addition to the frequency, our research team piloted a measure of interpersonal synchrony that was informed by the labor-intensive procedures specified in Condon and Ogston (1967) and the varied behavioral indices of interaction captured by the Communication Complex Scale (Brady et al., 2012). In addition, development of the measure was influenced by prior categories of engagement for mother-infant and peer interactions (Adamson, Bakeman, Deckner, & Romski, 2008; Bakeman & Adamson, 1986) and the Anchor Points for Observational Ratings of Positive Synchrony (Criss, Shaw, & Ingoldsby, 2003). Although informative, prior coding schemes tended to focus on individual behavior (instead of distributed properties across people) or rank behaviors hierarchically based on neurotypical expectations—both of which were inconsistent with our theoretical framework. Consequently, the research team developed a checklist of synchrony indicators based on this prior literature that could be applied specifically to dyads in a nonhierarchical fashion. The checklist, referred to as Interpersonal Synchrony Checklist initially included 10 indicators but through trial applications to prior behavioral data was streamlined into the following 7 indicators: shared activity, shared affect, shared eye gaze (to place, object, or person), mutual eye contact, turn-taking, coordinated change in corporal alignment, and imitative behaviors; see Appendix D for operational definitions of each indicator. Two undergraduate research assistants participated in the entire development process. Then, they practiced

implementation on data form a prior study until they reached 80% agreement between themselves on at least two sessions and began independent coding for the current study. Coding included review of each communicative offer as coded within ELAN plus an additional 3 second time frame within the video. The extended time frame was used to maximize the possibility of capturing slower responses while also being limited by the time frame used to delineate two communicative offers as independent events (e.g., 3 seconds). A separate tier was developed in ELAN to annotate which synchrony indicators were present.

Inter-observer agreement. Reliability of the dependent variables was estimated through inter-observer agreement (IOA) using frequency ratio procedures. IOA was derived on 20% of the total sessions (across all study phases: baseline and social support). For communicative offers, the number of communicative offers coded by the coder with lower total was divided by the total number of communicative offers coded by coder with higher total each session. Mean IOA was 90.9% (range: 80-100%) for communicative offers across all phases. Segmented by nature of phase, IOA was 94.9% (range: 80-100%) for baseline phases and 90.7% (range 88.9-92.9%) for supports phases. For synchrony indicators, the total number of synchrony indicators coded per session was divided by the total number of synchrony indicators per session. Mean IOA was 87.09% (range: 75-100%) for interpersonal synchrony coding including baseline and supports phases. Segmented by nature of phase, IOA was 84.9% (range: 75-100%) for baseline phases and 90% (range 80-100%) for supports phases.

Data Analysis

The initial research question regarding the nature of John's communication profile was addressed through a combination of traditional behavioral measures that incorporated standardized assessment, parent/teacher report, and a speech-language sample. In addition,

results were strengthened by the integration of both qualitative and quantitative analysis of data from semi-structured interview and classroom observations.

Qualitative analysis. Ethnographic methods were used to inform the second and third questions regarding the nature of peer interactions. Specifically, semi-structured interviews were transcribed in Microsoft Word by an undergraduate research assistant using line-by-line methods for adult interviews and sequential methods for child interview; the latter allowed more detailed representation of nonverbal aspects of communication (Hengst, 2003). Next, I reviewed each transcription in conjunction with the original recording and resolved any discrepancies through consensus with the original transcriber. I offered adult participants an opportunity to review their initial and final interview transcripts for clarification or correction. Only one participant offered feedback. Specifically, Leila asked for a word clarification on her final interview, and the word *autistic* was replaced by *artistic* in the original transcription. Interview data were used to provide descriptive background information and help triangulate key findings.

In addition to interviews, I wrote analytical memos to help ensure credibility and trustworthiness (Guba & Lincoln, 1985) and to record analytical insights of the data collection process (Patton, 2002). Specifically, I recorded reflections following each baseline and intervention session, and often recorded key insights, examples and opinions from weekly lab meetings. Like interviews, memos were used to help guide the analytic process and to help triangulate key findings.

Finally, video recordings were used to conduct situated discourse analyses of instances that exemplified the nature of peer interactions before and after the delivered support. For this purpose, the research team iteratively discussed the nature of observed peer interaction throughout the process of data collection and five salient examples of recurrent patterns of

interaction were selected. Each salient example was narrated into Microsoft Word by one member of the research team using microanalysis procedures (Ratcliff, 2003), and then that narration was reviewed in conjunction with the video by either me or Dr. DeThorne.

Quantitative analysis. To address the questions related to frequency of peer interaction across baseline and during social support phases, a single subject ABAB design was employed (Horner et al., 2005; Kazdin, 2011). Specifically, the introduction of social supports alternated with baseline phases to document any resulting changes in the dependent variables (i.e., communicative offers and synchrony) via visual inspection (Kazdin, 2011). Specifically, mean variations, trending variations, latency of changes, and the percent of overlapping data points across phases were assessed. Additionally, five sessions across baseline and support phases were coded for the frequency and synchrony of communicative offers between Ethan and María for comparison purposes.

CHAPTER 3: FINDINGS/RESULTS

Q1: What is the nature of John's communication profile?

Expressive communication. Converging evidence across initial assessments (see Table 3), classroom observations, and participant interviews indicated that John had a significant expressive language impairment. His expressive spoken language consisted predominantly of single word productions. Specifically, the 25-minute speech-language sample (from the previous study) yielded 24 recognizable spoken utterances, 21 of which were single words. The remaining three utterances were potentially multiword, with one approximation each of "want to push," "a push," and "a bath," but limited intelligibility made it difficult to segment individual words with certainty. Of the 24 recognizable utterances, 14 were immediate imitations of his mother's speech productions. For example, John repeated "push" when Alison asked, "Shall I push?" and repeated the word "ten" after she finished counting to ten. Alison directly reported that John spontaneously produced 80 of the 396 words listed on the McArthur Bates CDI (Fenson et al., 2006), which corresponded roughly to the mean for 18-month-old boys within the normative data provided by the measure. Similarly, the Vineland-III (Sparrow et al., 2016) expressive language score corresponded to an age-equivalent of "less than 3 years-old."

In addition to spoken language, John was beginning to use the app LAMP Words for Life™ via a tablet as an AAC device. During their initial interview, Joe and Alison reported that John could not yet use his tablet without direct prompting. Alison elaborated, "We are trying to prompt him in every situation that requires communication" including when reading and when in therapies. I observed John using emergent word combinations via his AAC device during the first and second support phases during art class. For example, I observed him selecting, "I want a

break" when he wanted to leave the classroom. Also, I observed him once selecting "I feel …" and then searching the emotions page on his tablet after I asked him if he was tired.

John's recognizable communicative functions during the speech-language sample appeared as requests and responses to direct commands or questions. For example, when reading a book, Alison asked John, "What is it here?" and he responded /bukIt/, which his mother interpreted as "blanket." When I entered the assessment room and asked John, how are you, he replied with /gʌ/, which his mother and I interpreted as "good." Requesting was also observed in the classroom through a combination of words, vocalizations, signs, and non-verbal communication. For example, to ask for a break he said, /baba/ paired with the sign for bathroom performed using both hands. In addition, he was observed using a combination of vocalization, eye gaze, arm waving, and jumping in what appeared to be an attempt to bring one of his favored classmates to his table.

Alison, Joe, and some of John's peers described during their initial interviews that they communicated with John mainly through vocalizations, words, and gestures. Joe mentioned that John "can sign for bathroom, nod yes, and shake his head no." When I asked Ethan specifically how he communicates with John, he said: "You (..) have to ask him a couple times and then eventually he'll say yes or no (…) it is pretty easy (…) he makes like a squeak kind of noise, and then, you can kind of tell like it's meant to sound like hi or something like that." When I asked María how she knows when John is not okay, she said: "Well, when he is not okay, he like screams a lot, and, um, he goes like (she plugs her ears with both hands) cause it's like loud." I also asked her how she knows when John is happy, and she stated, "Um, well, when he's really not screaming and when he's, um, cooperating with the people (…) like when he's talking to people, when he's being kind to people." Based on observations and peer interviews, John's

peers in art class did not seem familiar with his AAC use. During his initial interview, I asked Ethan about whether he used the tablet to communicate with John. Ethan responded: "I don't really know what like the iPad does. I know that it's a thing that they teach those special needs kids to use the iPad. Like if you're mute and you can't talk. Like you could like apparently click on the thing that you want to do."

In specific relation to speech, John's intelligibility was low. His overall speech intelligibility as assessed through the ICS (McLeod et al., 2012) lead to an overall score of 1.85/5.00, which indicated poor intelligibility of his speech by others. From the speech-language sample taken a year prior to the present study when John was 8-years-old, his phonetic repertoire within the 24 recognizable words included 8 vowels: /ɪ,ɛ,ə,ʌ,u,ʊ,o,ɑ/ and 14 consonants: /p,b,t,d,k,g,n,ŋ,w,j,h,f,s,ʃ/. Rothics vowels, diphthongs, Interdentals, affricates, and lateral consonants were not observed. No word-initial or word-final clusters were neither observed. The syllable shape of his intelligible words was predominately CV (n=7), but also included V (n=3), VC (n=1), VCV (n=1), CVC (n=4), CVCV (n=3), CVCVC (n=2), CVCVCV (n=1), and CVCCV (n=1). Based on milestones for speech development provided in Tager-Flusberg et al., (2009), John's phonetic repertoire and syllable use were generally consistent with18-30 months of age. Of interest, vocalizations noted during the speech-language sample also included audible mouth movements (i.e., sucking, kissing, tongue smacking sounds), humming, laughs, and vocalizations of unclear significance. Productions of the same word were produced inconsistently across the sample; for example, the word "push" was pronounced /pus/, /pʊʃ/, and /putu/, and "yeah" was pronounced both as /wʌ/ and /jʌ/. Finally, unusual prosody was frequently noted, such as use of a high pitch and a tendency to vocalize on the inhalation. Though some findings appeared consistent with classic features of childhood apraxia of speech (e.g., inconsistent productions,

unusual prosody), John's small number of spontaneous speech productions, poor intelligibility, and limited engagement with direct standardized assessments made the nature of the impairment difficult to specify.

Comprehensive language impairment and other cognitive challenges. Language comprehension was also difficult to assess, particularly as distinct from auditory processing and attention to speech. Alison reported during her initial interview that John had attentional difficulties, and Leila mentioned in her initial interview that John had difficulties sitting and listening for long periods of time. During the assessment sessions, his interviews, and even the implemented support during art class, there were several times when I was not able to elicit a clear response from John. Sometimes, nonverbal cues such as staring into space suggested that John was attending elsewhere or directed inward. During the final interview, John's mom did report that she suspected that he might be experiencing seizures, but she was having a hard time attaining relevant medical examinations.

Based on results from the MacArthur Bates CDI (Fenson et al., 2006), John's receptive vocabulary was substantially limited, with his mother reporting that he understood 180 words from the total list of 396. This score corresponded approximately to the mean for 17-month-old boys reported in the measure's normative data. Similarly, the Vineland-III (Sparrow et al., 2016) results corresponded to an age-equivalent of less than 3 years-old (see Table 3). During the speech-language sample, interviews, and classroom observations, I did observe John responding to simple questions. For example, John appeared to approximate *ball* when Alison asked him what he wanted to play. When I asked John during his initial interview whether he liked school, he said "yes", and when I asked him whether he liked to draw, he said /hm/ and shook his head left and right (i.e., no). Also, during the initial and final interviews, I asked John who his friends

were, and he consistently named the same classmates from the life skills class via his AAC device. In addition, John would also respond to my greeting (e.g., saying: "hi" and waving my hand) by waving his hand or giving me a high five.

Sensory-motor differences. In addition to speech-language impairment, relatively pervasive (and potentially related) impairments were identified in John's fine motor and praxis skills (i.e., ideation and motor planning) paired with heightened reactivity and sensory seeking in relation to some sensory stimuli (see Table 3). Specific to oral-motor skills, Alison reported via the NOT-S interview (Bakke et al., 2007) that John used to swallow large bites of food without chewing and used to take 30 minutes or more to eat a main meal. Alison reported on the DCDQ'07 (Wilson et al., 2009) that John had difficulties with control during gross motor movements, fine motor skills, including handwriting, and general coordination. DCDQ'O7 (Wilson et al., 2009) results are consistent with difficulties in motor planning found in SPM (Miller-Kuhaneck et al., 2007), and in turn, both results are consistent with John's apraxia diagnosis. John's motor impairments seemed relatively specific to fine motor, rather than gross motor, activities. For example, his gross motor score on the Vineland was above age-expectations, while his fine motor abilities on the same measure, were notably impaired. In accordance with these findings, María reported in her initial interview that "he (John) can do a lot of things he doesn't really show he can do."

In regard to his sensory profile, the SPM (Miller-Kuhaneck et al., 2007) demonstrated over-reactivity and sensory seeking behaviors in hearing, visual, and tactile sensory systems. For example, Joe reported on this measure that John demonstrated "distress at loud sounds" and "complains about classroom light" (i.e., over-reactiveness). Consistently, María reported in the initial interview that John had a hard time tolerating noisy environments. In addition to such

sensitivity, Joe reported via the SPM (Miller-Kuhaneck et al., 2007) that John demonstrated sensory seeking activities, such as "makes noises, hums, sings, or yells during quiet class time" and "spins or flicks objects in front of eyes" (i.e., sensory seeking). Regarding his tactile sensory profile, Joe reported through the SPM (Miller-Kuhaneck et al., 2007) that John showed distress when someone accidentally touched him (i.e., over-reactiveness) although he frequently sought out touching peers during class (i.e., seeking). Based on SPM (Miller-Kuhaneck et al., 2007), Joe also reported that John looked for objects that have extreme temperatures (cold or hot) such as windows (i.e., seeking). The combined profile of seeking sensory input while also demonstrating over-reactivity was also supported by NOT-S (Bakke et al., 2007) results, in which Alison reported that John sought sensory stimulation through biting and sucking his hands and objects daily. In fact, I observed John biting a chewy tube or his hands, especially during stressful situations. Alison also reported that John showed over-reactivity to some food textures. Related to this, the SPM (Miller-Kuhaneck et al., 2007) revealed over-reactivity to "tastes and odors of different food." Regarding proprioception, John demonstrated a sensory seeking profile. According to Joe's report via the SPM (Miller-Kuhaneck et al., 2007), John tended to "run, hop, or bounce instead of walk." Also, he used to chew and put in his mouth objects and materials. During the final interview, Alison mentioned that these sensory challenges affect other activities. She stated specifically, "he's actually very smart and I know you don't see this so much at school because he's sensory overwhelmed."

