

Joint Attention Revisited: Examining Heterogeneity Among Children with Autism

Sarah Hurwitz

A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the School of Education.

Chapel Hill

2010

Approved by:

Linda R. Watson
Harriet A. Boone
Gregory J. Cizek
Lee K. McLean
Samuel L. Odom

©2010
Sarah Hurwitz
ALL RIGHTS RESERVED

Abstract

Sarah Hurwitz

Joint Attention Revisited: Examining Heterogeneity Among Children with Autism

(Under the direction of Linda R. Watson)

Joint attention has long been considered absent or deviant in children with autism. Although this deficit is seen, there is variability in joint attention within the population and some children with autism employ it. Little is known about the profile of joint attention skills of these children or how joint attention use affects concurrent language. The present investigation examines the subgroup of children with autism who use joint attention and compares them both to children with autism who do not use joint attention and to pair-wise matched children with developmental disabilities.

Two analyses were undertaken: Study 1 compared subgroups of children with autism ($MA \leq 30$ months). Thirty-two children with autism (16 with joint attention skills and 16 without) of similar age ($M=43$ months) and nonverbal MA scores ($M=17$ and 13 months, respectively) were examined. The results of Study 1 indicated that children with joint attention skills had significantly higher concurrent language scores than those without. Study 2 compared 20 pairs of MA-matched children (20 children with autism and joint attention and 20 with developmental delays). Videos were coded for initiation and response to joint attention and many of its forms. The results from Study 2 showed that once engaged in joint attention bids, both groups used the forms in similar ways; no differences were found in point, show, other gestures, eye contact, affect, nor toward

whom the bid was directed. Conversely, children with autism initiated significantly less frequently and adults offered them more bids in order to engage them in joint attention. Concurrent language scores of the matched groups were not significantly different.

This investigation demonstrates that there is a subgroup of children with autism that uses joint attention. They use the forms in similar ways to children with developmental delays but engage in bids less frequently. Possible reasons for fewer bids are that children with autism are not intrinsically motivated to participate in social sharing and they have difficulty disengaging from a current focus of attention. Intervention recommendations include a goodness-of-fit model employing joint attention intervention for children from the lowest ability group and social/language interventions for others.

Acknowledgements

Thank you so much to all that have supported me through the long process that produced this dissertation. Along the way, I have had three fantastic kids who fill me with pleasure and satisfaction. I love you Ella, Guy and Ariel. I deeply appreciate my husband Eitan Goldman, who provided exceptional advice and whose pride helped motivate me to complete the thesis. And of course, thank you to my advisor Linda Watson who always made herself available when I came to town and balanced providing me with excellent feedback and guidance while also giving me the confidence to work things out on my own.

Thanks to Chris Wiesen from the Odum Institute who provided me with invaluable statistical advice and to Siobhan Colgan, my friend and classmate, who helped me collect data and gave much moral support.

I acknowledge the coffee shops and reading rooms across Chapel Hill, NC and Bloomington, IN where I worked between nursing babies and running preschool carpools (I especially recall the delicious home cooking at The Green Bean, the sun soaked tables to spread out at the Monroe County Public Library Silent Reading Room, the many languages spoken at Three Cups, and the chocolate croissants at Café Driade and The Open Eye Café).

Finally, I dedicate this to all of the children with autism and their families that I have worked with over the past 15 years. You have inspired me to ask the questions and desire the answers that research can provide. Especially to Liam who enthusiastically wanted to share his world with me, even before he had the language to do so.

Funding Acknowledgements: NICHD R01-HD-042168, “Unusual Sensory Experiences in Young Children with Autism” 2003-2008, Baranek, PI

List of Tables

Table

1. Child Demographics for Children with Autism in Study 1	25
2. Child Demographics by Diagnostic Group for Study 2	32

List of Figures

Figure

1. Hypothesized language development over time for typical children and those with autism	20
2. Groups of children compared in the present investigation.....	21
3. Boxplots for language scores for each group of children with autism.....	43
4. Language scores by MA, with JA group identified for children with autism.....	44
5. Correlation between Attention Following (AF) score and concurrent language score, with JA group identified	45
6. RJA Ratio for matched pairs of children	47
7. Number of JA bids offered by adults, for matched pairs of children.....	48
8. Proportion of responses to JA bids accompanied by a vocalization for matched pairs of children.....	49
9. Number of IJA bids made by children per minute for matched pairs.....	50
10. Proportion of IJA bids that included vocalizations for matched pairs of children.....	51
11. Attention following scores from the Joint Attention Measure for matched pairs of children.....	52
12. Scatterplot of scores for Initiating Score from the JA Measure and IJA bids/min with diagnostic group identified.....	53
13. Language scores for matched pairs of children.....	54
14. Correlation between MA and language scores, with diagnostic group identified	55

Table of Contents

List of Tables	vii
List of Figures	viii
Chapter	
I. Introduction.....	1
II. Literature Review	3
Joint Attention Defined.....	3
Joint Attention and Autism	4
Joint Attention and Language Development.....	6
Joint Attention as a Pivotal Skill for Learning Language.....	9
Joint Attention Interventions.....	10
Diagnostic Tools and Joint Attention.....	13
Affect	15
Need for Future Study.....	15
Research Questions and Conceptual Framework.....	18
Study Goals	18
Research Questions	19
Conceptual Framework	19
Application of the Conceptual Framework to RQ1	19
Application of the Conceptual Framework to RQ2	20
Operational definitions of RJA and IJA.....	22
III. Methodology	24
Study 1: Within-Autism Comparisons	24
Participants.....	24
Inclusion Criteria.....	25
Measures	26
Procedure	27
Study 2: Video Coding Study – Comparison of children with Autism and DD.....	31
Power and Effect Size	31
Participants.....	32
Matching	33
Video Analysis.....	35
Inter-rater Agreement.....	37
Data Management	38
Statistical Analyses	39
IV. Results.....	42
Results from Study 1	42

Association with Concurrent Language	42
Results from Study 2.....	45
Broad RJA Analyses.....	46
Examination of the forms of RJA used.....	48
Broad IJA Analyses	49
Examination of the forms of IJA used	50
Scores from the JA Measure	51
Association with concurrent language scores	53
V. Discussion	56
Study 1	56
Study 2	57
Language.....	61
Implications for Intervention	63
Implications for Screening.....	66
Heterogeneity and Autism	66
Strengths of this Study	68
Limitations to this Study	68
Future Study.....	69
Conclusion	70
Appendix A.....	71
Appendix B	73
References.....	77

Chapter 1

Introduction

By around their first birthday, most children will excitedly point to a balloon floating up by the ceiling and then look over to see that their parents see it too. They have learned an early emerging social-communication skill called joint attention (JA). JA is when two people pay attention to the same object or event at the same time and monitor one another's attention to that focus (Jones & Carr, 2004). JA skills emerge naturally in typically developing children between the ages of 9 and 18 months as children learn to gesture and use eye contact for social interaction. In children with autism though, development of JA has repeatedly been found to be absent or delayed (e.g. Mundy, Sigman & Kasari, 1990; Sigman & Ruskin, 1999; Stone et al., 1997).

This JA deficit in autism is found consistently when children are examined as a large diagnostic group. Currently though, there is a realization that heterogeneity exists among children with autism regarding symptom presentation (Ingersoll, Schreibman & Stahmer, 2001). This heterogeneity has not been well examined with regard to JA. Given that there are some children with autism who appear to use JA, several questions arise. Primarily, is there a subgroup of children who use JA, and if so, in what ways do they differ from the children with autism who do not use JA? For example, are they older or do they have higher mental ages or better language scores? Further, how does this JA-intact subgroup use the forms of JA? Do they use JA in similar ways to other children with

developmental delays other than autism, or do they use JA in an autism-specific pattern of some kind?

This study takes a closer look at subgroups of children with autism based on their JA ability. Because JA has been found to be predictive of language ability and is theorized to be a pivotal skill necessary for typical language development (Mundy & Crowson, 1997), language is an important outcome in this examination. Determining if children with autism use the forms of JA in some unique way when compared to children without autism is also important. Finally, this investigation has implications for screening tools that rely on the absence of JA as a key symptom for early identification of autism, because these tools could miss the subgroup of children who use JA, thus delaying early diagnosis and intervention.

Chapter 2

Literature Review

Joint Attention (JA) skills are a group of prelinguistic behaviors used for social communication. JA occurs when two people share attention around some object or activity and monitor one another's focus on that object or event (Jones & Carr, 2004). In addition, JA often involves using and understanding gestures (such as showing, tapping and pointing at objects or other people) in an effort to share awareness with another person (Mundy, Sigman & Kasari, 1990).

Each time a person attempts to engage in JA, they are initiating a JA bid. A child can respond to the JA bid made by an adult partner or the child can initiate a bid himself or herself. Responding to a JA bid from an adult (RJA) occurs when the child looks where the adult is indicating, monitors the adult's eye gaze, or alternates between looking at an object and the adult's face. For example, a child could respond to a JA bid by looking at an item that her mother is holding up to show her (e.g. "Look at this flower!"). JA can also involve initiating JA (IJA) when the child points something out, shares an object or information or otherwise indicates interest to an adult. For example, a child could initiate JA by pointing to a big truck driving by and looking back and forth from his mother to the truck to make certain that she sees it. In typical development, JA skills begin to emerge early in a child's life, usually before the first birthday, and they are intact by 18 months (Jones & Carr, 2004).

JA, in most conceptualizations of this ability, is used only to share attention with another person, not as a request for an item or action. This point differs somewhat across the literature and there are some studies that include requesting behaviors as a form of JA while others do not. For the purposes of this paper, the definition of JA is based on the *Early Social Communication Scales* (ESCS, Mundy et al., 2003), a widely used measure of JA and other early social-communicative behaviors. According to the ESCS, “The function of Joint Attention behaviors is to share attention with the interactive partner or to monitor the partner’s attention. They differ from Behavioral Requests in that they do not appear to serve an instrumental or imperative purpose (e.g., trying to get or activate an object or event). Rather, their function seems to be more to share experiences of objects or events with others” (p. 16). The focus is on gestures and eye gaze used by children in JA (i.e. the nonverbal communication) and the intent of the communicative events.

It is important to note that the same gestures that are used during JA – these are the forms of JA – can also be used to make requests. Since the forms can be used in various contexts, it is important to consider their intent or function. For example, a child can use a point either to draw attention to a character on the TV or to request the adult change the channel. Thus, since the form of the gesture can be used in multiple ways, it is the functional component of the event that makes JA more than just a repertoire of gesture and gaze skills (Jones & Carr, 2004).

Joint Attention and Autism

In general, there is a well-established JA deficit among children with autism. It has been shown that children with autism do not typically develop JA or they do so in an atypical and delayed manner (e.g. Dawson et al., 2004; Mundy, Sigman & Kasari, 1990;

Sigman & Ruskin, 1999). Children with autism comment and use the forms of JA significantly less often than members of comparison groups (Mundy, Sigman & Kasari, 1990; Stone, Ousley, Yoder, Hogan & Hepburn, 1997). In fact, the JA disturbance is considered to be so prevalent in autism that it has been referred to as a core deficit, which means it has specificity (is unique to the disorder), universality (is universally present) and primacy (emerges at a young age) (Whalen, Schreibman, & Ingersol, 2006).

The JA deficit in autism includes both difficulty in initiating bids toward others and paucity in responding to others' JA attempts. This deficit is prevalent enough in autism that it can be used to differentiate children with autism from members of other diagnostic groups. Dawson et al. (2004) compared groups of children with autism spectrum disorder (ASD), developmental delays (DD) and typical development. The ASD group had lower levels of IJA and RJA than mental age (MA) matched DD and typically developing children. The researchers employed a discriminant function analysis to see if they could identify children with and without ASD (they combined typical and DD groups) and using IJA ability alone, they were able to correctly classify 83% of the children with ASD and 63% of the children with no ASD. Mundy, Sigman and Kasari (1990) also found that the JA deficit distinguished 70-80% of children with autism from a mentally retarded control group because, they explain, very few of the controls exhibited a JA deficit.

Social impairments that may be precursors to JA appear from a very early age for children with autism. In a retrospective video analysis, Clifford and Dissanayake (2007) demonstrated that children later found to have autism used less eye contact at 6 months and less IJA and RJA at 1½ years old than typically developing children. Swettenham et al. (1998) found that 20-month-olds with autism spent less time looking at people and more

time looking at objects than other children. These studies indicate that beginning at a very young age, children with ASD have less interest in social engagement than other children.

Children with autism may not use JA for several reasons, including atypical neurological development (Mundy & Crowson, 1997), difficulty in shifting attention (Landry & Bryson, 2004), and a lack of social motivation (Stone et al., 1997). Stone and colleagues (1997) suggest that children with autism exhibit a lack of social-communicative interest because they do not find sharing attention with others to be intrinsically rewarding. For typically developing children, sharing attention is pleasurable but for a child with autism, social interaction might be seen as a chore. On the other hand, other forms of social interaction like requesting result in the acquisition of a desired object, thereby making that object a natural reinforcer. In their study, Stone et al. found that children with autism actually requested more than children from a DD comparison group, but that they communicated by commenting only 1% of the time (compared to about 30% of the time for the DD group).

There are several reasons why this deficit is important. Primary among them is that JA is related to both concurrent and future language and may be a pivotal skill necessary for language acquisition to occur.

Joint Attention and Language Development

JA skills are associated with children's language abilities both concurrently and over time (Dawson, et al., 2004; Mundy, Sigman & Kasari, 1990; Sigman & Ruskin, 1999). Logically, this association makes sense because in order to learn a new word, a baby must be focused on the same object that an adult is labeling. If the child is engaged in joint attention and looking at the object, s/he can map the word and object to one another.

Additionally s/he can use gaze alternation to ensure that s/he is looking at the same thing that the adult is identifying (Jones & Carr, 2004). By contrast, the child with poor JA may not be paying attention to the same objects that the adult is labeling; instead s/he may be attending to his or her own toy. Thus, the label given by the adult will not match the child's focus of attention and that child will have difficulty learning the new word.

The logic behind the association between JA and language has been supported by research evidence. In their early study, Mundy, Sigman and Kasari (1990) examined a sample of 15 children with autism who began the study with limited expressive language (fewer than 5 words), and two control groups (a mental age-matched group of children with mental retardation and a language age-matched sample of children with Down syndrome and other developmental delays). They found that JA was related to concurrent expressive language scores and was also predictive of expressive language development a year later for the autism group. Initial language, mental age, chronological age, and IQ were not predictive of language. They theorized that the development of JA skills reflected an emergence of social-cognitive processes that provide a foundation for language acquisition.

Sigman and Ruskin (1999) also showed that JA was predictive of language skills. Children with autism, Down syndrome, other DD and typically developing children all showed an association between JA and concurrent language ability. They found "...that children with autism who initiated joint attention, responded to joint attention, and used a greater diversity of functional and symbolic play acts were concurrently more verbally adept" (p. 101). For the children with autism, there was also an association between RJA and later expressive language.

There is some disagreement in the literature about whether IJA, RJA or both predict language. Most JA studies have found an association between some form of JA and some kind of language but they often use different measures to assess JA and variable language outcome measures. Thus the specific details of the JA-language association are somewhat ambiguous.

For example, support for RJA predicting language comes from Murray et al. (2008) who found that for 3- to 5-year old children with autism, RJA was positively correlated with concurrent receptive language scores and mean length of utterance, but that IJA was not. In contrast, Toth, Munson, Meltzoff and Dawson (2006) found that it was IJA that was associated with concurrent language ability but that this association was not maintained over time.

Several studies found an association between JA and receptive language rather than expressive language. One longitudinal study (Charman et al., 2003), found that early JA as measured by gaze switching was positively associated with receptive language but not expressive language. Another by Thurm, Lord, Lee and Newschaffer (2007) found that RJA at age 2 predicted receptive language at age 5 (although IJA did not), and neither RJA nor IJA predicted later expressive language. On the other hand, the Sigman and Ruskin (1999) study found an association between RJA and expressive language.

These seemingly inconsistent findings might result from the studies using different measures of JA, different outcome measures, and different samples of children with autism, children of different ages or different study designs. Regardless of the details, overall, most studies have found that there is a relationship between JA and either concurrent and/or future language development for children with autism. In fact, the

acquisition of JA skills may be critical for language development to occur (Mundy & Neal, 2000).

Joint Attention as a Pivotal Skill for Learning Language

Language is related to early JA ability and it is possible that JA is a pivotal skill needed for typical language development to occur (Mundy & Crowson, 1997). A pivotal skill is one that, when improved, causes positive changes in other areas of functioning (Koegel, Koegel, Harrower, & Carter, 1999). Mundy and Crowson theorize that for some reason, likely a neurological deficit, children with autism do not show typical levels of JA. This neurological deficit causes them to miss out on language and social inputs from the people around them. In turn, missing these early social and language skills means the children's brains are deprived of stimulation that promotes further neurological development.

A negative feedback loop, described by Schertz and Odom (2004), may be established for young children with autism in which the initial neurological deficits cause the child to miss out on many social and language inputs which, in turn, cause the brain to develop poorly. The resulting secondary neurological deficits hamper the higher levels of learning that are needed for the advancing steps of language. Because brain development and language acquisition are assumed to be interactive processes wherein environmental influences shape neural connections (and neural connections influence the child's encounters with their environment), each step of the process is important.

In addition, when a child fails to initiate or respond to the social approaches of interactive partners, the child's behavior may deter his adult partner from attempts at further social engagement. The degree to which parents synchronize their focus of

attention to their child's focus has been found to relate to the child's language many years later (Siller & Sigman, 2002). Unless the adult is very persistent, the child with autism ends up having fewer communicative opportunities than other children, ultimately adding to the negative feedback loop and pushing the child further and further from the typical path of language development.

On the other hand, if JA skills are less impaired or if they can be improved upon before extensive deviations from the typical path have occurred, some of the secondary deficits might be avoided. Theoretically, better JA earlier may lead to a better developmental path that will be built on for improved language and social development. Early intervention could effectively mitigate some of the secondary neurological deficits allowing children's development to remain closer to the typical path (Mundy & Neal, 2000).

