WHICH COMPONENTS OF JOINT ATTENTION ARE CRITICAL FOR CHILDREN WITH AUTISM SPECTRUM DISORDERS TO LEARN NEW WORDS?

by

DANA SCHULLER SMITH

FRED J. BIASINI, COMMITTEE CHAIR
MARIA I. HOPKINS
DAVID SCHWEBEL
JASON SCOFIELD
SCOTT SNYDER

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DEVELOPMENTAL PSYCHOLOGY

ABSTRACT

Though established that language deficits comprise a core element of a definitive autism diagnosis, relatively less research has been conducted to understand the bases for impaired language abilities as compared to understanding the social deficits associated with the disorder. Children with an autism spectrum disorder (ASD) have impoverished joint attention (JA) abilities, evidenced by their relative difficulty both in initiating bids for JA as well as responding to them. Once accepted that JA was crucial in lexical development in typically developing (TD) children, recent trends have diverged from this perspective, shedding light on JA’s role in lexical development in an ASD population. The purpose of the current study was to determine which components of JA children with ASD used to learn novel words.

Nineteen children with ASD (aged 32-77 months) and 29 TD children (18-30 months) participated in a within-groups study of 4 experimental conditions with novel objects and a control condition with familiar objects. Three of the experimental conditions in which an experimenter attempted to teach the child a novel name for a novel object had a critical element of JA removed, while the fourth was a situation in which optimal JA could be attained. Study premeasures included receptive and productive language assessments and JA measures.

MANOVA results indicated both groups learned the novel labels for the novel objects in the optimal and familiar conditions. The TD children had worse than chance
performance in the condition in which JA cues were absent. Vocabulary size played a key role in how all participants performed on the tasks, suggesting a strong determinant of any child’s ability to learn novel labels was his or her preexisting word usage.

The ability to respond to bids for JA seemed to predict word learning outcome in children with ASD, but not for TD children. The ability to initiate bids for JA, however, had no significant effects on children’s abilities to learn novel words. Implications and future research directions are discussed.

Keywords: autism, joint attention, language
DEDICATION

This is dedicated to my two Lenas - one who was so proud of me, but left too soon to see my hard work materialized, and the other who has a little more growing to do before she might understand why I did it.
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TABLE OF CONTENTS

ABSTRACT ........................................................................................................................ ii
DEDICATION ................................................................................................................... iv
ACKNOWLEDGMENTS ................................................................................................. v
LIST OF TABLES ........................................................................................................... ix
LIST OF FIGURES ......................................................................................................... x
LIST OF ABBREVIATIONS ............................................................................................ xi

CHAPTER

1 INTRODUCTION AND BACKGROUND ................................................................. 1

Lexical Development in TD Children ................................................................. 2
Joint Attention in TD Children ............................................................................ 5
The Role of JA in Lexical Development for TD Children ...................................... 9
Theoretical Frameworks ..................................................................................... 11
  Constraints of Principles Theories ................................................................. 12
  Associative Learning Theory ......................................................................... 13
  Social Pragmatic Learning Theory ............................................................... 15
  Emergentist Coalition Model for Word Learning .......................................... 16
Brief Overview of ASD ....................................................................................... 18
Lexical Development in Children with ASD ..................................................... 18
Joint Attention in Children with ASD ............................................................... 20
The Role of JA in Lexical Development for Children with ASD ....................... 22
Specific Aims ........................................................................................................ 27
  Rationale for Hypotheses ............................................................................ 29

2 METHOD .................................................................................................................. 30

Participants ............................................................................................................ 30
# TABLE OF CONTENTS (Continued)

Recruitment ................................................................................................................32
Pre-Measures .................................................................................................................34
  Verbal Communication Assessment ........................................................................34
  Nonverbal Communication Assessment of Joint Attention ..................................35
Materials .....................................................................................................................37
Procedures ....................................................................................................................39
  Consenting the Parent ..........................................................................................39
  Warm-up ............................................................................................................39
  Condition One: Optimal Joint Attention ............................................................40
    Training .........................................................................................................41
    Comprehension of Novel Label ....................................................................41
  Condition Two: No Object ..................................................................................42
    Training .........................................................................................................42
    Comprehension of Novel Label ....................................................................43
  Condition Three: No Experimenter .....................................................................43
    Training .........................................................................................................43
    Comprehension of Novel Label ....................................................................45
  Condition Four: No Child ....................................................................................45
    Training .........................................................................................................46
    Comprehension of Novel Label ....................................................................46

## 3 ANALYSES AND RESULTS .................................................................................47

  Participant Demographics ..................................................................................47
  Effects of Age on Task Success .........................................................................48
  Results on Premeasures .....................................................................................48
    MacArthur Communicative Development Inventory .......................................49
    Rossetti Infant-Toddler Language Scale .........................................................50
    Early Social Communication Scales .................................................................52
  Correlations between Premeasures .................................................................53
    Rossetti and MCDI ..........................................................................................53
    MCDI and ESCS .............................................................................................54
    Rossetti and ESCS ..........................................................................................55
  Test Performance between Children with ASD and TD Children ......................56
    Aim 1 ............................................................................................................56
    Aim 2 ............................................................................................................57
  Word Learning Task Performance by Group .....................................................57
    Familiar Control Task ......................................................................................58
    Optimal Condition ..........................................................................................59
    No Object Condition .......................................................................................59
    No Experimenter Condition ..........................................................................59
    No Child Condition ........................................................................................60
  How the Premeasures Related to Word Learning Task Performance ..................60
    MacArthur Communicative Development Inventory .......................................61
TABLE OF CONTENTS (Continued)

Rossetti Infant-Toddler Language Scale ...................................................62
Early Social Communication Scale ..........................................................64
Additional ESCS Analyses .................................................................67
How Word Learning Task Performance Related to the Premeasures .............70
  Familiar Control Task ........................................................................71
  Optimal Condition ............................................................................72
  No Object Condition .........................................................................73
  No Experimenter Condition..............................................................73
  No Child Condition ..........................................................................73

4 DISCUSSION ...........................................................................................75

  Addressing Specific Aim 1 .................................................................75
  Addressing Specific Aim 2 .................................................................77
    No Experimenter Condition..............................................................78
    No Child Condition ........................................................................79
    Additional Analyses of Experimental Conditions ............................81
      No Object Condition ......................................................................81
  Explanations for Success of Participants with ASD in Task Conditions ....82
  Differences in Language Premeasures ...............................................83
  Differences in Joint Attention ............................................................85
  Conclusions .....................................................................................86
  Limitations .......................................................................................87
  Future Directions .............................................................................90

5 LIST OF REFERENCES ...............................................................................93

APPENDICES

  A LIST OF NOVEL LABELS ................................................................103
  B EXPERIMENT CODING SHEET ......................................................105
  C ESCS CODING SHEET .....................................................................108
  D ETHICAL APPROVAL ......................................................................110
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Tables</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Descriptives of study participants, M(SD) .............................................................50</td>
</tr>
<tr>
<td>2</td>
<td>Rossetti means and standard deviations, M(SD) ...................................................51</td>
</tr>
<tr>
<td>3</td>
<td>Correlations among study premeasures .......................................................................53</td>
</tr>
<tr>
<td>4</td>
<td>Participants’ test statistics per condition ................................................................58</td>
</tr>
<tr>
<td>5</td>
<td>Rossetti comprehension (median split 0-24 months, 24+ months) ..................................63</td>
</tr>
<tr>
<td>6</td>
<td>Rossetti expression (median split 0-24 months, 24+ months) ......................................64</td>
</tr>
<tr>
<td>7</td>
<td>IJA - Initiations of joint attention (split &lt;6 initiations, &gt;6 initiations) ...............66</td>
</tr>
<tr>
<td>8</td>
<td>RJA – responses to bids for joint attention (split &lt;50%, &gt;50% success) ....................66</td>
</tr>
<tr>
<td>9</td>
<td>Means (standard deviations) and ANOVA results of ESCS components ........................69</td>
</tr>
<tr>
<td>10</td>
<td>Standardized canonical coefficients and structure weights from DFA model .........70</td>
</tr>
</tbody>
</table>
# List of Figures

<table>
<thead>
<tr>
<th>Figures</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Novel study objects..................................................................</td>
<td>38</td>
</tr>
<tr>
<td>2  Number of children per group by MCDI score level.......................</td>
<td>49</td>
</tr>
<tr>
<td>3  Participants’ average comprehension and expression abilities..........</td>
<td>51</td>
</tr>
<tr>
<td>4  Task success by group (ASD split by RJA ability)..........................</td>
<td>67</td>
</tr>
</tbody>
</table>
## LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>Autism Spectrum Disorder</td>
</tr>
<tr>
<td>ESCS</td>
<td>Early Social Communication Scales</td>
</tr>
<tr>
<td>DFA</td>
<td>Discriminant Function Analysis</td>
</tr>
<tr>
<td>IJA</td>
<td>initiating bids for joint attention</td>
</tr>
<tr>
<td>JA</td>
<td>joint attention</td>
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<tr>
<td>MCDI</td>
<td>MacArthur Communicative Developmental Inventory</td>
</tr>
<tr>
<td>RJA</td>
<td>responding to bids for joint attention</td>
</tr>
<tr>
<td>TD</td>
<td>(neuro)typically developing</td>
</tr>
</tbody>
</table>
CHAPTER 1
INTRODUCTION AND BACKGROUND

The ability to make social exchanges by way of language is the key factor separating human beings from our simian ancestors. Using verbal or gestural cues affords us the ability to transfer and receive messages that transmit intentions. This serves as the core means for our communicative abilities which, in turn, enable us to function effectively in society. Linguists, cognitive psychologists, developmental psychologists and the like continue to piece together the puzzle of how we acquire language. In a sense, scientists are exploring how we learn that proficiency which is the essence of our humanity.

Infants tend to be masterful learners of the languages which surround them, forever amazing – and embarrassing - parents with their expanding utterances. In fact, between the ages of one and three years, typically developing (TD) children progress from using no spoken language to communicate using nearly 1000 words (Gotzke & Sample Gosse, 2007). Occurring around the 24 month period in this three year span, these toddlers undergo the transformation referred to as the vocabulary explosion. This period of intense word usage is when they experience a rapid increase in the rate at which words are added to their expressive vocabularies (Benedict, 1979; Bloom, 1973; Dromi, 1986; Goldfield & Reznick, 1990; Lifter & Bloom, 1989; Gopnik & Meltzoff, 1986; Nelson, 1973). This acceleration in their use of spoken words begins in infants around 17
months of age or just around the time they have learned their first 40 to 50 words (Mervis & Bertrand, 1994), primarily nouns for simple, uncomplicated object terms such as “duck” or “ball”. A mother’s acclaim of her child’s intelligence is not unfounded; studies have discovered typically developing children can learn a word after minimal (1 or 2) exposures, an ability referred to as \textit{fast mapping} (Carey, 1978).

Unlike that of their typical counterparts, language learning for children with an autism spectrum disorder (ASD) does not progress in so rapid or predictable a manner. Because the deficits in social responding behaviors in toddlers with ASD is one of the earliest markers of the disorder (Tager-Flusberg, Joseph, & Folstein, 2001; Thurm, Lord, Lee, & Newschaffer, 2007), it follows that the study of the normal development of early language will lead to a better understanding of its pathologies. Researchers of human language acquisition continue to address the central question of what mechanisms play a key role in preparing children to learn an effective means of communication. In doing so, researchers seek to determine the importance and value of such aspects of word learning as joint attention and understanding others’ social nonverbal cues.

\textbf{Lexical Development in TD Children}

Before attempting to find a resolution, the problem itself needs elucidating. The acquisition of TD children’s lexicon of novel words for objects may be understood as a mapping problem in the sense that new words must be mapped or linked to the appropriate objects. To solve this problem and to map words onto their newly discovered referent objects successfully would seem to require the mutual activation of both the object and the label in working memory so the two may be connected. A simple
hypothesis might thus be that TD infants link the noun label they hear at a point in time to the object in view at that very same time point in order to make the word-object connection.

This hypothesis that objects are linked to word forms through temporal contiguity alone is not correct in that this simple associative process is not necessary, and may not even be sufficient in the word mapping phenomenon (Baldwin, 1993; Bloom, 1997). In one of her oft-cited experiments, Baldwin (1993) showed that words may be mapped to objects by typical 19 month old children even when the perceived name and the viewed object were separated in time, which she posits is a common learning situation. Baldwin demonstrated that children who were told the name for an object that was out of view were able to learn the label which belonged to that object. In order to do so, Baldwin compared word learning successes in two conditions: 1.) Follow-in labeling where the infant looked at a toy prior to the experimenter labeling it; and 2.) Discrepant labeling where the experimenter looked at and labeled a toy other than that of the infant’s focus. Baldwin found that the child understood the experimenter’s intentions during the discrepant labeling episode, a finding further supported by the infants’ absence of mapping errors, defined as linking the wrong word to the targeted object. Without attention to these reference cues, one would expect children learning their first words to make many wrong mappings; that is, with ambiguous reference, children might associate any object that they happen to be attending to simultaneously with the word they happen to hear.

Studies which documented word-to-referent match in the verbal input for children found that the phenomenon of discrepant labeling (i.e. not matching the parent-uttered
word to what the child is viewing) occurred for roughly 30%-50% of total labeling episodes (Collis, 1977; Ganea & Saylor, 2007; Harris, Jones, & Grant, 1983). Regarding discrepant object labeling, Baldwin (1996) found that while naming objects that were out of the child’s view in one of two similar looking buckets, the child nonetheless could successfully map an object to its intended name by relying on the experimenter’s gaze directed toward the unseen object while it was in the bucket. Taken together, the results from these discrepant labeling scenarios support the belief that the children in these word learning tasks did not learn by simple attentive or associative processes alone which object received which label. Instead, it appeared the children who were successful in these tasks may have been relying on some other cues to avoid mapping errors and learn the correct labels for the objects.

The results of the discrepant-labeling scenarios seem to suggest that TD children relied on more than the simultaneous associations between the object they saw and the label they heard to learn that both were related. It could be posited that the children in these learning situations made an enormous social cognitive leap in assuming what the experimenter named was really not the bucket itself, even though the bucket was the only object in the child’s view when the experimenter uttered the novel label; rather, it seemed the children were able to generalize the experimenter’s label to the object they perceived was in the bucket. The discrepant labeling findings seem to indicate that infants link labels to objects separated in time by relying on the referential cues provided by the experimenter (Baldwin, 1993). Referential cues in such a scenario, including following an adult’s line of regard or attending to an adult’s pointing cues, seemed to play an additional role in children’s word learning abilities.
Joint Attention in TD Children

In spite of the fact that most children cannot produce wholly unmistakable words by their first birthdays, they are nonetheless able to coordinate their attention between other people and objects as well as communicate their personal objectives and desires. Researchers of language and human social development have discovered that what leads to the achievement of a working vocabulary is not a series of random events with the eventual attainment of language; rather, typical language development generally advances in a reliable and predictable fashion.

Research has established that TD infants of about 6 months of age can follow another’s gaze to a present object (Butterworth & Cochran, 1980; Hains & Muir, 1996; Scaife & Bruner, 1975) and a few months later at about 9 months to a year of age, they are able to follow a pointing gesture (Baldwin, 1993; Leung & Rheingold, 1981; Murphy & Messer, 1977). These months leading up to a TD child’s first birthday are marked by a variety of changes suggestive of a bourgeoning level of social-cognitive understanding including JA engagement, gestural communication, imitation, and finally language production (Carpenter, Pennington, & Rogers, 2002). Baldwin (1991) showed how TD children as young as 16 months of age could already contribute to the social coordination with another in the achievement of joint reference. The findings of this particular study determined that when the experimenter labeled the novel object that was occupying the young toddler’s focus (follow-in labeling) while at the same time manipulating the experimenter’s own novel object (discrepant labeling), the child learned the label for the experimenter’s object and not the object of the child’s own focus (Baldwin, 1991). The findings of this task further suggest that by about a year and a half, infants actively seek
information from social encounters and gather what is needed to parse out the reference of a particular word.

In contrast to following another’s nonverbal requests for attention to a present object, more recent studies have shown TD infants also responded to requests for absent objects which were never directly labeled (Ganea & Saylor, 2007; Saylor, 2004), suggesting an ability to interpret ambiguous verbal references. In one such study (Ganea & Saylor, 2007), infants heard an experimenter mention an absent known object a number of times while apparently searching for this object. Then, either immediately or after a few minutes, the experimenter announced she knew where it was and walked into another room only to ask the child to get it for her, never directly asking for the targeted object by label. The children were able to find the requested object even without exact label, findings suggestive of Baldwin’s ambiguous referent studies (1991; 1993) in support of the view that infants actively seek reference information even in potentially confusing circumstances.