In sum, John expressive communication profile is characterized by single words, emergent word combinations, some conventional gestures, concomitant language comprehension challenges, and poor intelligibility associated with motor speech impairment. His communication profile is likely shaped by fine motor impairment, paired with relative strengths

in gross motor abilities, and sensory-motor differences across visual, hearing, and tactile modalities that suggest both over-sensitivities and sensory-seeking behaviors.

Q2: What is the frequency and nature of peer interactions between John and two of his non-autistic peers during art class?

Frequency of peer interaction. Regarding the frequency of communicative offers, Table 4 provides the frequency of peer interactions between John-Ethan and John-María during the first phase of baseline (i.e., previous to the implementation of social support). To adjust for different session lengths, frequency of peer interactions was presented as communicative offers per five minutes. The average of peer interactions between John and Ethan across the 7 baseline sessions was 1.6 communicative offers/5 minutes (range: 0–2.8). Similar to the John-Ethan dyad, the average of peer interactions between John and María across the same baseline sessions was 1.2 communicative offers/5 minutes (range: 0.4-1.6). Communicative offers between Ethan and María for a random sampling of two baseline sessions (1 and 3) are also presented in Table 4 for comparison and were notably higher, at 8.6 and 5 communicative offers/5 minutes respectively.

Information from initial interviews revealed limited peer interactions between John and his peers at school, which was noted by all participants. When asked who John frequently interacted with, all the adult participants specified John's interactions mainly occurred with adults. Specifically, Alison described herself as John's primary play partner. Leila, the art teacher, mentioned Joe and John's head teacher, and Joe mentioned John's interactions with the SLP, the occupational therapist (OT), and the social worker. During the initial interviews, reported examples of peer interactions primarily included John's twin brother and the other children in his special education classroom. For example, Alison mentioned that John sometimes played with his brother although she noted that "It's very challenging" in general. Joe mentioned

peer interactions involving "the five other kids that are (…) in the functional skills class," while also noting some peers during specials, and also referenced peers who were involved in John's pullout social work activities. Leila specifically mentioned John's limited peer interactions during art class, although she also recognized his attempts to interact with other students. She said: "I've seen him kind of want to interact and kind of go around the kids, but I haven't seen him really…uh…ever...uhm…use cues that they would understand…uh…for interactions."

Ethan also mentioned at the beginning of the study that his interactions with John were relatively rare. When I asked Ethan how often he plays with John, Ethan said: "Hmm well, in P.E., we don't really get to play that much. So, I mean, I don't really play with him that much, but I do play with him a little." When I asked the same question to María in the initial interview, she mentioned that she interacted with John "only in art class when I see [she sees] him." María mentioned that John's interactions occurred mostly with "his special needs friends" whom "he can talk with more." During his initial interview, when I asked John to show me his friends, he used his AAC device —prompted by Joe— to select two friends from the "life skills" class. Given that students from the 3rd grade general education art class were not available on his AAC device at that time, I asked John directly if Ethan was his friend, but John did not appear to respond. John said "yes" when I asked him if he played with Ethan and María. He also said "yes" and nodded when I asked him whether he played with María or Ethan during breaks.

Last, I also took note of limited peer interactions during baseline within my analytical memo. In reflecting on the second observation session I described a specific situation in which Leila was showing John's table materials for the clay project. I noted that even though all students were at the same table as John, none of them were talking to him. I wrote of John, "He

stands up and jumps, waving his arms. Some students look at him, but he interacts mostly with his aid."

Nature of peer interaction. The nature of communicative offers observed during the first baseline phase was examined via behavioral measurements. Table 5 shows the average number of synchrony indicators of each communicative offer per session between John and Ethan and between John and Maria. The average number of synchrony indicators of each communicative offer was calculated by adding the total number of indicators coded per session (across all communicative offers) and dividing that by the total number of communicative offers per session. The average of communicative offer synchrony indicators per session between John and Ethan across the 7 baseline sessions was 1.0 (range: 0–1.5); the most common indicators were eye contact and shared eye gaze (see Table 6). Similar to the John-Ethan dyad, the average communicative offer synchrony indicators per session between John and María across the same baseline sessions was 1.4 (range: 0.8-1.8), with shared eye gaze and eye contact also as the most commonly coded indicators. For comparison, the average communicative offer synchrony indicators between Ethan and María for session 1 and 3 of the first baseline phase was 2.23 (range: 2.1-2.4); in this dyad, the most common synchrony indicators were shared eye gaze, parallel activity, and taking turns.

In addition to the prominence of eye gaze noted from the synchrony analyses, initial interview data and situated discourse analysis from the first baseline phase depicted peer interactions as largely single turn exchanges that tended to be non-egalitarian in nature, sometimes directed explicitly toward the paraprofessional instead of John. Within the initial interview, Joe, described the nature of John's peer interactions during social work time, "She'll (referring to the social worker) always pull a student out, like a peer, and maybe, they'll play a

game together in her office where he uses his communication to say *your turn* or *all done*." Additionally, Joe described one peer interaction occurring during music: "For example, today going to music, he (John) sits down next to María (…) and you know she'll say *hi John*, and John can, you know, recognizes that he's being greeted and will say *hi*."

Next, I offer three examples of interactions from the initial baseline that emerged as salient within the research team discussions. This first example demonstrates a potential for peer interaction that is not actualized, thereby highlighting the limited frequency of peer interactions and the tendency to "talk around" John. This example came from session 7 of the first baseline phase when Leila, the head teacher is preparing the class for drawing one another's portraits (see figure 5).

> ***Drawing each other.*** Ethan and María are seated on one side of the table, while John is seated across them with Joe (the paraprofessional) seated behind him. Each student has an upright mirror in front of them, and Leila, is handing out blank paper to complete the assigned activity of drawing portraits of one another. Given that there are only three children at their table, Leila suggests that all three children could draw one other. María suggests that Leila sit at the table and partner with someone. Joe suggests that Ethan could draw María, and before he could finish speaking, María interrupts him and suggests that Joe could draw with John. Joe says, "That works" and begins to work with John independently.

No communicative offers between John and either peer were coded in this example, thus illustrating the limited nature of peer interaction involving John and the tendency for his peers to interact directly with his paraprofessional instead of him.

Another example of the tendency for the peers to interact with John's paraprofessional instead of John himself is taken from Session 3 of the first baseline phase in which children were working on making tiles for the titanic project (see Figure 6).

> ***Talking to the paraprofessional.*** Ethan and María are seated together on one side of the table, while John sits across from them. Joe is behind John to assist him providing hand-over hand facilitation to scrape paper off of the clay. John is using his left hand to complete the work. María and Ethan are watching what John is doing. María rises her gaze explicitly toward Joe and asks him, "Wait, is he (John) a lefty?" Joe replies, "It kind of depends. He eats with his right hand. He writes with his right hand. But, he uses his left hand to do some other stuff."

There are no communicative offers between John and his peers coded within this example, though it does illustrate the prominent role of eye gaze within the interaction: María and Ethan are both watching what John and Joe are doing. However, it was interesting that when it came to the question of John's handedness, María directed her question explicitly to Joe rather than John himself, and Joe readily responded. Their actions seemed to ignore John's agency and implied that he could not answer for himself.

The third example of baseline interaction is taken from Session 5 during a drawing activity in which children were asked to complete a group sketch of the titanic (see Figure 7).

> ***Drawing the iceberg***. Ethan and John are sitting at opposite sides of the table, facing each other. Joe is sitting behind John, and John appears to be staring off in the distance. Leila approaches the table and asks what Ethan is planning to draw for the titanic sketch. After Ethan explains his idea to Leila, she says, "Now, let's see how to incorporate John." Ethan leans toward John, looks at John and says, "Hey, John." John appears to be

engaging in a self-stimulating behavior by repeatedly tapping the back of his AAC device while he is staring off at an unspecified location. Ethan calls John's name again and asks, "Do you want to draw an iceberg?" John looks at Ethan without a notable change in facial expression and continues tapping his AAC device. Joe puts his own hand on top of John's hand, effectively stopping the tapping. Ethan asks John a second time whether he wants to draw an iceberg. Joe chimes in and repeated the question, but John still does not reply. Ethan insists on John's attention by looking at him again and saying, "Draw an iceberg here, draw an iceberg here, ok John, John, draw an iceberg here." Ethan and John look at the paper that Ethan is showing John. Ethan pushes the paper towards John and hands a pencil to him. John does not take the pencil. He looks at his AAC device and starts tapping it repeatedly again. Joe pulls the paper toward John, takes the pencil offered by Ethan, and physically prompts John to take the pencil, which he does. Ethan looks at Joe and says: "It doesn't really matter what it looks like as long it looks like spiky."

Two communicative offers were coded between John and Ethan in this example. The first communicative offer involved John looking at Ethan after Ethan asked John whether he wanted to draw; eye contact was the only synchrony indicator. The second communicative offer involved both Ethan and John looking at the paper when Ethan was telling John to draw an iceberg; shared eye gaze was coded as the only synchrony indicators. In addition to highlighting the role of eye gaze in the communicative offers, this example illustrates the partial "turn" between the two boys, which was mediated by Joe. Although the boys made eye gaze, the question about wanting to draw seemed to go unanswered. Of interest, Ethan appeared to be assuming a teacher/director role in his interaction with John —prompted by Leila— by giving him instructions for the task. When John does take the pencil, which could be seen as a

reciprocal gesture, Ethan then directs the spoken directions to Joe instead of John (as can be seen by his eye gaze), as if Joe were responsible for what was going to be drawn instead of John.

In sum, peer interactions between John and peers during baseline were relatively limited in frequency and when occurring, were characterized by a prominence of eye gaze, single turns, and a non-egalitarian nature.

Q3: How does direct support for peer interaction shape the frequency and nature of communicative offers between John and two of his non-autistic peers during art class?

Relation between social support and frequency of communicative offers. The relation between social support and the frequency of communicative offers was examined primarily through visual inspection of quantitative data and qualitative data from interviews. The functional relation between the provided social supports and the frequency of communicative offers was examined through the ABAB single case experimental component, which is displayed in Figure 8. Figure 8 shows the frequency of communicative offers between John and Ethan during baseline and social support phases. The x-axis of Figure 8 represents observational sessions across baseline and support phases. The y-axis represents the frequency of communicative offers per 5 minutes. Double lines in the first intervention session mark modification of the provided support through the inclusion of alternative activities. Orange triangles represent data from sessions in which participants were away from the table for the entirety of the session. The black arrow represents the time point at which John's total time in art class was shortened based on reported changes to his IEP. The round purple arrow represents the session in which the microphones were added.

Quantitative analysis of the data through visual inspection revealed a functional relation between the provided social support and the frequency of communicative offers in John-Ethan's

dyad (see Figure 8) through consideration of means, latency, trends, and percent of non-overlapping data (PND). Specifically, mean changes were observed across all phases in the anticipated directions. The average of communicative offers/5 minutes for John-Ethan dyad was 1.6 (range: 0-2.8) for the first baseline phase, 3.0 (range: 1.6-3.9) for the first social support phase (2.5 before supports modification and 3.5 after supports modification), 1.1 (range: 0-2.3) for the second baseline phase, and 3.7 (range: 2.6-5.6) for the second supports phase. In sum, the average number of communicative offers doubled between baseline and social support phases for John and Ethan.

Changes across phases (i.e., latency) were observed immediately for John-Ethan. Specifically, communicative offers changed from 0 to 1.6 communicative/five minutes across the first transition from baseline to social support, though it is important to note that 1.6 did overlap with the range in the dependent variable from the first baseline. However, when comparing the penultimate data point of the first baseline phase to the second data point of the first supports phase, the frequency of communicative offers increases from 1.7 to 3.4 showing effectiveness in a short time frame. The transition from the first phase of social support to the second baseline was immediately associated with a drop from 3.9 to 1.3 communicative offers/5 minutes. Finally, the transition from the second baseline to the final social support phase was associated with a noticeable increase from 0 to 5.3 communicative offers/5 minutes.

Changes regarding trends observed across phases were assessed through linear regression and supported study predictions in three of the four phases. The frequency of communicative offers during the first baseline phase showed a slightly decreasing trend (slope of - 0.08), which changed to an increasing trend (slope of 0.32) during the first supports phase. The trend shifted again to negative (slope of -0.22) during the second baseline—all of which were consistent with

predictions that social supports would lead to increased communicative offers. In contrast to predictions, the second supports phase was associated with a negative trend (slope of -1.33) as well.

Finally, in support of predicted affects, the PND was minimal when baseline and support phases were compared for the John-Ethan dyad. PND between the first baseline phase and the first supports phase was 84.62% when all data points from supports phase were included (before and after supports modification), which is considered an "effective" size effect (cf. Scruggs & Mastropieri, 1998). Similarly, a PND of 100% was observed between the second baseline phase and the second supports phase, which corresponded to a "very effective" treatment effect (cf. Scruggs & Mastropieri, 1998). The overall PND between baseline and support phases was 85%, which is considered "effective" according to Scruggs and Mastropieri (1998) metrics. In sum, the majority of parameters (means, trends, latency, and PND) used to assess effectiveness through visual inspection supported a functional relation of moderate effect size between the provided social support and the frequency of communicative offers between John and Ethan.