Joint Attention Interventions

Early intervention is key in the treatment of ASDs because it results in improved outcomes (Koegel, 2000). Many researchers have called for studies on the effects of JA interventions (e.g. Jones & Carr, 2004; Schertz & Odom, 2004) because of the potential downstream improvements that acquiring a pivotal skill might provide. Although there have been relatively few JA intervention studies to date, JA intervention is considered to be an established treatment approach based on an evaluation of the efficacy of six JA intervention studies (National Autism Center, 2009). These JA intervention studies, along with several others conducted to date, provide some promising results. Two key issues have been addressed through this line of inquiry: 1) can JA be taught to young children

with autism and if so, 2) does learning JA affect other skill sets such as language development thus providing evidence that it is a pivotal skill?

In order to see if they could teach children to use JA, Kasari, Freeman, and Paparella (2006) used a combination of applied behavioral analysis (ABA) strategies and milieu teaching in their randomized controlled intervention for joint attention and symbolic play. They had three groups: one received a JA intervention, one received a symbolic play intervention and one was a control group who got regular early intervention services (as did the others) but not the interventions targeted above. Results were that children in the JA intervention initiated significantly more than the other groups. Those in the play intervention showed more diverse types of symbolic play and both intervention groups generalized gains to play with their mothers. The control group did not make changes in these areas of development despite being in a full-day early intervention center-based program five days a week during the 6-week period when the JA and symbolic play interventions were taking place.

Whalen and Schreibman (2003) also developed an extensive intervention to teach JA skills. They broke JA into its component parts and attempted to teach each of the forms of JA to five children with autism. This intensive (3 days a week for 1.5 hours each day) program used what the authors call a naturalistic behavior modification technique. Sessions were conducted in a research lab where children were required to produce target responses (e.g. respond to an object being tapped or an adult's point) or else the toys that they were playing with were removed. Results were that four out of five children made some gains in both responding to and initiating joint attention bids. This study demonstrated that children with autism could learn the forms of JA but left unclear was if

they also learned the function of JA. The authors themselves questioned how one can know if the children understood the intent of the JA behaviors. Perhaps the children were using the required forms in order to avoid having their toys removed but they may not have been desirous of sharing attention with another person.

Overall, these studies imply that children with autism can be taught to initiate and respond to JA bids even if future study to refine the methods may be warranted. This resolves the first question regarding whether JA can be taught.

The second question, regarding if JA is a pivotal skill, is still being answered. Schertz and Odom (2004) question whether targeting JA in the preverbal period improves language any better than intervention focused on language skills and social development directly. One study (Jones, Carr & Feeley, 2006) found that when participants learned to use JA, there was an increase in the number and variety of vocalizations that they exhibited during JA episodes. The authors felt that this supported the pivotal skill theory but they did not formally attempt to analyze the association between JA and language acquisition so broad conclusions regarding this association could not be drawn.

Additional support for JA being a pivotal skill can be found in a follow up study by Whalen, Schreibman and Ingersoll (2006). They showed that teaching JA skills to the children with autism in their initial study produced collateral changes in social and language skills that were not directly targeted by the intervention.

In another follow up study, Kasari, Paparella, Freeman and Jahromi (2008) revisited the children from all three groups (JA intervention, play intervention and control) one year later. They found that expressive language was better in both the JA intervention group as well as the symbolic play group than in the control group. On closer inspection,

the children with the low initial expressive language skills (i.e., less than 5 spontaneous words and less than 20 months language age equivalent score) who were in the JA intervention showed greater expressive language growth than children with low expressive language skills in the other two groups.

In summary, there is a need for more JA intervention studies and replications of those above. These studies provide initial evidence for the importance of JA as a pivotal skill and demonstrate the feasibility of addressing JA specifically in intervention.

Diagnostic Tools and Joint Attention

Given that JA is an early emerging skill, it is often included in autism screening and diagnostic measures. The benefit of using JA as an early indicator to flag autism is that soon as autism is suspected, intervention services can be initiated.

Early screening tools such as the *Checklist for Autism in Toddlers* (CHAT, Baron-Cohen et al., 2000) and *Modified Checklist for Autism in Toddlers* (M-CHAT, Robins et al., 2001) use JA as one of the key indicators of autism risk. The “gold standard” diagnostic tools, the *Autism Diagnostic Observation Schedule* (ADOS, Lord et al., 2000) and the *Autism Diagnostic Interview* (ADI-R, Lord et al., 1994), measure both RJA and IJA as part of a larger assessment. JA is included in these and other measures because it discriminates diagnostic groups from one another.

These screening tools can flag a child as possibly having autism or a related disorder at a very young age (i.e. younger than age two), before diagnosis typically occurs. The average age for children diagnosed with autism is around 3.5 years (Baird et al, 2006). This relatively old age is common because language delay is often the impetus for an initial evaluation and may not be evident to families until the second birthday or later. The

American Academy of Pediatrics now recommends a screening for autism at 18 and 24 months and stresses, “Deficits in JA seem to be one of the most distinguishing characteristics of very young children with ASDs” (Johnson, Myers, & the Council on Children with Disabilities, 2007, p. 1191). Thus the JA deficit is an important red flag for autism in very young children.

Several studies support using JA as an early diagnostic flag. For example, Sullivan et al. (2007) found that RJA discriminated children with autism from children with more subtle symptoms associated with a broader autism phenotype (BAP), and from a non-BAP group, at 24 months. Only the children with autism failed to respond to RJA. “This finding suggests that a lack of response to Look + Point cues at 24 months signals the need for further developmental evaluation” (p. 45). In the CHAT, children with autism were delayed in three key developmental aspects: gaze monitoring, pointing for interest, and pretend play. Children who did not show these three types of behaviors were highly likely to have autism rather than other DD or typical development (Charman, 2003). On the other hand, the CHAT missed many cases of autism (around 50%) when using these criteria; Baird et al. (2000) found that although very specific, the CHAT lacked sensitivity and provided false negatives for children who had intact JA at 18 months.

Currently, autism screening tools use JA as an early indicator of autism and often help to identify children who are delayed in this realm. The tools have been shown to lack sensitivity, though, and miss cases of autism where children demonstrate JA ability. Having false negatives can be problematic in that children who are not diagnosed soon enough will be unable to benefit from some early intervention services.

Affect

Affect, or emotional expression, is a common part of social interaction and is used as a window into how a person is feeling about a given situation. Children with autism have been reported to exhibit less positive affect than other children both generally, as during play sessions with their mothers (Bieberich & Morgan, 1998; Joseph & Tager-Flusberg, 1997), and specifically during JA interactions with researchers (Kasari, Sigman, Mundy & Yirmiya, 1990). JA deficits "...may reflect not only a disturbance in attention regulation and social-cognitive processes but also disturbances in affective processes" (Mundy et al., 1990, p.126).

Clifford and Dissanayake (2008) found that the frequency of social smiling was the same for children with autism and typically developing children but that the quality of affective expression discriminated the groups from one another. There has not been extensive research done to determine if there is a range of affect expression within the spectrum of autism. Bieberich and Morgan (1998) noted that there was limited research on the affect of preadolescents with autism and suggested that, "...a semistructured play situation may provide a useful context for evaluation of emotional expression in these children" (p. 333).

Need for Future Study

Although it has been widely accepted that children with autism show a syndrome-specific core deficit in JA skills, this may not be fully accurate. The JA deficit is not absolute for children with autism; they exhibit a range of individual differences in their JA abilities (Naber et al., 2008). These individual differences may have been masked in previous studies for several reasons including the use of group-matching designs and the

fact that older studies may have examined a more narrow autistic population than would be included using current diagnostic criteria. A few current studies begin to suggest that there is in fact, heterogeneity among children with autism and more detailed examination of this diversity is needed.

Previous studies generally used group-matching designs to compare JA abilities for children with different diagnoses. Taking a group average score gave the impression that most children with autism had poor JA because there were low scorers who dragged averages down. This made group comparisons appear more extreme. Even though the foundational work of Sigman and Ruskin (1999) found that children with autism used RJA at significantly lower rates than those with Down syndrome and typically developing children, a closer examination of the distribution of the data indicates that there are 20% of children with autism who use RJA more frequently than the average typically developing child. Mervis and Robinson (1999) question how a JA deficit can be considered universal among children with autism if there is a subgroup of them who can use it normally: “If a substantial proportion of individuals with autism respond to joint attention at relatively high levels, one must wonder if response to joint attention is appropriately considered a deficit of autism in general, or if there are subtypes of autism that do not involve such problems” (p. 124). They recommend using pair-wise matching in research to alleviate some of the confounds of group-matching designs.

The early studies into JA and autism included children recruited from the 1970s and 1980s (e.g. Mundy et al., 1990; Sigman & Ruskin, 1999) who were more severely affected compared to the range of individuals that are on the autism spectrum using today’s diagnostic criteria. This may have provided a narrower, more homogeneous sample of

children with autism. With a more recent sample, there could be more of a range of JA abilities. Several very recent studies using more current samples have found that not all children with autism exhibit a JA deficit.

Naber et al. (2008) found that children with autism do not show a fundamentally different developmental pattern of JA from other children. They found that at 24 months, children with autism used less JA than DD and typical controls but by 42 months they had similar levels of most JA. Over time the developmental trajectory for all JA behaviors was comparable and even the one measure of JA that remained lower for the children with autism at 42 months improved along a similar slope to the rising JA rates of the other children.

Another study found that children with autism were able to sustain periods of supported joint engagement, a similar construct to JA, at similar rates to typically developing children. Adamson, Bakeman, Deckner & Ronski (2009) showed that children with autism used joint engagement but that they had a different pattern of joint engagement from other groups of children. They examined groups of children with autism, Down syndrome, and typically developing children and found that all of the groups of children differed in their joint engagement from one another. The children with autism used less coordinated joint engagement (attending both to a shared object and adult partner) than the children with Down syndrome and those with Down syndrome were less likely to attend to symbol-infused joint engagement (using or attending to language) than those with autism. On the other hand, according to the authors, "It is particularly noteworthy that young children with autism and with Down syndrome were often able to sustain periods of supported joint engagement at a rate comparable to that observed in typically developing

18- and 30-month old children” (p. 93). Each disorder affected the way children used joint engagement but all children, regardless of their diagnosis, used some forms of it.

Supporting this, MacDonald et al. (2006) found that children with autism between 2 and 4 years old had only minor deficits in RJA, although their IJA deficits were fairly severe.

These recent studies reveal that the JA abilities of children with autism are complex. Not enough is known about the extent of JA deficit in autism; perhaps JA is not as universally absent as previously generalized or perhaps the relatively inclusive diagnostic umbrella from current samples allows for a more heterogeneous population that includes children with a wider range of JA skills.

To summarize, the existence of a JA deficit exists in some children with autism is not in question. On the other hand, the extent of this deficit across the diagnosis is unclear, as are the patterns of JA use that might differentiate children with autism from other diagnostic groups. More information is needed about the heterogeneity of skills among children with autism.

Research Questions and Conceptual Framework

The main goal of this study is to learn more about the heterogeneity of JA skills for children with autism. More specifically, it is designed to clarify the nature of JA among children with autism, to learn more about the relationship JA has to language, and to explore its role as a pivotal skill. Additionally, for the children with autism who use JA, the extent to which their skill sets are distinguishable from those of children with DD is a primary objective. These goals are an important addition to the JA literature for both differential diagnostic and intervention planning purposes.

Research Questions

RQ1: How do children with autism and poor JA compare to children with autism who use JA with regard to CA, MA, and language ability?

Hypothesis 1: Children with autism who have better JA skills will have better language skills than those with poor JA.

RQ2: How do children with autism who use JA compare to MA-matched children with DD with regard to IJA, RJA, affect, adults toward whom they initiate and language?

Hypothesis 2: Children with autism who exhibit some JA skills will have similar overall levels of JA to those with DD, but some differences will still be evident. Specifically, I expect children with autism to demonstrate more neutral affect during JA episodes and to initiate more to their parent than to the experimenter, whereas the children with DD will show more positive affect and initiate primarily with the experimenter conducting the assessment. I also hypothesize that the children with autism who have JA skills will have more similar language levels to the children with DD than they will to the children with autism and no JA skills. This will hold true when controlling for MA.

Conceptual Framework

If Mundy and Crowson (1997) are correct about JA being a pivotal skill for learning language, all children who demonstrate JA abilities should develop better language than those who do not. According to their model, a primary neurological deficit for children with autism means JA does not develop properly. This paucity of JA then causes secondary neurological deficits and ultimately language development is affected.

Application of the Conceptual Framework to RQ1. This study classifies children with autism into subcategories based on their RJA skills. For this initial grouping, RJA is

used as a skill that a child either has or does not have (similar to calling children “walkers” or “talkers”). Theoretically the children who use JA will take a different developmental path than those who do not use JA, resulting in enhanced language development for the former subgroup. Figure 1 suggests the track children’s language development might take over time. This study does not have a time element so a snapshot will be taken of concurrent JA and language skills.

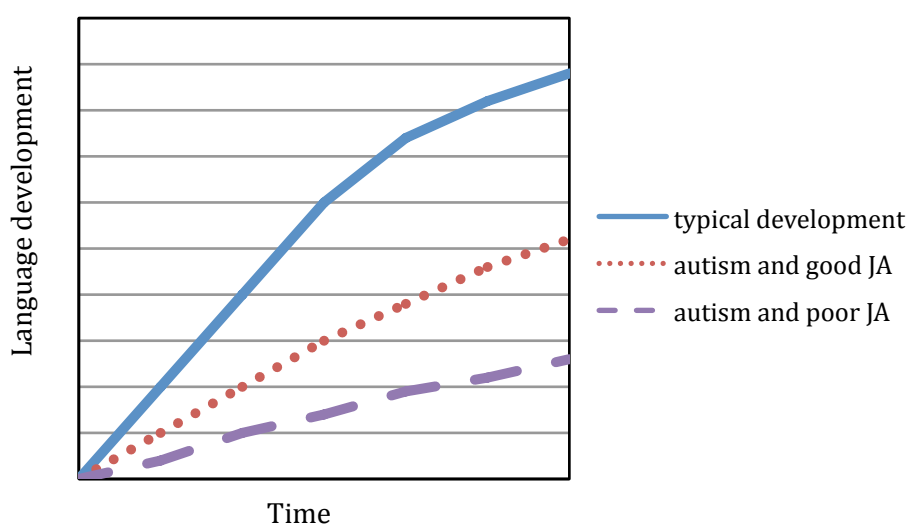


Figure 1. Hypothesized language development over time for typical children and those with autism.

Of course the JA deficit is probably not the only reason children with autism have a language delay. Issues such as cognitive delay, additional differences in neurological functioning, lack of motivation to interact, and other issues likely contribute. For this reason, comparing children with autism to one another allows us to control for these factors and focus on the direct impact of variability of JA on differences in language skills.

Application of the Conceptual Framework to RQ2. A second aspect of this study is to compare the topography of JA skills of children with autism to those of well-

matched children with DD. The reason for this comparison is to see whether the types of JA evidenced in the autism group are the same as in groups of children with other disabilities. Whereas both groups may demonstrate JA, the goal here is to identify if there are differences between them. For example, children with autism, who by definition have a social deficit, may feel more comfortable initiating JA with a familiar adult whereas children with DD, who typically are not socially impaired beyond their MA level, might initiate toward any interactive partner regardless of familiarity.

Two main types of analyses are conducted in this investigation (see Figure 2): 1) within the autism sample, the children who use JA are compared to those with poor JA skills; 2) between diagnostic groups, the children with autism and JA skills are compared to children with DD. Language for both groups is an important outcome variable. It may be that JA is such an important element in language development that children with autism and JA skills are more similar in their language functioning to the children with DD than to other children with autism. On the other hand, the other issues related to autism may overwhelm the JA factor, meaning that the two subgroups of children with autism will be more similar to one another than either subgroup is to children with DD.

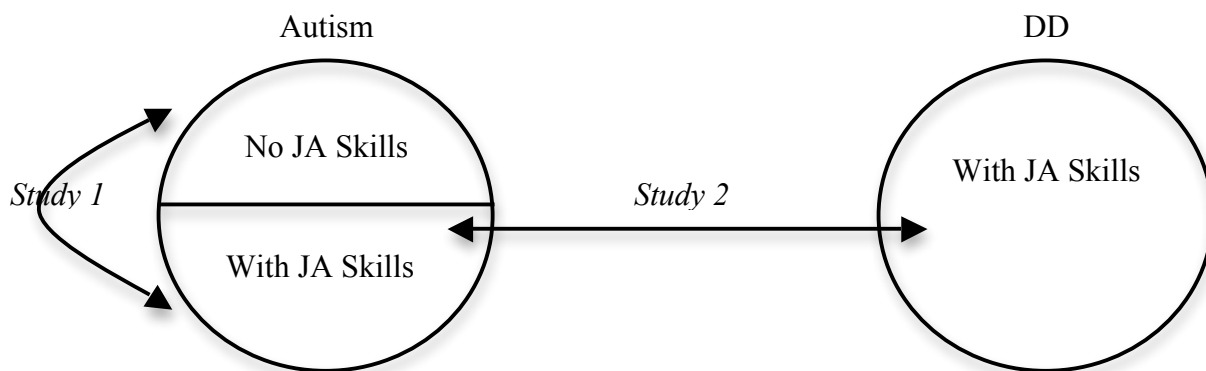


Figure 2. Groups of children compared in the present investigation.

Operational definitions of RJA and IJA

For the purposes of this study, the definitions of JA are based largely on those used in the *Early Social Communication Scales* (ESCS; Mundy et al, 2003) which stated: “The function of Joint Attention behaviors is to share attention with the interactive partner or to monitor the partner’s attention. They differ from Behavioral Requests in that they do not appear to serve an instrumental or imperative purpose (e.g., trying to get or activate an object or event). Rather, their function seems to be more to share experiences of objects or events with others” (p. 16). Requesting and ongoing conversation around an object or event after shared attention is established are not considered JA for the purposes of this study.