By the age of a year and a half, children’s engagement in JA episodes is well-established (Butterworth & Jarrett, 1991; Kasari, Freeman, & Paparella, 2001; Mundy & Gomes, 1998). Progressive stages of development through the first 2 years of life are as follows: the child begins to communicate in a solely dyadic manner, attending only to the other communication partner or object of interest before the child moves into a triadic exchange with his or her coordination of attention divided between the communicative partner and the object of interest (Bakeman & Adamson, 1984). By the age of 2, children have deeply ingrained understandings of others intentions and shared attention. On
account of this, JA has been implicated as an early indicator of children’s understanding that other individuals have thoughts and beliefs unlike their own (Charman et al., 2000).

Three discrete developmental milestones have been proposed to contribute to this eventual attainment of triadic JA skills in the infant’s first year which provide favorable conditions for the development of language: (1) the child shares attention with the speaker to an object, (2) the child understands that the speaker’s reference (gaze, point, etc.) has intention, and (3) the child concludes that the speaker’s intention is referring to the shared object of (1) (Scofield & Behrend, in press). The coordination of attention begins with the caregiver’s focus on what the child is looking at (Bakeman & Adamson, 1984), and advances to the child’s attention and gaze shift to other locations, persons, objects, or events of interest (Butterworth, 1995). This response to another’s line of regard sets the stage for the subsequent discussion on responding to bids for JA. This capacity for shifting gaze between child and caregiver has also been believed to give rise to the child’s eventual abilities to determine others’ intentions, visual perspectives, and emotional states of being (Wetherby, 2006).

The second proposed milestone en route to JA of the children’s understanding of intentions in gazes or points occurs when a child looks at his or her caregiver with intent to share an emotion. For example, a child may see a favorite toy located across the room and display a facial expression conveying excitement that is meant to share that joy with his or her caregiver (Wetherby, 2006). The child may also express distaste at an event that does not go his or her way or demonstrate fear upon seeing a suspicious stranger. All of these emotions are done to share a feeling and communicate some intention (e.g.,
“let’s celebrate finding my lost toy!”, “I’m not happy with this outcome”, and “I don’t like the looks of that creepy man!”

Finally, the third developmental milestone a child must attain before JA and eventual language production is established is the sharing of intentions. This refers to the child’s ability to signal to others in an effort to achieve a particular goal (Wetherby, 2006). This intentional communication which is expressed in gestures, sounds, and other behaviors is attained by the end of the child’s first year of life. The child eventually begins to use language to express these intentions (Wetherby & Prizant, 1993) toward the end of the second year of life.

In accordance with the belief that a child must attain certain developmental milestones before reaching full JA understanding and language, JA has been subcategorized into distinctive groupings of production. Some developmental researchers separate JA into protoimperatives or imperative triadic exchanges and protodeclaratives or declarative triadic exchanges, with the former serving instrumental or requesting purposes, and the latter serving as a way for the child to comment, indicate, or share awareness of an interesting object or event (Bruinsma, Koegel, & Koegel, 2004; Gleason, 2001; Gómez, Sarria, & Tamarit, 1993; Mundy, Sigman, & Kasari, 1993). Yet another way JA’s qualities of requesting and showing behaviors has been regarded is in children’s responding to JA bids (RJA) or initiating JA bids (IJA) (Bruinsma et al., 2004). Subsequent sections highlight just how essential the components of RJA and IJA are in the process of early word learning.
The Role of JA in Lexical Development for TD Children

For the purposes of brevity and clarity in this review, Tomasello’s (2003) oft-cited definition delineating JA as the child’s ability to draw another person’s attention toward or be drawn by another person to a stimulus event, object, or person by way of such nonverbal means as eye gaze or point will be adopted. The infant’s apparent ability to follow an adult’s line of regard in order to understand their intentions in a word learning episode more than simply suggests that language does not proceed in a vacuum; rather, it seems evident that language develops in a world imbued with human interaction and social meanings. Both the ability to attend to social communicative partners and the ability to share focused attention on objects, other people, or events are widely believed to precede the onset of a child’s first spoken words.

The study of the developmental trajectory of JA related to communicative competence has typically ended here - with the child dividing attention between the partner and the object or event of interest. However, a relatively new line of research has taken this process a step further with the suggestion the child may engage in polyadic communicative exchanges where the learner (child) may play the role of onlooker while overhearing an object’s label concomitant with observing a dyadic exchange (Akhtar, 2005; Akhtar, Jipson, & Callanan, 2001; Jaswal & Markman, 2003). These authors’ aims to redefine traditional JA were couched in their findings that simply overhearing a dyad’s communicative exchange may be sufficient for the child to learn the intended object’s label. The child learned the object’s label by way of eavesdropping, in a sense, in order to grasp the communicative partner’s meanings or intentions. This nontraditional mode of
word learning is illustrated in a series of studies (Akhtar et al., 2001) that show TD children were able to learn object words by the age of 25 months.

The authors found the children in their studies did equally well learning the word when the children themselves were addressed as when they overheard the word being spoken in reference to an object or action. These findings provide evidence for the active role taken by word learners, further suggesting children have some understanding of how JA functions to assist the intended (and in this case unintended) learner to determine the reference of a word.

The role of JA in early language learning may thus be best understood by explaining the role of the referential intent of another’s point, gaze, etc. (Baldwin, 1995). When parents are very attentive with regards to what their child is engaged in and follow the child’s focus of attention while providing object labels, children learn words at a much faster rate relative to their peers whose parents did not label for them objects with which they were presently interacting (Akhtar, Dunham, & Dunham, 1991; Tomasello & Farrar, 1986). This finding suggests it may not be enough for parents simply to expect children to respond to bids for JA by commenting on objects in their own field of view when aiming to teach them words; instead, parents might attempt to follow their children’s lines of regard to assist in their learning of new object labels. However, Baldwin (1991) determined that when an experimenter uttered a novel label for one of several possibilities, a child would check to see where the experimenter was looking, therefore revealing a child would indeed seek an adult’s intended object of focus in determining the referent of a novel word instead of relying solely on follow-in labeling to learn words.
Some significant correlations between JA measures and word learning in TD children have been made. Strong positive relationships between JA and early lexical acquisition in TD children have been found in the developmental literature (Mundy & Gomes, 1998; Sigman & Kasari, 1995; Smith, Adamson, & Bakeman, 1988; Tomasello & Farrar, 1986). Tomasello’s (1995) arguments on the utility of understanding the referential intent of others support the view that novel word learners must infer another adult’s (teacher, parent, etc.) purposes by way of point or eye gaze in order to learn the target object’s label. Consequently, if children are unable to grasp the concept of shared attention on an object, word mapping may not occur because the referential intent of the speaker may not be recognized and understood by the child.

As previously noted, a speaker’s point toward an object or directed eye gaze toward a target may serve as the reference to that object. Otherwise, the child might employ both the adult speaker’s point and gaze in tandem to the jointly attended object. In all, it has been believed that the child and the adult’s joint engagement to each other and to the same object in the same location at the same point in time is the optimal condition for the occurrence of successful word-to-object mappings (Tomasello & Farrar, 1986). Because of this required dance between gaze and point following, it has also been proposed that TD infants’ early developed sensitivity to point cues, either by participation or vicariously, may enable them to capture word-referent mappings.

Theoretical Frameworks

Several theories have been proposed regarding how word learning develops. The observations of Willard Van Orman Quine (1960) and his theory on the indeterminacy of
translation might help put the difficulties in understanding word learning into perspective.
Quine asked how a linguist in a foreign land and armed with no prior knowledge of the
native tongue might translate a native’s utterance projected toward a scampering rabbit in
the distance. Would the visiting linguist presuppose the native’s statement of gavagai
meant rabbit? Or might the foreign word translate into dinner? Was the native motioning
toward the grassy plain beneath the rabbit? Or could he even have been speaking of some
undetached rabbit part, perhaps a long ear? The possibilities are nearly limitless without
language to parse out the native’s meaning with further querying.

There are several competing theories for how children solve Quine’s problem, or
more specifically, how they progress from learning their first words to nearly mastering
their native tongue in about one year’s time. The first account is one that embraces
Quine’s puzzle, while the second and third stand in stark contrast to one another but
together reject the problem. Lastly, the fourth proposed is more of an amalgam of
associative and social referential accounts.

*Constraints or Principles Theories*

The driving force behind constraint-based theories of word learning is that
because word-to-object mappings have many options for which target object receives
which label, humans must use certain constraints or principles that reduce the search
space (Hollich, Hirsh-Pasek, & Golinkoff., 2000). In an attempt to explain how TD
children experience a vocabulary explosion around their second year of life, Markman
(1987) proposed the whole-object principle, meaning that upon hearing a novel label
directed toward a novel object, the novice learner labeled the whole object rather than an
object part or attribute (i.e., the entire rabbit or his hopping motion rather than his ear or
hind quarter in Quine’s fictional situation). This naming of the whole object was even
found to occur when the novel object had a particularly salient part.

Along similar lines of the constraints theory, the mutual exclusivity principle
highlights the importance that an object can receive only one label (Jaswal & Hansen,
2006; Markman & Wachetl, 1988). In their studies, 3-5 year old participants were given a
novel term for a part or an attribute of an object. When they were given the part or
attribute for already known objects, participants applied the novel label as a part or
attribute term, but when given the name for unfamiliar objects, they applied the label as a
term for the entire object itself (Markman & Wachtel, 1988). Therefore, the findings of
the mutual exclusivity theory suggest children are biased to believe that words do not
have overlapping reference. As can be deduced by the preceding examples, the overall
goal of the constraints theory sets out to make word learning less of a challenge by
limiting potential recipients of the given label.

**Associative Learning Theory**

Regarding Quine’s predicament of the indeterminacy of translation, associative
theorists believe word learning is much more straightforward than having to learn basic
object principles or rely on constraints that narrow the search space once a label is heard
(Hollich et al., 2000). Associative accounts of learning are based on the assumption that
children learn their first words for objects, and even subsequent and more complex terms,
by way of relative saliency of that object to others in its perceptual field as well as how
often they come in contact with the object and its label (Hollich et al., 2000). This
learning theory is therefore based on associations between the object children see along with the label they hear associated with that object (temporal contiguity). As other researchers have speculated, children learn the labels for objects in their environment through “dumb attentional mechanisms” (Colunga & Smith, 2004; Smith, Jones, & Landau, 1996), meaning there is nothing sophisticated about learning new words and they do so by noting the most salient objects, actions, or events in their environment and then associate the most frequently used label with the most prominent candidate (Hollich et al., 2000). Researchers of associative accounts assume the most simplistic of views are at base in the word learning phenomenon.

Associative accounts of word learning stand in opposition to the belief that infants learn their first words in a slow, deliberate manner (Gelman & Markman, 1987), proposed to be based on learned beliefs about category membership (e.g., their shape, function, or material composition). In one sense, this sort of reflective and measured word learning has been termed “smart” in that the child needs in place conceptual understanding of an object’s structure prior to learning the word for that object (Colunga & Smith, 2004). On the other hand, the associationist’s belief that word learning is rather a “dumb” process does not imply the infant is unintelligent; rather, these theorists propose the infant’s mechanisms for learning the new words may be unconscious, speedy and therefore automatic.

Associative word learning accounts do not embrace referential understanding and might be expected to yield non-words to object mappings. That is, a child who is learning by associative means may focus more reliably on situational cues that are prone to change. Again, this could be where the object is positioned during the naming episode, as
in a focus of the child’s or a focus of the speaker’s (Baldwin, 1993). It seems possible that a child might learn a non-word such as a buzzer or a chime represents some object in his or her field of view while concurrently experiencing the related auditory stimulus. If this were the case, hearing children, in spite of everything, might map gestures to labels that happened upon the scene at the same time; however, it seems silly to imagine that these erroneous mappings would occur in word learning episodes. However, Namy and Waxman (1998) found surprising results suggesting that typical children younger than 18 months actually were more likely to associate gestures as sufficient labels for novel objects, whereas 26 month old children appeared to realize the value of a word world and chose only to map spoken words onto novel objects.

**Social Pragmatic Learning Theory**

Social-pragmatic, or referential, accounts of word learning are rooted in the belief that children need interactions with their language-proficient parents or caregivers in order to learn the names for objects. Because children require this guidance by more experienced word learners to make the object-label connections, it proves most successful when parents are attuned to their child’s intentions and respond by supplying words for those objects or events the child wishes to know (Nelson, 1988). As mentioned previously concerning episodes of follow-in labeling, when parents attend to and follow their child’s focus while providing labels for those objects or events, children learn words faster than children whose parents do not do this labeling (Akhtar et al., 1991; Tomasello & Farrar, 1986). Underlying the referential view is the assumption that children are social by nature, thus arrive at the word learning situation armed with the essentials of
reciprocal communication (Carpenter, Nagell, & Tomasello, 1998), such as having the ability to follow an adult’s gaze and eventually grasp the concept of JA and its functions in word learning tasks. Thus, in this way JA is an ingredient in the larger social-pragmatic approach to word learning.

Social pragmatic theorists in support of such mechanisms, therefore, may not view Quine’s indeterminacy problem as a real issue to be dealt with because environmental input from the caregiver acts to eliminate the ambiguity of which label applies to which object (Hollich et al., 2000). In other words, the novice learner with adequate referential understanding does not have to guess as to what the other is referring to during a naming episode.

**Emergentist Coalition Model for Word Learning**

An alternative suggestion has been made that may be viewed as a hybrid of both the associative and referential perspectives on children’s word learning. The research on TD children’s shift towards attention to reference from pure association suggests that the ability to acquire language changes from nonverbal symbol development to actual uttered word usage. In fact, the Emergentist Coalition Model of language learning incorporates the two processes with word learning beginning as primarily an associative skill and only when the children are able to follow attentional cues do they employ their social partner’s referential intent as to the meanings of novel words (Hollich et al., 2000), thus moving from an associationist’s perspective to one of a social-pragmatic theorist.

This focus on a transition from basic association to more conceptual understanding of language suggests that language development is actually a product of
multiple cues working in concert. Upon hearing a new word, novice learners have these various cues (attentional, social, and linguistic) available to them. Therefore, a child may learn an object’s name when he hears a label uttered while he is manipulating the object himself (follow-in labeling) or he may learn an object’s label while a caregiver focuses on a particular object while uttering a label whether or not the child is attending to that caregiver’s focus. Though the reliable method for learning a label may be the latter instance, there is evidence that children with ASD indeed learn their first words for new objects they encounter by the former, more associative, manner (Baron-Cohen, Baldwin, and Crowson, 1997). At issue is when the novice learner becomes able to access and employ the necessary cues per each situation. Hollich and his colleagues (2000) in their work with TD children suggest novice learners may not choose and use the correct cues early in development, but learn over time to weigh them differently.

The proposed study borrows from Hollich and colleagues’ Emergentist’s view that TD children may be in transition from associative knowledge to more referential learning while presenting conditions supportive of both perspectives. The model, however, offers little in the way of dealing with how children with ASD learn their first words. The remainder of this analysis supplies evidence that children with ASD appear to rely on more associative modes of word learning. This belief, along with the support that TD children are social in nature, guides this study to adopting a blend of the preceding theoretical perspectives.
Brief Overview on ASD

Autism is a developmental disorder, meaning it involves delays that disrupt development in several areas. The condition of autism and its related disorders are diagnosed based on a description of predictable patterns of deficits in social behavior and communication while being accompanied by restricted and repetitive interests or behaviors. This dissertation will focus on the area of social communication, namely the development of first words for children who are developing language. Additionally, a marked deficit in JA stands as another core feature in the DSM-IV criteria (American Psychiatric Association, 1994). The onset for these various symptoms of social and language deficits as well as restrictive, stereotyped behaviors must exist prior to 36 months of age for the child to be considered for a diagnosis of autism.

Autism has been estimated to affect about one in 110 individuals, with males four times more likely to be diagnosed than females (APA, 1994). Autism is a spectrum disorder, signifying it ranges in degrees of severity in each of the three mentioned domains (of language use and communication, social interaction, and restrictive and repetitive behaviors and interests). Persons must have deficits, even if mild, in each of the three listed areas of impairment to receive a definitive diagnosis. Given that no exact biological markers have been pinpointed in the condition, it continues to be diagnosed via behavioral indicators rather than genetic ones.

Lexical Development in Children with ASD

Though a principal feature of ASD is a deficit in lexical skills, there is vast heterogeneity in the language abilities among children who have received an ASD
diagnosis (Wetherby, 2006). It has been found that while many children with ASD may never acquire any productive language skills, others go on to develop extensive vocabularies, though with a language that overall appears quite different from their TD peers (Frith, 1989). Previous estimates have suggested that nearly one-half of persons with autism use no functional speech (Lord & Paul, 1997; Lord & Rutter, 1994; Wetherby & Prizant, 2000), but more recent studies narrow the estimates down to less than a quarter of the population with autism are without language, defined as a daily use of five words or fewer (Lord, Risi, & Pickles, 2004). Delayed and deviant language stands as a core characteristic of autism regardless of the accuracy of the assessments.