Effects observed in the quantitative analysis were also reflected in the final interviews conducted with the primary and secondary participants. Two of three adult participants stated that the provided support had positive effects on John's peer interaction. For example, when I asked Leila about what kind of interactions she had observed recently (post supports) in the classroom, she said: "I've seen lately (…) watching, the kids are going to him (John)…um…and without any prompting (…) and incorporating him." Joe also mentioned that the provided support impacted John's peer interaction. As a follow up question to the observed effects question, I asked Joe what changes he noticed while the support was delivered; Joe replied, "There's more going on, again, working with students as opposed to being at a table with

students where you work on kinda your own thing. There's definitely a lot more active social (…) there's a much great[er] element of that during intervention."

In addition to the reported and observed increase of peer interactions between John and Ethan, I observed more classmates joining John's table during the first support phase compared to the first baseline. From the videotaped classroom observations, I documented five new classmates who gravitated to our table during the first support phase, specifically between Sessions 2 and 5. Three of the five children became our incidental participants and remained at the table for the rest of the program. I also documented the gravitation of children toward our table in my analytic memos. Particularly for Session 3 of the first support phase, I wrote: "We have a new classmate (a girl) on the table in addition to the other two peers that joined us last session. It has become a popular table."

Impact of social supports on the nature of communicative offers. The impact of the social support on the nature of communicative offers was examined quantitatively though measurement of interpersonal synchrony and qualitatively via interviews, researcher analytical memos and discourse analysis. Triangulation of data was conducted across participants and/or data sources. Accordingly, three key findings emerged: 1) increased eye contact, shared activity, and turn-taking during supports phases, 2) emergence of egalitarian interactions during support phases, and 3) adoption of clinician-implemented routines and strategies implemented during supports phases by other adults and peers. Findings are reviewed here by data source.

Interpersonal synchronization. The functional relation between the provided social supports and the quality of communicative offers was examined via synchrony indicators using the ABAB Single Case Experimental design, which is displayed in Figure 9. Figure 9 displays synchrony of communicative offers between John and Ethan across baseline and social support

phases. Like in the frequency of communicative offers graph, the x-axis represents observational sessions across phases. The y-axis represents the average of communicative offer synchrony per session. Double lines in the first intervention session mark modification of the provided support. Black arrow mark modification of amount of time that John participated in the art class because of changes on his IEP. The round purple arrow represents the session in which the microphones were added.

Visual inspection of synchrony data across phases did not provide consistent support for a functional relation between the provided social support and the average synchrony of communicative offers in the John-Ethan dyad (see Figure 9), even though some positive indicators are present. Specifically, mean changes were observed across all phases in the expected direction. The average synchrony of communicative offers for the John-Ethan dyad was 1.1 (range: 0-1.5) for the first baseline phase, 1.5 (range: 0.7-2.9) for first social support phase (1.08 before supports modification and 1.84 after supports modification; range 0.7-2.9), 0.8 (range: 0-1.7) for the second baseline phase, and 1.4 (range: 1.0-1.5) for the second supports phase. In sum, the average communicative offer synchrony increased 0.5 between baseline and social support phases for John and Ethan.

In addition to encouraging mean data, changes across phases (i.e., latency) were observed immediately for John-Ethan across the phases. Specifically, the average of synchrony of communicative offers per session changed from 0 to 0.7 from the first baseline to the first support phase and from 1.4 to 0.7 across the second transition from the first social support phase to the second baseline phase. The transition from the second baseline to the final social support phase was associated with a noticeable increase in average communicative offer synchrony—

from 0 to 1.5 per session. Despite the consistency of the latency data, it is worth noting that there was substantial overlapping data across phases, as will later be noted.

Changes regarding trends observed across phases were operationalized through linear regression and were consistent with predictions for three of four phases. The average of synchrony indicators per communicative offer during the first baseline phase showed a decreasing trend (slope of -0.14), which changed to an increasing trend (slope of 0.27) when supports were implemented during the first supports phase. When comparing data points of the first supports phase and the second baseline phase, trends also differed. The second baseline phase displayed a decreasing trend (slope of -0.11), which is the opposite of the increasing trend observed in the first supports phase. Differences in trend were not observed between the second baseline and the second supports phase (slope of -0.25)—both were decreasing.

In stark contrast to the other indices, the PND did not support a functional relation between the social support and changes in the average synchrony indicators per communicative offers between John and Ethan. PND between the first baseline phase and the first supports phase was only 15.4% when all data points from the supports phase were included (before and after supports modification), which is considered an "ineffective treatment" (cf. Scruggs & Mastropieri, 1998). Similarly, 14.3% of PND was observed between the second baseline phase and the second supports phase. The overall PND between baseline and support phases was 15%.

Additionally, the nature of communicative offers was observed by analyzing the frequency of *individual* synchrony indicators across phases. Table 6 shows the frequency of each coded synchrony indicator per number of sessions presented by phase in the John-Ethan Dyad. Specifically, shared activity, shared eye gaze, eye contact, and turn-taking increased during supports phases, and they were the most common indicators observed. From shared activity,

coordinated activity increased from 0 instances during first and second baseline phases to 1.7 and 2.0 during first and second supports phases, respectively. Shared eye gaze was constant across baseline and first support phases (frequency of 6.0), but it decreased to 2.5 during the second baseline phase and increased again during second support phase to 11.7. Eye contact increased from 1.9 and 0.3 during first and second baseline phases to 3.7 and 4.0 during first and second supports phases. Finally, turn-taking increased from 0.6 and 0.3 during first and second baseline phases to 4.0 and 3.0 during first and second supports phases. In short, although interpersonal synchrony data did not show a functional relation between the provided supports and the average of synchrony indicators per communicative offer, data revealed mean changes with short latency for eye contact, shared eye gaze, coordinated activity, and turns-taking during supports phases.

Changes in nature of peer interactions reported by participants. Interview data provided support for the importance of shared activity and the presence of turn-taking across peers, as well as the emergence of more egalitarian interaction. When I showed the video-clip *catching ball game* from session 4 during the first supports phase and asked Joe what is happening on this video, he specifically noted shared activity (i.e., playing ball) and the presence of turn-taking:

> He's playing ball with the kids. The thing that stands out to me though is because (…) it's a skill that we've worked on (…) a lot of times you play ball with John (…) you'll give him the ball and then he'll just kind of throw it off somewhere, but what stands out to me here is he's actually taking turns with the kids (…) He's really responding to who throws him the ball and then throwing it back or saying oh give it to Elise and throws it to Elise.

During María's final interview, shared activity also emerged when I asked her: "What is going on here?" in response to viewing the video clip, *drawing landscape together* (see Appendix C). Specifically, she responded, "Um, well, we're drawing and we're tracing the

picture and John wants to draw too so he came over, so yeah." When I followed up by asking how she felt about this, María replied: "Happy cause I'm there and, um, John is... participating in the activity and I feel like he's having fun." Ethan also mentioned the role of shared activity in his final interview. When I asked him what activities he engaged in with John during art class, Ethan mentioned one of the supplemental activities, specifically a dice game, that I had introduced during session 6 of the first supports phase. He specified, "I remember we did this thing like where you would role this dice, and it would say something (…) it says like sticker you would put a sticker on it and like, and we played that with John."

In addition to specifying the activities, the verbs that Joe, Maria, and Ethan chose—"playing," "participating," "having fun," and "we played"—were indicative of emergent egalitarian interaction. Such descriptions contrasted with *drawing the iceberg* example from baseline when Ethan's role appeared more consistent with directing John's participation in the activity. Leila also mentioned more egalitarian interactions during the final interview. When I asked her about the kind of interactions that she has observed between John and the peer participants, Leila said:

> The last session (…) I saw María literally reach over the table and uh talk to John about whatever we were doing some glazing uh mixing glaze or whatever and uh she just had a lot of joy on her face uh with that and she really was intending to interact with John and to and to invite him into an interaction (…) I thought that was awesome.

When I asked her specifically, whether she noted any change in terms of interaction after the support began, Leila stated:

> It just became much more um uh natural and easy (…) I didn't see Ethan as much the last time, but I know that I saw him before at other times voluntarily uh going to John and not

like they kinda had to (…) Ethan seemed to be consistently interested and and cooperative about that and kinda volunteering.

Although egalitarian interactions were emergent, non-egalitarian elements continued to persist. For example, in the previous quote, Leila mentioned that Ethan "volunteered" for interacting with John, which appears to approach the role as more of a task than a mutually enjoyable friendship. Similarly, Joe's final interview also referenced elements of hierarchical peer interaction even after the provision of supports. When I showed Joe the *drawing a landscape together* video clip where John, María, and Ethan were drawing a landscape together during session two of the second supports phase (see Appendix C), Joe stated:

> I remember this session, and I remember thinking that he was engaged with it more so than he normally would be (…) I suppose it stands out to me that when he does draw uhm…when he when he starts to do it he's immediately reinforced positively by María and Ethan who say oh good job good job John high five (…) it's something that you don't always get from John uh that he is kinda in there between two kids and wanting to do what they're doing."

In particular, his reference to María and Ethan providing immediate positive reinforcement to John appears consistent with viewing them in more of an instructor than friendship role, although the two roles need not be mutually exclusive. It is also relevant to note that Joe is reporting María's use of a practice (e.g., giving high fives) to John that I introduced in Session 3 of the first supports phase as a means to promote nonverbal interaction and turn-taking. We did not observe peers initiating high fives with John at any point before I introduced it.

In addition to support for an increase in some synchrony indicators and emergent egalitarian interactions, interview data also revealed changes in how Joe conceptualized his role

with John. After we saw the *self-portraits* clip (see Appendix C), I asked him what he would do differently. Joe replied: "…rather than working on something with him or having me basically kinda going it hand-over-hand with him, ya know, have him work with another student?" Additionally, differences between Joe's responses during the initial and final interview also demonstrated how the provided supports changed Joe's conception of his own role during art class. During the initial interview, I asked Joe what kind of activities are part of his job. He replied, "Basically I just go through his daily schedule with him from the time that he gets here." In contrast, during the final interview, I asked Joe how he conceptualizes his role with John at school. Joe replied that he prevents John from running away, and he added, "I feel like I also am there to …try to facilitate interaction with him and other students so … that's my main role."

Changes in nature of peer interactions observed within discourse analysis. The adoption of clinician-implemented routines and strategies were also noted through discourse analysis, as were eye gaze, turn-taking, shared activity, and the emergence of egalitarian interactions.

This first example was taken from session four of the first intervention phase. The specified art class activity was drawing self-portraits, but I had brought stickers and a ball in order to better capitalize on John's interests and strengths (see Figure 10).

> ***Catching ball game.*** Ethan, John, Mymo, Elise, and another classmate are all sitting at the same table. Ethan is sitting between Mymo and another classmate on the opposite side from John. Elise is sitting at the head of the table between Mymo and John. Joe and I are standing slightly behind John. All the children are playing with stickers by putting them on their faces and looking at themselves in the mirror while John darts away from the table. I take out a small, colorful ball to motivate John to come back to the table and

ask him if he wants to throw it to Mymo. John reaches for the ball and initiates throwing it to Mymo. John and Mymo pass the ball back and few times while they share eye gaze toward the ball, and Ethan and Elise watch them. Elise asks John if she can have the ball, but John continues throwing the ball toward Mymo. At this point, Joe comments to me about how John has been working on turn taking, and that this activity is particularly good for him. I verbally prompt John to pass the ball to Elise, and they pass it back and forth. John tries to pass the ball to Ethan, but the ball is blocked by one of the mirrors. I move the mirror away and say, "Ethan, I think he wants to play with you." Ethan throws the ball to John, and they throw it back and forth making eye contact. Ethan throws the ball to Elise, and she passes it back to John while sharing eye gaze toward the ball. John throws the ball to the classmate on the right of Ethan, but he does not notice and the ball falls on the ground.

In terms of frequency of interaction, this example included one coded communicative offer between John and Ethan from which eye contact, shared eye gaze, shared activity, and turn-taking were coded as synchrony indicators. Also notable in this example is the relatively egalitarian roles adopted by all the children. In fact, Elise asked John directly if she could have the ball, a request which acknowledged his agency and differed from prior peer questions that had been directed toward the paraprofessional. For example, the nature of the interaction contrasted with the *Drawing the iceberg* example presented from baseline, in which Ethan took on the role of instructor/director in his interaction with John and also the *Talking to the paraprofessional* example in which María directed her question about John's handedness directly to his paraprofessional instead of John.

This second example from the discourse analysis is taken from the first session of the second baseline phase and illustrated the adoption of a greeting routine that I had initiated during the first support phase (see Figure 11).

Paraprofessional strategies. John and Joe walk into the room and up to their assigned table where Ethan, Gold, María, and Elise are already seated. Joe verbally prompts John to greet his peers by saying, "Say hi to Elise, say hi María…" and by physically taking John's arm to initiate a wave to each of his peers. Ethan anticipates John's greeting and says, "Hi John." Each peer responds by saying hello to John while waving. When John finishes greeting everyone at the table, María says, "Can I have a high five?" and reaches out to John for a high five. Joe physically scaffolds this interaction by helping John high five María. Gold then also asks John for a high five to which John appears not to respond. She continues to call his name to get his attention to ask for a high five. María and Ethan also start calling John's name to get his attention. John turns to Gold and places his hand on her outstretched hand. Gold then says, "John, can I have a high five?" and rises her hand. He looks at her, smiles to her, and gives her a high five without any prompting from Joe. María exclaims "Yeah!"

This example included three communicative offers between Ethan-John and four between María-John. Synchrony indicators included turn-taking and eye contact. Also, this example highlighted the emergence of more egalitarian interaction when peers directed the speech to John instead of to Joe; however, the direct prompting (e.g., "Can I have a high five?") still appear somewhat indicative of an instructor role. Also notable from this example is how peers and Joe had adopted some of the routines I had implemented during session three of the first support phase when I asked John to give me a high five as a form of greeting. In a comparable way, Joe

verbally asked and physically prompted John to greet classmates at the beginning of the session. Also, John's classmates utilized the high-five as a form of greeting as I had introduced previously. The greeting routine highlighted in this example was supported by my analytical memo from that session. Specifically, I noted that Joe has "taken the ritual to say hello and bye to John prompting John to say hi to his classmates".