Response to Joint Attention (RJA) occurs when the child reacts to an overt bid by the adult to share attention. The adult must make a clear attempt to get the child to follow. For example, the adult might call the child’s name and turn their head to look at an object or they might say the word “look” or point at something. Then the child must clearly respond by either looking toward the indicated object, making eye contact with the adult or other such action to show that they are changing their focus to that of the adult’s.

Initiation of Joint Attention (IJA) occurs when the child initiates a shared attention bid with an adult. This can be done by pointing, showing, giving, or making eye contact with the adult around an object or event. This must occur without the adult’s prompting and does not include request behavior. A bid is considered complete after eye contact is broken or attention has been shifted to a new object.

Additional operational definitions for RJA and IJA can be found in the coding manual (Appendix B).

Chapter 3

Methodology

This examination of the JA abilities of children with autism and DD was done in two stages, hereafter called Study 1 and Study 2. Study 1 was designed to answer RQ1 comparing subgroups of children with autism, and involved a new analysis of data that was collected for the Sensory Experiences Project (SEP) at the University of North Carolina at Chapel Hill from 2003-2007. The group of children in Study 1 were all diagnosed with autistic disorder and were divided into groups based on their JA ability; then a within-autism examination of JA skills and language outcomes was undertaken. Study 2 was designed to answer RQ2 and included children with autism (and JA skills) who were matched to children with DD to see if, and in what ways, their JA, affect, language skills, etc. differed and were alike. In addition to using extant data from the SEP, Study 2 entailed a novel video coding analysis to address the research question more specifically.

Study 1: Within-Autism Comparisons

Study 1 compared children with autism who had JA abilities to children with autism who did not demonstrate JA abilities. The main goal of Study 1 was to determine if JA ability is concurrently associated with language ability among children who have autism.

Participants. Children enrolled in the SEP study were considered appropriate for this study if they were diagnosed with Autistic Disorder only (i.e. not Autism Spectrum or other variant of autism, PDD-NOS, and not children with DD). The children were divided

into two groups based on JA ability, those who had RJA skills and those who did not (see section below that describes how JA grouping was done). Data for 32 children were examined: 16 children were in each JA ability group (14 boys and 2 girls per group). The average age (CA) of children in both groups was 3½ years old. The children had nonverbal mental age (NVMA) scores of 30 months or less. Most of these children had both autism and an intellectual disability. Table 1 has a detailed description of child demographics.

Table 1
Child Demographics for Children with Autism in Study 1

JA ability group	Total N	# of girls	CA (months)	NVMA (months)
No-JA	16	2	Mean 43.00 SD 10.45 Range 31-67	Mean 13.25 SD 5.79 Range 4-26
Yes-JA	16	2	Mean 43.38 SD 16.86 Range 20-70	Mean 17.75 SD 7.01 Range 4-30

Inclusion criteria. Children were considered appropriate for Study 1 if: 1) They were administered Module 1 or 2 on the *ADOS*; 2) they were administered the *Preschool Language Scale 4* (PLS-4) and the *Mullen*; 3) they were 20 months to 7 years of age; and 4) they met strict criteria for a diagnosis of Autistic Disorder. Diagnosis was determined using the following criteria: The child: a) received a clinical diagnosis of an autism spectrum disorder from a professional; b) had diagnostic algorithm scores indicative of Autistic Disorder on the *Autism Diagnostic Interview – Revised* (ADI-R; Lord, Rutter, & LeCouteur, 1994); and c) had diagnostic algorithm scores indicative of Autistic Disorder on the *Autism Diagnostic Observation Schedule* (ADOS; Lord et al., 1999). In addition, the child’s diagnosis was confirmed by the clinical impressions of an expert on the SEP team

based on the *Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition* (DSM-IV) criteria for Autistic Disorder.

Measures. All of the children in this study were administered the following measures: the *Autism Diagnostic Interview – Revised* (ADI-R; Lord, Rutter, & LeCouteur, 1994), the *Autism Diagnostic Observation Schedule* (ADOS; Lord et al., 1999), the *Mullen Scales of Early Development* (Mullen, 1995), the *Preschool Language Scale 4* (PLS-4; Zimmerman et al., 2005), and the Attention-Following and Initiating Joint Attention Protocol (Watson, Baranek, & Poston, 2003). The administration of all measures was videotaped as data were collected.

Autism Diagnostic Observation Schedule. The *Autism Diagnostic Observation Schedule* (ADOS; Lord et al., 1999) is a semi-structured, play-based, diagnostic assessment. According to the University of Michigan Autism and Communication Disorders Center (where ADOS author Lord is the director): “The ADOS can be used to evaluate individuals at different developmental levels and chronological ages, from toddlers to adults, from individuals with no speech to those who are verbally fluent” (UMAC website, 2007). The play-based nature of the ADOS provides a naturalistic setting for assessment and the child’s parent is present during the administration. The ADOS involves giving one of four modules based on the communication skills of the person being tested. Module 1 is administered to children who do not use phrase speech and Module 2 is for those with some phrase speech but who are not verbally fluent (Modules 3 and 4 are for subjects who are verbally fluent). Additionally, the ADOS Modules 1 and 2 have specific probes for IJA and RJA built into them. The naturalistic setup allows for opportunities for the child to spontaneously initiate JA and respond to JA bids. Children who were

administered Modules 1 and 2 were eligible for this study. (Western Psychological Services, 2007.)

Autism Diagnostic Interview – Revised. *The Autism Diagnostic Interview – Revised* (ADI-R; Lord et al., 1994) is a semi-structured parent interview used for diagnostic purposes based on the *Diagnostic and Statistical Manual of Mental Disorders, 4th edition* (DSM-IV; American Psychiatric Association, 1994).

Intelligence scale. *The Mullen Scales of Early Development* (Mullen, 1995) is a measure of development/intelligence appropriate for young children. A nonverbal mental age (MA) score can be obtained from the *Mullen Scales Visual Reception* score.

Preschool Language Scale, 4th Edition. *The Preschool Language Scale* (PLS-4; Zimmerman et al., 2005) provides receptive, expressive and total language scores of children from birth through age seven.

Attention-Following and Initiating Joint Attention Protocol. This JA Measure (Watson, Baranek & Poston, 2003) is conducted under structured testing conditions. It involves 16 trials, half of which are designed to probe the extent to which the child will follow attentional cues of the examiner (Attention Following) used as an RJA measure. The other half are designed to present opportunities for the child to initiate joint attention (IJA) with the examiner. The scores are calculated as proportion of opportunities (# missed/# offered), scores ranged between 0-1.

Procedure. In order to compare children with autism with one another, data were collected and organized, then children were divided into JA ability groups, and finally statistical analyses were completed.

Excel spreadsheet development. The first step in the process was to develop a spreadsheet to capture and organize all the information for this project. Data for each child with autism (as well as for those with DD included in Study 2) who was enrolled in the SEP study were gathered together from participant files, Data Core requests, and SEP staff. An Excel spreadsheet was created with the following categories:

- child ID number (no information which could identify participants was used);
- diagnostic group;
- gender;
- chronological age (CA);
- nonverbal mental age (MA) taken from the visual reception standard score of the Mullen;
- ADOS results related to JA including the following questions: Response to Joint Attention (questions B-11 and B-7 on Modules 1 and 2 respectively) and Spontaneous Initiation of Joint Attention (questions B-10 and B-6 on Modules 1 and 2 respectively);
- PLS-4 scores, specifically: Auditory Comprehension age equivalent and standard scores, Expressive Communication age equivalent and standard scores, and Total Language Score age equivalent and standard scores; and
- Joint Attention Protocol scores including the Attention Following score and the Initiating Joint Attention score.

Grouping by RJA ability. For the purposes of this study, children were classified into JA ability groups based on how they scored on the Response to Joint Attention (RJA) probe from the ADOS. The RJA probe involves the examiner first gaining the child's

attention by calling their name. Then the examiner says, “Look!” and turns his or her head deliberately toward a new object across the room (typically a stuffed mechanical bunny). The RJA score is based on how the child responds to this deliberate bid. A score of 0 or 1 means the child responds to a joint attention bid of the examiner (when s/he follows just the examiners eyes/gaze without needing a point the score is a 0; when the examiner uses a point and the child follows it, the score is 1). If the child does not respond to the examiner’s gaze or the point, s/he receive a score of 2 or 3 (if s/he attends to an object when it is put in front of him/her, s/he gets a score of 2 and if s/he has no interest in the target object s/he gets a score of 3). Thus, on this measure, a higher score indicates more impairment or a total absence of observed RJA skills.

JA groups were created based on the RJA probe for three reasons. First, RJA is considered a more basic skill than IJA since the child needs only to respond to what is being asked of him and not originate a behavior. Second, all of the children in this study who had IJA skills also had RJA skills, but the converse was not always true. That is, if a child could initiate JA, they also responded to it, but many children who were able to respond to JA did not initiate. Finally and most salient for this division, knowing when a child responded to a JA bid was very clear – either they looked or reacted in some way when asked to follow an adult’s attentional bid or they did not – thus using the RJA score was unequivocal.

For the purposes of this study, children who received a score of 0 or 1 on the RJA probe of the ADOS were placed in the “Yes-JA” group and those who received a score of 2 or 3 were placed in the “No-JA” group. These groupings were then confirmed using the Joint Attention Protocol’s Attention Following score (scored as the proportion correct out

of 8 probes). For the No-JA group, all except one child got .25 or below for their Attention Following score (the other child got .50). For the Yes-JA group, all of the children except one received a .50 or above on the Attention Following score (the other child got .125). Thus there was a 94% agreement in grouping between the ADOS and Attention Following score from the Joint Attention Protocol. Due to the overall agreement being so high, and because there was only one outlier child in each group, the ADOS RJA score was used for all cases. In this study, discussions of JA ability or lack thereof are based on these RJA ability groupings.

There were a total of 55 children who met autism and age cut-offs and could have been used in Study 1. Of these, 16 had RJA scores that placed them in the No-JA group, 38 in the Yes-JA group. There was one child with autism who was considered a JA outlier and excluded from the study. The outlier child did not demonstrate RJA but did demonstrate IJA ability according to ADOS scores. Because there was only one such case out of the 55 children with autism who could have been included in Study 1, the child was removed from the analyses.

Examining the data. An examination of the data by group was undertaken. It became clear that all of the children with the highest nonverbal MAs (all cases over 30 months) and the oldest children (all cases over 68 months) were in the Yes-JA group. Previous research studies have shown that children often learn how to respond to JA as MAs increase and they get older (Jones, Carr & Feeley, 2006).

Therefore, both to make the groups more equivalent in chronological and mental age, and to focus on JA as it functions as an early emerging skill, the cases with the highest MAs (MA scores over 30 months) were removed. A methodological decision was made to

set the groups to equal sizes, which worked well since 16 cases remained in the Yes-JA group when MA scores above 30 months were removed and the No-JA group already had 16 cases. Setting the groups to equal sizes captured all cases with MA scores of 30 months or less and provided groups with similar CA scores (see Table 1).

Statistical Analyses. The main question for this study was whether JA ability was associated with concurrent language scores. Group means were initially compared using independent samples t-tests. The total language age equivalent score from the PLS-4 was used as the dependent variable. An examination of means, variances and scatter plots was done, and tests for skewness, kurtosis and outliers were also completed.

MA is known to relate to language scores so an ANCOVA was run in order to see if JA ability was significantly associated with language after controlling for MA.

All statistics were run by exporting data from the Excel spreadsheet into SPSS 16.0 for the Mac and running the analyses via SPSS procedures.

Study 2: Video Coding Study – Comparison of children with Autism and DD

Study 2 compared children with autism from the Yes-JA group to children with DD who also had intact RJA skills. A video analysis was undertaken to examine the forms and frequency of JA that each child used, as well as children's affect during JA bids and the partner to which they directed JA. The goal of the video analysis was to determine if children with autism who demonstrate JA, do so in similar or different ways to their MA-matched DD peers.

Power and effect size. A power analysis was completed to determine how many matched pairs were needed. Results showed that to detect a medium effect size of 0.5 (with an alpha of .05 and a one-tailed test), using 20 matched pairs gave a power level of 0.7.

Thus 40 cases (20 from the autism group matched on MA with 20 from the DD group) were included in the video analysis.

Participants. There were 40 children whose video analyses were included in Study 2: 20 children with autism and 20 children with DD. The average MA scores were the same for both groups at approximately 26 months. The average CA was similar for the groups at 44.75 months for the autism group and 43.60 months for the DD group. The CA ranged from 20 months to 79 months; however, all children were younger than 68 months, with the exception of one older child in each group. There were eleven girls included in the video analysis, three with autism and eight with DD. Table 2 shows child demographics for Study 2.

Table 2
Child Demographics by Diagnostic Group for Study 2

Diagnosis	N	# of girls, boys	CA (months)	MA (months)	Language (months)
Autism	20	3, 17	Mean 44.75 SD 16.15 Range 20-79	Mean 26.15 SD 13.12 Range 5-50	Mean 24.10 SD 11.29 Range 11-50
DD	20	8, 12	Mean 43.60 SD 16.40 Range 20-78	Mean 26.75 SD 13.03 Range 11-50	Mean 27.40 SD 13.41 Range 12-54

Inclusion criteria. The group of children with DD included in Study 2 all had developmental delays that did not include symptoms of autism. They were classified as DD based on the following criteria: 1) a clinical diagnosis of mental retardation or developmental delay; 2) either an overall cognitive score that was two or more standard deviations below the mean, or scores that were at least 1.5 standard deviations below the mean on two separate areas of development; and 3) no clear symptoms of autism, as

confirmed by not meeting autism cut-offs on the ADOS and the *Childhood Autism Rating Scale*. Examples of the children in the DD group included children with Down syndrome, children with other genetic syndromes with no known association with autism (e.g. Williams syndrome), and children with non-specific developmental disabilities including idiopathic intellectual disability. All of the children with DD who were included in Study 2 had RJA scores on the ADOS that placed them in the Yes-JA group.

Exclusions: There were two children with DD who were considered JA outliers and excluded from the study. These children did not demonstrate RJA but did demonstrate IJA ability. Because in all other cases children who had IJA also had RJA, these two exceptions were excluded from Study 2.

For the children with autism included in Study 2, the same diagnostic criteria that were used in Study 1 were applied here; they all had a strict autism diagnosis and RJA scores that placed them in the Yes-JA group. Many of the same children from Study 1 were also included in Study 2 (13 of the 16 cases from the Yes-JA group). Of the three cases from Study 1 that were not included in Study 2, two had missing or damaged videos and the other had a MA score so low that he could not be well matched with any case from the DD group. To have sufficient power, Study 2 required twenty matched pairs (see Power and Effect Size section below). Therefore seven children not included in Study 1 were added to Study 2 and to make the matches, the MA cut-offs were higher.

Matching. Before video coding began, the children were placed into matched pairs – each child with autism was paired with a child with DD. Matching was based on MA and CA. Pair-wise matching was used for two main reasons: it eliminated some of the

variability between groups that might affect outcome measures and by doing so, it also provided a gain in power.

Matching was done initially on nonverbal mental age (MA) since that was most likely variable to correlate with JA ability and language scores. Then the child's chronological age (CA) was examined so that cases were matched as closely as possible on both MA and CA. (The CA had to vary more for some pairs than others given the relatively small sample.)

In order to get 20 matched pairs the following steps were taken.

1. The 39 children with autism and 35 with DD who had scores of 0 or 1 on the RJA probe of the ADOS were placed in a new Excel file.
2. The children were sorted by MA. Cases with the lowest MAs were matched first. An upper MA limit of 50 months was established (leaving a pool of 27 children with autism and 28 with DD).
3. Cases were matched by MA. Seventeen pairs were within 3 months of one another, and the remaining 3 pairs were matched within 4-6 months of one another.
4. Cases were matched by CA. For each potential MA match, the case with the closest CA was located. Most matches had CAs within 12 months of one another, although there were a few cases that varied more (16 of 20 pairs were within 12 months of each other for CA).
5. Each of the girls with autism (n=3) was matched with a girl from the DD group who had the most similar MA and CA. The remaining females with DD (n=5) were matched to males from the autism group.

After the twenty matched pairs were established, three pairs were found to be problematic due to unusable or missing videos. In the first instance, one member of the pair was missing a video so it was replaced using an unused child with similar MA and CA. For a second problematic pair, although only one member of the pair had problematic data, both cases were discarded and a new pair was made because there was no suitable unused case to make a match for the child with usable data. In the remaining instance, both individuals had missing data so the pair was discarded and a new matched pair was made to replace it.

Video Analysis. The video analysis consisted of data collected from two video clips of children engaged in semi-structured play with an examiner and a parent present. The play scenarios were designed to prompt RJA and IJA bids from the children. A total of between two and ten minutes of tape was examined for each child.

Use of the ADOS for the video analysis. The video clips for Study 2 came from each child's video-taped ADOS assessment. The ADOS is a semi-structured, play-based measure so it provides a more naturalistic setting than many standard JA measures in which the child and adult are seated at an examination table in a standard testing environment. Structured JA measures such as the ESCS and JA behaviors coded from naturalistic play samples have been found to be positively correlated, "providing support for the use of naturalistic sampling of joint attention skills as a viable alternative, or supplement, to structured measures" (Roos, McDuffie, Ellis Weismer, & Gernsbaher, 2008, p. 275).

During the ADOS, children can move around the room and interact with the play items. This is especially good for looking at IJA. The initiation of joint attention is

motivated by a child's desire to share attention, which is very difficult to tap in a structured testing setting. The ADOS protocol also allows for the child to choose to initiate to their parent or to the examiner. There is flexibility in the timing and technique of how probes are administered although the examiner tries to elicit target behaviors using a specific set of items and prompts for all children.

There are two sections of the ADOS that are ideal for probing RJA and IJA: the Bubble Play scenario and the Mechanical Bunny scenario. These sections were developed to provide contexts in which JA could be observed. For example, for Bubble Play the ADOS manual states: "This task provides a context for observation of the child's affect, initiation of joint attention, shared enjoyment, requesting, and motor behavior while the bubbles are present" (Lord et al, 1999, p. 2). Additionally, the Mechanical Bunny scenario includes a direct probe for RJA (i.e. the examiner tells the child to "Look!"). Because JA is expected during these scenarios, they were chosen for Study 2. Additionally, because all children were provided with similar prompts during Bubble Play and Mechanical Bunny, these two scenarios provided contexts for comparing JA across children.