Though language abilities of persons diagnosed with ASD may vary with some having no words to others using rich vocabularies, social pragmatic impairments are universal among those with the disorder (Tager-Flusberg et al., 2001). The need to attend to referential cues from a social partner may likely constrain a child’s ability to map words onto their referents. How do the findings from studies with TD children translate to children with ASD who are known to have core deficits in language? Because of the oft-cited requirement to focus on others’ intentions in order to learn an object’s label, it is reasonable to assume children with ASD who do, in fact, learn words do so not simply in a delayed manner as compared to their TD peers, but quite possibly in a different manner, one free from the boundaries of social engagement.

Children with ASD may be attending more heavily to associative cues, such as object position during naming rather than referential ones (whether the child or the experimenter is engaged with the object at the time of naming, again follow-in and discrepant labeling, respectively). As mentioned, Baron-Cohen and his colleagues (1997)
found children with ASD mapped words they heard to objects they were engaged with, which led to a large number of erroneous word-object mappings; on the other hand, their TD and developmentally delayed peers relied more consistently on direction of eye gaze to determine the labels for various objects. This different characteristic of word learning may be due in part to social interaction deficits among all who receive an ASD diagnosis.

The vast majority of ASD research has been focused on the etiology for the condition as well as the social and emotional underpinnings associated with it. A child’s language delay is one of the most frequently cited reasons for initial referral for young children who are later diagnosed with ASD (DeGiacomo & Fombonne, 1998; Thurm et al., 2007). As previously mentioned, significant correlations between JA measures and word learning have been found in TD children, but the relations have been found to a lesser extent in children with ASD. Thus, even though the manner by which persons with ASD learn and use language is a core component of the diagnosis, not a great deal is known about how children with ASD commence learning their first words. The remaining sections of this introduction will primarily concentrate on language abilities of those with ASD, specifically how children with ASD learn words to build a lexicon.

Joint Attention in Children with ASD

What underlies the language delays among one-quarter to one-half of persons with ASD is said to be a pervasive impairment in children’s JA skills (Carpenter et al., 2002), which involves gaze and point following behaviors. Of the published articles on JA in children with ASD, these children by and large show atypicality in their JA skills (Gernsbacher, Stevenson, Khandakar, & Goldsmith, 2008). Publications on the subject
reveal extensive research findings that not only do children with ASD have much more difficulties than their TD peers following another person’s gaze directions and pointing gestures (Loveland & Landry, 1986; Sigman & Ruskin, 1999), they also initiate fewer episodes for joint engagement with others (Charman, Swettenham, Baron-Cohen, Cox, Baird, & Drew, 1997; Mundy, Sigman, Ungerer, & Sherman, 1986). Language development seems a particularly obvious marker for parents that something may be amiss with their child. While parents may not recognize their child’s lack of pointing or showing behaviors or even heed their child’s affinity for lining up his stuffed animals as particularly out of the ordinary, they will seek explanations for why their child does not talk when his or her peers are already speaking in full sentences.

Related to the early indication of ASD in a child’s delayed language development, the failure to engage in JA episodes, both by initiating and responding to bids, is also one of the most reliable early markers of ASD in toddlers. JA engagement, and lack thereof, has even been suggested to be the earliest manifestation of ASD parents and practitioners may have to recognize the disorder (Baron-Cohen, 1989). A number of retrospective studies of home video analyses or parental reports reveal the presence of early markers for ASD based on previously unrecognized deficits in JA (Adrien, Lenoir, Martineau, Perrot, Hameury, Larmande, & Sauvage, 1993; Baranek, 1999; Clifford & Dissanayake, 2008; Osterling & Dawson, 1994; Werner, Dawson, Osterling, & Dinno, 2000). One of these retrospective studies of home video analyses linked social interaction impairments, poor attention, and lack of social smiles and facial expressions in the child’s first year of life to ignoring others, opting for solitude, and lack of eye contact in the child’s second year (Adrien et al., 1993). Likewise, Osterling and Dawson (1994) found in their well-
known report based on home videos from the children’s first birthday parties that children with ASD were much less likely to attend to other people, show others an object, or orient to their name than their TD controls were. It thus behooves researchers to develop better ways to identify this consistent indicator of the disorder in order to improve children’s odds at rehabilitative measures earlier since it has been shown that early diagnosis is crucial in seeking effective services for children and their families (Eikeseth, 2009; Myers, Johnson, Council on Children with Disabilities, 2007; Rogers & Vismara, 2008).

The Role of JA in Lexical Development for Children with ASD
Because children with ASD may never acquire the proficiency to regard others’ attentional indications, how then do they learn a language lexicon? Do they necessarily need to learn to understand referential intentions so as to learn a lexicon as previous research (Bono, Daley, & Sigman, 2004; Gulsrud, Kasari, Freeman, & Paparella, 2007; Ingersoll & Schreibman, 2006; Jones & Carr, 2004; Kasari, Freeman, & Paparella, 2006; Mundy & Crowson, 1997; Rocha, Schreibman, & Stahmer, 2007; Schertz & Odom, 2007) has sought to demonstrate? Or might they learn in an entirely different manner than their TD peers, a deviant means (Rice, Warren, & Betz, 2005) employing alternative methods to learn a lexicon free from the constraints and anxiety of social engagement? Being that children with ASD do lack many of the social and communicative skills necessary to heed others’ attentional indications, they are well suited to participate in research on word learning by associative, and not referential, processing.
In keeping with the discovery of significant relationships between JA and word learning in TD children, there have been some, albeit fewer, empirically derived discoveries in a population of children who have ASD. Mundy and his colleagues (1990) found that both RJA and IJA in 45 month old children with ASD were positive predictors of language development 13 months later. More conservative support has been found for a relationship between RJA and improved language in children with ASD (Bono et al., 2004; Siller & Sigman, 2002). In examining receptive language levels in children with ASD, Mundy, Sigman, and Kasari (1990) reported a positive association between the social measures of following an adult’s gaze and points (RJA measures) and the child’s resultant receptive language development. Along similar lines, Murray and her colleagues (2008) found RJA to be correlated positively with receptive language scores, but not with expressive language scores.

Based on the many findings of increased rates of RJA among children with ASD, it may then come as no surprise that RJA was also found to develop before IJA in TD children (Murray, Creaghead, Manning-Courtney, Shear, Bean, & Prendeville, 2008). Earlier studies found a link between RJA and both expressive and receptive language scores in TD children (Mundy & Gomes, 1998). Concerning language development in children with ASD, a longitudinal study spanning 8-9 years linked RJA to long-term gains of expressive language skills (Sigman & Ruskin, 1999). In further support of a link JA has with a child’s subsequent language development, Bono and his colleagues (2004) reported evidence that the amount of intervention to improve JA given to children with ASD was directly proportional to the child’s future language skills. Underlying their findings, however, was the caveat that the measure of a child’s initial language skills was
as significant a link as the child’s positive response to the JA enhancing intervention. Therefore, whether or not the child saw improved language skills was mediated by that child’s baseline language prior to the study.

The implication throughout these studies that reported the JA – language link is that children with ASD may not acquire JA skills in their natural developmental trajectory, but might learn to understand how to engage in JA episodes and, most importantly, appreciate the value of these interactions with the proper interventions. Could it be that children with ASD just need a push toward understanding the importance of a point or gaze? And does this necessarily suggest the child will point in declaration himself? The following studies suggest this may not be the case.

Though the evidence appears promising for children with ASD to eventually learn to respond to bids for attention, a number of studies found that children with ASD rarely, if ever, initiate bids for JA (Kasari et al., 2006; Leekam & Ramsden, 2006; MacDonald Anderson, Dube, Geckeler, Green, Holcomb, Mansfield, & Sanchez, 2004). Highlighting the value of JA in subsequent language abilities, researchers have attempted to design interventions to teach children with autism this fundamental referential skill. In one such study, children with autism were randomly assigned to a JA or a control task, the former training them on how to engage in pointing behaviors while being encouraged to share attention between researcher and objects through eye contact (Gulsrud et al., 2007). The testing took the form of novel probes (noisy objects in motion) to determine the child’s degree of achievement in responding to and initiating JA episodes. It was found that children in the JA intervention, indeed, were more likely to engage in shared interactions, but did not increase their rates of showing and pointing behaviors. The suggestion is that
one of the lower developmental skills, shared interactions, emerged before the more sophisticated ones, which did not arrive at all in this particular study.

In another study exploring IJA bids in children with autism, Landry and Loveland (1988) reported a weak positive relationship between IJA and language development in children with ASD, evidenced by their study participants’ having advanced language skills but at the same time having poor JA skills overall. The poor JA skills were largely attributed to the children’s lack of pointing and showing behaviors; the children in this study were more likely to respond to bids for JA than to initiate them. Thus, the relationship between JA in general and language appeared minimal at best in their study. Other studies have reported that JA and vocabulary development are completely uncorrelated in a population with autism (Lord & Pickles, 1996; Morgan, Maybery, & Durkin, 2003; Stone & Yoder, 2003; Travis, Sigman, & Ruskin, 2001).

Some other work has proposed that JA skills actually improve over time, though the mechanisms for this change are not explicitly outlined. Naber and her colleagues (2008) found in a longitudinal design spanning about two years that JA skills of children with ASD tend to improve over time from 24 months to 42 months of age. A relative dearth of research has been undertaken to determine how JA develops in children with ASD. Consequently, the link between JA and language development in children with ASD continues to remain unclear.

Along similar research lines, a series of longitudinal studies on children with ASD found links between JA in the preschool years and ensuing language development. Charman (2003) found JA abilities at 20 months had a positive association with language abilities at 42 months in children with ASD, while Mundy and colleagues (1990) found
JA behaviors such as gaze alternating and following as well as pointing and showing behaviors, but not social interaction, child’s IQ, and protoimperative (or requesting) behavior were associated with language abilities one year later. Other investigations have found similar links between RJA and language gain at follow up (Sigman & Ruskin, 1999; Stone & Yoder, 2001).

Though considerable quantities of research data on JA in the ASD population have been reported, the vast majority of the literature on the JA-language link regards children who are typical in their development. Because of this comparable deficiency of experimental studies and subsequent evidence for exactly how children with ASD learn a lexicon, it may be premature to assume these children do so by the same mechanisms as children who are typical in their development, i.e. by way of understanding others’ intentions and cues toward reference, rather than by merely associative means. The present idea is that because children with ASD are deficient in making and understanding social exchanges, they may use associations to bind words to their referent objects or events. Furthermore, even if TD children begin word learning by making associations, they eventually learn the value of their own and others’ intentions and referential input. JA research and its implications for language development in ASD will inevitably assert itself amid the ongoing discourse between social and behavioral domains in the further discovery of understanding how first words are acquired. The primary objective of this dissertation is to determine which components of JA facilitate word learning for children with ASD.
Specific Aims

Prior research has demonstrated that JA has a significant positive relation with language development in children who are developing typically. It then makes sense that improving the JA abilities of children with ASD would subsequently improve their language skills. Though a substantial amount of research has been conducted on the JA-language links in children with ASD, few results are consistent. Since the research done on children with ASD cannot conclusively identify JA as a necessary condition for language to occur, it remains a point of dispute as to what degree children with ASD can learn to initiate bids for JA as well as respond to them and what effect this has on language acquisition. Wetherby (1986) noted in her chapter in Charman & Stone’s book Social and Communication Development in Autism Spectrum Disorders that the best predictor of a child’s increase in JA was how well the parent synchronized his or her attention (again, follow-in labeling) to that of the child’s.

On a final note, though much research has indicated that JA abilities overall have a positive association with language skills in TD children, it remains to be seen how children with ASD learn words. It may be that children with ASD learn the words of their native tongue in a manner wholly distinctive from their TD peers. It might also be they learn just as the TD children have (e.g., moving from an associative account for word learning to one which presupposes their awareness of others’ intentions). Underlying this assumption is the characteristic associated with ASD that those with the disorder do not understand social cues - and JA is undoubtedly social in nature. In spite of the fact that children with ASD may develop large vocabularies, they still appear to process language
like TD one-year olds with a propensity to learn their words through attention to salient associative cues (Hennon et al., 2003).

The overarching goal of the proposed research was to determine whether or not children with ASD could learn a lexicon differently from traditional methods (of enforcing their engagement in JA), and how they might have done this. The conditions under which children with ASD learned a lexicon were investigated. In doing so, the comparison between simple associations versus an understanding of referential intent was determined. A main issue addressed was to determine if and how children learned words when social cues like JA were present and what happened when they were absent.

The study had two specific aims:

Aim 1: To determine whether children with ASD learned a lexicon in a manner similar to TD children who were at the outset of their vocabulary explosion.

H1: If children with ASD relied on surface level associative cues, it was expected that children with ASD would learn their lexicon in a similar manner to how novice, but not experienced, TD word learners learned their lexicon. (Note: Novice learners and experienced learners were distinguished by their MCDI verbal age premeasures.)

Aim 2: To evaluate the learning conditions under which children with ASD were most successful at learning words (by comparison between the optimal JA condition and the remaining three experimental conditions, each with one critical element removed).

H2: It was expected that if children with ASD relied on surface level associative cues more than experienced TD word learners, those children with ASD would learn the
lexical labels in conditions with elements removed more reliably than in the optimal JA condition (potentially due to an aversion to social interaction with the experimenter or to their inability to capitalize on social JA cues). Likewise, it was expected that TD children scoring low on the MCDI would employ similar associative cues to learn words in the tasks (i.e., both children with ASD and low verbal age TD children were predicted to have success in condition three – no experimenter.)

Rationale for hypotheses

Based on findings about how incipient TD word learners used associative properties to learn novel words (Smith & Smith, unpublished data), it was suggested that the beginning TD learners might perform like ASD learners. This suggestion is in line with the Emergentist Coalition Model for word learning. Research has shown that TD children are not adept at employing all word learning cues available to them (e.g., attentional, social) at the outset of word learning (Hollich et al., 2006). Only with time and “practice” will TD children learn to employ particular cues at appropriate times. Furthermore, because it has been found that children with ASD attend surface level cues of associative properties more than social referential ones (Baron-Cohen et al., 1997), it seems plausible they did not initially understand the implicit meaning of social exchanges, nor would they attain this understanding (notwithstanding interventions). If learners with ASD, in general, rely on more surface cues to reference, it may be inferred that they have not attained a deep understanding of language or rules of social discourse.
CHAPTER 2

METHODS

Participants

The study participants included 19 children with ASD (4 females) and 27 TD children (18 females). A total of 29 TD children were enrolled and completed the research study, but data could not be analyzed for 4 of them (2 female) on account of missing or incomplete premeasures. The children who had received prior autism diagnoses by licensed clinical psychologists were recruited from a school for children with ASDs as well as those typical in their development. The classrooms in this school were inclusive in design, meaning children with ASD learned among TD children, to allow in part for modeling behaviors among classmates. Because of the population from which participants were recruited, the children with ASD diagnoses in this study had abilities closer toward the high functioning end of the autism spectrum. The higher functioning population was chosen to participate due to the increased likelihood they would have a relatively high degree of spoken language skills, thus a greater potential to learn words in the study conditions.

The TD participants were recruited from preschools and Mom’s Club groups in the Birmingham and Tuscaloosa areas of Alabama. The majority of the participants, both with ASD and TD, were from professional, upper middle class families due in part to the locations’ propinquities to large state universities. The overwhelming majority of the
children, 93.5%, were White, while the remaining 4.3% and 2.2% were Black and Asian, respectively.

The study participants included children between the ages of 32 and 77 months \((M = 49.68, SD = 11.24)\) who had formal diagnoses of ASD as well as TD children between the ages of 18-30 \((M = 24.32, SD = 3.84)\) months old. Chronological age matched participants were not recruited from the integrated classroom school. Instead, an attempt was made to match study participants on language age, generating a younger TD population. The rationale of opting for younger TD study participants was partly an effort to approximate a language control group for the children with ASD since the primary research question centered on lexical development. Language age was established by premeasures evaluating the participants’ receptive and expressive vocabularies.

Another reason for the recruitment of TD participants between 18-30 months was because of the evidence provided in support of 18 month old infants being able to establish a parent or experimenter’s reference of a novel label (Baldwin, 1991; 1993). The cutoff was set at 30 months since it stood at the latter end of the vocabulary explosion, a point at which TD children should have experienced a marked increase in their word usage, yet still an age at which they continued to add words (thus avoid the ceiling effect on the language measures). Of the children included in the study, a nearly representative number who had an ASD diagnosis were females, 4 of the 19 children, with the ratio of females to males receiving ASD diagnoses hovering around 1 in 4 (Newschaffer, Croen, Daniels, Giarelli, Grether, Levy, Mandell, Miller, Pinto-Martin, Reaven, Reynolds, Rice, Schendel, Windham, 2007), thus relatively few females actually participated in the study.
It was anticipated that a small fraction of study participants would tire of the tasks and decide not to continue to participate. If a child appeared unwilling or said he or she did not want to continue with the tasks, the study ceased and resumed after a short break. If the child appeared distracted or expressed a desire to end the task a second time, the session was terminated. Moreover, if a parent expressed unwillingness to continue (or commence) at any time, the experiment was concluded without delay. Sessions were delayed for two participants with ASD and completed another day and none were terminated on account of unwillingness to continue. All participants were compensated for their attempts, regardless of their decisions or abilities to complete the experimental sessions.