This final example from the discourse analysis came from session 1 of the second supports phase in which students were drawing animals (see Figure 12).

> ***AAC device.*** John is standing up on one side of the table, and I am standing up right next to him. María, Ethan, and another classmate are on the opposite side of the table with Gold in between them and Joe. John is vocalizing, nodding/shaking his head, extending his arms toward the front, and looking toward the back of the room. I am trying to figure out what he wants, and Joe approaches the table to help me. Gold and María are also looking at John when María smiles at the classmate next to her and says," He's saying something to you." John is still vocalizing and nodding. I ask his peers, "What do you think guys?" María points toward a different table and offers, "Maybe he might be looking at the paint colors right there." I ask John if he wants to paint. John stops vocalizing for a second, looks down briefly, and then returns to vocalizing, nodding, and looking in the same direction as he had been. Ethan enters the conversation by adding, "It kind of sounds like he's saying 'ball'." John yells, continues to vocalize and raises his hands. I improvise a ball for him by crumpling up a piece of paper. John leaves the table, moving toward Joe and vocalizing. Joe interprets that John wants a break and explains to him that we will take a break later. John comes back to the table and sits quietly. I prompt John to play ball with Ethan. Ethan throws the ball and John catches it, but instead of

throwing it back, he throws the ball on the table and smiles. John stands up and looks toward Joe while biting on his own hand. Joe asks, "Do you want me to say something with your talker?" Joe grabs the AAC device and passes it to John. I add, "Do you want to see your friend in the iPad?" Joe points to Gold, and asks John, "Who is that one?" John selects "Gold" via his AAC device. Joe and I are prompting John to say names of his friends with his iPad. Gold comes to watch what's happening and starts touching the AAC device. Ethan comes over to watch too. John and Gold start exploring the iPad together. John uses his AAC device to say, "Elise." It seems perhaps that John has been asking for Elise the whole time. I ask Elise to come to the table to say hi to John. Elise comes and greets John, and then, she asks him whether she could return back to her table to which John replies no by moving his head side to side.

This example represented 10 communicative offers; 4 of which included eye contact, 5 of which included shared eye gaze, and 2 of which included turn-taking. Note in particular the use of behavioral interpretation when María told her classmate, "He's saying something to you." In addition, María and Ethan both offer possible meanings of John's excited nonverbal behavior: María suggested that he might be referring to paint colors on another table, and Ethan offered that he might want to play ball. Such instances of behavioral interpretation by peers was not noted prior to the provision of social supports. Before this example, the clinician had illustrated behavioral interpretation a total of 10 times during the first supports phase. Peer use of behavioral interpretation was also supported by my analytical memo from the first session of the second baseline. Specifically, Leila had asked all children what they decided to draw. Then, she asked specifically what John (who was not at the table at that moment) decided to draw. Gold, Elise, and María said that they did not now, but Ethan said, "I think he tried to draw a ball." I

wrote in my memo, “Ethan provided an interpretation about John’s drawing. He never did it before!” Attributing meaning to John’s actions and activities is indicative of presumed competence, a prerequisite for building egalitarian peer interactions.

Social Validity

The social validity of provided supports was examined via interview data across all participants. In general, results supported the importance of shared and engaging activities for creating successful interactions and provided somewhat mixed results regarding the nature of peer interactions. First related to the role of activity, Joe mentioned the role of shared activity when I asked him about the utility of the provided supports:

> You had some good stuff that you brought in to sort of get him engaged I I thought (…) I think that trying different things and really focusing on getting him to work with other students toward a common rather than having them in four different places working on four different things around the table…having him actively working with the students uhm on the same project uh I think was probably helpful you know.

The role of activity came up for children too. When I asked what they liked about the provided supports, Ethan said: “I like it more just because we’re not doing the same thing but we’re doing something a little bit different.” María said: “I would say, um, when we got to use the stuff that you got- that was really fun (…) that was the one I really really liked. Elise, an incidental participant, also made positive comments during her written interview. She said that she liked to work on this table because “I don’t [she does not] always have to do what everyone does and I love [she loves] these activities.”

In regard to the relative roles within the peer interactions, some mentioned the egalitarian nature of the interaction in which learning and enjoyment were reciprocal, whereas others

focused on the value in "helping" John, which suggests a less egalitarian role. In regard to shared learning, Joe mentioned, "I think from the perspective of the other students in this class, (…) it's helped them also grow uh you know see in interact with him more than they normally would." Leila also mentioned the mutual enjoyment for all children involved; during the final interview she stated:

> It seems like the intervention (…) have worked uh and have been uh fun uh for John and ah conducive to getting him to interact. (…) the other kids have seemed to enjoy it too uh and get involved with it. So, it's it's I think it's been very useful.

One incidental participant, Gold, expressed enjoyment as a reason for working at our table: "I like it because it is fun, and I like spending time with my friends." When I asked Mymo how he felt about working at this table, he said "good about myself." One incidental participant, Elisa, specified that she learned "how to interact with John." However, the idea of helping John also emerged; Gold noted," I wanted to help John do things and help him figure out words."

On a related note, there was also evidence that the supports might have sometimes felt like a burden, largely because they specified/limited who one was expected to interact with. For example, María left the table during the second session of the first support phase, and she did not return until the sixth session of the first support phase. Accordingly, during the final interview, I asked her why she decided to leave the table. She replied:

> Well I just wanted to be with my friends and I didn't want to tell you no because I thought that was kind of rude. So, I just kind of took a break and kind of left because, um, I just wanted a little break and I didn't want to say no like I don't wanna be filmed and I thought that was rude, but I eventually was going to come back.

Ethan mentioned that he would like to have more people involved. When I asked him what he did not like from this program, he said: "I don't really like it when I am pretty much the only person actually like playing and doing the thing. I normally like it when other people do it too." Elise said that she would like to change, "some girls that work and that's it."

Friend nomination also changed after the support was implemented. During the final interview, Ethan mentioned that John had become his friend after the program. María also mentioned John as her friend during the final interview although she said that he was her friend even before the support was implemented. However, during the same interview she said, "Well, the f- the beginning of it, I didn't really know him that well but now (she nods) I know him well." Two of the three incidental peers documented that after participating in this program they know more about John, and one of them mentioned that after the program he and John became friends. For example, when I asked Mymo if he knows the same about John before and after sitting at this table, Mymo stated: "No, I know a lot more." Also, Mymo said "no" when I asked him if he and John were friends before he sat on this table, and he say "yes" when I asked whether John was his friend now. John's specified friends were consistent before and after the delivered support. Specifically, when I asked John who his friends were during his final interview, he pointed to three of his classmates in the life skills class on his AAC device; two of them were also mentioned by John during the initial interview. John did not select any of his classmates from art even though they were now available on his AAC device.

In the final interviews, I asked participants what they would change. As previously mentioned, a couple of the children mentioned interest in changing/expanding the pool of peer participants. In addition, María and Gold mentioned that nothing should be changed. Of particular interest, Alison expressed that even though it was "great" to see John interacting with

other peers (after viewing a clip of playing ball), she thought that the activities still did not represent the extent of John's abilities. She said: "Nobody can picture him actually being able to understand more than this." Joe also mentioned some suggestions regarding the setting for this program. Joe said:

> I think art provides a really nice set up because you have like the table and you could kinda isolate your group and its especially good with the technology (…) perhaps in in a different setting because the truth of the matter is he's just not that engaged in that class(…) if you wanna see him highly motivated by something like if I take him into the gym and it's me and him and I hold onto the a ball here you go here's the ball so it's it's something that I feel like if we would of found something maybe a greater source of motivation for him.

CHAPTER 4: DISCUSSION

This study employed a mixed methods case study design to examine peer interaction involving a 9-year-old autistic child, John, and his non-autistic classmates during art class using a supports-based approach. In regard to key findings, John's expressive language profile was characterized by use of single words, emergent word combinations, some conventional gestures, concomitant language comprehension challenges, and poor intelligibility associated with motor speech impairment. His communication profile was likely shaped by fine motor impairment, paired with relative strengths in gross motor abilities, and sensory-motor differences that suggested both over-sensitivities and sensory-seeking behaviors across visual, hearing, and tactile modalities. Regarding John's peer interactions during art class at the beginning of the study, triangulated findings across data sources indicated a limited frequency of peer interactions that were characterized by a prominence of eye gaze, single turns, and a non-egalitarian nature. In considering the influence of social supports, convergence across data sources supported an increase in the frequency of peer interactions. Such interactions were characterized by increases in shared eye gaze, eye contact, shared activity, turn-taking, the adoption of routines and strategies used during support phases, and emergent egalitarian interactions. The following paragraphs will discuss key findings for each of the three research questions and how they contribute to the available literature. I will close with a consideration of future directions.

John's Communication Profile.

Key findings related to John's communication profile add to available literature in at least three ways. First, it provides a thick and rich description of an autistic child with limited speech, which helps represent a population that has been significantly understudied, especially in regard to peer interaction (Tager-Flusberg & Kasari, 2013). To the best of my knowledge, there is only

one other study examining the communication profile of an autistic child with limited speech and a history of PANDAS, and that other study (Cosford, 2009) provided a very limited description of speech and language abilities. In several ways this study is consistent with the small literature that is already available, particularly in regard to John's limited expressive vocabulary which was composed mainly of echolalic productions (Cosford, 2009; Kasari et al., 2013; Tager-Flusberg & Kasari, 2013). John's profile was consistent with Kasari and colleagues' (2013) description of minimally verbal children as having "a very small repertoire of spoken words or fixed phrases that are used communicatively" and that sometimes include "echolalic or stereotyped language" (p.480). In addition, the study highlighted John's use of multimodal communicative resources, including eye gaze, gestures, and access to AAC, which has been referenced in other studies of minimally-verbal autistic children as well (Tager-Flusberg et al. 2013; Vidal, Robertson, et al. 2018). Of particular interest, John's difficulties in speech production, intelligibility, and receptive language were broadly consistent with Cosford (2009) description of Child A, an autistic child with PANDAS described as having "marked difficulties with both expressive and receptive language… difficulties in pronunciation of some (consonants) [and]… poor speech intelligibility" (p.40).

A second relation between John's communication profile and prior literature is the documentation of autistic individuals' sensory-motor differences in general, and motor speech impairment in particular. In particular, the DSM-V (2013) explicitly acknowledges potential sensory-motor differences in autistic individuals, noting a tendency to present repetitive movements and over- or under-reactivity to certain sensory stimuli. Although evidence of motor impairment/differences in autistic children is fairly prevalent (e.g., Couture et al., 2009; Donnellan et al., 2012; Ming et al., 2007; Provost et al., 2007; Sipes et al., 2011), specification of

the prevalence and nature of this motor speech impairment is unresolved, especially in regard to whether or not apraxic features are present (cf. Shriberg et al., 2011; Tierney et al., 2015). John's motor speech profile appeared consistent with childhood apraxia of speech in his articulation errors and unusual prosody. However, the full extent of his sensory-motor differences, paired with difficulty in completing standardized assessments, made differential diagnosis difficult.

It is interesting to consider how John's profile relates to the literature that examines the nature of sensory-motor differences in autistic adults and highlights how understanding such differences might challenge conventional assumptions about autism and social interaction (e.g., (Donnellan et al., 2012; Robledo & Donnellan, 2016). In particular Donnellan and colleagues (2012) note:

> Organizing and regulating sensory information and movement in order to participate in social relationship may be frustrating for people with such differences. These differences can involve difficulties initiating and executing movements or difficulties with stopping, combining, and switching sensation and movement, including speech, thought and emotion (…) making social relationship and many other activities very challenging and even overwhelming.

In several ways John's profile seemed consistent with this literature, in particular evidence of difficulty with motor planning paired with heightened reactivity and sensory seeking behaviors. Such sensory-motor differences likely contributed to the impression that he was less socially engaged and capable than he really was. Leila, the head art teacher, noted that John show an interest in interacting with peers, but not in ways they could easily understand. Specifically, she noted his tendency to "…kind of go around the kids, but I haven't seen him really…use cues that they would understand..." Accordingly, baseline observational data

indicated that peers often "talked around" John or directed their questions to his paraprofessional (Joe), indicating a potential underestimation of John's competency and/or interest in responding. María, one of John's classmates, also seemed aware of this possibility to some extent. During the initial interview she noted that John, "…can do a lot of things he doesn't really show he can do." John's mom commented that it was difficult to see at school how smart John really was because he was "sensory overwhelmed." Consistent with this conclusion, Joe mentioned that he was surprised to see John so engaged with peers and taking multiple turns during the *catching ball game* clip, even though Alison's reaction to this video clip was that this was a very basic activity for him. In short, it is interesting and important to consider the extent to which John's sensory-motor differences may be an integral aspect of his disability that contributes to misconceptions about his abilities and extent of sociality. Underestimating the sociality of autistic individuals can have deleterious effects.

A third and related consideration was the difficulty in achieving valid differential diagnostic information for John, particularly in regard to the nature of his speech impairment and also his receptive language abilities. The challenges of achieving valid and reliable assessment data for minimally-verbal autistic children in general, and in relation to receptive language in particular, has been highlighted across prior literature (Kasari et al., 2010, 2013; Tager-Flusberg & Kasari, 2013). One important factor is that available measurements are not well-suited to assess receptive language in autistic children with sensory-motor differences. Many of the tests draw on cognitive abilities such as attention, motivation, and coping with frustration which can be particularly challenging for autistic students (Kasari et al., 2010, 2013; Tager-Flusberg & Kasari, 2013). Accordingly, it was difficult to isolate receptive impairments from other domains. Additionally, many of the assessments used to assess receptive skills in this population, such as

the MacArthur CDI (Fenson et al., 2006), have been developed for younger children, and they have not been validated for school-age children (Kasari et al., 2013). Such findings underscore the need for multiple forms of assessment, with a heavy reliance on observational data across varied contexts and interviews with familiar communicative partners.