Video coding procedures. For each of the two coded scenarios, a coding sheet was completed (see Appendix A). The procedure used to code the videos is explained in detail in the coding manual in Appendix B. To summarize, every time a JA bid was initiated by either the child (IJA) or an adult (providing an opportunity for RJA), the details of that bid were recorded. For each bid, as many forms of JA as were seen during that bid were checked off. For example if the child initiated a bid, the way in which she did so (e.g. did she point at an object or make other gestures, made eye contact, vocalize, etc.) was recorded. The child's affect during the bid was recorded as positive, negative, neutral or

uncodeable, and the adult partner with whom the child interacted during the JA bid was recorded (i.e., the parent or the examiner). Each time an adult initiated a bid, the child's response (or lack thereof) was scored along with the rest of the information listed above. Thus a record was made of each RJA or IJA bid and the details about that bid were noted.

The start and end time for each scenario was recorded to provide a total time for each coded session. This was needed because the amount of time it took to administer each segment varied depending on whether the child was very engaged or feeling fatigued, how quickly the examiner got the required information, and other related factors.

The coder watched each video scenario at least three times: first to get an overview of the segment, then to look for IJA bids made by the child, and finally to look for the child's response to JA bids made by adults. This provided a systematic way of approaching the videos, thus facilitating reliable coding.

Inter-rater agreement. Coder training involved two coders who learned about JA and how it was defined for this study, and then practiced using the coding manual (Appendix B) and coding sheets with sample videos that were not part of the study. This continued until the two coders reached 80% agreement on three consecutive videos. It took several weeks of training until the coders felt confident of their understanding of the codes and ability to maintain reliability.

The main coder was a research assistant with a master's degree who was hired for the purposes of coding tapes for this study. The research assistant was blind to diagnosis and did not know which cases constituted the matched pairs. She was provided with a list of ID numbers, in no particular order, to code.

The second coder was the author. The tapes to be coded by both people were chosen at random and their diagnostic groups were not accessed before scoring the tapes.

Intraclass correlations (ICC) were used to document reliability between observers (Osterling et al, 2002). The ICC is frequently used in studies of children with ASD as a method of establishing interrater agreement.

Inter-rater agreement was established based on 20% of the videotapes, selected randomly. The intraclass correlation coefficients ranged from good to excellent. The ICC is reported for variables of interest as follows: RJA bids offered by adult (.94), RJA no response by child (.88), RJA look by child (.79), RJA eye contact (.97), RJA gesture (.63), RJA vocalization (.85), RJA affect neutral (.88); IJA bids initiated by child (.95), IJA point (.96), IJA show/give (.83), IJA eye contact (.97), affect positive (.93), affect negative (.80), partner parent (.91), partner examiner (.94).

Inter rater agreement was also calculated using a point by point agreements/agreements+disagreements method. For this agreement was generally good ranging from .60 to .83. For specific variables, the proportion of agreement was as follows: RJA bids offered by adult (.72), RJA eye contact (.83), RJA look by child (.60), RJA vocalizations (.75), IJA bids initiated (.68), IJA show (.77), IJA eye contact (.79), affect positive (.69), partner examiner (.81).

Data management. The data from the coding sheets were entered into an Excel file. The read-in of this data was verified to ensure accuracy. Added to this file were child diagnosis, matched pair number, CA, MA and language scores.

Several categories from the data sheets were combined or deleted: the eye contact categories of Eye Contact and Alternating Eye Contact were combined into an Overall Eye

Contact category because due to the constraints imposed by videotaping in a semi-structured environment it was difficult for the coders to be reliable on what type of eye contact was made (although they were quite reliable once the two eye contact categories were combined). The Point categories (Proximal and Distal) were combined because there were not many instances of either. The uncodeable category from the coding sheet was deleted because it was rarely used. For RJA, the adult's actions were not analyzed because they did not vary much (the adult always verbalized, usually looked at the object of attention and occasionally gestured). The time codes (Start Time and End Time) were converted to length of time elapsed in minutes.

The two scenarios (Bubbles and Mechanical Bunny) were added together to make one total observation per child. This was done because the scenarios were both part of a single, larger play-based assessment and they could have as easily been scored on a single coding sheet. Additionally the measurements were not independent of one another. Combining the two lines into one was straightforward: the two scores for a child were added together to give a combined number for each category (e.g. the time each scenario took was added together to give a total time, the number of bids including Eye Contact were totaled up, etc.).

Due to the fact that observation times were different across children, there was variability in the amount of time that they could have initiated JA bids. A new category was created called IJA Bids/Time. This was the number of IJA bids divided by the total observation time, giving the number of times a child initiated JA bids per minute.

A similar category was created for RJA. It was not based on time but rather the number of instances for each case that an adult made a JA bid, expecting a response from

the child. A ratio score (called RJA Ratio) was determined by taking the number of RJA bids made by the adult and dividing it into the number of bids to which the child responded (i.e. if the adult tried to get the child's attention three times and the child responded twice, the RJA Ratio would be $2/3$ or 0.67).

Statistical Analyses. To answer RQ2, a series of statistical analyses were conducted. The groups were compared in three main sections: with regard to 1) the broad RJA levels and the forms of RJA used, 2) the broad IJA levels and the forms of IJA used and 3) the associations with children's concurrent language.

To determine if children from both diagnostic groups used RJA in similar ways, a repeated measures logistic regression allowing for multiple trials per subject (e.g. # bids a child responded to over # bids offered by an adult) was used. The matched pairs were examined as a unit (hence the repeated measures aspect to the regression). This was the analysis employed to look at the forms of RJA as well: i.e. eye contact, point, other gestures, if the child looked at the requested object/action, if they vocalized during the bid and their facial affect.

For the broad IJA examination, the IJA bids made over time were analyzed using a repeated measures loglinear poisson regression that adjusted for time (the log of time was used as an offset to account for the varying lengths of time children were observed). For the forms of IJA (like the number of times eye contact was made during an IJA bid, the number of points, show, other gestures, vocalizations, etc.), the logistic regression procedure from RJA was used (i.e. for each IJA variable, a repeated measures logistic regression allowing for multiple trials per subject with the number of IJA bids made by

each child as the denominator, and the frequency of point or a vocalization, etc. as the numerator).

A check of the scores from the Joint Attention measure was run to see how they related to the video coding scores. The Attention Following score on the Joint Attention measure provides another measure of response to JA. A correlation of the RJA Ratio score and the Attention Following score was run. A correlation of the IJA/minute score and the Initiating Joint Attention score from the Joint Attention measure was run. Finally, correlations for both Joint Attention measure scores were run with the concurrent language score.

The final analysis involved determining if the groups differed on concurrent language scores. This comparison was made using a repeated measures linear regression allowing for multiple trials per subject. The model was also run using MA as a covariate. A correlation between MA and concurrent language score was run to see how strong this relationship was for these children.

Chapter 4

Results

The results of this investigation are presented in two sections: (a) The results from Study 1 that addressed RQ1: How do children with autism who have JA compare to children with autism who do not have JA skills with regard to CA, MA and language ability? (b) The results from Study 2 that addressed RQ2: How do children with autism and JA skills compare to MA-matched children with DD with regard to RJA, IJA, affect, adults toward whom they initiate, and language ability?

Results from Study 1

The No-JA group and the Yes-JA group were compared for differences in CA and MA. The average CA for children was not significantly different, 43.00 months for the No-JA group and 43.38 for the Yes-JA group, $t(30) = -.076, p = .94$. The average MAs were not significantly different, 13.25 for the No-JA group and 17.75 for the Yes-JA group, but the significance value was just above the .05 cut-off, $t(30) = -1.98, p = .057$. The Cohen's d was .70, and $r = .33$ for the association between group and MA, values reflecting a medium effect size of JA group on MA.

Association with concurrent language. The average language scores differed significantly between the two groups. The mean for the No-JA group was 9.25 ($SD = 3.86$), and the mean for the Yes-JA group was 17.06 ($SD = 5.26$) (see Figure 3). Initially, t -tests were run with language scores as the outcome measure. The Yes-JA group had

significantly higher language scores than the No-JA group, $t(30) = -4.79, p < .001$. Cohen's $d = 1.69$ and $r = .646$, values representing a large effect size.

Next, in order to control for the potential effects of MA on language, an ANCOVA was run using MA as a covariate and language as the outcome measure. In the ANCOVA, MA was significantly related to children's concurrent language scores, $F(1, 29) = 20.12, p < .001$. When the effect of MA was removed, there was still a significant main effect of JA group on language scores, $F(1, 29) = 17.99, p < .001$. Figure 4 depicts a scatterplot of MA scores by language. It shows that for children with JA had higher language than those with No-JA and that MA and language were correlated.

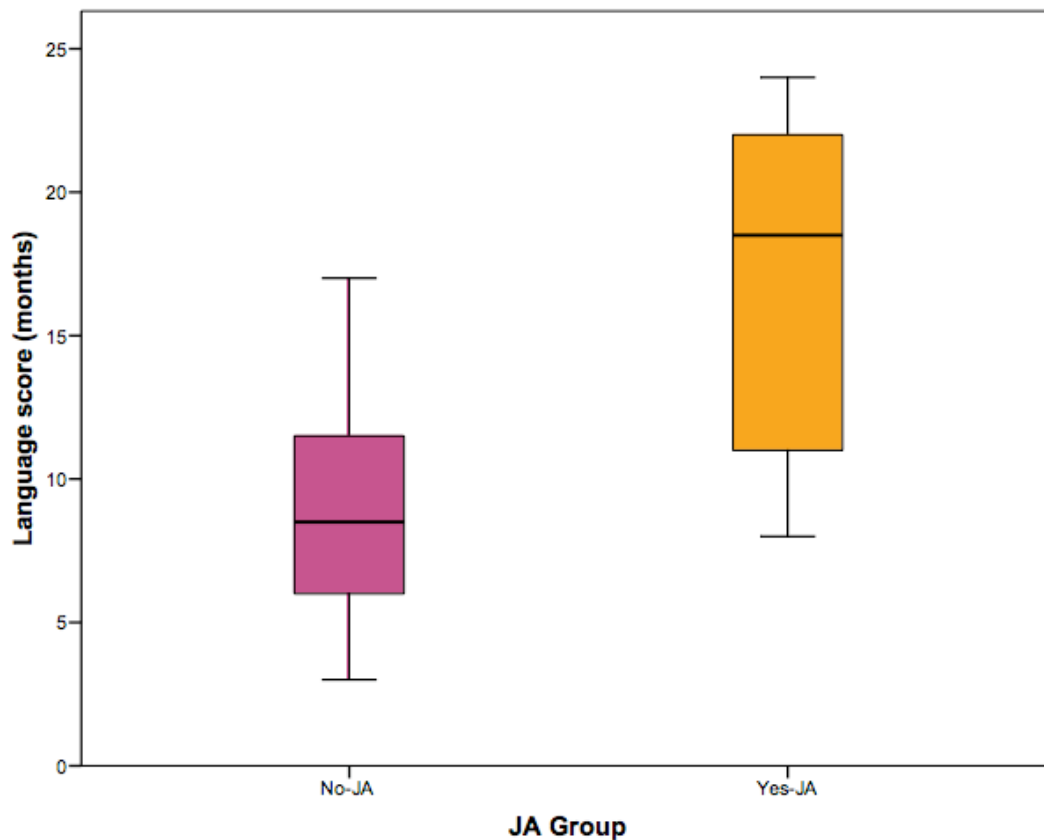


Figure 3. Boxplots for language scores for each group of children with autism.

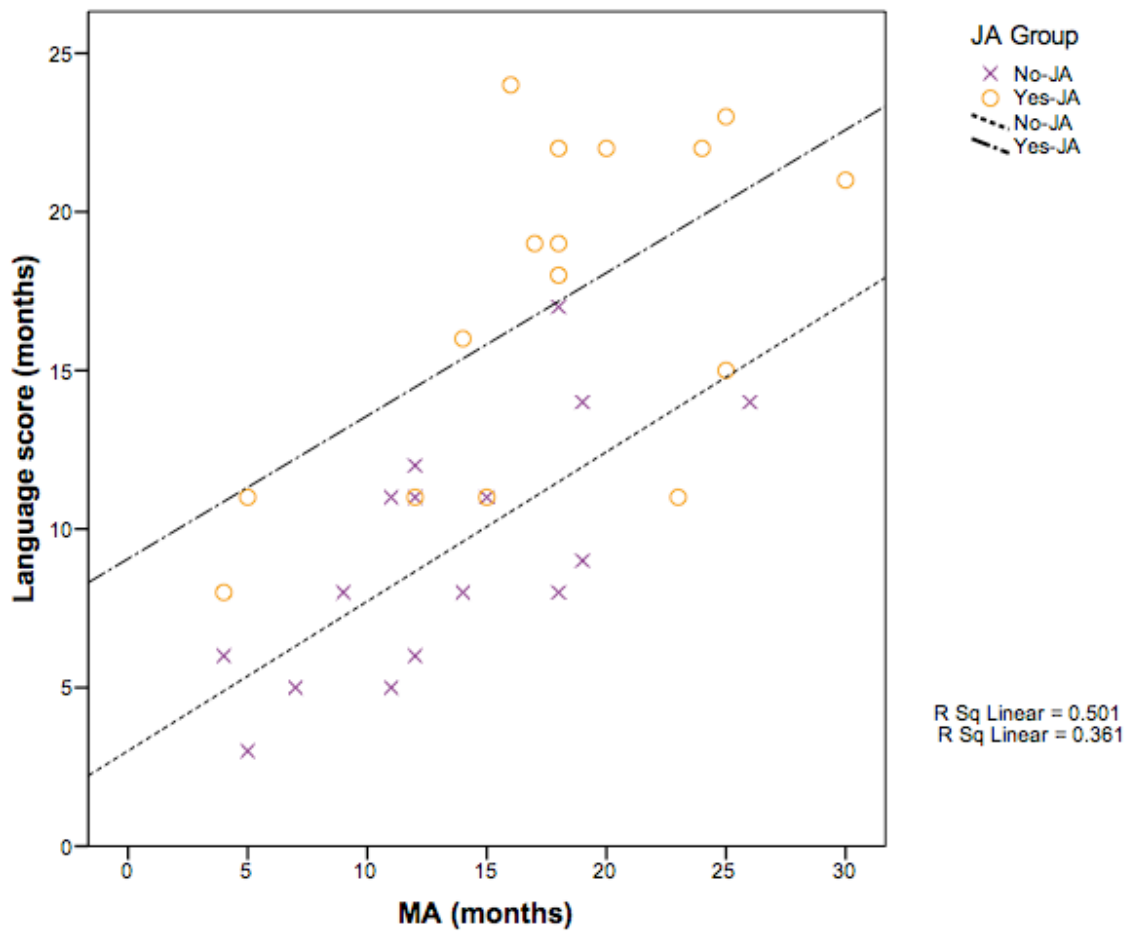


Figure 4. Language scores by MA, with JA group identified for children with autism.

Two correlations for the Attention Following score from the Joint Attention measure were made. First, examining the Attention Following score and the RJA score from the ADOS showed the two scores were very strongly correlated at $r(29) = .85$, $p < .001$. Next, a correlation was run between the Attention Following score and the concurrent language score using a partial correlation to hold the effects of MA constant; the Attention Following score was strongly correlated with concurrent language score after partially out MA, $r(28) = .64$, $p < .001$ (the simple correlation without controlling for MA

was also strong, $r(29) = .77, p < .001$). Figure 5 shows the correlation between Attention Following score and concurrent language score. The lower Attention Following scores were mostly from the No-JA group, and these cases generally had low language scores.

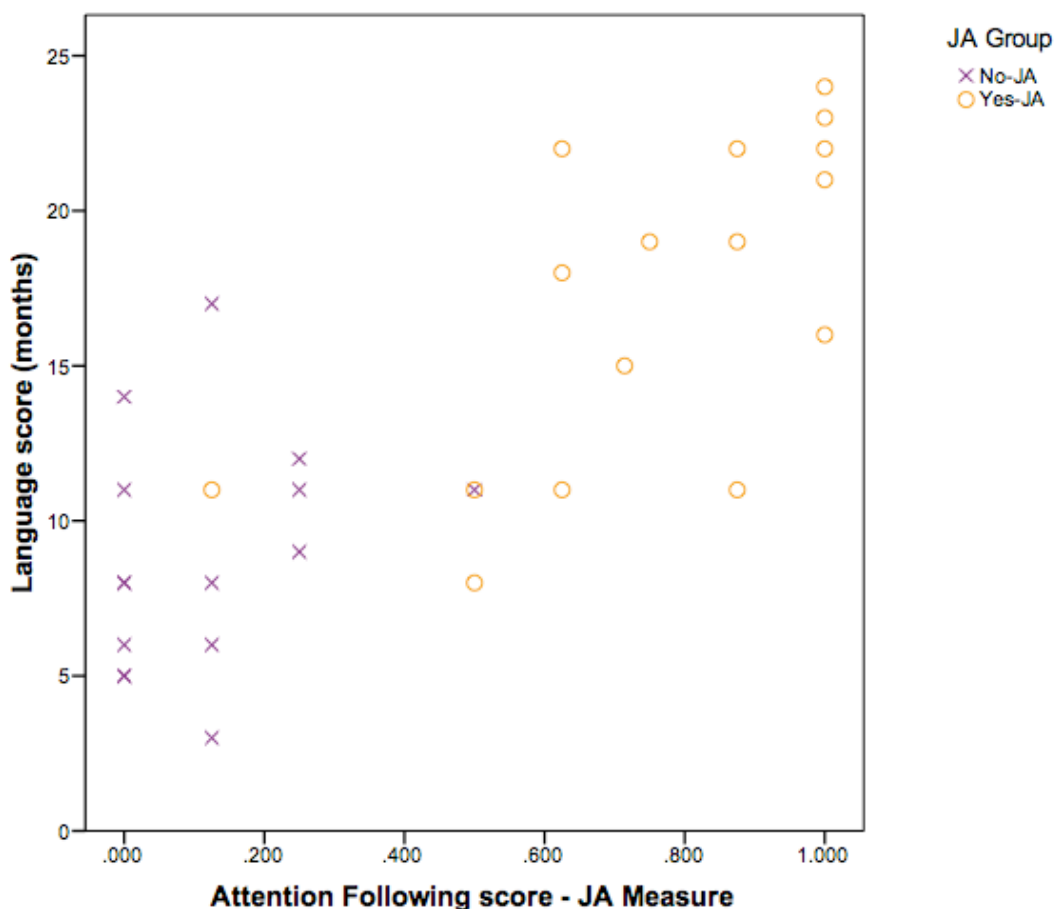


Figure 5. Correlation between Attention Following (AF) score and concurrent language score, with JA group identified.