Recruitment

Researchers took two avenues to recruit participants at schools depending on the precautionary requirements and child protection bylaws of each school. In the Tuscaloosa preschool for children who were typical in their development, the researchers distributed study information by way of speaking to the program director and teachers before completing project intention forms and undergoing background checks. From there, the preschool teachers were detailed on the study before relaying information to parents of potential participants and having them sign consents if they wished to participate. In this way, the program director ensured the parents protection inasmuch as they would not have felt pressured by the researchers to have their child participate since researchers never spoke directly to parents.
The second means of recruitment involved the researchers speaking directly with parents as a means of recruitment in the school for children with ASDs. In their recruitment, the researchers set up an information table during the children’s morning drop-off time in attempts to speak with parents about the study. Parents were provided with as much information as they wished on the study before providing researchers with their contact information as to where they could be reached. Both appeals for participation involved meeting with and gaining formal written approval from the program director of each school prior to approaching any teacher or parent with information about the study.

The option of attending the experimental sessions with their children was left for the parents to decide in both schools. Because of their busy schedules, parents often chose to have their children pulled from their classrooms during nonacademic times of the school day to participate in the study. In these cases, the researchers collected home addresses during recruitment and sent a packet of materials for each parent to complete before the study. These packets contained two primary investigator-signed copies of the consent forms (one for parent to retain and one for return), the MCDI, a wide-ranging portion of the Rossetti scales which were highlighted for the parents’ checked responses, and an instruction letter on completing the enclosed forms. The researchers also included a stamped and addressed envelope for facilitation of material return.

A final manner of recruitment outside the confines of schools was speaking with friends and family directly about having their children participate. It was in these roving cases that the study was performed in participants’ homes (with as similar and controlled an arrangement as possible, always including a table, three chairs, and adjacent walls for
the posters to be displayed.) It was also in these cases that parents or other primary care
givers commonly attended the study sessions.

Premeasures

*Verbal Communication Assessment*

Each participant’s language age was determined. The parent of each participating
child was instructed to complete part *I* of *Words and Sentences* of the MacArthur-Bates
Communicative Development Inventory (MCDI; Fenson, Marchman, Thal, Dale,
Reznick, & Bates, 2007), a checklist assessing the words in each child’s productive
vocabulary. This checklist was found to be a reliable and valid measure of expressive
vocabulary in TD children as well as children with ASD (Wetherby, 2006). The total
number of words the child could produce on the particular form used in this measure
reached ceiling at 680. Each participant’s productive vocabulary level was given a score
of Low, Medium, or High (Figure 1). A between group analysis revealed no significant
difference in this productive language score, $p = 0.123$.

Participants’ receptive language was measured as well. This was done with the
Rossetti Infant-Toddler Language Scale (Rossetti, 1990). This criterion-referenced test
was administered directly to the child and included experimenter observations,
elicitations of child behaviors, and/or parent responses that the child engaged in particular
behaviors. Each of the determinants of whether the child engaged in a particular behavior
(experimenter observation, parent or experimenter elicitation, and parental response) was
weighted equally. The primary aim of the scale was to determine the child’s mastery of
specific language skills. Among what it measured within both preverbal and verbal areas
of communication and interaction, the scales discriminated between mastery of particular skills and the emergence of those skills. The scales were shown to be reliable and valid both with children who are typical in their cognitive development as well as with those who have autism and have been used in both populations (Silva & Cignolini, 2005). The scales of most utilization to the researchers were language comprehension and language expression. The Rossetti language expression measure differed from the MCDI in that the former determined a child’s pragmatics age while the MCDI quantified their lexicon.

The Rossetti was administered differently based on the availability of each participating child’s parent’s presence during the study. Because of the amount of materials for the parent to complete (informed consent and productive vocabulary assessment), the parents had the option during recruitment of completing the Rossetti on their own if they preferred to have their child participate while at school. In these situations, researchers analyzed the parent’s responses to the language categories and corroborated these responses during their time with the child. Though no statistics were run on parent and experimenter agreement in the study, the scales’ author determined parental responses on the scales to be reliable and valid (Rossetti, 1990).

Nonverbal Communication Assessment of Joint Attention

In addition to their language abilities, the participant’s ability to engage in JA episodes was determined by a structured JA assessment called the Early Social Communication Scales, or ESCS (Mundy, Hogan, & Doehring, 1996). The ESCS was very essential to the current study due to its being one of the very few structured assessments of its type seeking the particular behaviors associated with JA engagement.
These scales were designed to elicit and measure nonverbal communication skills that generally emerge between the ages of 8 and 30 months of age in TD children or in children with developmental delays who fall within this verbal age range.

Ordinary items were used in the scales (wind-up toys, hand-operated toys, a book). The study room had 4 posters on the walls surrounding the experimenter and child - two of them behind the child and one on either side. In cases in which the study was conducted in a child’s home and there were already pictures convenient to the family table and chairs where the study occurred, there was no need to hang all the posters for use with the distal pointing tasks. Tasks in the JA scales included (1) the child’s individual episodes of eye contact or alternates while engaged in toy play with the experimenter – IJA low; (2) the child’s individual episodes of pointing to or showing an item for the experimenter or parent – IJA high; (3) how often the child responded to a point in a book- RJA low; and (4) how often the child looked when the experimenter pointed to a poster. Throughout the implementation, the experimenter followed protocol to ensure measure validity. The scales took an average of 10-15 minutes to administer.

Comprising the JA portion of the scales were tasks aimed at measuring initiating and responding to JA, initiating and responding to behavioral requests, and initiating and responding to social interaction. The proposed study included only the JA components of the scales. These measures included both the child’s attention directing behaviors (IJAs), for instance pointing and coordinating with the experimenter to an object and responding to JA (Mundy et al., 1986), and the child’s attention following behaviors (RJAs), such as eye gaze and head turns to attend to the experimenter’s visual focus (Scaife & Bruner,
1975). Metrics for the IJA behaviors were in the form of total frequencies while RJA behaviors were coded as proportions of responding.

The ESCS have been determined to have a high degree of validity and reliability for use in children with varying levels of developmental abilities, including children with autism (Mundy, Hogan, & Doehring, 1996; Mundy et al., 1986; Roos, McDuffie, Weismer, & Gernsbacher, 2008). The scales, which were designed to be videotaped for coding at a later time, had a high degree of interrater agreement as well. All of the interobserver reliability coefficients for the frequency scores exceeded 0.65 (mean = 0.77, range 0.65 – 0.91). The ESCS were completed on 27 TD participants and 19 participants with ASD; of those, 11 TD and 7 with ASD were coded by multiple coders for interrater agreement.

The premeasures were typically conducted on the same day as the actual experiment unless the child was believed to be overwhelmed with too much testing (which occurred for only 2 participants, one TD and one ASD). The standard for determining whether the child was believed to be capable of continuing was if s/he was willing to go on and did not show signs of restlessness or fatigue. If the child’s parent or caregiver was present, the researchers allowed him or her to determine the child’s degree of compliance. As outlined in the consent form, the study could cease at any time with no negative consequence.

Materials

The study space contained one table and three chairs. Two of the chairs were on one side of the table directly across from the other chair. In the circumstances in which
the study was conducted in one of the schools, there was also an observation room adjacent to the study room which served a twofold purpose: (1) the interactions were observed and coded by an unbiased onlooker (undergraduate research assistant) in order to ensure interrater reliability with a video coder who later coded the child’s responses and behaviors after the experimental session; and (2) the glass observation window which doubled as a mirror from the perspective of those in the study room reflected for the experimenter what engaged the child during one of the study conditions (no experimenter condition – condition three). The entire experimental sessions were video recorded for post session coding and reliability. Additionally, all experimental conditions were counterbalanced and randomly assigned in an attempt to mitigate carryover affects due to practice and fatigue.

A set of 12 familiar objects and 36 novel objects were used both in the warm up and experimental portions (Figure 1). Twelve novel labels were chosen for the study due to their being unfamiliar to the children, easily repeatable, and following the phonotactic constraints of English without actually being any English word (Appendix A). Though there were 36 novel objects in total, only 12 labels were applied because only one of the three novel objects in each of the four conditions in the within subject’s design were labeled for testing the child’s novel label comprehension.

Figure 1. Novel study objects (three groups of 12 to facilitate viewing).
As by definition in a within subject’s design, each child (TD and those with autism) participated in each of the four counterbalanced study conditions, again by random assignment. Each condition included three familiar objects and 12 novel objects (run in groups of three.) Thus, in each of the four conditions, each participant saw 3 familiar and 12 novel objects. See coding sheet in Appendix B for further details.

Procedures

Consenting the Parent

Prior to the study’s commencement, the experimenter greeted both the adult (either teacher or parent) and provided the child with adequate time to warm up to the experimenter. If the parent or care giver chose to be present during the child’s participation, the experimenter asked the parent not to engage in play with the child or to encourage the child’s attention to any object unless instructed to do so for the duration of the premeasures and the experiment. The experimenter then administered the ESCS and corroborated the parental responses on the Rossetti.

Warm-up

The free play during the warm-up with all the study objects (12 familiar and 36 novel) was deemed necessary to remove any novelty effects upon presentation of any objects during training or testing as well as ensure the child knew the names of the familiar objects. The child was presented with all study objects for a minute or two of free play before the study officially commenced. The experimenter then removed the novel objects from the tabletop. After removal of these novel objects, the experimenter
sought to determine the child’s comprehension of familiar labels by asking the child, “Where is the [spoon, ball, duck, cup, shoe, etc.]?” and observed whether the child responded appropriately. (This mimicked the testing for novel label understanding as well.) Correct selections signified that the child understood the experimenter’s queries and appeared willing to abide by experimenter requests in subsequent testing for comprehension of the novel objects. If the child did not know a familiar object’s name, the experimenter chose a different familiar object to include in the study from a box beneath the table. If the child asked the name for any of the novel objects during the brief period of free play, the experimenter or parent replied to the child’s inquiries neutrally with answers such as, “I don’t know its name.” Furthermore, if the child was excessively interested in an object (as might be the case with children with restrictive and repetitive behaviors), it was replaced with another less appealing object. The warm-up was administered in the same manner for every child before proceeding with the study conditions.

**Condition One: Optimal Joint Attention**

In this control condition which also served as the baseline for the remaining conditions, participants had the opportunity to engage fully in a JA object labeling episode with the experimenter. In a traditional JA approach, the experimenter labeled the preselected target object for the child while s/he was engaged with that object as well as attempted to engage the child’s attention toward the target object while the child attended to another object.
Training. After the free play warm up, the experiment began. The experimenter placed three novel objects on designated areas on the tabletop, parallel to the child and about 6” apart from one another. Next, the experimenter picked up the target which had been preselected by the coding sheet to be labeled and with her voice animated looked at it and exclaimed, “Look at this! It’s a blicket. See? This is a blicket!” The experimenter repeated the novel label twice during each of the three anticipated episodes of joint engagement with additional phrases such as, “Look! A blicket” or, “This is a blicket,” for a total of six utterances of the novel label. If the child was engaged with another toy during the labeling of the target object, the experimenter made sure to draw the child’s attention to the target object, enlisting the parent’s help if and when necessary. If the child never even looked at the target object, the experimenter proceeded to the next condition. In order to ensure the child did not choose the target due to general exposure effects, the experimenter drew the child’s attention to the other two non-target novel objects on display as well, stating for each a neutral, yet salient, remark such as “Look at this! Wow, see this?” The sequence of novel presentations was counterbalanced, (i.e., target, non-target, non-target; non-target, target, non-target; non-target, non-target, target).

Comprehension of novel label. Next, the child was asked to choose the target by its given label. This was done by the experimenter’s asking the child, “Where is the [novel label]?” An object was considered selected if the child picked it up, proximally or distally pointed at it, or described it (a selection situation which never occurred). If the child again failed to respond verbally or gesturally, the object the child looked at for the
longest duration was recorded as his or her choice. Throughout the testing of the child’s comprehension of whether or not the novel term was applied to the correct target, the experimenter took measures to ensure the child was not inadvertently cued to the correct object. In order to do so, the experimenter aimed to establish eye contact with the child and not look at any of the objects while asking for the target by its new name.

Because the child’s prior knowledge of the names for the familiar objects were determined during the free play warm up session, novel testing was counterbalanced with familiar testing of label comprehension to ensure the participant understood the demands of the task (i.e., retrieving novel objects requested by label). This was done by placing three familiar objects on the tabletop, just as how the labels for the novel objects was tested, and asking the child for one of them by name.

The child was tested with each target novel object once before moving on to the next set of novel objects in the condition, repeating the same procedure and testing for the response with another novel label on which the child was trained. Again, the procedure was executed a third time with three more novel objects and a different novel label. In all, the child engaged in activities with nine novel objects (with one in each set of three receiving a novel label) in each condition. There were no preferential responding trials to control for any potential preference on the part of the participant. The training was completed on three objects per each condition in lieu of the preference-control trials.

**Condition Two: No Object**

There was no inclusion of viewing a novel object simultaneous to its label being uttered in this experimental condition. Participants were engaged only with the
experimenter and not with the object. The study design was based on those in which the object was labeled while it was out of the child’s field of view (Baldwin, 1991; Saylor & Ganea, 2007; Smith and Smith, unpublished data). In a discrepant-labeling condition of Baldwin’s (1991) study, the experimenter placed one of two novel toys from the tabletop into the bucket. Then, while holding the bucket upright with both hands so the child could not see the contents, the experimenter labeled the toy within the bucket while the child was looking at the visible toy (discrepant labeling). Afterward, the experimenter rattled the bucket until the infant looked at it, before positioning the bucket so the infant could see the toy inside.

This current study design borrowed from Baldwin’s design in that there was not a discrepancy between what the experimenter labeled and what the participant saw (though this may have occasionally occurred.) Instead, the experimenter of the current study employed the bucket as a concealment tool to label the object while out of view of the child. The current design also did not draw the child’s attention to the object within the bucket at the close of labeling episodes; rather, the child never saw the object within the bucket and the child’s choosing of the target during testing depended on his or her eliminating the incorrect (viewed) objects in favor of that one seen only in the free play at the beginning (that object within the bucket). Successful word-object mapping required of the participant to take note of the experimenter’s experience of viewing the target object in the bucket.

Training. The experimenter placed three novel objects on the tabletop, about 6” apart, in full view of the child. There was an opaque bucket in front on the experimenter
(and out of the child’s reach) in which the experimenter placed the target novel object in full attention of the child. The experimenter looked inside the bucket and said, “Wow! It’s a [novel label]. I see a [novel label] in here!” The label was repeated six times as in condition one. The experimenter was careful to maintain the bucket’s upright stance in efforts not to allow the child to view the contents of the bucket throughout the experimental session. The sequence of object presentations was counterbalanced, (i.e., target in bucket, non-target, non-target; non-target, target in bucket, non-target; non-target, non-target, target in bucket).

**Comprehension of novel label.** The testing procedure was identical to that used in Condition One.

**Condition Three: No Experimenter**

There was no involvement of the experimenter, in the traditional sense, in this experimental condition. Participants in this condition were engaged with the novel object while they heard the object label uttered. Most importantly, the experimenter’s social cues were absent for the duration of the experimental condition.

**Training.** The experimenter placed three novel objects about 6” apart from each other on the tabletop before the child and placed the rest out of the child’s view. Then, the experimenter attempted to remove herself from the child’s attention by either facing a two-way mirror or peeping through the video camera’s viewer window. Regardless of the technique to “ignore” the child, the experimenter had her back turned to the child. Such
techniques as these have been used reliably in previous studies (Baldwin, 1991, 1993; Baron-Cohen, Baldwin, & Crowson, 1997). The experimenter’s position allowed her to observe the child’s actions with the objects. From this vantage point, the experimenter labeled the novel object only while it was being manipulated by the child or while it was visibly a focus of the child’s attention. A similar procedure was employed with Baldwin’s (1993) aforementioned study of follow-in labeling as well as the Baron-Cohen, Baldwin, and Crowson (1997) study which found children with ASD linked words they heard with objects they happened to be engaged with at the time. The experimenter aimed to label the novel object six times, as keeping with previous conditions. There were a few situations in which a child never attended to the target object, in which circumstances the six label objective was not attained. Aside from the different style of labeling in this condition, another distinction is that rather than providing the child with neutral comments while engaged with the non-target novels objects, the experimenter said nothing while the child attended to the non-target objects.

Comprehension of novel label. The testing procedure was identical to those used in conditions one and two.

Condition Four: No Child

There was no involvement of the child during the actual word learning task in this experimental condition. Instead of engaging with the experimenter who labeled the novel object, the child instead was present during an interaction between the experimenter and a study confederate. It was anticipated the child would learn the novel
label by observational means and not direct engagement with the experimenter. This procedure was based on Akhtar and colleagues (2001) and Floor and Akhtar’s (2006) studies of polyadic exchanges in word learning situations.