Peer Interactions Previous to Delivered Support.

The second research question of this study focused on describing John's peer interactions during art class. Like many previous studies, most of which have focused on more verbal autistic children (e.g., Bauminger & Kasari, 2000; Reilly et al., 2014), this study revealed relatively limited frequency of peer interaction (i.e., roughly one to two communicative offers every five minutes). These results are consistent with DeThorne et al. (2015) and Vidal (2016), both of which reported one to three communicative offers every five minutes in a minimally verbal autistic child within both a preschool and later early elementary school setting. The present study also contributes notably by providing descriptive information on the nature of communicative offers across peers. Whereas prior studies have tended to focus on verbal aspects of peer interaction (e.g., Reilly et al., 2014), the present study focused explicitly on communication as distributed across multimodal resources. Both dependent variables, communicative offers and synchrony indicators, were multimodal in nature, incorporating such behaviors as eye gaze, gestures, corporeal alignment, etc. Of particular interest, shared eye gaze emerged as the most common synchrony indicator during the initial baseline phase, with eye contact as the second most common (see Table 5). These findings contradict many autism studies that tend to characterize autistic individuals as lacking eye contact and joint attention skills (e.g., Baron-Cohen, 1989; Mundy & Crowson, 1997; Wetherby et al., 2004). However, the present study's finding is consistent with the qualitative study by DeThorne et al. (2015) which documented

frequent fleeting eye contact by Aaron, a preschool-age autistic child, in his classroom interactions. Readers are also referred to previous studies that have found that autistic individuals have different gaze patterns compare to neurotypicals when exploring faces, in particular a tendency to focus less in the eye region and more on the mouth region compared with neurotypical peers (e.g., Sterling et al., 2008; Van Der Geest et al., 2002). In addition, ethnographic work by Ochs and Solomon (2010) indicated that non-face-to-face alignment, such as shared gaze toward a common object, may be more consistent with autistic sociality. Specifically, Ochs and Solomon state, "Although securing the attention of a child severely impacted with autism is often very challenging, non-face-to-face alignments may optimize opportunities for social coordination for severely affected persons with autism in ways that face-to-face interaction does not" (p.81). In sum, patterns of eye contact and eye gaze in autistic individuals are more accurately depicted as different rather than lacking and are likely shaped by multiple aspects of the context. Such contextual details highlight the role of activity, partner, and resources on the nature of peer interaction.

Related to the role of communicative partners, the present study revealed the tendency of John's peers to interact with John's paraprofessional instead of John and when interacting directly with John to take on a role of instructor/director, especially within the initial baseline sessions. As examples, recall how María asked Joe whether or not John was left-handed, even though John was seated right there, and how Ethan assumed a teacher role in the *drawing the iceberg* excerpt. These examples help illustrate the importance of presumed competence by communicative partners, which may be particularly critical for nonspeaking autistic individuals, (cf. DeThorne et al., 2015; Robledo & Donnellan, 2016) and the need for educators, parents, and therapists to consider how children are being socialized into interacting with one another. Adults

can intentionally or inadvertently be socializing peer into hierarchical interactions. For example, consider Leila's comment of "Now, let's see how to incorporate John" in the *Drawing the iceberg* scenario, a comment which could be seen as framing John's inclusion as a "task" rather than a mutually-enjoyable activity. Similarly, my verbal prompt to John of "Can you give me a high five?" was taken up both by Joe and non-autistic classmates (see both María and Gold in the example *Paraprofessional strategies*) and could be viewed as evidence that I unintentionally socialized John's peers into more of clinician/teacher role.

Changes in frequency and nature of peer interactions after provided social support

Related to the importance of communicative partners, the third research question explored the influence of providing social support for peer interaction. To the best of my knowledge, this is one of the first studies demonstrating experimental evidence related to an explicit supports-based approach. Whereas previous intervention studies have used certain features of a supports-based approach, such as the focus on shared activity (R. Koegel et al., 2012), few studies have incorporated all three of the elements as highlighted by Vidal et al. (2018): a) focus on participation in shared activity, b) encourage the flexible use of multiple communicative resources, and c) support egalitarian interaction. This current study contributed explicitly to the supports-based approach as an evidence-based practice by using an experimental single case design to demonstrate changes in the frequency of communicative offers associated with the provided supports; those changes were tied to increased eye contact, shared eye gaze, shared activities, and turn-taking. In addition, the mixed method design offered evidence of social validity.

Specifically related to egalitarian interactions, the present study revealed emergent egalitarian interactions between John and his peers after support was implemented. However, as

previously mentioned the persistence of non-egalitarian or hierarchical interactions between John and peers suggests that considering other environmental factors is relevant for attaining more success in this area. In particular, pre-existing ableist attitudes of peers, school personnel, and even the therapist impacts the nature of peer interactions. For example, peers' behaviors as role models to teach John how to complete the assignments, the narratives of adult participants about peers as volunteers, and the promotion of helping dynamics by the therapist and adult participants contributed to power imbalance dynamics hindering his opportunities to be socialized into more egalitarian interactions. Similar issues have been described in the literature pointing out the negative impact of ableism on education (Hehir, 2002; Shyman, 2016). To address this issue, it could be important to develop activities that place autistic students in the role of expert (see Vidal, Robertson, et al., 2018; Wolfberg et al., 2008). During such activities, adults should consistently scaffold interactions and interpret child behaviors to promote more awareness and understanding between students (see Robertson, 2011; Vidal, Ernat, et al., 2018; Wolfberg et al., 2008).

In addition to ableist attitudes, another factor that appeared to contribute to the persistence of non-egalitarian interactions was the current educational infrastructure that tended to segregate children with substantial special education support needs. In the present case, John's formalized instruction was primarily conducted at home or within a segregated special education classroom. Specifically, he spent approximately 20-40 minutes per day within his 3rd grade general education class, and even then, baseline data suggested that this time in the same physical classroom was spent in relative social isolation. John's art classmates mentioned in their interviews that they had limited interactions with John, in part because they rarely saw him. In contrast, Elise —who was a family friend outside of school— showed a special affinity with

John and more understanding of his differences. Accordingly, more time engaged together seems critical for building successful peer relationships, particularly for autistic individuals who are likely to demonstrate relatively idiosyncratic patterns of interaction. This claim is supported by previous literature stating that the amount of peer interactions and the opportunity of developing friendship is associated with the amount of time that peers spend together (Antia & Kreimeyer, 2001). In addition to physical segregation, there were dissociation between John's academic curriculum and the general education curriculum of his non-autistic peers. Specifically, John's education appeared delineated as a responsibility of the special education team, which did not appear to communicate regularly with the general education art teacher. During the initial interview, Leila explicitly mentioned this issue reporting that she knew little about John and that she did not obtain access to his IEP even when she asked for it.

A third factor that likely contributed to the continuance of non-egalitarian peer interactions within the present study was the nature of activities conducted during art class. School-based activities tended to privilege abilities that were not John's strengths and interests. Particularly, the observed art class activities drew heavily on fine motor skills (e.g., drawing, painting, and clay modeling), which were especially challenging and potentially unmotivating for John. Compare for example, the hierarchical peer interactions during the *Drawing the iceberg* example that drew on fine motor skills that were difficult for John, relative to the multi-turn and multi-party interactions in the *catching ball* example, an activity that drew on John's gross motor skills and interests. Previous literature also has stated the relevance of designing meaningful and motivating activities to encourage peer interactions in autistic children in a more egalitarian way (Finke, 2016; R. Koegel et al., 2012; Vidal, Robertson, et al., 2018). Shared interests and suggested activities will vary based on the specific individuals, but prior studies of friendships

involving autistic students have noted music, watching videos, playing on the computer and ball games as common interests (Bauminger & Shulman, 2003; Finke, 2016; Vidal, Robertson, et al., 2018).

Finally, the present study also illustrated the related role of time in shaping patterns of interaction. In this study, it was observed that routines and patterns of interactions implemented during support phases were taken up by adults and peers. As an example, Joe expanded his concept of his role from preventing John running away and helping him in academic work to include facilitating peer interaction—a role that is consistent with prior studies that highlight the key role of supporting adults as cultural brokers or behavioral interpreters in peer interaction (cf. Robertson, 2011; Vidal, Ernat, DeThorne, 2018; Wolfberg et al., 2008). Peers also shaped their patterns of interaction by taking up some of the routines (e.g., high five) and strategies (e.g., behavioral interpretation) provided during support phases. Similar findings were found in a study conducted by Vidal and colleagues (2018) that also revealed changes in patterns of interactions after supports were delivered.

The importance of time and the complex dynamics of peers and supporting adults relates to a complication in implementing the ABAB design. ABAB design inherently relies on the repeated implementation and withdrawal of supports to demonstrate a functional relationship between the independent variable (i.e., supports) and the dependent variable (i.e., communicative offers). While demonstrating a functional relationship is currently essential to providing the experimental evidence required for evidence-based practices (ASHA, 2005), the method inherently interrupts the relationships and patterns of interaction established across participants. After the second baseline phase, I found it difficult to re-establish the patterns of interaction that we had built during the first supports phase. One indication of this was the particularly high number of

strategies I employed in the first session of the second support phase (i.e., 16 strategies/10 minutes), which was significantly higher related to the overall average of the rest of the sessions (i.e., average of 8 strategies/10 minutes). Another indication of the difficulties in re-establishing the patters of interactions during the second support phase was the number of peers at the table. In particular, during the first two sessions of the second supports phase, Elise and Mymo —who had been present for the last four sessions of the first support phase— were away from the table for the whole session, returning just for the third session. My hope is that this study helps to contribute to discussions about what methodologies are the most suitable for studying peer interaction, especially within the context of naturalistic settings.

Future Directions.

The present study suggests three avenues for future directions. First, additional research into autistic children with inconsistent access to speech should be conducted. Special emphasis should be placed in evaluating the possibility that there is a meaningful subtype of children with significant sensory-motor differences at the root of their communicative profile (including peer interaction challenges) and how such differences may or may not be directly related to PANDAS.

Second, further research, both basic and applied, is needed to examine peer interaction using a distributed model and the associated supports-based approach. Broadening our lens of what peer interaction in autistic children with inconsistent access to speech looks like and how best to support them is critical if we are trying to make changes to quality of life indicators such as friendship networks and community participation.

Related to this, the third and final avenue I will highlight here is encouraging future studies that directly provide support for school personnel using a supports-based approach.

Training personnel from this approach will help to reduce ableist attitudes and socialize autistic students and their peers into more egalitarian interactions and friendships. It will give autistic students and non-autistic peers the opportunity to better understand each other by highlighting commonalities, interests, and strengths that are not always evident when peer interaction is approached from a skills-based approach. This also would help to address the double empathy issue described by Milton and Sims (2016), supporting peers in being more aware of the differences associated with autistic sociality. In closing, it is our responsibility as speech-language pathologists to offer all students the chance to experience social interaction that respects and values diversity.