Results from Study 2

For the children with autism and DD, MA and CA were compared. The average MAs were similar for the two groups; for the children with autism, the mean MA was 26.15 months ($SD\ 13.11$) and for the children with DD it was 26.75 months ($SD\ 13.03$), t

(38) = $-.145$, $p = .885$. The average CAs also were similar; the mean CA for the children with autism was 44.75 months ($SD = 16.15$) and the mean CA for the children with DD of 43.60 months ($SD = 16.40$), $t(38) = .223$, $p = .824$.

Broad RJA analyses. The RJA levels from the video analyses were examined. Children's overall RJA levels did not differ significantly between groups. That is, the total number of JA bids a child responded to, given the number of bids the adult offered, did not differ significantly, $\chi^2(1, N = 40) = 1.416$, $p > .05$ (see Figure 6).

Although the children's RJA relative to the number of JA bids did not distinguish the groups, further RJA examination revealed two interesting points: First, the adults offered children with autism significantly more RJA bids than they did children with DD, means of 3.65 bids ($SD = 1.84$) and 1.95 bids ($SD = 1.05$) respectively, $t(38) = 3.58$, $p = .001$. To examine this relationship within the matched pairs, a repeated measures logistic regression was run with "RJA bids offered by adult" as the outcome. The results were similar – adults offered significantly more JA bids to children with autism than to those with DD, $\chi^2(1, N = 40) = 15.17$, $p < .001$. Figure 7 depicts the number of JA bids offered by adults to the matched pairs of children. Second, although all of the children in this analysis responded to at least one JA bid made by adults, nine of the children with autism (45%) failed to respond to some of the bids while only two of the children with DD (10%) did not respond to one or more bids by adults. This is a significant difference for "No response," results from the repeated measures logistic regression: $\chi^2(1, N = 40) = 4.43$, $p = .035$. Thus, children with autism were offered more JA bids than those with DD and more of the children with autism ignored one or more of those bids, but there was not a significant group difference in the percent of bids to which they responded. Ceiling effects may have

been operating here, as many children from both groups had RJA ratio scores of 1.00 (29 children in all).

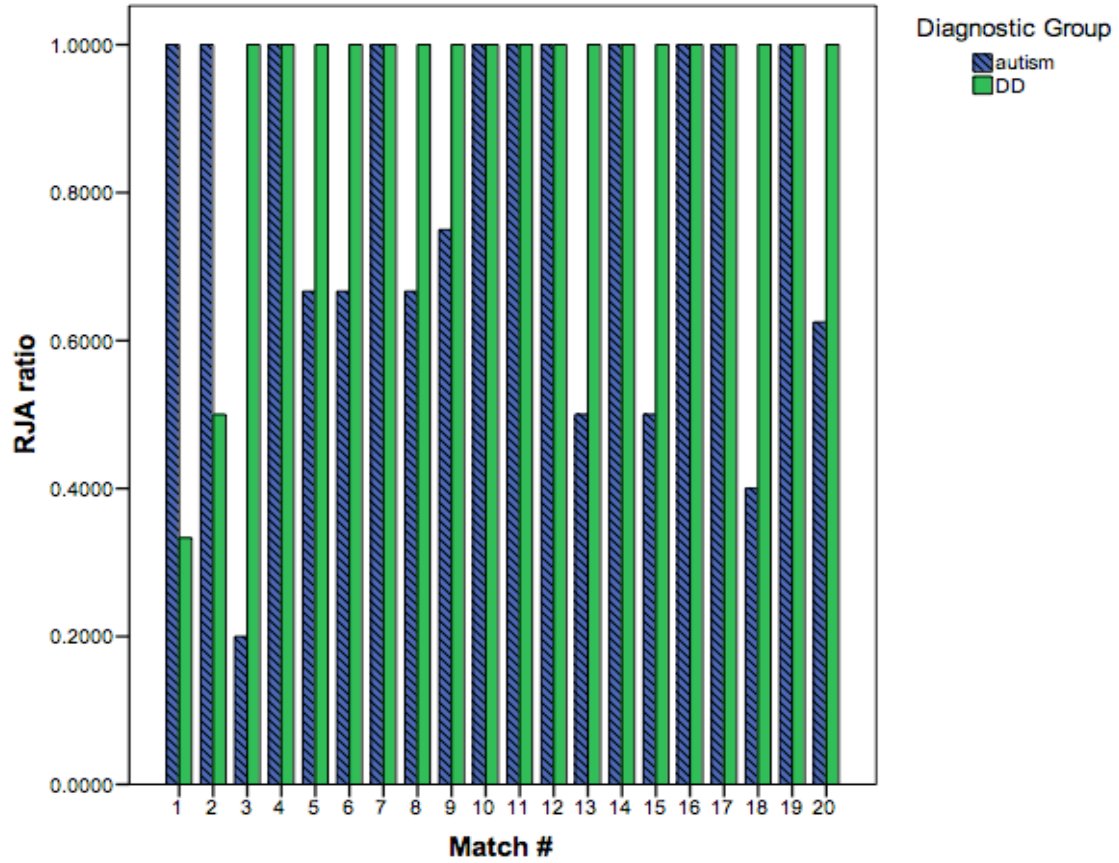


Figure 6. RJA Ratio for matched pairs of children.

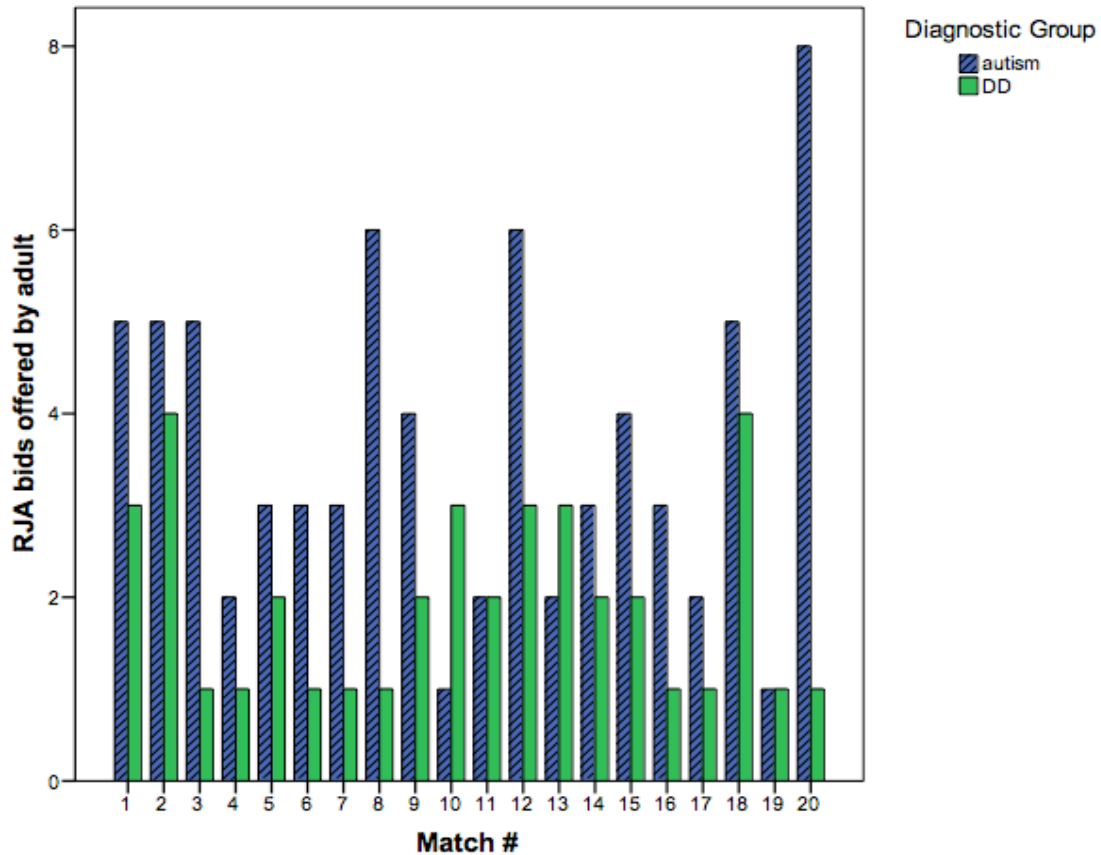


Figure 7. Number of JA bids offered by adults, for matched pairs of children.

Examination of the forms of RJA used. The forms of RJA that were used when children responded to JA bids were examined. When involved in RJA, children were compared on their levels of eye contact, where they looked, what gestures they used, whether they vocalized during the bid and their facial affect. There was only one area of significant difference in the RJA profiles of the two groups: the children with autism vocalized significantly more than their matched pairs with DD. Results of the repeated measures logistic regression were: $\chi^2(1, N = 40) = 7.46, p = .006$. In fact, only three children with DD (15%) vocalized at all during RJA whereas 16 of the children with autism (80%) made some vocalization during RJA (see Figure 8). Otherwise, there were no

significant differences in the amount of eye contact children used, in their facial affect (positive or negative), or in the use of looks or gestures during RJA.

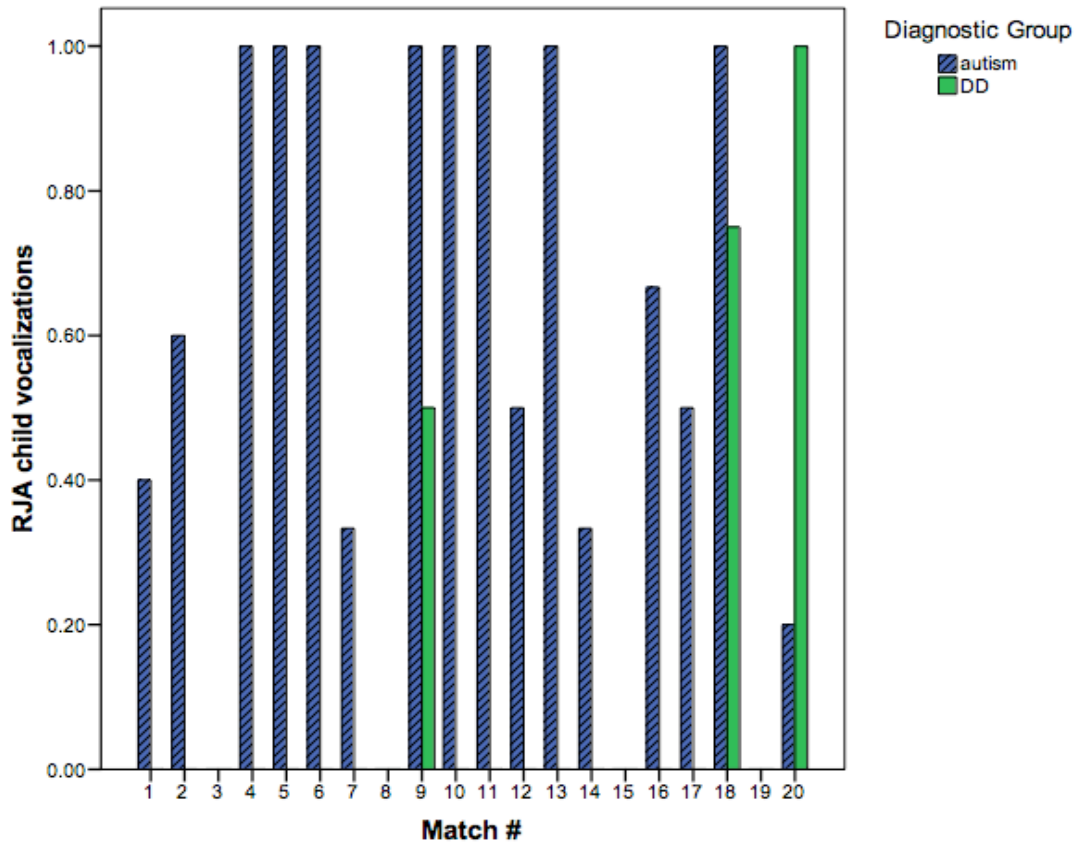


Figure 8. Proportion of responses to JA bids accompanied by a vocalization for matched pairs of children.

Broad IJA analyses. The IJA scores from the video analysis were examined.

Children with autism initiated JA significantly less frequently than those with DD, results from the loglinear poisson regression: $\chi^2(1, N = 40) = 4.434, p = .035$. Figure 9 depicts the IJA bids made by each child per minute.

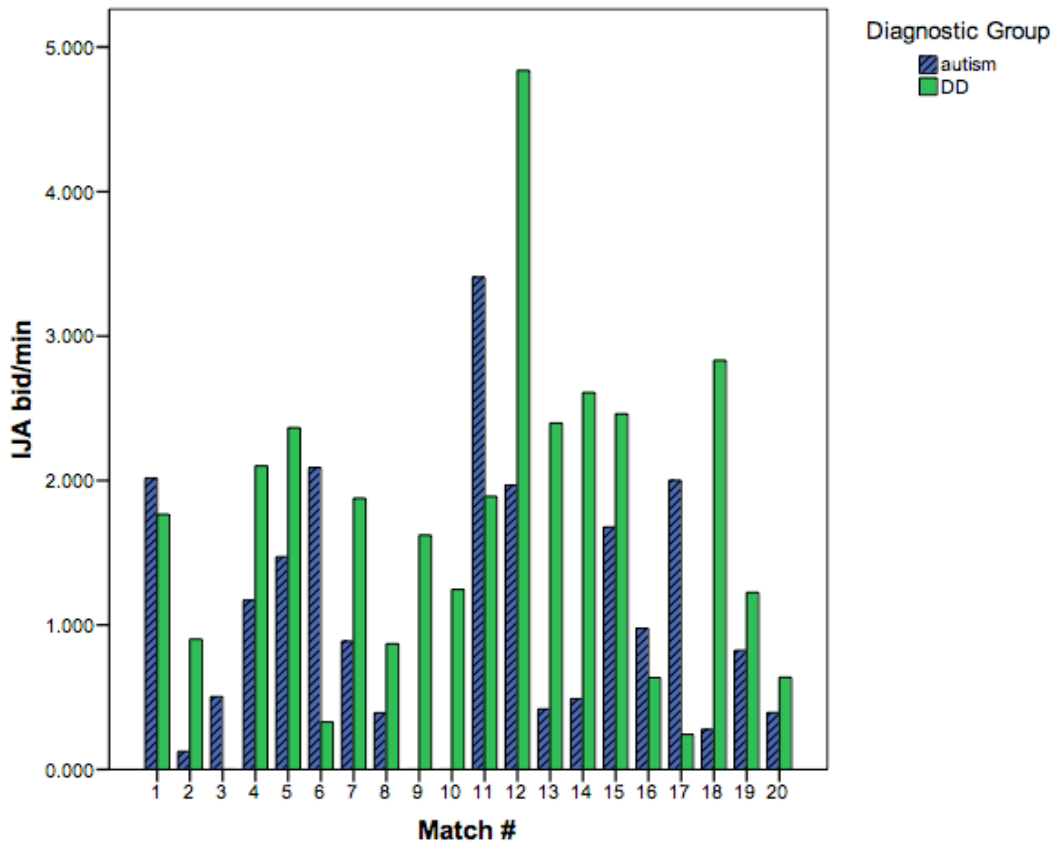


Figure 9. Number of IJA bids made by children per minute for matched pairs.

Examination of the forms of IJA used. During IJA bids, there were no significant differences in the type or variety of bids children with autism and DD used. To be specific, when children made IJA bids, the children with autism and those with DD were equally likely to point, show, or use other gestures, and their levels of eye contact, and type of facial affect were all similar between the groups. There was not a significant difference between the groups regarding to whom bids were directed (i.e. parent or examiner).

Of note, children from both groups used vocalization during IJA bids (15 of the children with DD and 11 children with autism) (see Figure 10). This is in contrast to the RJA with vocalization comparison, when many fewer children with DD vocalized during a bid.