**Training.** Unlike Floor and Akhtar’s (2006) method in which the child was asked to wait while the experimenter played the game with the confederate, the child in the current study was not engaged throughout the training. For the duration of their game, neither the confederate nor the experimenter made eye contact with the child nor spoke to him or her. The experimenter placed the three objects on the tabletop in full view of the child but turned herself to the study confederate already seated in the room (typically an undergraduate research assistant with whom the child was already made comfortable during the free play warm up).

The experimenter made the same declarations for the confederate as she did for the child in the other study conditions such as, “Look at this! It’s a [novel label]. See? This is a [novel label]!” for the target novel object and, “Look at this! Wow, see this?” for the two non-target novel objects. Each object was shown one at a time. The novel was labeled six times. By way of the condition’s design, the child was not ostensibly involved in learning the novel object’s label but was tested in the same manner as before. One caveat about this condition is that the child’s attention to the labeling interaction with the confederate is required for the child’s learning of the novel label.

**Comprehension of novel label.** The testing procedure was identical to those used in the other conditions.
CHAPTER 3

ANALYSES AND RESULTS

The present study adds to the recent child language development literature on the importance of having particular JA skills when learning new words (Murray et al., 2008). The results demonstrate that the ability to respond to JA bids becomes critical in children’s success in learning novel words in conditions with varying opportunities for JA engagement. The children with ASD with high RJA levels performed similarly to TD children, while the children with ASD with low RJA levels performed near or below chance on all the conditions.

Participant demographics

The final analyses were completed on 46 participants, 19 of whom had ASD diagnoses. Of those with ASD, 15 were male. The mean age was 49.7 months ($SD = 11.2$). Of the 27 TD participants, 11 were male. The mean age was 24.3 months ($SD = 3.8$). One subject was removed before running the analyses. This TD subject was 20 months old at the time of study, and performed at levels significantly below that of his peers both on the Rossetti (exhibiting language comprehension at the 9-12 month level) and on the ESCS (receiving scores of zero across nearly all measures).
Effects of Age on Task Success

Based on prior findings from early research on typically developing children (Bloom, 1973; Dromi, 1987; Nelson, 1973), chronological age was anticipated to be positively correlated with familiar task success. Age was found to have a significant correlation with familiar task success for TD children ($r = 0.39, p < 0.01$). This finding was absent for children with ASD ($r = -0.17, p > 0.10$).

Tests were conducted to assess if the age of participants also affected their performances on the experimental conditions. The Bonferroni correction was applied, setting the significance at $p < 0.0125$. The Bonferroni correction was applied to the analyses to adjust the $p$-values. It must be noted, however, that Bonferroni tends to be rather limited in its utility. The correction controls only the likelihood of committing false positives, while naturally increasing the probability of producing false negatives, thus reducing overall power. Though age was significantly correlated with familiar task success for the TD children, there were no significant relations to report when accounting for age and their performances on the study conditions. There were no significant correlations to report between age and task success for participants with ASD.

Results on Premeasures

Analyses were first run on all the study premeasures which had been gathered on all the participants before being correlated with each other to determine the impact of the participants’ language abilities on the specific aims and hypotheses. The receptive and productive language premeasures were the MacArthur Communicative Development Inventory and the Rossetti Infant-Toddler Language Scales and the joint attention
measure was the Early Social Communication Scales. Though they were already
determined in the literature to be reliable and valid, preliminary analyses were completed
on the premeasures. SPSS 11.5 and Microsoft Excel were used for all the analyses to test
the effects of the premeasures on task performances.

MacArthur Communicative Development Inventory

The MCDI was used to determine the participants’ expressive vocabulary levels.
Participants’ scores were the total number of words they produced to make up their
MCDI count (as reported by their parents).

The children with ASD had overall higher vocabulary levels ($M = 420.58$, $SD = 222.05$) than the TD children ($M = 316.24$, $SD = 209.61$), but the difference in means was
not significant ($p > .10$). The three levels of the MCDI count were represented nearly
equally among TD children, but rather skewed in their representation of vocabulary
levels in children with ASD, with over half of children with ASD having high levels of
language production (see Figure 2).

![Productive Vocabulary Levels by MCDI Count](image)

Figure 2. Number of children per group by MCDI score level.
Rossetti Infant-Toddler Language Scale

The Rossetti was used to measure the participants’ receptive vocabulary levels of comprehension and expression. Basal and ceiling scores on each of these language measures were used to determine language age of the participant. Table 1 details the participants’ descriptives along with their scores on the MCDI and Rossetti.

Table 1
Descriptives of Study Participants, M(SD)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>age in months</th>
<th>MCDI</th>
<th>Rossetti measures</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>baseline comp.</td>
<td>ceiling comp.</td>
<td>baseline express.</td>
<td>ceiling express.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD</td>
<td>19 (15 male; 4 female)</td>
<td>49.7 (11.2)</td>
<td>420.6 (222.1)</td>
<td>20.1 (7.8)</td>
<td>28.6 (7.1)</td>
<td>19.2 (9.1)</td>
<td>26.3 (8.2)</td>
<td></td>
</tr>
<tr>
<td>TD</td>
<td>25 (9 male; 16 female)</td>
<td>24 (3.8)</td>
<td>306.4 (208.2)</td>
<td>23.1 (6.9)</td>
<td>28.8 (5.9)</td>
<td>21 (6.3)</td>
<td>28.3 (5.7)</td>
<td></td>
</tr>
</tbody>
</table>

The Rossetti performances of comprehension and expression between the TD and ASD groups were compared using independent samples t-tests. The differences in the basal comprehension and ceiling comprehension measures were not significant, respectively $t(42) = -1.45, p > 0.10$ and $t(42) = -0.19, p > 0.10$. The differences in the basal expression and ceiling expression measures were not significant either, $t(42) = -0.91, p > 0.10$ and $t(42) = -1.05, p > 0.10$. There were no significant differences between the comprehension and expression performances found between the TD and ASD groups. But, the between-group correlations among the comprehension and expression scores on both basal and ceiling measures showed positive correlations at the $p < 0.01$ level,
ranging from \( r = 0.72 \) to \( r = 0.84 \). Table 2 and Figure 3 provide the Rossetti means and standard deviations as well as a pictorial representation of the scores.

Table 2

*Rossetti means and standard deviations, M(SD)*

<table>
<thead>
<tr>
<th></th>
<th>comprehension</th>
<th>expression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>baseline</td>
<td>ceiling</td>
</tr>
<tr>
<td>AD (N=19)</td>
<td>20.13 (7.78)</td>
<td>28.61 (7.09)</td>
</tr>
<tr>
<td>TD (N=27)</td>
<td>23.34 (6.85)</td>
<td>28.98 (5.85)</td>
</tr>
</tbody>
</table>

Based on the correlations among the scores, the Rossetti appeared to have served its predicted purpose of determining a valid receptive language age. Accounting for the nonsignificant differences as well as the between group correlations, the Rossetti

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51
provided evidence for a well-matched control group for the experimental group with ASD.

*Early Social Communication Scales*

The ESCS were used to measure the participants’ engagement in JA episodes. The portions of the JA measures in the ESCS critical to this study were the participants’ basic (low) and more sophisticated (high) levels of both initiating JA and responding to JA. The low and high levels were collapsed in both categories to create one IJA measure and one RJA measure.

In counting the total number of IJA episodes, children with ASD had a mean score of 4.79 (SD = 4.66), showing a large range among their actual initiations for JA. In averaging the total percentage of RJA episodes, they had a mean score of 0.58 (SD = 0.38), showing they responded to bids for JA just over 50% of the time. When summing the total IJA episodes, TD children had a mean score of 7.61 (SD = 3.53). In averaging the total percentage of RJA episodes, they had a mean score of 0.83 (SD = 0.26), showing they responded to bids for JA 83% of the time, much more than children with ASD did.

Next, results of the independent samples *t*-tests suggested that the means on IJA scores were significantly different between the ASD (M = 4.79, SD = 4.66) and TD (M = 7.61, SD = 3.53) groups with TD children having higher initiation scores, *t*(44) = -2.34, *p* < 0.05. RJA means were also significantly different at the *p* < 0.05 level, with the TD (M = 0.83, SD = 0.26) group having higher responding scores that the ASD group (M = 0.58, SD = 0.38), *t*(44) = -2.63, *p* < 0.05.
Correlations between Premeasures

Next, correlations were run between the study premeasures to search for relationships and particular patterns among the variables (see Table 3). These relationships were used to flesh out between-group differences in the experimental conditions. Included in these correlations were the verbal measures of MCDI and Rossetti along with the nonverbal joint attention assessment of the ESCS.

Table 3

<table>
<thead>
<tr>
<th></th>
<th>MCDI (N = 44)</th>
<th>Comprehension (N = 44)</th>
<th>Expression (N = 44)</th>
<th>IJA (N = 44)</th>
<th>RJA (N = 44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCDI (N = 44)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comprehension (N = 44)</td>
<td>0.70**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expression (N = 44)</td>
<td>0.73**</td>
<td>0.86**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IJA (N = 44)</td>
<td>0.04</td>
<td>0.21</td>
<td>0.33*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>RJA (N = 44)</td>
<td>0.44**</td>
<td>0.61**</td>
<td>0.69**</td>
<td>0.39**</td>
<td>1</td>
</tr>
</tbody>
</table>

** significant at the \( p < 0.01 \) level
* significant at the \( p < 0.05 \) level

Rossetti and MCDI

Pearson correlations between whole comprehension scores on the Rossetti and their MCDI counts were run between the groups and then collectively for all the participants. Because the results on the Rossetti are not typically analyzed since its primary use is by speech therapists as a guide to direct their therapy and account for language growth (Rossetti, 1990), each comprehension score in this analysis which accessed the participants’ pragmatic skills in addition to vocabulary size, was an average
of the participants’ basal and ceiling scores. Both children with ASD \((r = 0.84, p < 0.01)\) and TD children \((r = 0.69, p < 0.01)\) had significant correlations between whole Rossetti comprehension scores and MCDI counts, validating that increases in language comprehension correspond to word production.

Correlations between whole expression scores on the Rossetti and participants’ MCDI counts were also analyzed. This was done to check for consistency in the parent-reported (MCDI) versus experimenter-observed (Rossetti) expression measures. Again, each expression score in this analysis which accessed the participants’ pragmatic skills in addition to vocabulary size, was an average of the participants’ basal and ceiling scores. Both children with ASD \((r = 0.78, p < 0.01)\) and TD children \((r = 0.84, p < 0.01)\) had significant correlations between whole Rossetti expression scores and MCDI counts, not surprisingly supporting as language expression increased, so did whole word production.

**MCDI and ESCS**

Correlations between the two ESCS joint attention measures, IJA and RJA, and participants’ MCDI counts were run between the groups. There were no significant correlations between initiating bids for JA and producing words for either group (ASD: \(r = 0.15, p > 0.10\); TD: \(r = 0.09, p > 0.10\)), not wholly surprising based on prior literature (Landry & Loveland, 1988; Morgan et al., 2003; Stone & Yoder, 2003).

There was a split in findings between the groups with children with ASD showing a strong significant correlation between responding to JA and producing words, \(r = 0.74, p < 0.01\), supportive of previous research (Mundy et al., 1990; Murray et al., 2008). TD children, on the other hand, had a nonsignificant correlation between their RJA and
MCDI scores \((r = 0.39, p > 0.10)\). Dependent upon the strong positive association between RJA and MCDI for the participants with ASD, the groups altogether showed a significant correlation \((r = 0.44, p < 0.01)\).

**Rossetti and ESCS**

Correlations between comprehension and expression scores on the Rossetti and their IJA and RJA scores on the ESCS were run between the groups and then collectively for all participants. Neither group had significant correlations between their Rossetti comprehension score and their IJA score.

Whereas comprehension and IJA were uncorrelated for all study participants, the correlation between the comprehension score and the RJA score showed strong significance for participants with ASD, with \(r = 0.73, p < 0.01\), suggesting a relation between their abilities to respond to bids for JA and their language comprehension. TD children had similar significance, though with weaker correlations between comprehension and RJA score, with \(r = 0.46, p < 0.05\). Neither group had significant correlations between their whole expression score on the Rossetti and their IJA score, suggesting no link between their abilities to initiate JA and their language expression. The correlation between the whole expression score and the RJA score showed a strong positive correlation with \(r = 0.79, p < 0.01\), for participants with ASD, suggesting a powerful relation between their abilities to respond to bids for JA and their language expression. TD children had significant outcomes, but to a lesser extent, between expression and RJA score, with \(r = 0.52, p < 0.01\).
Test Performance between Children with ASD and TD Children

Next, analyses were conducted to reveal any significant group differences among the word learning task conditions. Efforts were made to address the outlined study aims. Vocabulary levels of the TD participants were taken into consideration for the following analyses.

Aim 1

Analyses were conducted to see if Hypothesis 1 was correct in stating that children with ASD would learn novel words similarly to how TD children with lower vocabulary levels learned words, as determined by the participants’ performances on the task conditions. In the independent samples $t$-tests comparing the means between the groups, significance was found only in the familiar object control condition with the TD children with high MCDI counts ($M = 2.73, SD = 0.29$) having significantly different successes from the participants with ASD ($M = 2.13, SD = 1.08$), $t(30) = -2.24, p < 0.05$. The finding in the optimal condition was marginally significant, $t(30) = -1.85, p = 0.07$. No significant differences were found in any of the study conditions when comparing the TD participants with lower MCDI levels to the performances of participants with ASD. No significance in the various conditions between TD with low MCDI scores and children with ASD potentially suggested the two groups performed similarly on the particular tasks.
Aim 2

Hypothesis two, stating children with ASD and TD children with low MCDI scores would perform significantly better than TD children with high MCDI levels in the no experimenter and no child conditions, was not supported. In both conditions, within-group means were not significantly different for TD children when accounting for MCDI level by independent samples t-tests comparing mean performances. When the mean performance scores of children with ASD ($M = 0.74, SD = 0.73$) were compared to the performance scores of TD children with high MCDI counts ($M = 0.67, SD = 0.71$) in the no experimenter condition, the result was not significant, $t(23) = -0.84, p > 0.10$, highlighting no difference in performances between children with ASD and TD children with high vocabularies. Likewise, in the no child condition, the mean performance scores of children with ASD ($M = 1.26, SD = 1.28$) as compared to performance scores of TD with high MCDI counts ($M = 1.89, SD = 1.05$) was more in the expected direction of finding a difference, $t(23) = -1.95, p > 0.10$, but still not significant.

Word Learning Task Performance by Group

One-sample $t$ tests were conducted for each group to determine if performances on the experimental conditions (familiar, optimal, no object, no experimenter, no child) differed significantly from chance success. The familiar control condition served as the baseline to see if participants would retrieve an object when prompted in which both groups of participants were expected to succeed. The optimal JA condition was the situation which contained all the elements for an opportunity for JA engagement to occur, a test condition in which all participants were expected to succeed. The no object
condition, a situation which may have required the participant to rely on visual recognition skills, was one in which TD children with low vocabulary levels as well as children with ASD were expected to succeed. The no experimenter condition, a follow-in labeling situation, was one in which children with ASD and TD children with low vocabulary levels, but not TD children with high vocabulary levels, were expected to succeed. The no child condition which offered the opportunity for the participant to observe, though not actively engage in, an optimal word learning situation was one in which both groups of children were expected to succeed. Chance performance was fixed at 1, or .33 success, among the 3 objects on display for the child. Table 4 details the groups’ test statistics per condition.

**Table 4**

*Participants’ test statistics per condition (as compared to chance success)*

<table>
<thead>
<tr>
<th></th>
<th>familiar</th>
<th>optimal</th>
<th>no object</th>
<th>no exp</th>
<th>no child</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>M(SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.13(1.08)</td>
<td>1.68(1.11)</td>
<td>1.42(1.02)</td>
<td>0.74(0.73)</td>
<td>1.26(1.28)</td>
</tr>
<tr>
<td></td>
<td>t(18) = 4.58*</td>
<td>t(18) = 2.69*</td>
<td>t(18) = 1.80</td>
<td>t(18) = -1.80</td>
<td>t(18) = 0.89</td>
</tr>
<tr>
<td>TD</td>
<td>M(SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.37(0.81)</td>
<td>1.82(0.91)</td>
<td>1.28(0.89)</td>
<td>0.54(0.64)</td>
<td>1.36(1.06)</td>
</tr>
<tr>
<td></td>
<td>t(27) = 8.90*</td>
<td>t(27) = 4.80*</td>
<td>t(27) = 1.04</td>
<td>t(27) = -3.86*</td>
<td>t(27) = 1.78</td>
</tr>
</tbody>
</table>

* significant at the p < 0.01 level

**Familiar Control Task**

Participants with ASD chose the correct familiar study objects when prompted ($M = 2.13$, $SD = 1.08$), with $t(18) = 4.58$, $p < 0.01$. Likewise, TD participants chose the correct familiar study objects ($M = 2.37$, $SD = 0.81$), with $t(27) = 8.90$, $p < 0.01$. Both
groups performed significantly better than chance in the control task of familiar object retrieval.