FIGURES AND TABLES

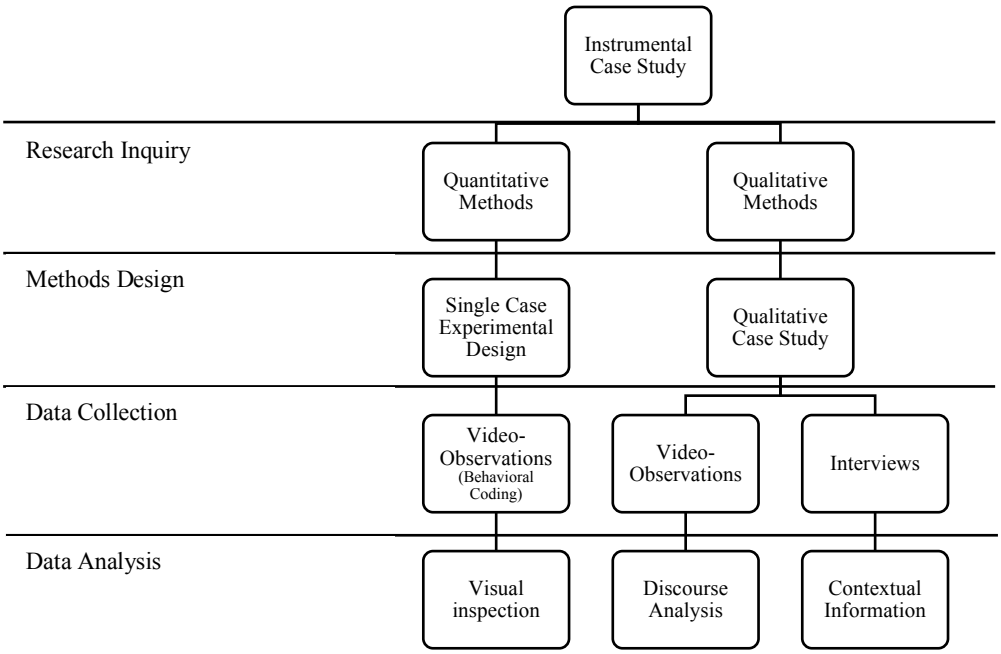


Figure 1: Summary of research methods employed in this study

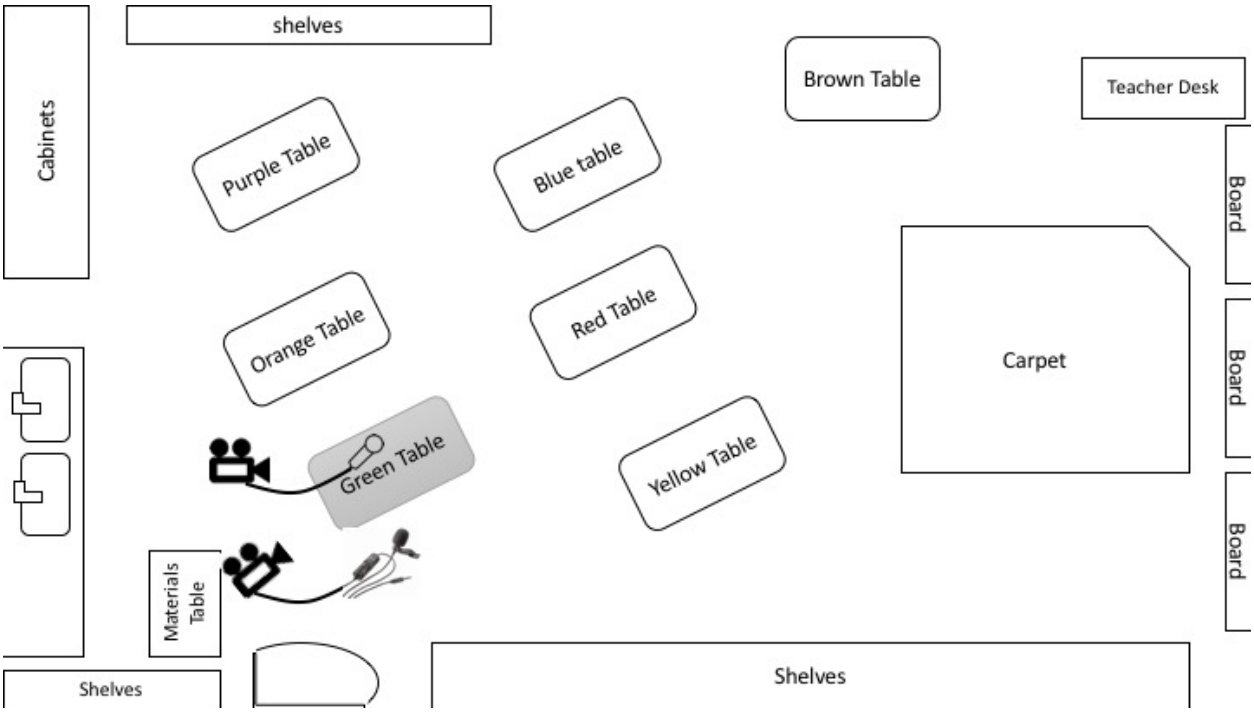


Figure 2: *Art classroom map including camera and microphones positions*.

Figure 3: Samples of art projects conducted during the study

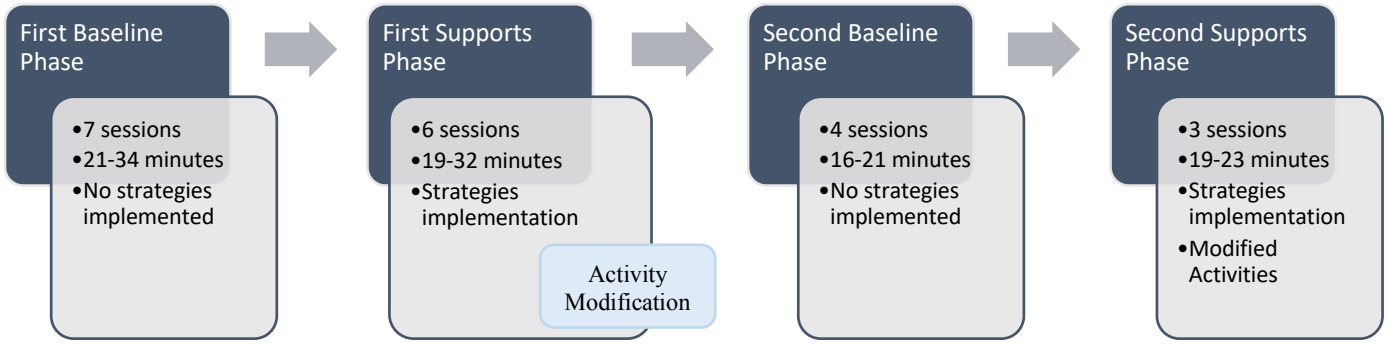


Figure 4: Scheme of the experimental design

Given that there are only three children at their table, Leila suggests that all three children could draw one another. María suggests that Leila sit at the table and partner with someone.

Joe suggests that Ethan could draw Maria.

María interrupts him and suggests that Joe could draw with John.

Joe says, "That works" and begins to work with John independently.

Figure 5: Drawing each other example.

Joe is behind John to assist him providing hand-over hand facilitation to scrape paper off of the clay. John is using his left hand to complete the work. Ethan and Maria are watching what John is doing.

Maria rises her gaze explicitly toward Joe and asks him, "Wait, is he (John) a lefty?"

Joe replies, "It kind of depends. He eats with his right hand. He writes with his right hand. But, he uses his left hand to do some other stuff."

Figure 6: Talking to the paraprofessional example.

Leila approaches to the table and asks for what Ethan is planning to draw for the titanic sketch. After Ethan explained his idea to Leila, she says, ""Now, let's see how to incorporate John."

Ethan leans toward John, looks at John and says, "Hey, John." John appears to be engaging in a self-stimulating behavior by repeatedly tapping the back of his AAC device while he is staring off at an unspecified location. Ethan calls John's name again and asks, "Do you want to draw an iceberg?" John looks at Ethan without a notable change in facial expression and continues tapping his AAC device.

Joe puts his own hand on top of John's hand, effectively stopping the tapping. Ethan asks John a second time whether he wants to draw an iceberg. Joe chimes in and repeated the question, but John still does not reply. Ethan pushes the paper towards John and hands a pencil to him. John does not take the pencil.

Joe pulls the paper toward John, takes the pencil offered by Ethan, and physically prompts John to take the pencil. Ethan looks at Joe and says: "It doesn't really matter what it looks like as long it looks like spiky."

Figure 7: Drawing the iceberg example.

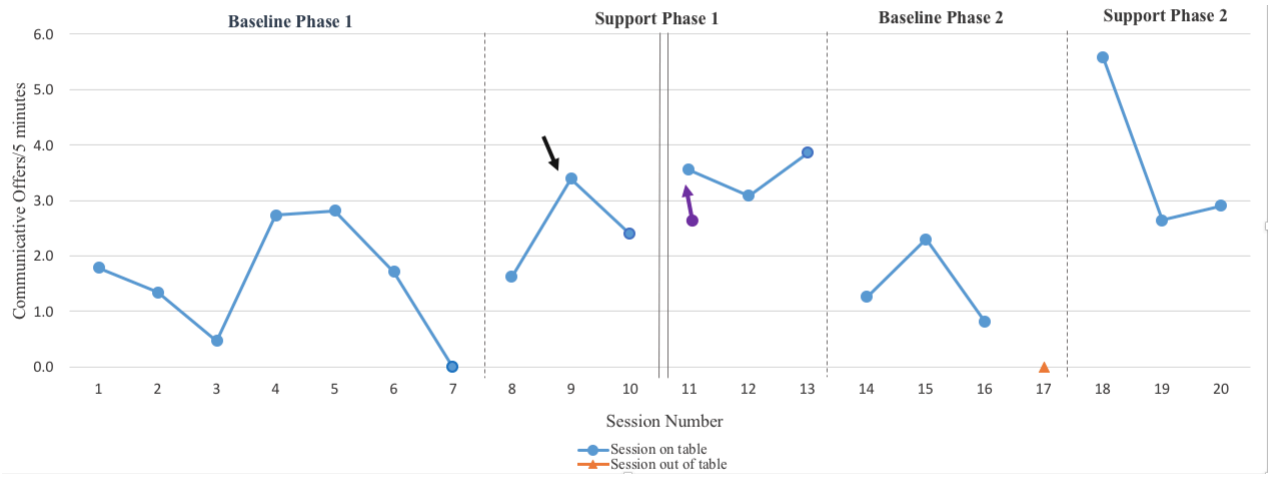


Figure 8: Frequency of Communicative Offers in John-Ethan Dyad

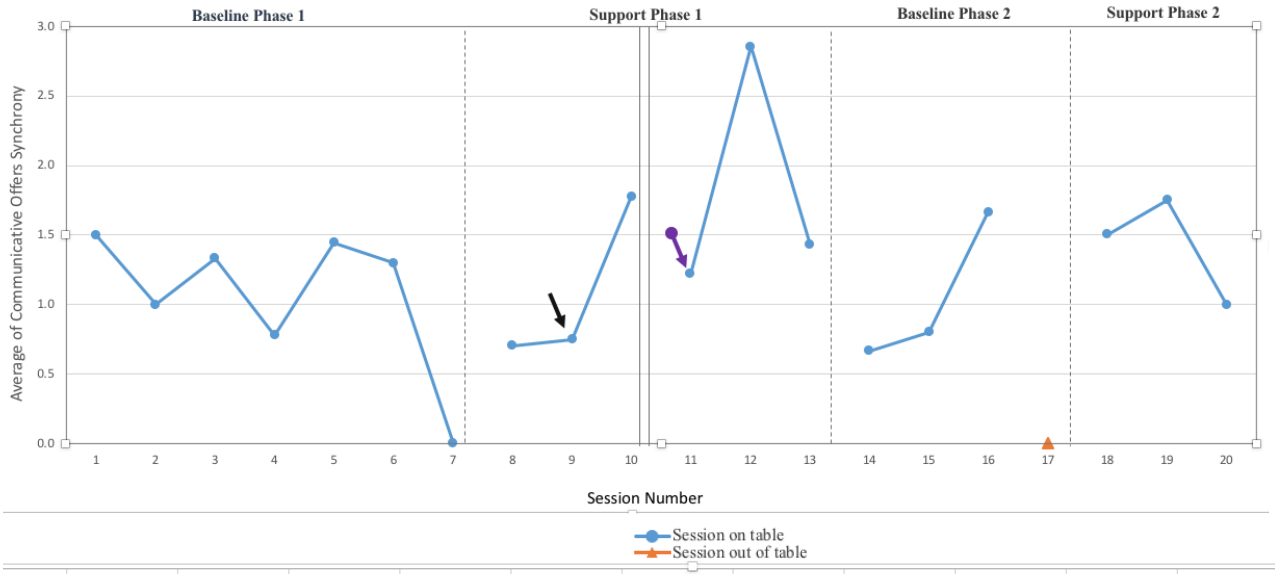


Figure 9: Average of Communicative Offers Synchrony Indicator in John-Ethan Dyad

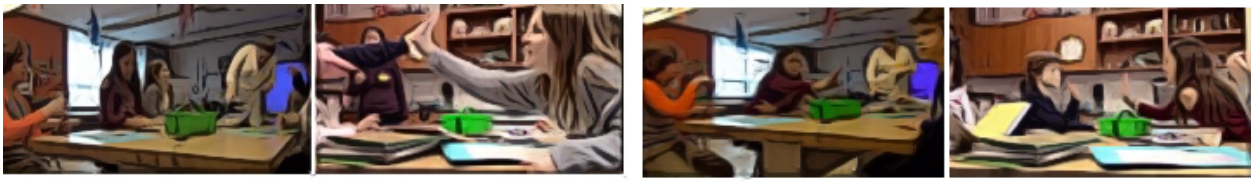
All the children are playing with stickers by putting them on their faces and looking at themselves in the mirror while John darts away from the table. I take out a small, colorful ball to motivate John to come back to the table and ask him if he wants to throw it to Mymo.

John reaches the ball and throws it to Mymo. Mymo and John pass the ball back a couple times. Elise and Ethan are watching.

Elise asks John if she can have the ball, but John continues throwing the ball toward Mymo. I verbally prompt John to pass the ball to Elise, and they pass it back and forth.

John tries to pass the ball to Ethan, but the ball is blocked by one of the mirrors. I move the mirror away and say, "Ethan, I think he wants to play with you." Ethan throws the ball to John, and they throw it back and forth making eye contact. Ethan throws the ball to Elise, and she passes it back to John while sharing eye gaze toward the ball.

Figure 10: Catching ball example



Joe and John are walking into the room. Joe verbally prompts John to greet his peers by saying, "Say hi to Elise, say hi Maria…" and by physically taking John's arm to initiate a wave to each of his peers. Ethan anticipates John's greeting and says, "Hi John." Each peer responds by saying hello to John while waving.

Maria says, "Can I have a high five?" and reaches out to John for a high five. Joe physically scaffolds this interaction by helping John high five Maria.

Gold then also asks John for a high five to which John appears not to respond. She continues to call his name to get his attention to ask for a high five. Maria and Ethan also starts calling John's name to get his attention. .

John turns to Gold and places his hand on her outstretched hand. Gold then says, "John, can I have a high five?" and rises her hand. He looks at her, smiles to her, and gives her a high five without any prompting from Joe. Maria exclaims "Yeah!"