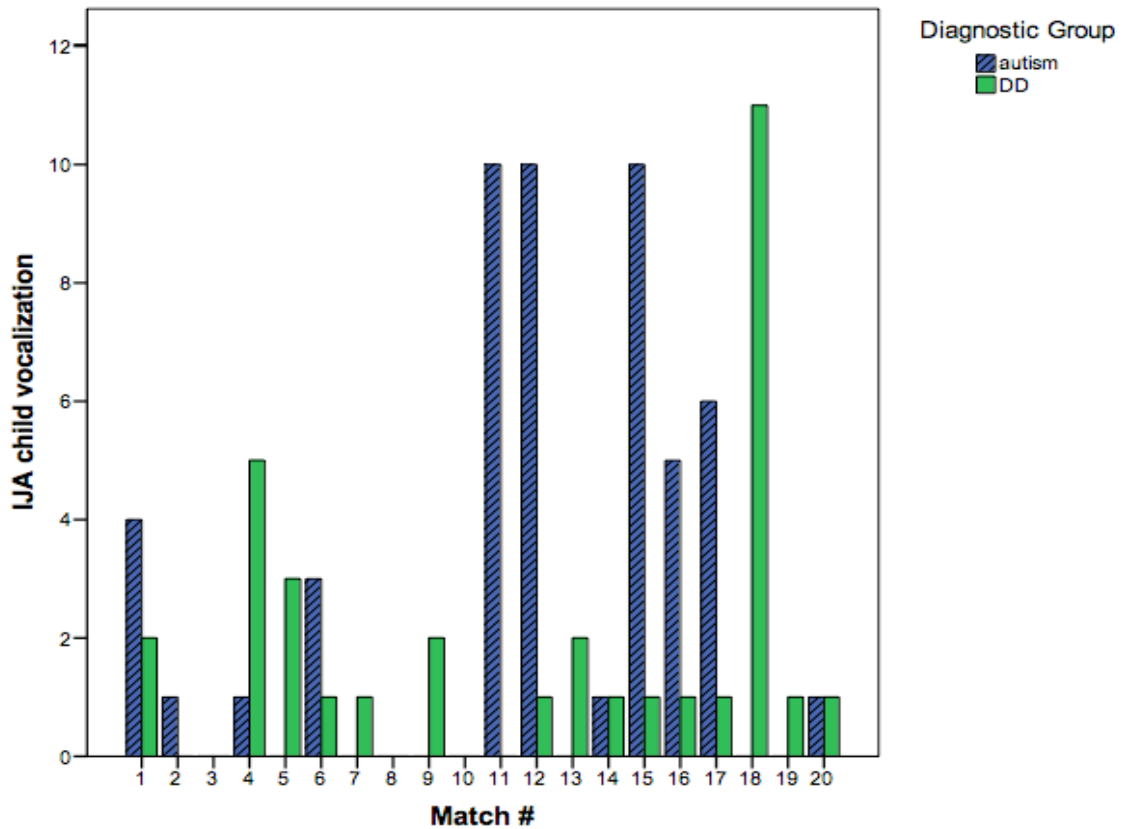


Figure 10. Proportion of IJA bids that included vocalizations for matched pairs of children.

Scores from the JA Measure. A correlation between the RJA Ratio from the video analysis and the Attention Following score from the Joint Attention measure was run. With both groups entered together, the RJA Ratio was correlated with the Attention Following score, $r(38) = .378, p < .05$, a medium effect. When groups were examined separately, the correlations were mixed. For the DD group, Attention Following scores were very highly correlated with RJA Ratio, $r(18) = .75, p < .001$. For the autism group, on the other hand, these two measures were weakly correlated, $r(17) = .168, p > .05$. Figure 11 shows the Attention Following scores. There was not a significant difference between diagnostic groups on their Attention Following scores, $\chi^2(1, N = 39) = .57, p = .45$.

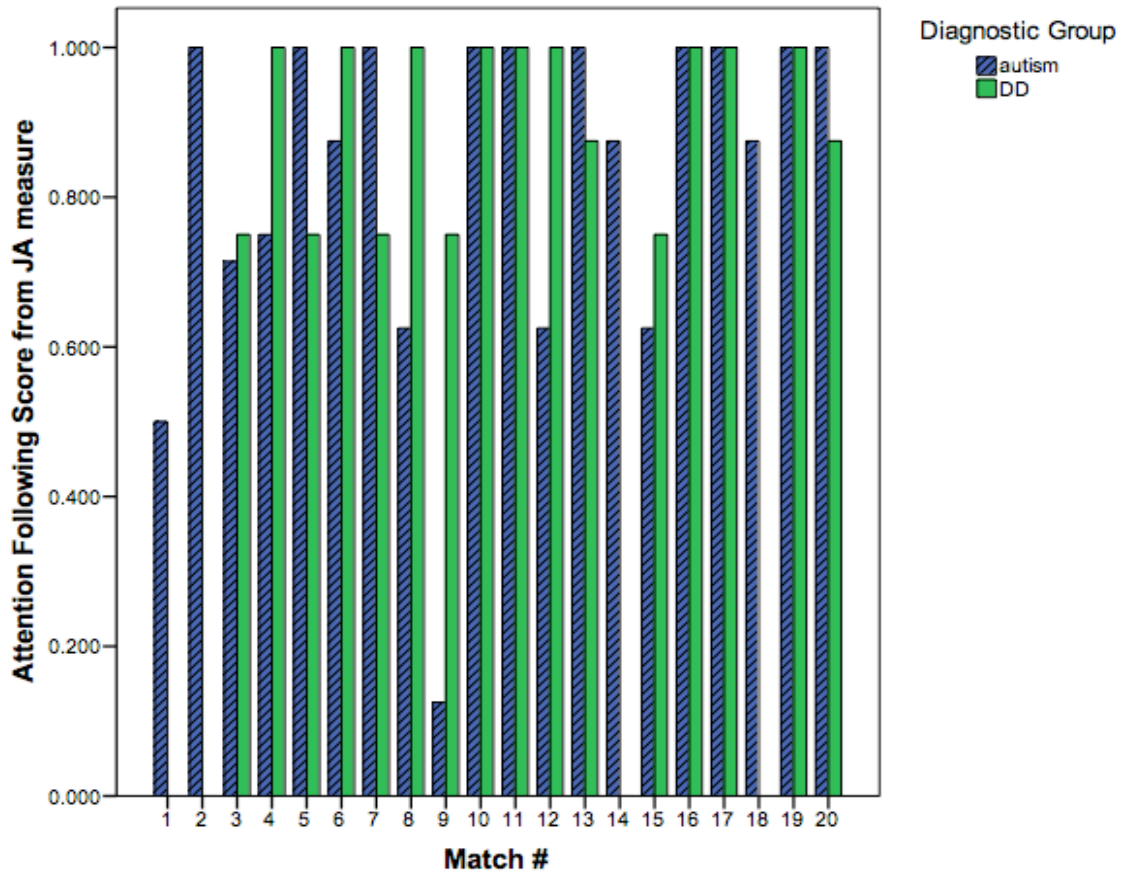


Figure 11. Attention following scores from the Joint Attention Measure for matched pairs of children.

The Initiating Joint Attention score from the Joint Attention measure was not correlated with the IJA/min score from the video analysis, $r(38) = .06, p = .717$ (see Figure 12). This held true when groups were examined separately.

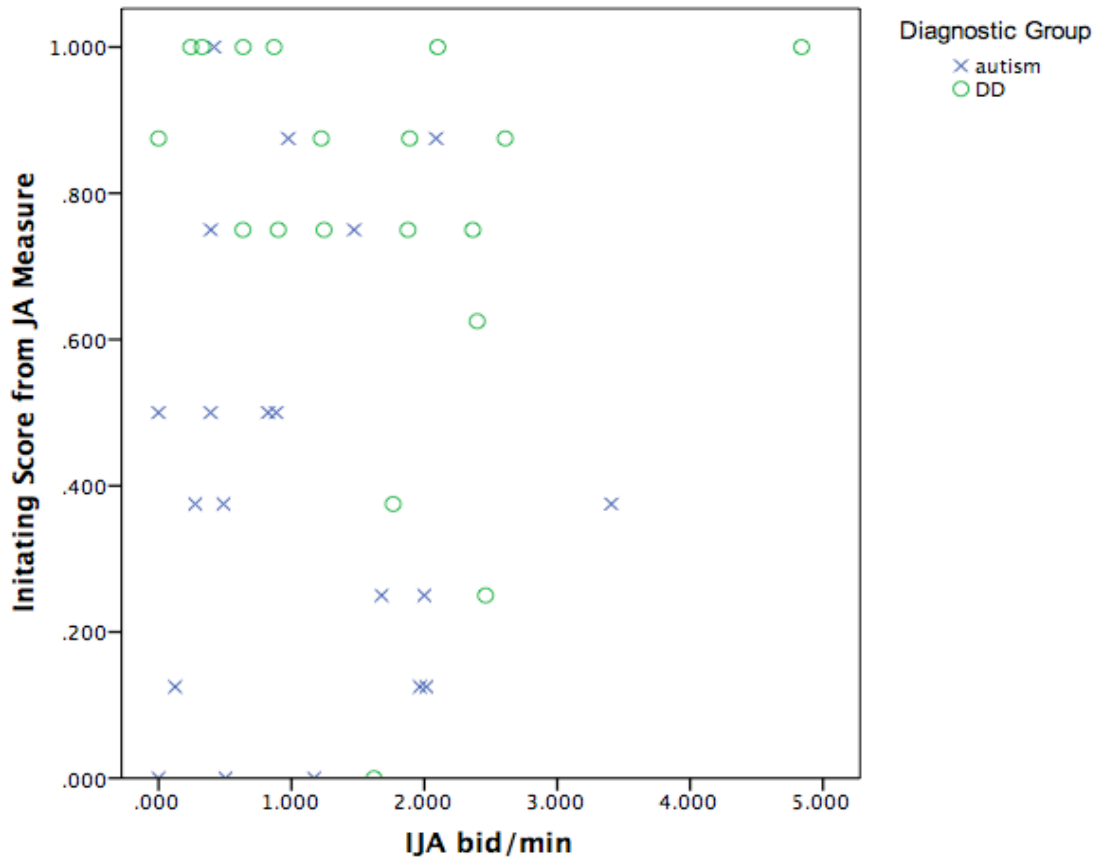


Figure 12. Scatterplot of scores for Initiating Score from the JA Measure and IJA bids/min with diagnostic group identified.

Association with concurrent language scores. The concurrent language scores were compared for the matched pairs of children. The average language scores were not significantly different for the two groups; for children with autism, the mean language score was 24.10 months ($SD=11.29$) and for children with DD it was 27.40 months ($SD=13.41$). A model was run to examine matched pairs of children, with language as the dependent measure. It showed no significant difference between the groups: $\chi^2(1, N = 40) = 3.07, p>.05$ (see Figure 13). This held true when the model was run with MA as a covariate: $\chi^2(1, N = 40) = 2.24, p>.05$.

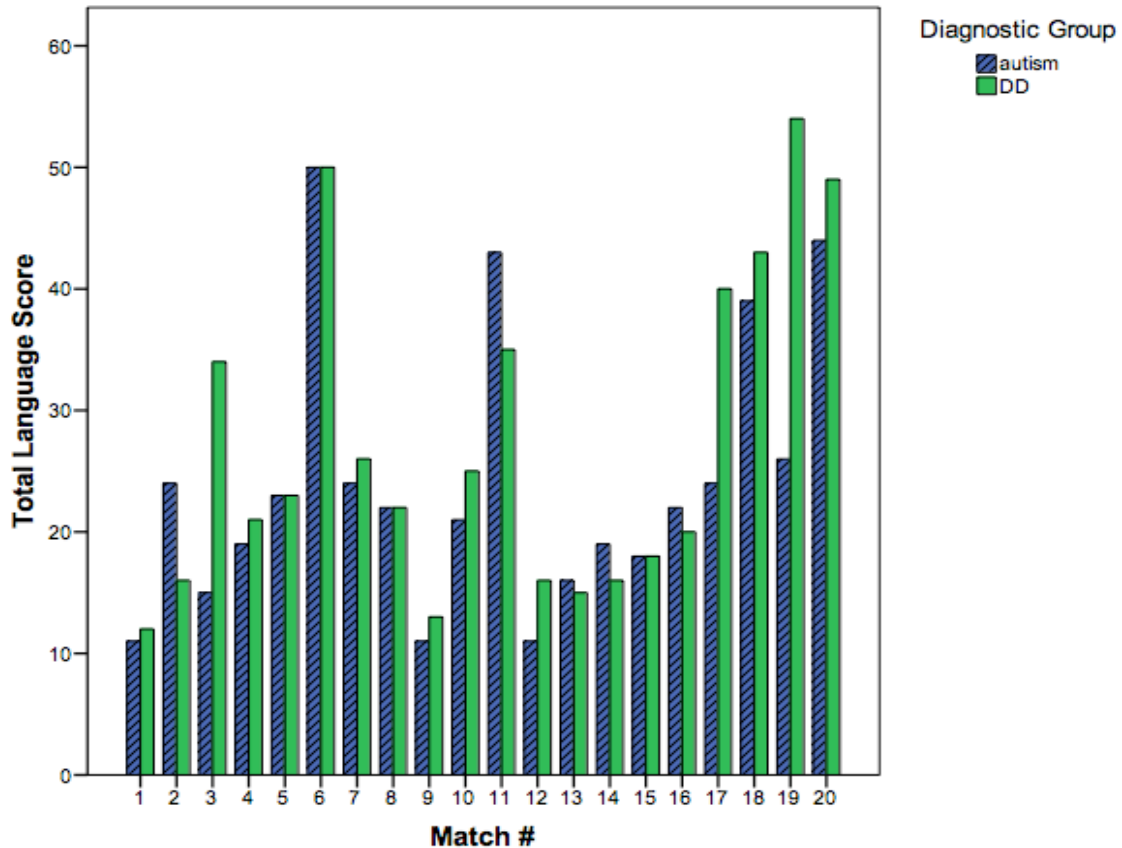


Figure 13. Language scores for matched pairs of children.

The nonverbal mental age (MA) scores and concurrent language scores were highly correlated with one another, $r(38) = .78, p < .001$ (see Figure 14).

Both the Attention Following and the Initiation scores from the JA Measure were correlated with concurrent language. The correlation between Attention Following from the JA Measure and language, by group, was: Autism $r(18) = .51, p = .023$; DD $r(17) = .46, p = .047$. The correlation between Initiation from JA measure and language, by group, was: Autism $r(18) = .46, p = .039$; DD $r(17) = .53, p = .020$. Neither the RJA Ratio nor IJA Bids/Minute score from the video analysis was correlated with the concurrent language score.

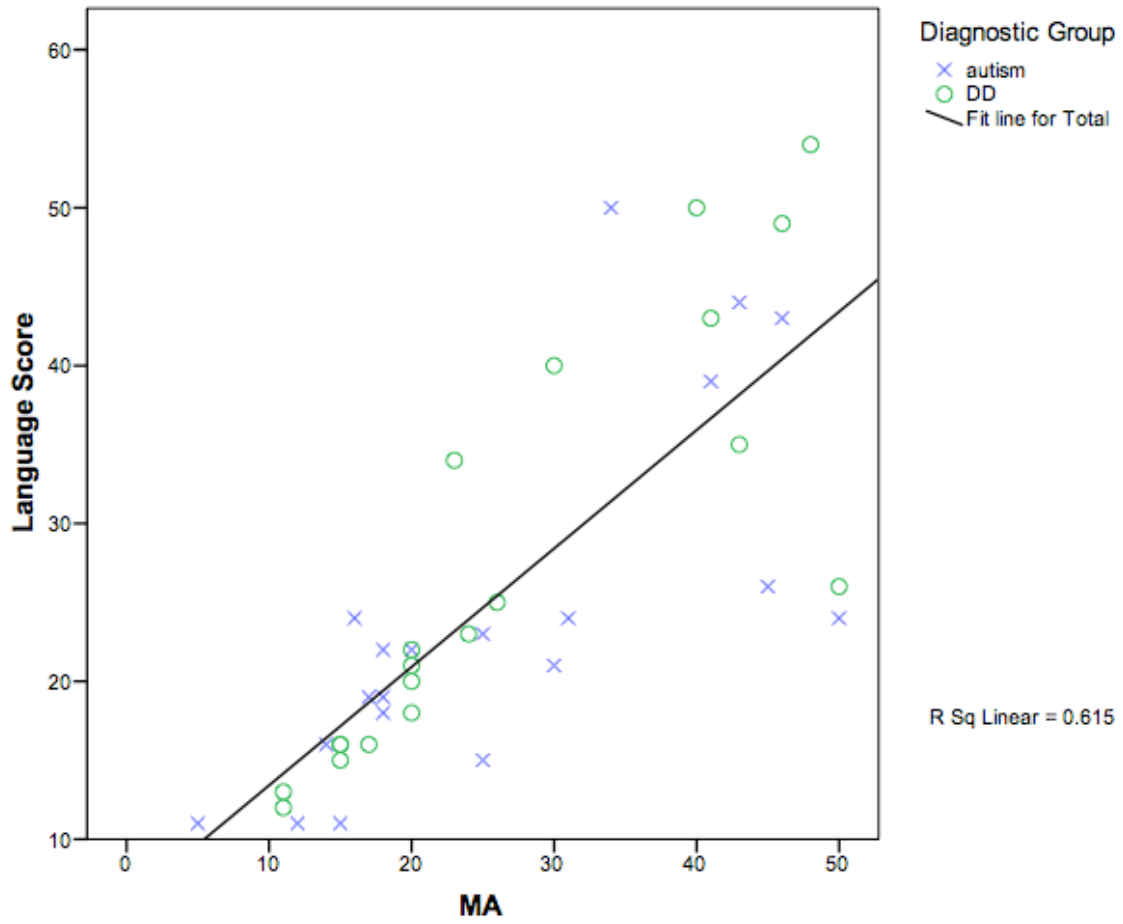


Figure 14. Correlation between MA and language scores, with diagnostic group identified.

Chapter 5

Discussion

The purpose of this study was to investigate the heterogeneity of joint attention abilities among children with autism. Findings illuminate that there is a subgroup of children with autism that demonstrate JA. The children with autism and JA skills had superior concurrent language skills to those without JA, even when controlling for non-verbal MA. Of special interest was how the subgroup with JA compared to MA-matched children with DD; fewer differences were found than expected. Children with autism were somewhat more difficult to engage in JA bids but once involved, they employed similar forms of JA to the children with DD.

Study 1

In Study 1, RJA was used to distinguish subgroups of children with autism. For this sample of relatively young children with autism (average age, 3½ years), those with no JA had lower concurrent language scores than the children from the Yes-JA subgroup, even when nonverbal MA was accounted for. Thus for otherwise similar children who had comparable ages, MAs, and all with a diagnosis of autism, JA ability was predictive of concurrent language.

It was hypothesized that the children with autism who had better JA skills would have better language skills than those with poor JA. This was the finding from Study 1 and

it is in line with previous research showing that children with better initial joint attention abilities also had better language skills (e.g. Toth et al., 2006; Murray, et al. 2008).

The reason that some children with autism were able to use JA while others did not is unclear. One potential explanation suggested from watching the ADOS videos was that children in the No-JA subgroup sometimes appeared to actively ignore RJA bids from adults. Perhaps this group was more resistant to social interaction than other children or more impaired neurologically with regard to socialization. It is worth mentioning that to be placed in the No-JA subgroup, a child had to be nonresponsive to repeated attempts by the examiner to get him/her to look. In most cases, the examiner got more animated and provided larger cues with each trial as s/he attempted to get the child's attention. When the child did not look, despite the adult's directed effort, it was unclear whether the child was avoiding the adult or instead was unaware of the request to socially engage. For example, a child might turn his or her body away or keep his or her eyes downcast, glued on the toys in his or her hand.