Optimal Condition

Participants with ASD chose the correct targets \((M = 1.68, SD = 1.11), t(18) = 2.69, p < 0.01\). TD participants also chose the correct target objects \((M = 1.82, SD = 0.91), t(27) = 4.80, p < 0.01\). There were significant differences between chance performance and actual test performance for both groups in this condition which included all the components conducive for joint attention engagement. Thus, both groups appeared to learn the novel labels during opportunities to engage in optimal JA.

No Object Condition

Participants with ASD had marginal success in choosing the correct study objects \((M = 1.42, SD = 1.02), t(18) = 1.80, p = 0.08\). TD participants \((M = 1.28, SD = 0.89)\) chose nontarget objects more than targets, but not at significant rates, \(t(27) = 1.04, p > 0.10\). No significant differences were found for either group in this condition in which the object was out of the child’s view during labeling.

No Experimenter Condition

Participants with ASD did not choose target objects \((M = 0.74, SD = 0.73), t(18) = -1.80, p > 0.10\). TD individuals chose non targets at rates significantly different from chance \((M = 0.54, SD = 0.64), t(27) = -3.86, p < 0.01\). There was a split in the outcomes between the groups with TD participants reaching significant findings and ASD
participants having performances that did not differ from chance. The findings for children with ASD were in the same direction of worse than chance performance, but not significant.

**No Child Condition**

Participants with ASD did not choose correct objects \((M = 1.26, SD = 1.28), t(18) = 0.89, p > 0.10\). TD children chose the correct target objects at marginally significant rates \((M = 1.36, SD = 1.06), t(27) = 1.78, p = 0.08\), a surprising outcome in light of research upon which this condition was modeled (Akhtar et al., 2001; Floor & Akhtar, 2006).

Across all the study conditions, all children performed statistically similarly except for their performance in the no experimenter condition in which children with ASD did not perform significantly differently from chance, while TD children chose targets at significantly lower than chance rates.

**How the Premeasures Related to Word Learning Task Performance**

Multivariate analyses of variance (MANOVAs) were conducted to determine if each premeasure differed for the two groups (ASD and TD) on the various experimental conditions (optimal, no object, no experimenter, no child). MANOVA was the preferred statistical test because an aim was to test the hypothesis whether the independent variables of group membership and low or high premeasure scores had an effect on the four study conditions. Participants’ scores on the premeasures were considered to identify relationships among the various independent variables of interest. MCDI count, Rossetti
comprehension and expression scores, and IJA and RJA scores were all compared to participants’ task performance in 2 (group) x 2 (premeasure) x 4 (test condition) MANOVAs.

*MacArthur Communicative Development Inventory*

Total vocabulary counts were compared to task performance on the experimental conditions. In an effort to determine the effects of vocabulary levels on test performance, a 2 (group) x 2 (MCDI level) x 4 (test condition) MANOVA was conducted. Levels of vocabulary counts were established by a median split between low levels (0-349 words) and high levels (350-680 words).

Significant main effects were found for MCDI level, Wilks’ $\lambda = .77$, $F(3, 38) = 3.89$, $p < 0.01$, but not for group or for the three-way interaction among group, MCDI level, and experimental condition. Follow-up ANOVAs based on the significant main effects for participants with ASD scoring at a high level on the MCDI count chose the correct target objects significantly more often than those with low MCDI counts in the no child condition, $F(1,18) = 9.36$, $p < 0.01$. Differences were of marginal significance, but in the expected condition, in the optimal condition, $F(1,18) = 8.21$, $p = .018$. There were no differences between high and low MCDI counts on task performances on the no object and no experimenter task conditions.

Follow-up ANOVAs for TD participants scoring at a high level on the MCDI count showed they chose the correct targets significantly more often than those with low MCDI counts in the no object condition, $F(1,24) = 8.67$, $p < 0.01$. The results also showed that TD children with high MCDI counts chose correct targets significantly more
often than those with low MCDI counts in the no object condition, $F(1,24) = 8.67, p < 0.01$, a finding not supportive of recent research on the effects of vocabulary levels on novel word gain in TD children (Smith & Smith, in preparation). There were no differences between high and low MCDI counts on task performances on the remaining task conditions.

*Rossetti Infant-Toddler Language Scale*

Levels of the Rossetti language comprehension and expression scores were compared to task performance on the experimental conditions. In an effort to determine the effects of comprehension and expression levels on test performance, separate 2 (group) x 2 (language measure level) x 4 (test condition) MANOVAs were conducted for both comprehension and expression. Levels of comprehension and expression were established by median splits between low levels (0-24 months) and high levels (greater than 24 months) of abilities.

Significant main effects were found for comprehension level, Wilks’ $\lambda = .80$, $F(3, 38) = 3.26, p < 0.05$, but not for group or for the three-way interaction among group, comprehension level, and experimental condition. Follow-up ANOVAs based on the significant main effects for participants with ASD scoring at a high level on the comprehension measure chose the correct target objects significantly more often than those with low comprehension levels. When considering the comprehension split in participants with ASD, there were no significant main effects between those with high comprehension scores versus those with low comprehension scores for success on the experimental conditions. On the other hand, language comprehension scores were
significantly higher for TD participants on several task conditions. Level of language comprehension played a significant role in TD childrens’ successes in the optimal condition, $F(1, 24) = 7.60, p < 0.01$, with those with high comprehension performing better than those with low comprehension. TD children with high comprehension levels had significantly better performance in the no object condition, $F(1, 24) = 10.60, p < 0.01$. TD children with high comprehension levels also had significantly better performance in the no child condition, $F(1, 24) = 13.57, p < 0.01$. See Table 5 for details on test statistics and actual counts of target object retrieval.

Table 5

*Rossetti comprehension (median split ≤ 24 months, > 24 months)*

<table>
<thead>
<tr>
<th>Group</th>
<th>Level of comprehension</th>
<th>Test Condition</th>
<th>Optimal</th>
<th>No Object</th>
<th>No Exp.</th>
<th>No Child</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>test statistic</td>
<td></td>
<td>$F(1,18)$= 2.35</td>
<td>$F(1,18)$= 3.07</td>
<td>$F(1,18)$= 0.48</td>
<td>$F(1,18)$= 5.75</td>
</tr>
<tr>
<td>lower: average success ($N=11$)</td>
<td>1.36</td>
<td>1.09</td>
<td>0.64</td>
<td>0.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>higher: average success ($N=8$)</td>
<td>2.13</td>
<td>1.88</td>
<td>0.88</td>
<td>2.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TD</td>
<td>test statistic</td>
<td></td>
<td>$F(1,24)$= 7.59*</td>
<td>$F(1,24)$= 10.59*</td>
<td>$F(1,24)$= 0.19</td>
<td>$F(1,24)$= 13.54*</td>
</tr>
<tr>
<td>lower: average success ($N=11$)</td>
<td>1.27</td>
<td>0.73</td>
<td>0.45</td>
<td>0.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>higher: average success ($N=14$)</td>
<td>2.21</td>
<td>1.71</td>
<td>0.57</td>
<td>1.93</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* significant at the $p < 0.01$ level
There were no significant main effects found for expression level, group or for the three-way interaction among group, expression level, and experimental condition. Follow-up ANOVAs found that among participants with ASD, level of language expression had no effects on whether participants succeeded on any the test conditions. On the other hand, TD children who had high expression scores on the Rossetti performed significantly better than those with low expression scores on one condition, the no object task, with $F(1, 24) = 13.57, p < 0.01$. See Table 6 for test statistics and target object retrieval counts.

Table 6

*Rossetti expression (median split ≤ 24 months, > 24 months)*

<table>
<thead>
<tr>
<th>Group</th>
<th>Level of comprehension</th>
<th>Test Condition</th>
<th>Optimal</th>
<th>No Object</th>
<th>No Exp.</th>
<th>No Child</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>test statistic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$F(1,18) = 6.10$</td>
<td>$F(1,18) = 1.48$</td>
<td>$F(1,18) = 1.14$</td>
<td>$F(1,18) = 5.40$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>lower: average success (N=13)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.31</td>
<td>1.23</td>
<td>0.62</td>
<td>0.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>higher: average success (N=6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.50</td>
<td>1.83</td>
<td>1.00</td>
<td>2.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TD</td>
<td>test statistic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$F(1,24) = 2.12$</td>
<td>$F(1,24) = 13.57^*$</td>
<td>$F(1,24) = 1.17$</td>
<td>$F(1,24) = 3.33$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>lower: average success (N=13)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.54</td>
<td>0.77</td>
<td>0.38</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>higher: average success (N=12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.08</td>
<td>1.83</td>
<td>0.67</td>
<td>1.75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
* significant at the $p < 0.01$ level

*Early Social Communication Scales*

IJA and RJA scores were also compared to task performance on the experimental conditions. In order to determine the effects of IJA and RJA scores on test performance
separate 2 (group) x 2 (JA level level) x 4 (test condition) MANOVAs were conducted for both IJA and RJA. Levels of IJA scores were established by a median split between low levels (at most 6) and high levels (more than 6) initiations of JA. Levels of RJA scores were established by a split between low levels (50% or less) and high levels (greater than 50%) of successful responses to bids for JA.

No significant main effects were found for IJA level, group, or for the three-way interaction among group, IJA level, and experimental condition. Among both groups of participants, level of IJA abilities had no effects on whether they succeeded on any the test conditions. (See Table 7).

However, the one-way MANOVA revealed a significant main effect for RJA level, Wilks’ $\lambda = 0.77$, $F(3, 40) = 3.93$, $p < 0.01$, thus confirming that ability to respond to bids for JA had a significant impact on performance on the test conditions. Upon consideration of the effects between the low and high abilities to respond to bids forJA, children with ASD who responded to over 50% JA bids chose significantly more correct target objects that children with ASD who responded to 50% or fewer JA bids in the optimal condition, $F(1, 18) = 8.03$, $p < 0.01$. RJA level played no significant role in TD childrens’ success on any of the test conditions. (See Table 8). When distinguishing the children with ASD by their RJA scores, the children with high RJA scores performed at similar levels to TD children (not distinguished by RJA on account of no significant differences) on the four study conditions plus the familiar control task. On the other hand, the children with ASD who had low RJA scores performed near or below chance on the study conditions (see Figure 4). Thus, RJA ability appeared to serve as the line of demarcation between success and failure on the experimental conditions.
### Table 7

**IJA - Initiations of joint attention (split ≤ 6 initiations, > 6 initiations)**

<table>
<thead>
<tr>
<th>Group</th>
<th>Level of IJA</th>
<th>Test Condition</th>
<th>Optimal</th>
<th>No Object</th>
<th>No Exp.</th>
<th>No Child</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>test statistic</td>
<td>$F(1,18)=0.02$</td>
<td>$F(1,18)=0.52$</td>
<td>$F(1,18)=0.51$</td>
<td>$F(1,18)=0.16$</td>
<td></td>
</tr>
<tr>
<td>lower: average success ($N=13$)</td>
<td>1.67</td>
<td>1.33</td>
<td>0.80</td>
<td>1.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>higher: average success ($N=6$)</td>
<td>1.75</td>
<td>1.75</td>
<td>0.50</td>
<td>1.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TD</td>
<td>test statistic</td>
<td>$F(1,26)=0.01$</td>
<td>$F(1,26)=2.45$</td>
<td>$F(1,26)=0.08$</td>
<td>$F(1,26)=0.01$</td>
<td></td>
</tr>
<tr>
<td>lower: average success ($N=6$)</td>
<td>1.88</td>
<td>1.63</td>
<td>0.50</td>
<td>1.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>higher: average success ($N=21$)</td>
<td>1.84</td>
<td>1.05</td>
<td>0.58</td>
<td>1.42</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*significant at the p < 0.01 level

### Table 8

**RJA – responses to bids for joint attention (split ≤ 50%, > 50% responses)**

<table>
<thead>
<tr>
<th>Group</th>
<th>Level of RJA</th>
<th>Test Condition</th>
<th>Optimal</th>
<th>No Object</th>
<th>No Exp.</th>
<th>No Child</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>test statistic</td>
<td>$F(1,18)=7.03^*$</td>
<td>$F(1,18)=4.83$</td>
<td>$F(1,18)=0.00$</td>
<td>$F(1,18)=6.32$</td>
<td></td>
</tr>
<tr>
<td>lower: average success ($N=7$)</td>
<td>1.00</td>
<td>0.88</td>
<td>0.75</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>higher: average success ($N=12$)</td>
<td>2.18</td>
<td>1.82</td>
<td>0.73</td>
<td>1.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TD</td>
<td>test statistic</td>
<td>$F(1,26)=3.23$</td>
<td>$F(1,26)=3.70$</td>
<td>$F(1,26)=0.10$</td>
<td>$F(1,26)=3.95$</td>
<td></td>
</tr>
<tr>
<td>lower: average success ($N=4$)</td>
<td>1.00</td>
<td>0.33</td>
<td>0.67</td>
<td>0.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>higher: average success ($N=23$)</td>
<td>1.96</td>
<td>1.33</td>
<td>0.54</td>
<td>1.54</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Additional ESCS Analyses. The above analyses collapsed the levels of IJA and RJA for more straightforward comparisons. Because the ESCS was the critical joint attention determinant in this study, attention needed to be paid to the low and high levels of IJA and RJA in order to determine their separate roles. A multivariate analysis of variance (MANOVA) was conducted to determine if the ESCS components (low IJA, high IJA, low RJA, and high RJA) differed for the two groups (ASD and TD). MANOVA was the preferred statistical test because an aim was to test the hypothesis whether the independent variable of group membership had an effect on the set of four dependent ESCS measures. A 2 (group) x 4 (JA measure) between-subjects MANOVA was performed on the behavioral frequency scores from the dependent variables of the ESCS: eye contact and alternates (low IJA), points and shows (high IJA), following points on a book (low RJA), and following another’s line of regard (high RJA).
independent variable was group membership, either ASD or TD. All tests of assumptions were satisfactory except for Box’s $M$ Test of Equality of Covariance Matrices. A significant Box’s $M$ indicated evidence that the homogeneity of variance-covariance matrix assumption was violated in MANOVA. It should be noted, however, that this was acceptable since the reported power was not low at 0.77. The error region was also decreased to reduce the chances of a Type I error occurrence.

The one-way MANOVA revealed a significant multivariate main effect for group membership, Wilks’ $\lambda = 0.68$, $F(1, 42) = 4.69$, $p < 0.01$, thus confirming that group membership had a significant impact on performance on the ESCS constructs. Given the significance of the overall test, the univariate main effects were examined, resulting in significant main effects found for two of the ESCS components. Table 9 displays these significant main effects seen in performances on IJA high and RJA high, respectively $F(1, 42) = 10.63$, $p < 0.01$, and $F(1, 42) = 10.17$, $p < 0.01$. Results from separate follow-up ANOVAs report similarly supportive findings of the differences in these two constructs allowing for their distinction from the other two nonsignificant ESCS constructs (IJA low and RJA low). The IJA high measure was significant in the follow-up analysis with an adjusted alpha, $F(1, 42) = 11.75$, $p < 0.01$. Likewise, the RJA high measure was significant with $F(1, 42) = 10.27$, $p < 0.01$. 
Table 9

Means (standard deviations) and ANOVA results of ESCS components

<table>
<thead>
<tr>
<th>Variable</th>
<th>ASD</th>
<th>TD</th>
<th>F (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IJA low</td>
<td>9.05 (9.22)</td>
<td>13.44 (5.77)</td>
<td>3.75 (0.06)</td>
</tr>
<tr>
<td>IJA high</td>
<td>0.53 (0.91)</td>
<td>1.96 (1.74)</td>
<td>10.63 (0.002)*</td>
</tr>
<tr>
<td>RJA low</td>
<td>0.61 (0.40)</td>
<td>0.8697 (0.26)</td>
<td>6.17 (0.017)</td>
</tr>
<tr>
<td>RJA high</td>
<td>0.54 (0.43)</td>
<td>0.8654 (0.23)</td>
<td>10.17 (0.003)*</td>
</tr>
</tbody>
</table>

*significance at the 0.01 level

Next, an effort was made to see if scores from components of the ESCS could be used to classify all the participants into groups. Thus, in order to predict group membership from the array of predictor, or discriminator, variables, a direct discriminant function analysis (DFA) was performed using the four components of the ESCS as predictors of group membership. Though similar mathematically, the techniques differed in that MANOVA helped to determine whether group membership was linked with significant mean differences in the combined dependent scores, whereas DFA asked if variables could be combined to classify the children into groups (Tabachnick & Fidell, 2007). Again, predictors were low IJA, high IJA, low RJA, and high RJA. The groups were children with ASD and TD children. Results of evaluation of assumptions of normality, homogeneity of variance-covariance matrices, linearity, and multicollinearity were satisfactory. Multivariate analysis revealed a significant difference ($\lambda = 0.68$, $X^2(4) = 15.71$, $p < 0.01$), with an $R^2$-canonical = 0.57, and 75% cross-validated classification (11 out of 44; chance was 50%). Table 10 shows the standardized canonical coefficients and the structure weights, revealing that two of the ESCS variables contributed to the
multivariate effect. Not surprising in light of the MANOVA findings, the children’s performances on the ESCS measures IJA high and RJA high prove most predictive of their group placements, either among the TD or ASD children. These results of 75% cross-validation paint ESCS in a favorable light as a good measure for JA abilities, distinguishing children with ASD from the TD children.