Figure 11: Paraprofessional Strategies example

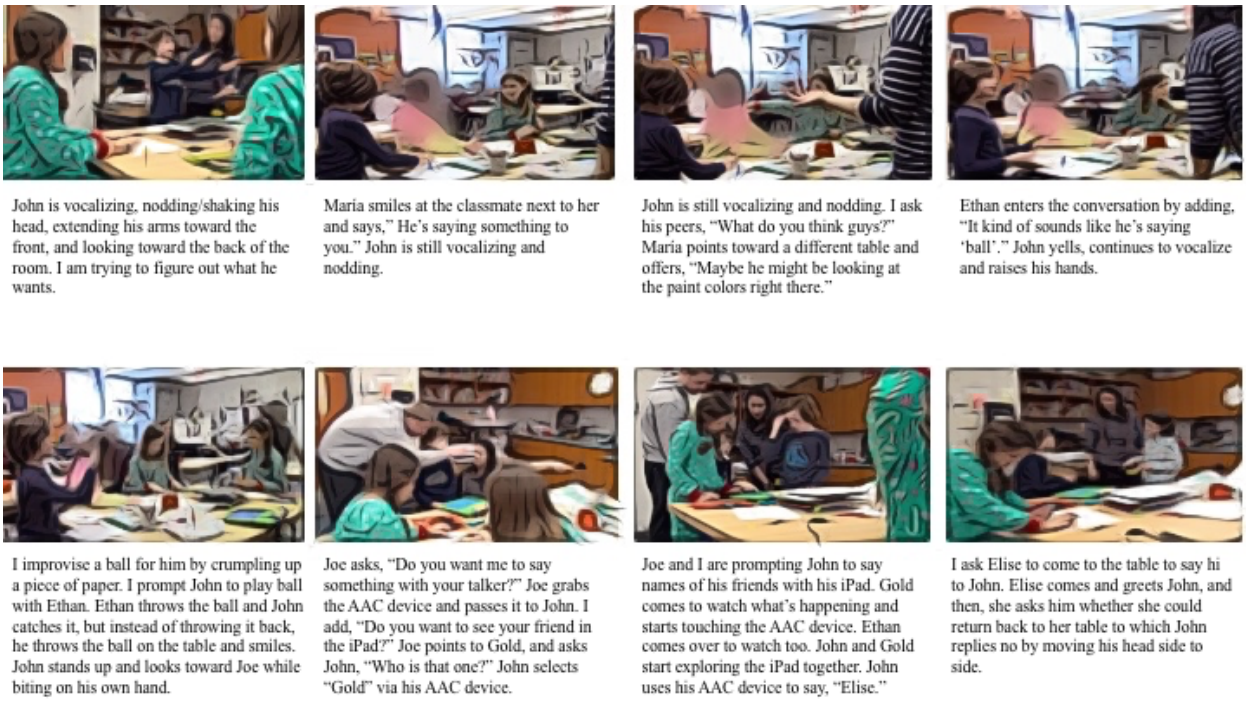


Figure 12: AAC device example

Table 1: *Clinician strategies employed during supports phases*

Clinician Strategy	Definition	Example
Scaffolding	Therapist (or another adult) facilitates an ongoing peer interaction verbally or nonverbally to shape the interaction when it has already started. Therapist (or another adult) supports social interaction through suggesting or showing an alternative way to communicate or interact.	Ethan is asking John whether he wants to draw or paint. The clinician suggests Ethan ask one thing at a time and wait for a response.
Behavioral Interpretation	Verbally provided meaning for a child's behavior (not limited to interaction behaviors) with the consequence of informing other children.	John is vocalizing while looking at Elise. The clinician says: *"I think he wants to say hello to you, Elise."*
Direct Prompt	Verbal or nonverbal direct or suggestive request (including indirect request) for one child to interact (verbally or nonverbally) with another child.	The clinician asks María, "*Can you pass the brush to John?"*
Environmental Arrangement	Clinician (or another adult) uses intentional verbal or nonverbal communication to reorganize the physical space to place the objective of increasing physical proximity between child participants and/or to change the children's positions with the objective of facilitating facial/body orientation toward other peers.	The clinician says John, "If you face the table that would be great. So, everyone can talk to you." Then, she physically prompts John to turn toward the table.

Table 2: Summary of Participants

Participants	Names	Age	Race	Role
Primary Participant	John	9:8 years-old	White/Caucasian	Autistic student
Secondary Child Participants	Ethan	8:7 years-old	White/Caucasian	Non-Autistic Peer
	María	9:2 years-old	White/Caucasian	Non-Autistic Peer
Incidental Peers	Mymo	8:11 years-old	White/Caucasian	Incidental Peer
	Gold	9:0 years-old	Multiracial	Incidental Peer
	Elise	Not reported	Not reported	Incidental Peer
Secondary Adult Participants	Alison	47 years-old	White/Caucasian	John's mom
	Joe	27 years-old	White/Caucasian	John's Paraprofessional
	Leila	60 years-old	Not reported	Art Teacher

Table 3: Summary of Assessments

Measure	Description	Results	Interpretation
Communication			
MacArthur-Bates CDI: *Words (updated)*	Standardized inventories of expressive and receptive vocabulary (Parent report)	180/396 (words receptively) 80/396 (words expressively)	18-months-old-age equivalent 17-months-old-age equivalent
Social Communication Questionnaire (SCQ; previous study)	Screening tool for ASD (Parent report)	30	Over 15 is indicative of autism
Speech-Language Sample (previous study)	Mother-child interactions during free play activities (i.e., swinging and jumping on a trampoline) and book reading activities.	8 vowels: /ɪ,ɛ,ə,ʌ,u,ʊ,o,ɑ/ 14 consonants: /p,b,t,d,k,g,n,ŋ,w,j,h,f,s,ʃ/ 24 intelligible words Inconsistent errors in articulation, unusual prosody, coordination issues	Limited phonetic repertoire, 18-30 months age-equivalent (Tager-Flusberg et al., 2009) Limited expressive vocabulary (12-24 months) Consistent with motor-speech disorder
Sensory-Motor Profile			
Intelligibility in Context Scale (ICS)	5-point Likert-scale to assess children speech intelligibility (Parent report)	1.85/5	Low intelligibility (< 2 SD) compared to both TD children and children with speech disorders.
Nordic Orofacial Test-Screening (NOT-S)	Sensory function, breathing, oral habits, chewing and swallowing, drooling, and dryness of mouth (Parent report)	Used qualitatively	Reduced sensitivity in oral cavity. Motor difficulties associated with chewing.
Developmental Coordination Disorder Questionnaire (DCDQ'07)	Clinical screening to identify coordination challenges (Parent report)		Indication of Developmental Coordination Disorder (DCD) or suspected DCD
Control during movement		13/30	
Fine Motor/Handwriting		4/20	
General Coordination		14/25	
Total		31/75	
Sensory-Motor Profile			
Sensory Processing Measure (SPM)	4-point Likert-scale to assesses praxis, social participation and the five sensory systems. (Teacher report)		
Social Participation		37 (77T)	Definite Dysfunction
Vision		15 (67T)	Some Problems
Hearing		21 (77T)	Definite Dysfunction
Touch		16 (70T)	Some Problems
Body Awareness		14 (65T)	Some Problems
Balance and Motion		14 (58T)	Typical development range
Planning and Ideas		26 (67T)	Definite Dysfunction
Total Sensory systems		113 (76T)	Some Problems

Table 3 (cont.)

Measure	Description	Results	Interpretation
Overall Assessment			
Vineland Adaptive Behavior (Third Edition)	Student functioning across parameters of daily life (Teacher report)		
Receptive		8	<3 years-old
Expressive		1	<3 years-old
Written		6	<3 years-old
Personal		4	5:0 years-old
Numeric		2	<3 years-old
School Community		2	<3 years-old
Interp. Relationship		7	<3 years-old
Play and Leisure		2	<3 years-old
Coping Skills		1	<3 years-old
Gross Motor		16	9:10 + years-old
Fine Motor		1	<3 years-old

Note. Sensory Processing Measure uses two different scores: Raw score and T-scores; raw scores indicate the sum of ratings of each item for each scale (i.e., higher raw score indicates more difficulties). T-scores are standardized scores in which a score of 50 or less is indicative of typical development; a score of 60-70 is indicative of "some problems," and a score over 70 is indicative of "definite dysfunction." The Vineland also uses a standardized score (v-scale) with a mean of 15 and a SD of 3.

Table 4: Description of Communicative Offers per dyads per 5 minutes before supports implementation

Session	John-Ethan	John-María	Ethan-María
Baseline1 S1	1.8	2.1	8.6
Baseline1 S2	1.3	1.6	
Baseline1 S3	0.5	1.2	5.0
Baseline1 S4	2.7	1.2	
Baseline1 S5	2.8	-	
Baseline1 S6	1.7	0.4	
Baseline1 S7	0.0	0.6	
Average per session	1.6	1.2	

CO: Communicative offers; CO/5: Communicative offers per 5 minutes; J-E: John-Ethan dyad; J-M: John-María dyad

Table 5: Description of average of Synchrony Indicators (SI) per dyads before support implementation

Session	Average # SI John-Ethan	Average # SI John-María	Average # SI Ethan-María
Baseline1 S1	1.5	1.0	2.1
Baseline1 S2	1.0	1.5	
Baseline1 S3	1.3	1.4	2.4
Baseline1 S4	0.8	1.4	
Baseline1 S5	1.4		
Baseline1 S6	1.3	1.8	
Baseline1 S7	0.0	0.8	
Average per session	1.1	1.4	2.2

SI: Synchrony Indicators; J-E: John-Ethan dyad; J-M: John-María dyad

Table 6: Average frequency of each coded synchrony indicator (SI) per number of sessions presented by phase in the John-Ethan Dyad

Synchrony Indicator	# SI/session First Baseline Phase	# SI/session First Support Phase	# SI/session Second Baseline Phase	# SI/session Second Support Phase
Shared activity				
Coordinated activity	0.0	1.7	0.0	2.0
Parallel activity	0.9	0.2	0.5	0.3
Shared affects				
Similar affects	0.0	0.2	0.0	0.0
Dissimilar affects	0.0	0.0	0.0	0.0
Shared eye gaze	6.0	6.0	2.5	11.7
Eye contact	1.9	3.7	0.3	4.0
Taking turns	0.6	4.0	0.3	3.0
Mediated by objects	0.6	2.3	0.0	1.3
Coordinated changes in corporal alignment	0	0.5	0.0	0.3
Imitative behavior	0.1	0.0	0.0	0.0

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APPENDIX A: IRB LETTERS

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Office of the Vice Chancellor for Research
Office for the Protection of Research Subjects
805 West Pennsylvania Ave
Urbana, IL 61801

August 30, 2017

Laura DeThorne, PhD
Speech and Hearing Science
901 S. Sixth St.
Champaign, IL 61820

RE: *Getting in Sync: A Study of Peer Interpersonal Communication*

IRB Protocol Number: 18033

Dear Dr. DeThorne:

This letter authorizes the use of human subjects in your project entitled *Getting in Sync: A Study of Peer Interpersonal Communication.* The University of Illinois at Urbana-Champaign Institutional Review Board (IRB) approved, by expedited review, the protocol as described in your IRB application. The expiration date for this protocol, IRB number 18033, is 08/29/2020. The risk designation applied to your project is *no more than minimal risk.*

***** Please note that approval letters from schools must be submitted to our office prior to any research taking place in the school environment.***

Copies of the attached date-stamped consent form(s) must be used in obtaining informed consent. If there is a need to revise or alter the consent form(s), please submit the revised form(s) for IRB review, approval, and date-stamping prior to use.

Under applicable regulations, no changes to procedures involving human subjects may be made without prior IRB review and approval. The regulations also require that you promptly notify the IRB of any problems involving human subjects, including unanticipated side effects, adverse reactions, and any injuries or complications that arise during the project.

You were granted a three-year approval. If there are any changes to the protocol that result in your study becoming ineligible for the extended approval period, the RPI is responsible for immediately notifying the IRB via an amendment. The protocol will be issued a modified expiration date accordingly.

If you have any questions about the IRB process, or if you need assistance at any time, please feel free to contact me at the OPRS office, or visit our website at https://www.oprs.research.illinois.edu.

Sincerely,

Michelle Lore

Michelle Lore, MS
Human Subjects Research Specialist, Office for the Protection of Research Subjects

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Office of the Vice Chancellor for Research
Office for the Protection of Research Subjects
805 West Pennsylvania Ave
Urbana, IL 61801

September 28, 2017

Laura DeThorne
Speech & Hearing Science
214 SHS Bldg
901 South Sixth Street

Champaign, IL 61820

RE: *Getting in Sync: A Study of Peer Interpersonal Communication*
IRB Protocol Number: 18033

Dear Dr. DeThorne:

Thank you very much for forwarding the modifications to the University of Illinois at Urbana-Champaign Institutional Review Board (IRB) office for your project entitled *Getting in Sync: A Study of Peer Interpersonal Communication.* I will officially note for the record that these minor modifications to the original project, as noted in your correspondence received 9/22/2017, Updating performance sites; Modifying recruitment procedures; Updating measures, have been approved. The expiration date for this protocol, IRB number 18033 is 08/29/2020. The risk designation applied to your project is *no more than minimal risk*.

Please note that additional modifications to your project need to be submitted to the IRB for review and approval before the modifications are initiated. To submit modifications to your protocol, please complete the IRB Research Amendment Form (see https://www.oprs.research.illinois.edu/forms-templates/forms/protocol-amendment-form). Unless modifications are made to this project, no further submittals are required to the IRB.

You were granted a three-year approval. If there are any changes to the protocol that result in your study becoming ineligible for the extended approval period, the RPI is responsible for immediately notifying the IRB via an amendment. The protocol will be issued a modified expiration date accordingly.

We appreciate your conscientious adherence to the requirements of human subjects research. If you have any questions about the IRB process, or if you need assistance at any time, please feel free to contact me at the OPRS office, or visit our website at https://www.oprs.research.illinois.edu.

Sincerely,

Michelle Lore

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APPENDIX B: INTERVIEW'S QUESTION SAMPLE

Initial & Final Interviews: Primary Child participant.

I want to learn how you and your classmates play and communicate during school activities. I would like to ask you some questions related to your school day and art class. Could you answer questions for me?

Context/Art Class

- Tell me about a typical school day.
    - Do you like to come to school?
    - What activities do you like?
        - Provide examples if needed (jump, play with paraprofessional, breaks).
- Tell me about your art class.
    - Do you like art class?
    - What activities do you like?
        - (Clay, paint, draw)
    - Who work with you during art class?

Social Dimension.

- Tell me about the people at your school.
    - Who do you spend time with (use pictures on AAC device)?
    - Who do you consider your friends (use pictures on AAC device)?
    - What do you enjoy doing with friends (use pictures on AAC device)?
    - What makes someone a good friend (use pictures on AAC device)?