Children with autism have been shown to have deficits in their ability to respond to attention getting strategies such as name call that adults use to socially engage them (Baranek, 1999). Perhaps the children in the Yes-JA subgroup were more attuned to the adults around them than the children from the No-JA subgroup. The reason underlying why apparently similar subgroups used JA so differently could be an interesting area for future study.

Study 2

The more in-depth analysis undertaken in Study 2 involved placing the subgroup of children with autism and JA skills into MA-matched pairs with children with

developmental delays. This was a more subtle analysis than has generally been done in other research, allowing well-matched children to be compared in pairs rather than as larger groups.

It was hypothesized that the children with autism would exhibit similar levels of JA to those with DD but that some of the forms used would differ. In fact, the opposite was true: both groups employed most of the forms of JA in the same way but children with autism engaged in JA less often or with more effort. During RJA episodes, the matched pairs of children did not differ on their levels of eye contact, where they looked, what gestures they used, or their facial affect. Similarly, during IJA bids, children were not significantly different in their use of point, show, or other gestures, their levels of eye contact, type of facial affect, nor to whom the IJA bid was directed.

One of the forms of JA that was hypothesized to differentiate groups was that children with autism would initiate more toward a parent than they would toward a relatively unfamiliar examiner. Surprisingly, children from both diagnostic groups interacted with both parents and examiners during the videotaped sessions. Children with autism have been found to be attached to their parents in similar ways to children with DD and found to direct more social behaviors to their caregivers than to strangers (Sigman & Mundy, 1989). In the current study, the children were sometimes interested in sitting on their parent's lap or touching in with them during the assessment session but, perhaps due to the relaxed and interactive format of the play-based assessment setting, they also interacted with the examiners. Children with autism in the current study did not initiate to their parents at higher rates than did the children with DD nor did they avoid the examiner.

On the other hand, it appeared to take more effort on the part of the adult to get a child with autism to respond to a RJA bid. Although the data showed that the overall level of RJA (as measured by both the RJA Ratio and the AF score from the JA Measure) was not found to be significantly different between groups, implying that children with DD and autism responded at similar rates, this was only part of the picture. It is possible that group differences regarding overall RJA levels were masked due to ceiling effects, as so many individuals had perfect response rates. Significant differences were found in the amount of RJA bids children with autism ignored when compared to their counterparts with DD, and adults made more attempts to get children with autism to respond.

Adults offered children with autism significantly more RJA bids than they did to children with DD. Perhaps the additional effort made by adults was needed because almost half of the children with autism ignored one or more bids made by adults, whereas only two of the children with DD failed to respond to every adult bid. The children with autism were offered more bids than their DD counterparts in 75% of the pairs. Children with autism may be less likely to participate in joint engagement with others, requiring a JA bid in order to establish a common focus of attention. If the adult and child are already sharing an interaction around a common focus, then the need to bid for JA is less. This is in line with previous research that showed caregivers used compensatory strategies, such as repetitive cueing, with very young children with autism in order to engage them in social interactions and play (Baranek, 1999).

One reason that the children with autism may have ignored more adult bids is due to a known inability to redirect their attention. It has been reported that children with autism have a difficult time changing their focus of attention from what they are currently

looking at or engaged with to something new (Landry & Bryson, 2004). This impaired disengagement seems to be evident very early in children with autism. Infants later diagnosed with autism demonstrate deficits in the ability to disengage visual attention as early as 12 months (Zwaigenbaum et al., 2005) and this deficit is not seen in infants with Down syndrome or in typically developing children who are over the age of 4 months (Landry & Bryson, 2004). The inability to disengage and the overly focused or “sticky” (Ibanez, et al., 2008) attention to their own tasks may explain why in the current study, adults had to be more persistent to engage the children with autism. Children with autism may have needed more prompts to disengage from what they were already doing and notice what the adult was indicating.

The issue of sticky attention and RJA may have important implications for the relationship between parent and child. It can become difficult and even frustrating for some parents to persist long enough to obtain a child’s attention when their child ignores repeated attempts at engagement. Consequently, their child’s current exposure to RJA is reduced, as well as their likelihood of offering opportunities in the future. It might be that a more determined adult is more likely to pursue a JA bid until the child responds. More responsive parents have been found to have children who develop better language skills (Siller & Sigman, 2008), and this could contribute to the hypothesized neurological negative feedback loop (Schertz & Odom, 2004) discussed earlier.

Although most children in this study initiated JA, children with autism did so significantly less frequently than did those with DD. Because the desire to initiate JA is purely social and comes unprompted by others, the child must purposely decide to use IJA. Mundy et al. (2007) support this theory in their work with typically developing infants.

They posit that the “variability in infant IJA may be related to stable differences in social motivation, which in turn are related to subsequent differences in the development of social cognition” and “the frequency of use of IJA in early infancy may be more affected by social motivation rather than a social-cognitive process” (p. 950) Thus, it is possible that a lack of motivation to share interest is a major reason that children with autism exhibit less IJA.

In order to see if a lack of motivation contributed to a low initiation of JA, Vismara and Lyons (2007) designed an intervention study that used children’s perseverative interests to motivate them to share attention. By making social engagement reinforcing to children with autism through the incorporation of the children’s perseverative interests into social interactions, they were able to increase the IJA of children with autism. A major contribution of the study is that it addressed the function of IJA rather than simply teaching the forms of it. The children were not directly taught IJA but when the scenario was motivating enough, they chose to use it.

Language

This study found no significant difference in language scores between the children with autism and their matched counterparts with DD. Overall, participants in the study had a wide range of language scores, with a low score of 11 months and a high of 54 months. Most of the matched-pairs ($n=15$) though, had language scores within five months of one another. These similar language scores can be partially accounted for by the fact that children were initially matched on their non-verbal MA scores and there was a high correlation between non-verbal MA and language, but their JA skills may also have had a critical impact.

In Study 1, JA was predictive of language above and beyond the children's MA. In Study 2 the children were closely matched on MA leaving the difference in JA to impact concurrent language. As it turned out, the children employed JA in similar ways (albeit at different frequencies), and this JA use may have accounted for the closeness in their language scores. The ability to employ JA may have facilitated language development, as the pivotal skill theory contends (Mundy & Crowson, 1990) and allowed children from both groups to develop language at similar rates.

There are many characteristics exhibited by children with autism that might have also affected language skills, so the similarity in language between children with autism and DD was not a forgone outcome. It could have been that other issues related to autism would have had an impact on language beyond JA and MA. Perhaps there were, but the children with DD also had issues relating to their disorders impacting language. The exact mechanisms underlying language development with these pair-wise matches is unknown but in this study, the differences in JA that were observed did not differentially impact concurrent language for children with autism versus children with DD.

The impact of less fluent JA use on future language development is unknown. Although there were many similarities in JA use in this study, there were also differences in the frequency that children initiated JA and the effort that adults employed to engage them in RJA. Engaging in fewer JA bids means that children with autism have less opportunity to learn language and have adults verbally expand on their focus of attention (e.g. the child who frequently points at things to draw attention to them is highly likely to get frequent responses from adults that are attuned to the child's focused of attention, "It's an airplane. Yes I see the airplane. It's making a lot of noise..."). Perhaps the children with

autism who can use JA also employ some other alternative strategy that helps them learn language. For example, are they more likely to imitate others, and then use imitation as a route to language development in a way that would help “make up” some of the differences in learning opportunities in JA episodes but also lead to some of the peculiarities we see in their language (e.g. rote phrases and peculiar word usages)? Or are they attending covertly sometimes when no overt response is observed?

Although the effect of fewer JA interactions was not reflected in concurrent language scores, over time as children grow and their language becomes more sophisticated, the impact might become more apparent. Adamson et al. (2009) wondered whether the use of only the more basic forms of joint attention (e.g. looking at an object being shown without coordinating attention with the adult) would provide the context that children need as language demands increase with age. They speculate that periods of more sophisticated joint engagement (e.g. coordinating attention with an adult or including language in the JA bid) “may provide a particularly rich context for toddlers to learn about theory of mind specifically (Nelson et al.) and about how to participate in the decontextualized, connected conversations that typically emerge during the preschool years” (p. 93). The long-term language use of children with autism and JA is an interesting area for future research to focus.

Implications for Intervention

The findings of this study have clinical implications. The range of JA ability found among children with autism has important impact for intervention and early diagnostic screening. Multiple studies have called for JA interventions and although this call is appropriate for some children with autism, it is not necessarily the correct treatment for all

children with the diagnosis. A better strategy would be to adapt a customized approach to intervention.

As suggested by others, the best intervention choices likely will involve a goodness-of-fit between child characteristics and treatment model (e.g., Ingersoll, Schreibman & Stahmer, 2001). One question posed by Schertz and Odom (2004) was “whether directly targeting joint attention for intervention in the preverbal period has a greater or lesser effect on later language and social skills than targeting language and social skill development directly” (p. 51). If JA is a pivotal skill then it should have downstream effects on language, but what happens with the subgroup of young children who already use JA? Perhaps this subgroup would make more progress if language and social skills were themselves the focus of intervention approach. There is enough heterogeneity in presentation among children with autism that some likely would benefit from JA interventions while for others, targeting language or social skills directly would be a better approach.

Anderson et al. (2007) agree that intervention approaches should be targeted to the diverse needs of children with autism. They found that children with autism show a greater heterogeneity and wider range of trajectories than other diagnostic groups and suggest that divergent groups require different treatments. The authors tracked development of children from age 2 - 9 and found that they fell into four developmental trajectories. Having a lack of JA was a risk factor for being in the slowest developing of four groups but for the three other groups, JA skills did not predict membership. They suggest that treatment approaches could be as follows: JA intervention for the lowest group, speech intervention

for the next group up, and for the two most rapidly progressing groups, interventions that fine-tune social and communication skills.

Interventions targeting JA have been successful for children with low language and play abilities (Kasari, Paparella, Freeman, & Jahromi, 2008). These children need to learn both the forms and the function of JA and directly targeting JA would likely improve children's attention to social interaction and allow them to focus on language. Teaching children with no JA how to use JA would have collateral effects on their language, thus this is an efficacious way to improve outcomes.

The children with autism who can use JA may benefit from intervention to help them use JA more frequently or respond to bids more quickly. They already can use the forms of JA so the intervention could focus on helping them to more rapidly disengage from current focus and respond to JA bids. For these children an intervention target could be motivating them to initiate JA more frequently so that they are engaged in JA more of the time. Additionally, the intervention could include components to help the child's communication partners to be persistent and to figure out how to accommodate the child by following the child's lead, using perseverative interests to motivate them, identify ways to help the child "overcome" their inclination to be overfocused, etc.

Finally, for the children who present with relatively good language, JA may not be an area for treatment at all but instead active attention to social and language skills would be more useful. For this group fine-tuning language and targeting specific social communication problems is warranted (Anderson et al., 2007).

Implications for Screening

The acknowledgement that there is a subgroup of children with autism who use JA, may help inform users of autism screening tools. Currently, many of these screening instruments do not accurately differentiate children with ASD from children with other disabilities in very young children (Ventola et al., 2007) and a significant number of children later diagnosed with autism are not identified using such tools (Baird et al., 2000). This is in part because failing the JA portion of the measures reliably pulls out children who do have autism from the general population and from children with other disabilities, but leaves the children with autism who pass the JA component lumped in with them. Perhaps these measures should be revised to better account for JA subgroups. In order to be more accurate, another layer must be included to recognize those children with autism that pass the JA probe; perhaps the frequency that children engage in JA bids may be a helpful aspect for this. Generally, screening tools could be improved upon by using a two-step system; first employing JA probes to identify the children who do not use JA but also adding another layer to distinguish those who have autism but also use JA.

Additionally, pediatricians utilizing ASD screening tools at scheduled visits should be informed that some children with autism engage in JA. By noting this possibility, the presence of JA will not eliminate or postpone the call for further assessment.

Heterogeneity and Autism

This study highlights one way to distinguish subgroups of children with autism. About half of the original sample of children with autism with nonverbal MA scores of 30 months or less used RJA. When examined as two distinct JA subgroups, much can be learned about children with and without JA that is obscured when averaging outcomes

from diverse groups. Other populations of children, like those with DD, do not have a large subgroup of children that lack JA skills so their average JA and language scores are higher. As evidenced by this research, these children look similar to the subgroup of children with autism that use JA, an examination of members of the subgroups provides a clearer picture of the heterogeneity of JA skills among children with autism.

To exemplify this grouping effect, a comparison of the entire group of children with autism was made to the group of children with DD. An ANCOVA was run with language as an outcome. With this comparison, there was a group difference in language even after controlling for MA. When looking at RJA, there was also a group difference. On the other hand, when the subgroup of children with autism and JA was matched to children with DD as in this study, there was no significant difference for either language or RJA.

There may be specific characteristics that allow some children with autism to develop JA while others do not. For example, JA subgroups may be representative of different underlying neurological processes. The initial social and communication abilities of JA subgroups may be different, reflecting varying neurological deficits and resulting in divergent developmental trajectories and diverse learning needs. Those with no JA could have more severe initial neurological problems than those that can use JA. Alternatively, they might have had similar initial deficits but more difficulty adapting to them. This lack of adaptability could be what causes more significant secondary neurological deficits.

That having been said, children with autism who have intact JA skills are autistic nonetheless. Other autism symptoms are still apparent even when a child knows how to use the forms of JA and sometimes these peculiarities affect JA itself. As discussed, sticky attention and lack of social motivation may be responsible for lower frequencies of JA use.

Other characteristics such as behavior problems, repetitive behaviors, social aversion and language delays might also interfere with JA engagement. Thus, in examining the heterogeneity among children with autism, JA is only one of a constellation of traits to consider.

Strengths of this Study

One of the greatest strengths of this study is that it took a close look at children with autism and showed that there is more variability among them with regard to JA than was generally described in the literature. Additionally, the matching and subsequent analysis of pairs of children with autism and those with DD allowed for more direct comparisons and eliminated much averaging of extremes that can occur when groups are analyzed all together. The matching with children with DD rather than typically developing children was also a strength, since this study examined many of the forms of JA to see if there was a JA deficit that was unique to autism or if it was instead related to other factors of developmental delay.

Limitations to this Study

This study has several limitations. First, the quality of the videos used in Study 2 was inconsistent. In some cases there was a person running the camera who was able to follow the child as s/he moved around the room, in other cases, the camera was stationary and the child was off camera or blocked from view for portions of the tape which made coding impossible during these times. In future studies, a dedicated videographer could ensure the entire scene is kept on camera regardless of where child and administrator move.

In addition, there were several different people who administered the ADOS to the children. This resulted in some variation in pace and style. Although the examiners were reliable with one another, they did not do everything in an identical manner. This may be a drawback for any play-based analysis but in any case, using a single examiner would have provided a more consistent administration.

There were some questions that came up in the data that remain unanswered. For example, the children with autism vocalized significantly more frequently during RJA than did the children with DD. Perhaps the children with DD were quieter, or maybe the children with autism were using vocalizations to self-stimulate more often. There was no relationship between vocalizations and concurrent language so it was not that children with better language vocalized more.

Finally, this study did not use any qualitative measures. A qualitative analysis might have provided more information about the children's personalities or other character traits potentially shedding more light onto why some children were able to employ JA while others were not.

Future Study

The course of JA development for subgroups of children with autism has not been well explored. It would be beneficial to know if the language trajectory for children with autism and JA is the same as for children with DD or if other symptoms of autism (like sticky attention and lack of social motivation) still put this group at a disadvantage for language development over time.

Additionally, assessment tools may need to examine how best to deal with JA subgroups. Given the importance of early diagnosis and intervention, it is germane to

consider that some children with autism will respond correctly to JA probes and thus could be missed by tools in their current forms.

Conclusion

In summary, children with autism show a wider range of JA ability than previously discussed. There are subgroups with regard to RJA, with one group that uses it and another that does not. Those with no JA have lower concurrent language scores than those with JA, even when controlling for other factors such as diagnosis, CA and NVMA. The subgroup of children with autism who exhibit JA tended to use it in similar ways to MA-matched children with DD, although not at the same frequency. It is possible that it took more effort on the part of an adult to engage children in RJA due to their sticky attention. Furthermore, it is plausible that the children with autism have low motivation to participate in social sharing, resulting in fewer IJA bids. Intervention recommendations are based on a goodness-of-fit model that suggests JA intervention for children with the lowest initial JA scores and social or language interventions for others.

Appendix A

Coding sheet for video analysis of JA skills

Child ID _____

Scenario: Bubble Play or Mechanical Bunny

Date _____

Start time: _____

Rater _____

End time: _____

Time code	IJA							Affect				Partner		
	Prox Point	Distal Point	Show/ Give	Other Gestures	EC	AEC	Vocalizatn	+	-	0	uncodable	Parent /Care giver	Examiner	uncodable

Appendix B

Coding Manual and Operational Definitions for Video Coding Analysis

“The function of Joint Attention behaviors is to share attention with the interactive partner or to monitor the partner’s attention. They differ from Behavioral Requests in that they do not appear to serve an instrumental or imperative purpose (e.g., trying to get or activate an object or event). Rather, their function seems to be more to share experiences of objects or events with others.” (ESCS manual, Mundy et al, 2003, p. 16)

Video Coding Procedures

Steps

1. Circle the section of video that is being coded and fill in the identifying information at the top of the coding sheet.
2. Find the beginning of the section of video to be coded based on the following criteria:
 - a. Bubble Play begins with the first pull of the trigger of the bubble wand.
 - b. Mechanical Bunny begins with the examiner saying, “Look!” and referencing the bunny.
3. You will watch each video through 3 times:
 - a. Watch it through once without coding to get an overview of the scene.
 - b. Watch it through once to look for RJA bids – focus on the examiner. Hint: look for overt initiations.
 - c. Watch it through once to look for IJA bids – focus on the child. Hint: eye gaze is important here.
4. Watch the video until a JA bid is made by the child or the examiner.
5. Record the TIME CODE at the start of the JA bid. (Reliability will be based on +/- 4 seconds from the perceived start of the event).
6. For each JA bid, record either IJA *OR* RJA information *AND*
7. Record Partner information *AND*
8. Record Affect information.
9. Finish coding at the end of the section of the video. Sarah will determine this for reliability purposes based on the following criteria:
 - a. Bubble Play ends when the examiner changes focus to a new event (even if the child still has the bubble gun).
 - b. Mechanical Bunny ends when the examiner changes focus to a new event (even if the bunny is still out).