Table 10

*Standardized canonical coefficients and structure weights from DFA model*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Standardized Canonical Coefficient</th>
<th>Structure Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>IJA low</td>
<td>0.260</td>
<td>0.436</td>
</tr>
<tr>
<td>IJA high</td>
<td>0.679</td>
<td>0.789</td>
</tr>
<tr>
<td>RJA low</td>
<td>-0.214</td>
<td>0.520</td>
</tr>
<tr>
<td>RJA high</td>
<td>0.667</td>
<td>0.693</td>
</tr>
</tbody>
</table>

How Word Learning Task Performance Related to the Premeasures

Next, analyses were conducted to find out how task performance on the various experimental conditions and control tasks corresponded to scores on the premeasures. Comparisons were made between the premeasures scores of participants who did well on the particular experimental task (retrieved at least 2 of the correct target objects of the 3 trials) and of participants who did poorly on the task (retrieved at most 1 of the targets).
**Familiar control task**

The MCDI count was significantly higher in participants with ASD doing better on the familiar control task, $F(1, 19) = 8.14, p < 0.01$, showing participants who did well on the familiar task tended to have larger vocabularies. Scores on the Rossetti language comprehension measure were higher for participants with ASD doing well on the familiar task, $F(1, 19) = 17.81, p < 0.01$, showing participants who did well on the familiar task tended toward higher language comprehension scores. A similar outcome was also found for participants scores on the expression measure, with $F(1, 19) = 10.51, p < 0.01$, showing they also had higher language expression scores, not surprising in light of the higher MCDI count among successful participants. RJA scores were marginally, though not significantly, higher for participants with ASD doing well on the familiar task, $F(1, 19) = 6.23, p = 0.02$ (again, using the Bonferroni correction). There was no significant relationship found between IJA scores and participants’ success in choosing the correct target objects for those with ASD.

Scores on the Rossetti expression measure were higher for TD participants doing well on the familiar task, $F(1, 24) = 7.83, p < 0.01$, showing participants who did well on the task had higher language expression scores. Similarly, RJA scores were higher for TD children who did well on the familiar task, $F(1, 24) = 34.77, p < 0.01$, showing participants who did well on the task responded to JA bids at higher rates than those not doing well on the task. MCDI counts were marginally higher in the expected direction for TD children doing well on the familiar task, $F(1, 24) = 7.18, p = 0.014$. There were no significant relationships between either Rossetti comprehension scores and IJA scores and TD participants’ success in choosing the correct target objects in the familiar task.
Optimal condition

The MCDI count was significantly higher for participants with ASD doing well on the optimal task than for those of those doing poorly on the optimal task, $F(1, 19) = 21.82, p < 0.01$, showing participants with ASD who did well on the optimal task tended to have larger vocabularies. Scores on the Rossetti comprehension measure were higher for participants with ASD doing well on the optimal task than for those doing poorly on the task, $F(1, 19) = 16.04, p < 0.01$, showing participants with ASD who did well on the optimal task tended to have higher language comprehension scores. Scores on the Rossetti expression measure were higher for participants with ASD doing well on the optimal task than for those doing poorly on the task, $F(1, 19) = 11.29, p < 0.01$, showing participants with ASD who did well on the optimal task had higher expression scores. RJA scores were higher for participants with ASD doing well on the optimal task than for those doing poorly on the task, $F(1, 19) = 11.88, p < 0.01$, showing participants who did well on the task responded to JA bids at higher rates than those not doing well on the task. IJA scores had no effects on participants’ success in choosing the correct target objects for those with ASD.

Scores on the Rossetti comprehension measure were higher for TD participants doing well on the optimal task than for those doing poorly on the task, $F(1, 24) = 11.35, p < 0.01$, showing TD who did well on the optimal task tended to have higher language comprehension scores. There were no significant effects of any of the other premeasures (MCDI count, Rossetti expression score, IJA score, RJA score), showing ability to choose the correct objects in the optimal condition was not significantly related to any measure other than comprehension score for TD participants.
No object condition

Participants with ASD scoring well on the no object task had no differences in performance on any of the premeasures. On the other hand, TD participants doing well in the no object task had significantly higher Rossetti scores, both comprehension and expression, $F(1, 24) = 9.55, p < 0.01$ and $F(1, 24) = 8.22, p < 0.01$, respectively, showing participants with ASD who did well on the no object task tended to have higher comprehension and expression scores. There were no significant effects of MCDI count, IJA score or RJA score on TD participants’ ability to choose the correct objects in the no object condition.

No experimenter condition

Participants with ASD doing well (again, choosing 2 or 3 of the correct target objects) in the no experimenter task had no significant differences in scores on any of the premeasures from participants doing poorly (choosing at most 1 correct target object). Similarly, TD participants doing well on the task had no significant differences in scores on any of the premeasures from those doing poorly.

No child condition

MCDI word counts were higher for participants with ASD doing well in the no child condition than for participants doing poorly, $F(1, 18) = 10.74, p < .01$. Rossetti language comprehension scores were marginally higher, though not significantly so, for participants with ASD doing well in the task, $F(1, 19) = 6.18, p = 0.02$. Participants with
ASD doing well in the task had no significant differences in Rossetti expression scores, IJA scores, and RJA scores, from participants doing poorly in the no child task.

TD children doing well in the no child task had no significant differences in scores on any of the premeasures from children doing poorly on the task. However, the comprehension scores were slightly, though not significantly, higher for TD children doing well on the no child task, $F (1, 14) = 7.24$, $p = 0.013$. 
CHAPTER 4
DISCUSSION

This study was twofold in its objectives. Broadly, the researchers sought to find out if children with ASD learned a lexicon in a manner similar to TD children, and if so, how the children with ASD went about doing so. Considering the social deficits pervasive among individuals with ASD, one might consider these children would learn their lexicons in a manner entirely different from their TD peers who have been found to attend to social pragmatic cues. While the bulk of lexical development research has been conducted on TD children learning words using social referencing cues such as joint attention, the results of this study revealed some insight as to how children with ASD might have learned words for the novel objects they encountered. In addressing these issues, attempts were made to establish which components of an optimal joint attention encounter, if any, were critical for children with ASD to learn new words.

Addressing Specific Aim 1

The first aim of the study was to determine whether children with ASD learned words similarly to how novice TD learners did. It was hypothesized that children with ASD would learn their lexicon in a similar manner to how novice, but not experienced TD word learners - as defined by their MCDI scores - learned a lexicon. The only significant finding was in the familiar control task, favoring the novel word learning
abilities of TD children in a comparison between means of children with ASD to TD children with high vocabulary levels. Of the remaining experimental conditions, few parallels can be drawn suggestive of how ASD children learn words in a manner similar to how novice TD word learners do so.

This first assumption was based in part by the Emergentist Coalition Model developed by Hollich and his colleagues (2000), positing TD children might begin word learning by making basic associations between object and label before maturational processes give way to their grasping the value of others’ intentionality. Children with ASD have been deemed deficient in making and understanding social exchanges. Thus, in support of H1, children with ASD as well as novice TD word learners might have resorted to using associations to bind words to referent objects or events. Even so, it could be argued that the optimal condition, containing all the elements of a traditional JA episode, had elements of both association and social pragmatics, causing it to adapt well for both developing and developed levels of joint attention. It has been suggested that the word learner as well as the teacher’s joint engagement to each other and to the same object in the same location at the same time is the optimal arrangement for successful word-object mappings to occur (Tomasello & Farrar, 1986). The implication from nonsignificant between-group performances on the optimal task is one that makes optimal joint attention a poor experimental measure due to the difficulty of parsing association cues from the more social cues, thus placing it in the realm of control task alongside the familiar object retrieval task.
Addressing Specific Aim 2

The second aim of the study was to uncover the learning conditions in which children with ASD thrived in their lexical development. It stated that if ASD learners indeed learned under similar conditions as beginning TD learners did, they would be more likely to learn labels for objects in the no experimenter and no child conditions than in the study conditions which included more necessity to interact (including the optimal condition). Hypothesis two stated children with ASD and TD children with low MCDI scores would perform significantly better than TD children with high MCDI scores in the no experimenter condition, a learning circumstance in which the label was somewhat disembodied from the situation. It was predicted that children with ASD would have the most success in conditions which not only reduced the demands on social engagement, but also utilized basic skills of associative learning.

Similar to finding few parallels between task performance of TD children with low MCDI levels and children with ASD per the first study aim, the second hypothesis was not supported in the expectation that if children with ASD relied on surface level associative cues more than experienced TD word learners, they would have success learning novel labels in the no experimenter and no child conditions. Likewise, it was expected that TD children scoring low on the MCDI would employ similar associative cues to learn words in the tasks as those with ASD used. These assumptions were derived in part on the finding that even while some children with ASD develop large vocabularies, they still tend to process language like TD one-year olds, learning their words through increased attention to associative cues (Hennon et al., 2003). The tendency of children with ASD to map perceived words onto salient objects of their
visual attention has also been a robust finding (Baron-Cohen et al., 1997, Preissler, 2008), in further support of the associative learning perspective.

No Experimenter Condition

There are a number of possible explanations for performance of children with ASD in the no experimenter condition. The nonsignificant results might suggest (1) children with ASD might require more than just hearing a name uttered when they happen to attend to a particular object to build an association (i.e., make the word-label mapping), (2) this study condition was artificial beyond the scope of their day-to-day learning experiences, (3) some had already understood the value of attending to social cues when engaged in the word learning task, (4) this sample had greater social-cognitive understanding than was anticipated due to the degree of their condition as well as their language and communication services received, (5) a larger sample is needed to amplify differences which were in the expected direction, and/or (6) novel objects may not have been interesting enough to capture the participants’ attention during labeling.

Several children with ASD (and not surprisingly nearly all who were TD) tended to look in the experimenter’s direction when the label was uttered in the no experimenter condition, even though her eye gaze was not visible. These findings echo Baldwin’s (1991) results that found children would look to see where the experimenter was looking when she uttered a novel label for one among an array of novel objects, thus not relying solely on follow-in labeling to learn the word referents. Research has shown that by the age of 42 months, children with ASD indeed have improved joint attention abilities (Naber et al., 2008), suggesting that a subsample of the current study’s children with
ASD may have previously gained a similar degree of joint awareness as their TD peers. However, similar conclusions of Naber and her colleagues were not drawn, even if different measures were used to determine JA in the current study. Follow-up analyses revealed that the children with ASD who were older than 42 months actually had worse, albeit not significant, high levels of IJA, as determined by their frequencies of points and shows. This finding might be a result of the younger children sampled having begun treatment for their ASD earlier than the older participants, the latter of whom might have been diagnosed on average later in childhood (thus less likely to receive early interventions which have been shown to enhance language abilities). While RJA skills did appear to improve with the age of the sampled group, ability levels were not significantly different between the younger and older participants. The lack of similar findings also highlights the potential of different subtypes of ASD in the current study’s sample of participants. There were no severity scores on the participants’ diagnoses collected at the time of study.

Though performance of the ASD participants did not reach significance, performance of the TD participants resulted in rather interesting findings in the no experimenter condition. The significantly worse than chance test performance among the TD children highlights the theory that not only are they beyond making basic associations to bind words to objects, they also appeared to seek the correct referents of the labels (though they could not discover them on account of the experimenter’s absent eye gaze) when they heard them uttered (Baldwin, 1991; Baron-Cohen et al., 1997). This finding also suggests TD children were avoiding the target which was labeled by the experimenter while she maintained an absent gaze. These results are supportive of both
discrepant (though the experimenter was not explicitly labeling an item she attended to) and follow-in labeling tasks, maintaining TD word learners’ need to attend to important social reference cues when making the word-object association.

*No Child Condition*

The outcomes were not as expected for the groups in the *no child* condition, as neither group reached significant outcomes. Recall in this condition that participants were situated next to the experimenter while she was engaged with teaching a confederate the label for the viewed object, a situation based on the polyadic communicative exchange scenario (Akhtar, 2005; Akhtar *et al*., 2001, Jaswal & Markman, 2003). It was expected both groups of participants would perform better than chance in this condition due to all of the components of JA being present, though between another dyad sharing the study space. The children with ASD might not have performed as anticipated in this condition because instead of being a condition containing associative cues, as proposed, the interaction between experimenter and confederate was perceived as primarily social in nature. The interaction between the experimenter and the confederate may have required a greater degree of the observer’s understanding than was initially hypothesized to extrapolate the word-object mapping. The TD children had marginally significant performance in the expected direction. A larger sample size might be needed to reproduce Akhtar’s (2005) findings, showing TD children can learn under such conditions. It was expected that the *no child* condition captured both social pragmatics and associative learning cues in its design, either of which could be utilized by the observer’s individual
strengths of grasping pragmatics or via basic mechanisms of attending to associative properties.

Additional Analyses of Experimental Conditions

No Object Condition. The participants with ASD had better performance than the TD participants in the no object condition, though not reaching significant levels. Upon inspection, the differences might have arisen from the participants’ vocabulary levels. Follow-up analyses revealed near significant differences in the test success when accounting for MCDI level, either low (340 or fewer words) or high (341-680 words). Contrary to what Smith and Smith (in preparation) found, that TD children with lower vocabulary levels tended to learn words by associative cues of location better than TD children with higher vocabulary levels, the results of this study found that children in both groups (ASD and TD) with larger vocabularies had greater success in the task. Children with ASD performed better (though not significantly) than the TD children with low MCDI scores. The no object condition certainly placed sophisticated learning demands on its participants, requiring them to attend to the bucket during labeling episodes while determining the objects in view were not being named. It also seemed beneficial for the word learner to have more developed visual recognition memory skills to succeed in this task of ambiguous reference since children were required to label the only object which was not seen before choosing it from an array including it and the others which were previously in view.

Because further investigation into the results showed TD participants with lower vocabulary levels performed significantly worse than their peers with higher vocabulary
levels, it appears vocabulary level may have been a key mediator determining the outcome of participants’ performance. An implication for identifying the experimental group with ASD as a whole clearly presented problems since it was determined that the difference in performance between the groups was near significance when productive vocabulary was a consideration.

Explanations for Success of Participants with ASD in Task Conditions

The overall success of participants with ASD in both the familiar control and optimal conditions illustrated the heterogeneous abilities of children in the group (Carpenter et al., 2001; Sigman & McGovern, 2005; Smith et al., 2007; Wetherby, 2006). Efforts were made for group matches on verbal age. Rather than matching participants individually, group matches were approximated in the study, primarily on account of the groups’ unequal sample sizes. The aim was to match them broadly on verbal age, an aim which was believed to be successful with the two groups’ (ASD and TD) having no significant differences in their receptive or expressive vocabularies, per the Rossetti.

An explanation for their successes is that the children with ASD might have required an ideal arrangement to succeed in a word learning task – an organization which may have been orchestrated for participants in the optimal JA condition. That is to say while some children may have attended to particular portions of the various opportunities to learn the word-object link in the comprehensive optimal design, other children in the task may have focused on other portions. For example, some children with ASD may have found social engagement exceedingly aversive, thus adapting well to the elements of associative learning (via attending to cues of object saliency while hearing the label)
contained in the optimal condition; others might have found the traditional method of 
following the experimenter’s social gaze between themselves and the object agreeable, 
thus learning as TD children have generally been believed to acquire words. This 
suggestion is discussed further in the Future Directions section.

Differences in the Language Premeasures

It has been well documented that TD children’s language development follows a 
steady trajectory, evidenced by such phenomena as vocabulary explosions and particular 
social communication behaviors (Bloom, 1973; Dromi, 1987; Nelson, 1973). As such, the 
sampled TD participants would have been at different points in their language 
development. They appeared to follow such standard rules of language development, as 
shown by their success on the experimental task conditions being associated with more 
advanced language comprehension ages. Though not formally hypothesized, it was 
expected that chronological age would be positively correlated with familiar task success 
in the TD children, the premise being some younger TD children sampled would be just 
beginning to learn words around them and might have more difficulties with particular 
learning cues, such as retrieval of requested target objects. Indeed, age was significantly 
correlated with the success of TD children in the familiar task. This finding of age being 
associated with developmental attainment was unique to the TD participants. Not 
surprisingly, no significant correlations between age and familiar task success among 
children with ASD were found in this sample, emphasizing the varied language skills as 
well as ages of participants within the groups. Based on these findings, it can be 
concluded that participants with ASD, as a whole, did not appear to experience a similar
predictable developmental shift as their TD counterparts. This conclusion provides additional support for prior research positing language development for children with ASD might not share the same preverbal foundation with TD children (Landry & Loveland, 1988), possibly learning in a different manner than their TD peers (Rice, Warren, & Betz, 2005).