- I am particularly interested in learning about Ethan/María. What have you noticed about Ethan/María?
    - Is she/he nice to you?
    - Do you like her/him
    - What does Ethan/María usually do during art class (provide options)?
    - Do you play with Ethan/María
    - Do you like to play with Ethan/María
    - What do you play with Ethan/María

Expectancies about Support

- Sometimes it's part of teachers' job to help children get along and have fun. What do you think about that?
    - Would you like someone to help you to play with friends?
    - Do you think teachers can help you and your classmates to play together?
    - How would you feel about a teacher helping you get to know Ethan/María?

Initial & Final Interviews: Secondary Child participants.

As I mentioned to you before, I am here to learn more about how children play and communicate during school activities. I would like to ask you some questions related to your school day, and particularly, during art class. Would you like to help me with that? You can skip any question that you do not want to answer—just shake your head "no" or say "skip."

Context/art class

- Tell me about a typical school day. Follow-up questions as needed to elicit:
    - Where?
    - What activities?
    - Who?
    - Give examples.
- Tell me about art class. Follow-up questions as needed to elicit:
    - Where?
    - What?
    - Who?
    - Give examples.

Social Dimension.

- Tell me about the people at your school. Follow-up questions as needed to elicit:
    - Who do you spend time with?
    - Who do you consider your friends?
    - What do you enjoy doing with friends? Art class?
    - What makes someone a good friend?

- I am particularly interested in learning about _____ (primary/secondary participant). What have you noticed about _____?
    - What does_____ (primary/secondary participant's name) usually do during art class?
    - Can you give an example of what _____ (primary/secondary participant's name) does in these situations?
    - Who does _____ (primary/secondary participant's name) like to play with/talk during art class?
    - How often do you interact to _____ (primary/secondary participant's name) during art class?
    - If you play with _____ (primary/secondary participant's name), what does it look like?

Communication Dimension

- How do you usually communicate with your classmates? Follow-up questions as needed to elicit:
    - What do you communicate about?
    - Use of any technology/object supports?
    - Nature and frequency of frustrations? Miscommunications?
    - Examples?

- Now, I would like to learn more about how you communicate with _____ (primary/secondary participant) in particular. Tell me about how the two of you communicate? Follow-up questions as needed to elicit:
    - What do you communicate about?
    - Use of any technology/object supports?
    - Nature and frequency of frustrations? Miscommunications?
    - Examples?

Expectancies about Support

- Sometimes it's part of teachers' job to help children get along and have fun. What do you think about that? Follow-up questions as needed to elicit:
    - What sort of things do you see teachers doing to help kids get along?
    - What kind of things help children become friends?
    - What do teachers do that make it harder for children to become friends?
    - Examples?
    - How would you feel about a teacher helping you get to know _____?

Video-elicitation Procedure

I am going to show you a short video of you and _____ to get your thoughts about it… [Show Video].

- Tell me what is happening in this video? Follow-up questions as needed to elicit:
    - How were you feeling during this video?
    - How can you tell what your classmate was feeling?
    - Why did/didn't you do _____?
    - Why do you think _____ did _____?
    - Would could you have done differently in this video?

Initial & Final Interviews: Secondary Adult participants.

I would like to ask you some questions related to _____'s (primary participant's name) *school day, and particularly, during art class. Please, feel free to skip any question that you do not feel comfortable to answer.*

Context/art class

- Tell me about a typical school day for _____ (primary participant's name). Follow-up questions as needed to elicit:
    - Where?
    - What activities?
    - Who?
    - Give examples.
- Tell me about for _____'s (primary participant's name) art class. Follow-up questions as needed to elicit:
    - Where?
    - What?
    - Who?
    - Give examples.

Academic Dimension

- Please, tell me about the academic work that you conduct with for _____ (primary participant's name). Follow-up questions as needed to elicit:
    - What activities do he/she enjoys?
    - Goals?
    - Strengths and Difficulties?
    - Supports/services?
    - Feelings of _____ (primary participant) about school?

Social Dimension.

- Tell me about _____'s (primary participant) social interactions at school. Follow-up questions as needed to elicit:
    - Who does _____'s (primary participant) spend time with?
    - Who does _____'s (primary participant) consider his/her friends?
    - What does _____'s (primary participant) enjoy doing with friends? Art class?
    - Examples?

- I am particularly interested in the relationship between_____ (primary participant) and _____ (secondary participant). What have you noticed about them?
    - How often do they interact during art class?
    - If they interact together, what does it look like?

Communication Dimension

- How does _____ (primary participant) usually communicate with his/her classmates? Follow-up questions as needed to elicit:
    - What does he/her communicate about?
    - Use of any technology/object supports?
    - Nature and frequency of frustrations? Miscommunications?
    - Examples?

- Now, I would like to learn more about how _____ (primary participant) communicate with _____ (secondary participant) in particular. Tell me about how the two of them communicate? Follow-up questions as needed to elicit:
    - What do they communicate about?
    - Use of any technology/object supports?
    - Nature and frequency of frustrations? Miscommunications?
    - Examples?

Expectancies about Support

- Sometimes it's part of teachers' job to help children get along and have fun. What do you think about that? Follow-up questions as needed to elicit:
    - What sort of things do you see teachers doing to help kids get along?
    - What kind of things help children become friends?
    - What do teachers do that make it harder for children to become friends?
    - Examples?
    - What school activities could be the best setting to provide social support?
    - What social-emotional outcomes do you expect to see in _____ (primary participant) after social supports are provided?
    - What communicational outcomes do you expect to see in _____ (primary participant) after social supports are provided?
    - What other outcomes do you expect to see in _____ (primary participant) after social supports are provided?

Video-elicitation Procedure

I am going to show you a short video of _____ (primary participant) and _____ (secondary participant) to get your thoughts about it… [Show Video].

- Tell me what is happening in this video? Follow-up questions as needed to elicit:
    - What are your perceptions regarding peer interaction?
    - How responsive do you think children are to each other?
    - Can you provide any explanation because this interaction was (un)successful?
    - Would could you have done differently in this video?

Final Interviews: Incidental Peers

In this page, you will find some questions related to the project that you were involved during art class. Please provide answers based on what you think and feel. There are no correct and incorrect answers. If there is any question that you don't feel comfortable to answer, you can skip it.

Why did you decide to come to this table?

Why did you decide to leave the table some days?

How did you feel working at this table during this time?

What did you like of being at this table?

What didn't you like of being at this table?

What did you learn?

What do you know about John?

Did you know the same about John before and after you sat at this table?

Was John your friend before you sat at this table?

Is John your friend now?

Could you mention John's strengths?

APPENDIX C: VIDEO-CLIPS TRANSCRIPTIONS

Drawing landscape together (Session 2, Second Support Phase, 30 seconds).

Ethan, María, and Gold are all hunched around the corner of the art table using markers to collaboratively draw a landscape. John is standing up between Ethan and María looking down at his hands. I am standing near John and offer him a marker, saying, "Do you want to draw? Can I help you to draw?" John takes the marker from me and opens it. I comment, "nice." I place my hand on John's back to guide him gently toward the table between John and María while saying, "Say, John, excuse me I will draw too." John starts to draw on the communal paper. María looks at John and says, "Good job John!" She extends her hand, and asks, "Can you give me a high five?" John continues to look downward but gently slaps her hand without any prompt from me. I comment, "good job." Ethan turns toward John and calls "John, high five" with a raised palm, to which John responds by gently slapping it (again without any physical prompting from me). Ethan turns back to his drawing.

Catching ball game (Session 4, First Support Phase, 21 seconds)**.**

Ethan, John, Mymo, Elise, and another classmate are all sitting at the same table. Ethan is sitting between Mymo and another classmate on the opposite side from John. Elise is sitting at the head of the table between Mymo and John. Joe and I are standing slightly behind John. All the children are playing with stickers by putting them on their faces and looking at themselves in the mirror while John darts away from the table. I take out a small, colorful ball to motivate John to come back to the table and ask him if he wants to throw it to Mymo. John reaches for the ball and initiates throwing it to Mymo. John and Mymo pass the ball back and few times while they share eye gaze toward the ball, and Ethan and Elise watch them. Elise asks John if she can have the ball, but John continues throwing the ball toward Mymo. At this point, Joe comments to me about how John has been working on turn taking, and that this activity is particularly good for him. I verbally prompt John to pass the ball to Elise, and they pass it back and forth. John tries to pass the ball to Ethan, but the ball is blocked by one of the mirrors. I move the mirror away and say, "Ethan, I think he wants to play with you." Ethan throws the ball to John, and they throw it back and forth making eye contact. Ethan throws the ball to Elise, and she passes it back to John while sharing eye gaze toward the ball. John throws the ball to the classmate on the right of Ethan, but he does not notice and the ball falls on the ground.

Friends on iPad (Session 4, Second Baseline Phase, 48 seconds)

María and another girl are sitting on one side of the table, while John and Joe sit across from them. Gold is seated at the end of the table between the two pairs. Both María and Gold appear to be watching the third girl manipulate the painting materials until they hear Joe querying John about their names. Specifically, Joe presents the iPad to John, which includes the newly incorporated pictures of John's classmates that I had requested. Joe looks to John and asks,

"Who is that? What's that word right there? Who is she?" and points to Gold across the table. At this point, both Gold and María look immediately toward Joe and move toward him to get a closer look at the iPad. Joe provides a touch to the underside of John's right forearm, while John selects "Gold" on the iPad. Both girls smile in response, with Gold responding, "aw" and María repeating "Gold" while returning to her seat. Joe continues looking toward the iPad and comments, "That was good." Gold remaining standing close to Joe and John. John looks at Joe and lightly scratches his fingers across Joe's cheek. Joe gently deflects John's touch to his face and continues questioning: Joe points to María and asks, "What about, what about her? What's her name?" John nods, looks at his iPad, and starts to navigate the selections with Joe's hand once again providing light support on John's forearm. After about ten seconds Joe points again and repeats the question, "What's her name? Do you see her?" John looks away from the iPad, puts his hand near Joe's neck, and produces a whine-like vocalization. Joe says John's name and puts a gentle hand on John's back. Both María and Gold gather closer to them out of interest. John rubs his own face with his right hand and then uses his left hand, supported gently by Joe, to select María twice on the iPad while smiling. Gold says "oooh" and looks to María, who says, "huh," and moves back across the table. Joe repeats, "María, that's María." Gold is still standing by Joe and John when she looks to the unnamed girl at the table and asks, "Do you have your picture taken on there?" The girl replies, "no," and Gold continues to look toward John and the iPad. Joe adds, "He's got Mymo and Ethan."

Self-portraits (Session 2, First Support Phase, 34 seconds)

Joe and John are sitting on one side of the table while Ethan and two other boys sit across from them. John is sitting quietly with his iPad on his lap looking forward into space. Joe is looking quietly toward the table with what appears to be an unfocused gaze for approximately 10 seconds. During this time, the other three boys at the table are looking at the mirrors in front of them and drawing. One of the boys asks Ethan, "Can you look straight for just a second?" At that point, I still down at the table next to Joe, and Joe calls John's name and hands him a pencil. For approximately 15 seconds, Joe provides hand-over-hand support for John's drawing on the paper—both are looking toward the drawing intended. Johns pulls away from the drawing and Joe follows suit. John fiddles with his iPad a bit. Joe points his pencil toward a mirror and asks, "Can you see yourself in there John?"

APPENDIX D: OPERATIONAL DEFINITION OF SYNCHRONY INDICATORS

A. Shared Activity. Both children are engaged in the same activity. Shared activities include coordinated activity and parallel activities. There is no shared activity when at least one child seems to be "uninvolved with any specific person, object, or activity, although they might be scanning the environment as though looking for something to do." They may be walking around, looking through the window, or just be seated thinking of something else.

1. **Coordinated activity.** "Any form of social interaction whereby two or more individuals coordinate their actions in space and time" (Sebanz et al., 2006). Shared cooperative activities include but not limited to drawing, walking, and playing a video game **together** (i.e., doing something together; Bratman, 1992; Carpenter, 2009). The description of the interaction should be with a plural subject (we, you, or they), and an action verb (e.g., Aaron and Lucia are building a castle; Kutz, 2000).
2. **Parallel activity.** Primary and secondary child participants are conducting the same activity individually (e.g., each child is painting their own landscape, typing at the computer, or completing their own assignment).

B. **Shared affect.** Use of reciprocal expressions (e.g., facial expression, voice tone, or widening eyes) directed toward a peer. Affects will not be considered shared when the expression is not explicitly directed toward another peer event when they are sharing space (Bishop & Lahvis, 2011). There is no shared affect if either one of the children is not engaged in the emotional state (e.g., one children is laughing, but the other one is not).

1. ***Similar Affect***. Both children have similar emotional expressions (e.g., one of the child smiles, the other child smiles back)
2. ***Dissimilar Affect.*** Children show reciprocal expressions, but these expressions differ between them (e.g., one child is laughing at his classmate, the classmate frowning in response.

C. **Shared eye gaze**. Primary and secondary child participants direct their eye gaze toward a common place, object, or person.

D. **Eye Contact**. Primary and secondary child participants look at each other eyes. It could be sustained or fluttered during the interaction.

E. **Turn-Taking.** Interval filled by a verbal or nonverbal communicative behavior performed by a child, who stops and waits for a verbal or non-verbal (e.g. nodding, throwing a ball back) response from the communicative partner (i.e., reciprocal exchange). It includes reciprocal gestures (e.g., turning toward or away from a peer, moving the head side to side to say no after a peer question, hand waving when someone says hello, or receiving an object from a peer).

    1. **Please code as E.1 turns mediated by objects.**

F. **Coordinated change in corporal alignment**. Both participants arrange their own bodies in order to interact with a peer. Indicators of synchrony could be, but are not restricted to, face to face, side by side or nested alignment (e.g., one person behind the other).

G. **Imitative behaviors**. One person performs a specific behavior that is mimicked by his/her communicative partner (e.g., repetition of a word, imitation of a gesture or posture). The behavior could be imitated in the same modality, or the communicative partner can use a different means of communication (cross-modality).