Definitions

- **INITIATION OF JOINT ATTENTION (IJA):** IJA means that the child shares attention around an object or event with an adult by pointing, showing, giving, or making eye contact with the adult. This must occur without the adult's prompting. For example, if the adult makes a comment or a big movement and then the child makes eye contact, do not count this as IJA. Score as many forms of IJA as are appropriate for each IJA bid (e.g. pointing, vocalization and eye contact can all be scored). A bid is considered complete after eye contact is broken or attention has been shifted to a new object.

Types of IJA are:

- a. **POINTING:** The child points at an object with the index finger. The point can be proximal or distal. It cannot be used as a request.
 - b. **SHOWING:** The child holds up an object for the adult to see. Child does not let go of object.
 - c. **GIVING:** The child attempts to hand an object to the adult. The child can push the object in the direction of the adult and let it go (even if the adult does not have control of the object).
 - d. **Other gestures:** The child gestures to initiate a JA bid with an adult. For example, the child pats the bunny and smiles at the adult or the child reaches toward the bubbles and says "bubbles!" Gestures that are not intended to share attention are not scored here.
 - e. **ACCOMPANIED BY VOCALIZATION:** The child makes a sound, says a word or word approximation to draw attention to an object or event. This must occur with other forms of IJA in order to be clear that it is meant as part of sharing attention rather than as a simple sound or the child commenting to herself.
 - f. **EYE CONTACT (EC):** The child's eyes are directed toward the face of an adult. This can be fleeting or maintained for a few seconds. The child can also look from an object to the adult but not back again to same object (this would be AEC). EC can be scored even if the adult's eyes are not in the frame as long as it clear that the child is looking at the adult's face. Score only EC or AEC, not both.
 - g. **ALTERNATING EYE CONTACT (AEC):** The child looks from an object to the adult and back to the object *or* looks from the adult to the object and back to the adult as if to see if the adult sees what the child sees. Score only EC or AEC, not both.
- **RESPONSE TO JOINT ATTENTION (RJA):** RJA means that the child reacts to a bid by the adult to share attention. The child must look at the object that the adult is indicating or he must make eye contact with the adult to show that he is attending. Adult must be overtly prompting the child to share attention (e.g. "Look at the bunny's soft tail!"). Additionally the adult must be attempting to change the child's focus of attention; if the child is already looking, do not code RJA. Responses should be intentional so that the child is not coincidentally looking at the same object as the adult. For each overt JA bid made by the adult, record the adult's

action and the child's response. More than one form of RJA can be recorded for each RJA bid.

Types of ADULT PROMPTS are:

- a. LOOKS: The adult looks deliberately at an object that they want the child to see.
- b. POINTS: The adult points at an object that they want the child to see.
- c. GIVES VERBAL PROMPT: The adult tells the child to look at an object.

Types of CHILD RESPONSES are:

- d. LOOK AT OBJECT: The child looks at the object that the adult is indicating or looks toward that object even if they do not find it. This must be a shift from where ever the child was looking previous to the JA bid. If the child is already looking at the object when the adult comments on it/is already doing what the adult asks before they ask it, do not count this as a RJA bid.
 - e. EYE CONTACT (EC): The child's eyes are directed toward the face of an adult. This can be fleeting or maintained for a few seconds. The child can also look from an object to the adult but not back again to same object (this would be AEC). EC can be scored even if the adult's eyes are not in the frame as long as it clear that the child is looking at the adult's face. Score only EC or AEC, not both.
 - f. Alternating Eye Contact (AEC): The child looks from an object to the adult and back to the object *or* looks from the adult to the object and back to the adult as if to see if the adult sees what the child sees. Score only EC or AEC, not both.
 - g. VOCALIZATION: The child makes a sound, says a word or word approximation. This will often occur with other forms of RJA in order to be clear that it is meant as part of sharing attention rather than as a simple sound or the child commenting to himself but if the vocalization is clearly in response (e.g. the adult says, "Do you see the big one?" and the child replies, "Yes!") then it can be coded alone.
 - h. NO RESPONSE: The child continues to attend to whatever they were doing before the adult attempted to share attention.
- AFFECT: Record whether the look on the child's face during the JA bid is positive (+), negative (-), neutral (0) or if it cannot be determined (CAN'T TELL). A positive score means that the child is smiling or looking excited during the bid. A negative score means that the child is crying, making a sad or angry face or otherwise looking distressed (this can include scared or frustrated) during the bid. A neutral score means that the child's face looks neither positive nor negative. A CAN'T TELL score means that the child's face is not visible on the video at any time during that bid. If the child changes expression during the bid, record the first affect (positive or negative) shown. The affect noted should be in the first 3-4 seconds of the bid.

(Past that time, their affect may be related to another event so should not be counted.)

- **PARTNER:** Record who the interactive partner is (PARENT/CAREGIVER or EXAMINER). Typically a parent or caregiver is in the room while the examination occurs. If this is not the case, record “No parent present” in the notes section of the coding sheet.

Other Comments

1. When trying to determine where one JA bid ends and the next begins, look for a change in focus. For example: If the child initiates by pointing out the bunny’s ears and then smiles at the examiner and pats the ears and then makes a vocalization this would be one IJA bid. If the child does the same thing and then turns the bunny around and shows his furry tail, this is a change in focus from the ears and can count as a new IJA bid.
2. Only score when the child is in the frame of the video. If you cannot see the child, do not score.
3. If there is an ongoing conversation, only code times when there is shared visual attention or gestures used. Talking about the same thing does not count as JA for the purposes of this study.
4. If you are unsure about a code because it is ambiguous or the camera work makes it difficult to determine what is happening, do not code it. When in doubt, leave it out.

References

- Adamson, L., Bakeman, R., Deckner, D., & Ronski, M. (2009). Joint engagement and the emergence of language in children with autism and Down syndrome. *Journal of Autism and Developmental Disorders*, 39, 84–96.
- American Psychological Association. (1994). *Diagnostic and statistical manual of mental disorders (4th edition)*. Washington, DC: American Psychological Association.
- Anderson, D., Lord, C., Risi, S., DiLavore, P., Shulman, C., Thurm, A., Welch, K., & Pickles, A. (2007). Patterns of growth in verbal abilities among children with autism spectrum disorder. *Journal of Consulting and Clinical Psychology*, 75, 594–604.
- Baird, G., Charman, T., Baron-Cohen, S., Cox, A., Swettenham, J., Wheelwright, S., et al. (2000). A screening instrument for autism at 18 months of age: A 6-year follow-up study. *Journal of the American Academy of Child and Adolescent Psychiatry*, 39, 694–702.
- Baranek, G. (1999). Autism during infancy: A retrospective video analysis of sensory-motor and social behaviors at 9-12 months of age. *Journal of Autism and Developmental Disorders*, 29, 213-224.
- Baron-Cohen, S., Wheelwright, S., Cox, A., Baird, G., Charman, T., Swettenham, J., Drew, A., & Doehring, P. (2000). Early identification of autism by the checklist for autism in toddlers (CHAT). *Journal of The Royal Society of Medicine*, 93, 521–525.
- Bieberich, A., & Morgan, S. (1998). Brief report: Affective expression in children with autism or Down syndrome. *Journal of Autism and Developmental Disorders*, 28, 333-338.
- Bruinsma, Y., Koegel, R., & Koegel, L. (2004). Joint attention and children with autism: A review of the literature. *Mental Retardation and Developmental Disabilities*, 10, 169-175.
- Charman, T. (2003). Why is joint attention a pivotal skill in autism? *Philosophical Transactions of the Royal Society of London: Biological*, 358, 315–324.
- Charman, T., Baron-Cohen, S., Swettenham, G.B., Drew, A., & Cox, A. (2003). Predicting language outcome in infants with autism and pervasive developmental disorder. *International Journal of Language and Communication Disorders*, 38, 265-285.
- Charman, T., Swettenham, G., Baron-Cohen, S., Cox, A., Baird, G., & Drew, A. (1998). An experimental investigation of social-cognitive abilities in infants with autism: Clinical implications. *Infant Mental Health Journal*, 19, 260-275.

- Clifford, S., & Dissanayake, C. (2008). The early development of joint attention in infants with autistic disorder using home video observations and parental interview. *Journal of Autism and Developmental Disorders, 38*, 791-805.
- Dawson, G., Toth, K., Abbott, R., Osterling, J., Munson, J., Estes, A., & Liaw, J. (2004). Early social attention impairments in autism: Social orienting, joint attention and attention to distress. *Developmental Psychology, 40*, 271-283.
- Ibanez, L., Messinger, D., Newell, L., Lambert, B., & Sheskin, M. (2008). Visual disengagement in the infant siblings of children with an autism spectrum disorder (ASD). *Autism, 12*, 473-485.
- Ingersoll, B., Schreibman, L. & Stahmer, A. (2001). Brief Report: Differential treatment outcomes for children with autistic spectrum disorder based on level of peer social avoidance. *Journal of Autism and Developmental Disorders, 31*, 343-349.
- Johnson, C., Myers, S. & the Council on Children with Disabilities. (2007). Identification and evaluation of children with autism spectrum disorders. Clinical report of the American Academy of Pediatrics. *Pediatrics, 120*, 1183-1215.
- Jones, E., & Carr, E. (2004). Joint attention in children with autism: Theory and intervention. *Focus on Autism and other Developmental Disabilities, 19*, 13-26.
- Jones, E., Carr, E. & Feeley, K. (2006). Multiple effects of joint attention intervention for children with autism. *Behavior Modification, 30*, 782-834.
- Joseph, R., & Tager-Flusberg, H. (1997). An investigation of attention and affect in children with autism and Down syndrome. *Journal of Autism and Developmental Disorders, 27*, 385-396.
- Kasari, C., Freeman, S., & Paparella, T. (2006). Joint attention and symbolic play in young children with autism: A randomized controlled intervention study. *Journal of Child Psychology and Psychiatry, 47*, 611-620.
- Kasari, C., Paparella, T., Freeman, S., & Jahromi, L. (2008). Language outcome in autism: Randomized comparison of joint attention and play interventions. *Journal of Consulting and Clinical Psychology, 76*, 125-137.
- Kasari, C., Sigman, M., Mundy, P., & Yirmiya, N. (1990). Affective sharing in the context of joint attention interactions of normal, autistic and mentally-retarded children. *Journal of Autism and Developmental Disorders, 20*, 87-100.
- Koegel, L.K (2000). Interventions to facilitate communication in autism. *Journal of Autism and Developmental Disorders, 30*, 383-391.
- Koegel, K., Koegel, R., Harrower, J., & Carter, C. (1999). Pivotal response intervention 1: Overview of approach. *The Journal of the Association for Persons with Severe Handicaps, 24*, 174-185.

- Landry, R. & Bryson, S.E. (2004). Impaired disengagement of attention in young children with autism. *Journal of Child Psychology and Psychiatry*, *45*, 1115-1122.
- Lord, C., Rutter, M., DiLavore, P., & Risi, S. (1999). *Autism diagnostic observation schedule*. Los Angeles: Western Psychological Services.
- Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism diagnostic interview – revised. The autism diagnostic interview – revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders*, *24*, 659-685.
- Luyster, R., Kadlec, M., Carter, A., & Tager-Flusberg, H. (2008). Language assessment and development in toddlers with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *38*, 1426-1438.
- Mervis, C. & Robinson, B. (1999). Methodological issues in cross-syndrome comparisons: Matching procedures, sensitivity, and specificity. *Monographs of the Society for Research in Child Development*, *64*, 115-30.
- Mullen, E. (1995). Mullen scales of early learning. Circle Pines, MN: AGS.
- Mundy, P., Block, J., Delgado, C., Pomares, Y., Van Hecke, A., & Parlade, M. (2007). Individual differences and the development of joint attention in infancy. *Child Development*, *78*, 938-954.
- Mundy, P., & Crowson, M. (1997). Joint attention and early social communication: Implications for research on intervention with autism. *Journal of Autism and Developmental Disorders*, *27*, 653-676.
- Mundy, P., Delgado, C., Block, J., Venezia, M., Hogan, A. & Seibert, J. (2003). *A manual for the abridged Early Social Communication Scales (ESCS)*. Miami: University of Miami.
- Mundy, P., & Neal, R. (2000). Neural plasticity, joint attention and autistic developmental pathology. In L. Glidden (Ed.), *International review of research in mental retardation* (Vol 23). New York: Academic Press.
- Mundy, P., Sigman, M. & Kasari, C. (1990). A longitudinal study of joint attention and language development in autistic children. *Journal of Autism and Developmental Disorders*, *20*, 115-128.
- Murray, D., Craghead, N., Manning-Courtney, P., Shear, P., Bean, J., & Prendeville, J. (2008). The relationship between joint attention and language in children with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities*, *23*, 5-14.
- National Autism Center (2009). *National standards report*. Randolph, MA: NAC.

- Naber, F., Bakermans-Kranenburg, M., van Ijzendoorn, M., Dietz, C., van Daalen, E., Swinkels, S., Buitelaar, J., & van Engeland, H. (2008). Joint attention development in toddlers with autism. *European Child and Adolescent Psychiatry, 17*, 143-152.
- Osterling, J., Dawson, G., & Munson, J. (2002). Early recognition of 1-year-old infants with autism spectrum disorder versus mental retardation. *Development and Psychopathology, 14*, 239-251.
- Robins, D., Fein, D., Barton, M., & Green, J. (2001). The modified checklist for autism in toddlers: An initial study investigating the early detection of autism and pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 31*, 131-144.
- Roos, E., McDuffie, A., Weismer, S., & Gernsbacher, M. (2008). A comparison of contexts for assessing joint attention in toddlers on the autism spectrum. *Autism, 12*, 275-291.
- Schertz, H., & Odom, S. (2004). Joint attention and early intervention with autism: A conceptual framework and promising approaches. *Journal of Early Intervention, 27*, 42-54.
- Schertz, H., & Odom, S. (2007). Promoting joint attention in toddlers with autism: A parent-mediated developmental model. *Journal of Autism and Developmental Disorders, 37*, 1562-1575.
- Siller, M., & Sigman, M. (2008). Modeling longitudinal change in the language abilities of children with autism: Parent behaviors and child characteristics as predictors of change. *Developmental Psychology, 44*, 1691-1704.
- Sigman, M., & Ruskin, E. (1999). Continuity and change in the social competence of children with autism, Down syndrome, and developmental delays. *Monographs of the Society for Research in Child Development, 64*, v-114.
- Stone, W., Ousley, O., Yoder, P., Hogan, K., & Hepburn, S. (1997). Nonverbal communication in two- and three-year-old children with autism. *Journal of Autism and Developmental Disorders, 27*, 677-696.
- Stone, W., & Yoder, P. (2001). Predicting spoken language level in children with autism spectrum disorders. *Autism, 5*, 341-361.
- Sullivan, M., Finelli, J., Marvin, A., Garrett-Mayer, E., Bauman, M., & Landa, R. (2007). Response to joint attention in toddlers at risk for autism spectrum disorder: A prospective study. *Journal of Autism and Developmental Disorders, 37*, 37-48.
- Swettenham, J., Baron-Cohen, S., Charman, T., Cox, A., Baird, G., Drew, A., Rees, L., & Wheelwright, S. (1998). The frequency and distribution of spontaneous attention shifts between social and nonsocial stimuli in autistic, typically developing, and

- nonautistic developmentally delayed infants. *Journal of Child Psychology and Psychiatry*, 39, 747-753.
- Thurm, A., Lord, C., Lee, L., & Newschaffer, C. (2007). Predictors of language acquisition in preschool children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 37, 1721-1734.
- Toth, K., Munson, J., Meltzoff, A., & Dawson, G. (2006). Early predictors of communication development in young children with autism spectrum disorder: Joint attention, imitation, and toy play. *Journal of Autism and Developmental Disorders*, 36, 993-1005.
- University of Michigan Autism and Communication Disorders Center. The ADOS. Retrieved March, 2007, from www.umaccweb.com/diagnostic_tools/index.html.
- Ventola, P., Kleinman, J., Pandey, J. et al. (2007). Differentiating between autism spectrum disorders and other developmental disabilities in children who failed a screening instrument for ASD. *Journal of Autism and Developmental Disorders*, 37, 425-436.
- Vismara, L., & Lyons, G. (2007). Using perseverative interests to elicit joint attention behaviors in young children with autism: Theoretical and clinical implications for understanding motivation. *Journal of Positive Behavioral Interventions*, 9, 214-228.
- Watson, L., Baranek, G., & Poston, V. (2003). Attention-Following and Initiating Joint Attention Protocol.
- Western Psychological Services. Autism Diagnostic Observation Schedule (ADOS). Retrieved March 2007, from <http://portal.wpspublish.com/portal>.
- Whalen, C., & Schreibman, L. (2003). Joint attention training for children with autism using behavior modification procedures. *Journal of Child Psychology and Psychiatry*, 44, 456-468.
- Whalen, C., Schreibman, L., & Ingersoll, B. (2006). The collateral effects of joint attention training on social initiations, positive affect, imitation, and spontaneous speech for young children with autism. *Journal of Autism and Developmental Disorders*, 36, 655-664.
- Zimmerman, I., Steiner, V., & Pond, R. (2005). *Preschool Language Scale, 4th Edition*. San Antonio, TX: Harcourt.
- Zwaigenbaum, L., Bryson, S., Rogers, T., Roberts, W., Brian, J., & Szatmari, P. (2005). Behavioral manifestations of autism in the first year of life. *International Journal of Developmental Neuroscience*, 23, 143-152.