That the participants with ASD had higher reported MCDI word counts than the TD children sampled indicated most of the children with ASD had higher-than-expected productive vocabulary levels. Nevertheless, high vocabulary levels for this group should not have been surprising given the inclusionary criteria for study enrollment (of some amount of spoken language). It appeared children with ASD capable of producing words already gained a degree of insight required to learn any words, a finding which might also help to predict the vocabulary explosion in TD individuals. In other words, it might be that individuals, TD or with ASD, either “get it or they don’t” with regards to word learning. TD childrens’ (not significantly) higher Rossetti scores also seem logical since the Rossetti measures pragmatics of language, rather than the lexicon specifically.

Though it might seem that a large vocabulary would immediately place children with ASD alongside their TD peers relating JA abilities as well, vocabulary size alone does not make for social ability. For instance, it has been reported that children with ASD who do go on to develop extensive vocabularies still showed evidence of deficits in pragmatics and other social cognitive skills involved in language, such as echolalia, stereotyped phrases, and irregular intonation (Frith, 1989). Even so, based on their successes in the study’s optimal condition, it remains yet to be determined whether children with ASD might be successful at using social information to direct their word-
object links. The children with ASD who had higher vocabularies (over 330 words) were, on average, younger than the more language-impaired children with ASD in the sample, supporting the possibility that early intervention might benefit a positive language outcome.

Differences in Joint Attention

Though participants with ASD did not differ significantly from TD participants in their low level IJA and RJA abilities as determined by the ESCS, the key differences were in the more sophisticated measures of initiation of and response to JA cues. Based on these differences in means on the ESCS, JA abilities of both groups could readily be distinguished. The information derived from the analyses can be used to determine which components of JA played an invaluable role for both the TD and ASD child’s lexical acquisition. Consistent with prior research findings (Carpenter et al., 2002; Charman et al., 1997; Loveland & Landry, 1986; Mundy et al., 1986; Sigman & Ruskin, 1999) children with ASD sampled in this study, indeed, initiated fewer episodes of joint engagement (IJA high) and had more trouble following others’ gaze direction and points (RJA high) when compared to the TD participants.

Though children with ASD had inferior abilities of engagement in the more sophisticated JA measures, they nonetheless acquired substantial vocabularies. The lack of significant differences between the low and high levels of IJA on any of the test conditions for participants with ASD demonstrated that the rate of their initiations had no significant effect on their abilities to learn novel words, reiterating the finding of Landry and Loveland’s (1988) research study finding the children with ASD in their sample had
quite advanced vocabularies while exhibiting little in the way of IJA bids. An interesting, though perhaps expected, finding was the fact that high level RJA (gaze following) had a significant effect on vocabulary scores in children with ASDs. The results, though not based on a longitudinal analysis, uphold prior findings supporting positive relationships between RJA and subsequent language development (Mundy *et al*., 1990; Murray *et al*., 2008). These follow-up results suggest that having the ability to follow another’s gaze to deliberate locations may be beneficial to children with ASD in acquiring new words. The TD participants had no significant correlations between high levels of either JA measure and MCDI word counts. The results suggest TD children may require some means of acquiring words other than the more sophisticated abilities to initiate and respond to JA.

Conclusions

Taken together, the experiment, along with the various outcomes among the premeasures, result in some important findings for lexical acquisition in children with ASD. Of central consequence is the word learner’s ability to follow another’s gaze or point in response to bids for JA. This skill seems pivotal to one’s mapping a novel word onto its novel referent. Based on the JA findings of this research study, it can be argued that this social cognitive skill may not be the only determinant of children’s language acquisition, but undeniably seems to be part and parcel to its development. A number of questions still need addressing: Does mastery of this specific JA skill precede language development only among children with ASD? What other skills besides JA engagement are needed to succeed in word learning tasks? Perhaps even if successful in vocabulary achievement, persons with ASDs have language which appears altogether different from
TD individuals’ language (Frith, 1989), never comprehending all the social pragmatics and nuances (including inflection, volume control, affect, etc.) to appear ‘typical’ in their production.

Results also indicated that a strong determinant of children’s abilities to learn novel labels was their preexisting word usage. Though tautological to suggest a key component of the ability to acquire new words is already being endowed with a relatively large vocabulary, this seems one interpretation of the results for children with ASD. Supportive of previous research (Bono et al., 2004), it appears that children’s initial language skills are as important to their novel label acquisition as their response to JA interventions. Based on this conclusion, it might be that the children with ASD who used large vocabularies will have better prognoses with regards to word learning than their less verbal peers.

Limitations

A fundamental limitation of the study lies in the fact that most of the study participants with ASD were enrolled in programs to improve their social, pragmatic, language, and behavioral skills. All except one child were receiving treatment interventions at the privately-funded school from which they were recruited. The majority of the individuals were diagnosed and receiving treatment before the age of three years. In spite of the services rendered before testing, the results may still be generalized to a broader population in light of the fact that the need for community services for the individuals with ASD is nationally-recognized, thus ideally available to all with
diagnoses. It could be a consideration, however, that the quality of services received at the particular private school from which we recruited was markedly higher than average.

Another limitation to generalizing this study’s results lies in the fact that the sampled ASD population, as a whole, had better language abilities than most children with ASD in this age group. Recall the requisite for enrollment was having some degree of productive language, a characteristic of around 50% of those with ASD (Lord & Paul, 1997; Lord & Rutter, 1994; Wetherby & Prizant, 2000). The results are thus not highly suggestive of all individuals with ASDs, an issue further illustrating the differences among those in the population. Findings from this study may be suggestive of children with ASD who have acquired language since most in the sample tended towards higher total word counts. It might have been useful to obtain a slightly younger sample of children with ASD in an effort to reach those children who were closer to the TD participants (i.e., more varied in their stages of lexical acquisition). Many had reached ceiling in the language measures, behavioral assessments of their efforts en route to these achievements might have been more enlightening as to their language learning processes undertaken.

A third limitation based on the DFA outcome is that children in the group with ASD who appeared typical in the DFA based on their scores on the ESCS might actually not have had an ASD at all. The participants’ ages at diagnosis were not collected at the time of testing, but it could be they received them at a relatively early age to their later-diagnosed peers and might have had a misdiagnosed language delay which appeared autism-like at the time of their assessment. Additionally, based on the opinions of the principal investigator as well as several school administrators, teachers, and even parents,
a handful of the children with ASD seemed typical. The judgment of their typicality was one based not only on lexicon alone, but an opinion which included attention to pragmatics, language, intonation, social engagement and conversational content.

Decision to remove particular subjects was one of necessity. Subjects were removed from analyses due to their not having completed measures, either missing premeasures or inabilities to complete the experimental conditions. Also based on anecdotes in accordance with DFA outcomes, children from the TD group may have been on the horizon of receiving a diagnosis of some pervasive developmental disorder. Justification for removal of the solitary TD participant with complete measures who appeared less-than-typical in his testing was based in part on his receptive language scores. It would have been within normal limits for a child of his age (20 months) to have relatively few words in his expressive vocabulary, but his having a receptive vocabulary average of 10.5 months raised a red flag. Additionally, his behavior during the ESCS assessment as well as the experiment itself was anything but typical for his population, not explained away by his need for a nap, snack, or diaper change, an estimation substantiated by the DFA. His ESCS scores were more in line with those in the ASD group and though the ESCS are in no way diagnostic in the study, they did show between-group patterns among the study participants. There is the potential that this particular subject’s parent, having already known that the research matter concerned autism, enrolled her child in the study with a preexisting concern that her child did not seem normal relative to his peers. It could be that perhaps this parent wanted insight into her child’s development, though not necessarily believing he had an ASD. In fact, there were several instances in which parents of TD children asked the experimenter at the
study’s commencement if she believed their children were developing normally.
Naturally, the experimenter avoided discussion of each child’s typicality, suggesting the
parent take the child to a clinician for assessment and/or referral if genuinely concerned.
No children with ASD were removed from analyses on account of the difficulty in
recruiting from this population, even though two of them were considered nonverbal (two
children had under ten words documented on their MCDI.)

The researchers went to great lengths to ensure consistency in the study
conditions, but reliable results are vastly different from valid ones in science. It may be
necessary to stress that just because a finding is not significant does not necessarily mean
its results stand in opposition to its hypothesized direction. Thus, the issue of validity
comes into play, suggesting a study condition may not have been valid for its intended
measure. The study’s setting must be taken into consideration. The majority of the
participants were run in a secluded room adjacent to the students’ classrooms, while the
studies conducted in participants’ homes were conducted in as controlled a manner as
possible. Though the situations were intended to approximate authentic learning
situations the child might have encountered, the study was designed in such as way to
parse particular characteristics of JA out from the “noise” of other JA characteristics.

Future Directions
Perhaps the most significant study finding is the one that places RJA at the
forefront of language acquisition among children with ASD. While children with ASD
may never acquire normal language relative to their peers (Frith, 1989), their ability to
respond to JA cues should be part of the training in their treatment programs and
interventions. The focus of interventions could be one of teaching young children how to follow others’ gazes, as this skill seems particularly valuable in their subsequent abilities to learn new words for encountered objects (Bono et al., 2004; Sigman & Ruskin, 1999; Siller & Sigman, 2002; Stone & Yoder, 2001). This training seems a feasible undertaking since children with ASD have been shown eventually to learn to respond to JA bids, even if they might never initiate them (Kasari et al., 2006; Leekam & Ramsden, 2006; MacDonald et al., 2004). The results of this study emphasize high level RJA (gaze following to a distal location) as most deficient in children with ASD, as opposed to low level RJA (following a proximal point), so the treatment efforts could stress the former. It may be that the common training techniques used with children who have ASD negatively impact their ability to use RJA cues. For example, holding a novel object only in the vicinity of the teacher’s or parent’s own face or eyes when trying to teach a label may not be sufficient in teaching children to respond to cues for JA. The teacher or parent might instead draw the child’s attention to a distal object after establishing eye contact. The teacher might also show enthusiasm and suspense as encouragement for child to look between the object and the teacher’s gaze.

Another area related to JA skills that could be examined is to compare participants’ RJA skills to their proficiency in learning the novel words within the experimental conditions. To do so would require retrospective viewing of the video recordings of the study participants engaged in the actual word learning tasks. Coders would need to be blind to the group membership and keep records of episodes of eye contact, initiations for JA and responses to bids for JA throughout each session, maintaining the established ESCS coding guidelines throughout. The video clips of the
experimental tasks were viewed for reliability of object choice alone, rather than for actual JA engagement (a measure scored only in viewing the ESCS administration). It would be interesting to note whether episodes of JA predicted novel label acquisition in the experimental conditions themselves. It might be that some children would find social engagement extremely aversive, thus would adapt well to conditions in which the elements of associative learning (via attending to cues of object saliency while hearing the label) are in place, such as in the optimal condition. Still, others might have greater success in the traditional method of following the experimenter’s social gaze between themselves and the object in this condition, thus learning as TD children have been believed to acquire words. Those who are more ‘traditional’ in terms of their learning technique might also have higher word counts on average.
CHAPTER FIVE

LIST OF REFERENCES


Smith, D. S. & Smith, L. B. (in preparation). The role of space in children’s object name learning: does location matter?


APPENDIX A

LIST OF NOVEL LABELS
Modi
Bandu
Kujo
Toma
Zeebee
Blicket
Shmoby
Rabble
Murker
Dax
Snoogle
Furkle
APPENDIX B
CODING SHEET
**Joint Attention CODING SHEET**

Subject’s FIRST name *only*: _______________

Subject’s birthdate: __ - __ - 20

Today’s date: __ - __ - 20

Subject’s age today: ___________

Diagnosis? Y N

**Familiar warm-up**

Condition 1: ________________ *(optimal, no object, no experimenter, or no child?)*

Set 1: correct response? Y N novel label: __________ sequence:

Familiar Set 1: correct response? Y N

Set 2: correct response? Y N novel label: __________ sequence:

Familiar Set 2: correct response? Y N

Set 3: correct response? Y N novel label: __________ sequence:

Familiar Set 3: correct response? Y N

Condition 2: ________________ *(optimal, no object, no experimenter, or no child?)*

Set 1: correct response? Y N novel label: __________ sequence:

Familiar Set 1: correct response? Y N

Set 2: correct response? Y N novel label: __________ sequence:

Familiar Set 2: correct response? Y N

Set 3: correct response? Y N novel label: __________ sequence:

Familiar Set 3: correct response? Y N

Condition 3: ________________ *(optimal, no object, no experimenter, or no child?)*

Set 1: correct response? Y N novel label: __________ sequence:

Familiar Set 1: correct response? Y N

Set 2: correct response? Y N novel label: __________ sequence:

Familiar Set 2: correct response? Y N

Set 3: correct response? Y N novel label: __________ sequence:

Familiar Set 3: correct response? Y N
Condition 4: ______________________ (optimal, no object, no experimenter, or no child?)

<table>
<thead>
<tr>
<th>Set</th>
<th>correct response?</th>
<th>Y</th>
<th>N</th>
<th>novel label: ________</th>
<th>sequence:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set 1</td>
<td></td>
<td>Y</td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Familiar Set 1</td>
<td>correct response?</td>
<td>Y</td>
<td>N</td>
<td></td>
<td></td>
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<tr>
<td>Set 2</td>
<td></td>
<td>Y</td>
<td>N</td>
<td></td>
<td></td>
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<tr>
<td>Familiar Set 2</td>
<td>correct response?</td>
<td>Y</td>
<td>N</td>
<td></td>
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<tr>
<td>Set 3</td>
<td></td>
<td>Y</td>
<td>N</td>
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<td></td>
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<tr>
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<td>N</td>
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**Comments on experimental session:**
APPENDIX C

ESCS CODING SHEET
# Early Social Communication Scales - Coding Sheet

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<tr>
<th>Subject Number</th>
<th>Date Administered</th>
<th>Date Scored</th>
<th>Tape Number</th>
<th>Counter</th>
<th>Examiner</th>
<th>Notes</th>
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## Initiating Joint Attention

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<tr>
<th>Type of Contact</th>
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<th>5</th>
<th>10</th>
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<tr>
<td>Total</td>
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<table>
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<tr>
<th>Point of Contact</th>
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<th>10</th>
<th>15</th>
<th>20</th>
<th>Sum</th>
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</thead>
<tbody>
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<td>Point and BC</td>
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<td>Total</td>
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<table>
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<th>Show</th>
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<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>Sum</th>
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</thead>
<tbody>
<tr>
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</tbody>
</table>

| RJA Total |   |   |    |    |    |     |

## Responding to Joint Attention

### Following Point

<table>
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<th>2</th>
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<th>10</th>
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### Line of Regard

<table>
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<tr>
<th>Left</th>
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<th>Right</th>
<th>Back Right</th>
<th>Total 1</th>
<th>Delayed</th>
<th>Total 2</th>
<th>Delayed</th>
<th>% Correct</th>
<th>RJA Total</th>
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Note:

- **Initiating Joint Attention**
- **Responding to Joint Attention**
- **RJA Total**
APPENDIX D

ETHICAL APPROVAL
Form 4: IRB Approval Form
Identification and Certification of Research
Projects Involving Human Subjects

UAB's Institutional Review Boards for Human Use (IRBs) have an approved Federalwide Assurance with the Office for Human Research Protections (OHRP). The Assurance number is FWA00005980 and it expires on September 29, 2013. The UAB IRBs are also in compliance with 21 CFR Parts 50 and 56.

Principal Investigator: SMITH, DANA S
Co-Investigator(s):
Protocol Number: X090816001
Protocol Title: Which Components of Joint Attention Help and Hinder Children with Autism to Learn New Words?

The IRB reviewed and approved the above named project on 5-13-11. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services. This Project will be subject to Annual continuing review as provided in that Assurance.

This project received EXPEDITED review.
IRB Approval Date: 5-13-11
Date IRB Approval Issued: 5-13-11

Marilyn Doss, M.A.
Vice Chair of the Institutional Review Board for Human Use (IRB)

Investigators please note:

The IRB approved consent form used in the study must contain the IRB approval date and expiration date.

IRB approval is given for one year unless otherwise noted. For projects subject to annual review research activities may not continue past the one year anniversary of the IRB approval date.

Any modifications in the study methodology, protocol and/or consent form must be submitted for review and approval to the IRB prior to implementation.

Adverse Events and/or unanticipated risks to subjects or others at UAB or other participating institutions must be reported promptly to the IRB.

470 Administration Building
701 20th Street South
205.994.3789
Fax 205.994.1201
irb@uab.edu

The University of
Alabama at Birmingham
Mailing Address:
A8 470
1530 3RD AVE S
BIRMINGHAM AL 35294-0104