

Florida International University
FIU Digital Commons

FIU Electronic Theses and Dissertations

University Graduate School

4-30-2015

Evaluating the Role of Social Approach Behaviors in Children with Autism

Jessica M. Weber

Florida International University, jwebe002@fiu.edu

Follow this and additional works at: <http://digitalcommons.fiu.edu/etd>

 Part of the [Developmental Psychology Commons](#)

Recommended Citation

Weber, Jessica M., "Evaluating the Role of Social Approach Behaviors in Children with Autism" (2015). *FIU Electronic Theses and Dissertations*. Paper 2242.

<http://digitalcommons.fiu.edu/etd/2242>

This work is brought to you for free and open access by the University Graduate School at FIU Digital Commons. It has been accepted for inclusion in FIU Electronic Theses and Dissertations by an authorized administrator of FIU Digital Commons. For more information, please contact dcc@fiu.edu.

FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida

EVALUATING THE ROLE OF SOCIAL APPROACH BEHAVIORS IN CHILDREN
WITH AUTISM

A dissertation submitted in partial fulfillment of the

requirements for the degree of

DOCTOR OF PHILOSOPHY

in

PSYCHOLOGY

by

Jessica Weber

2015

To: Dean Michael Heithaus
College of Arts and Sciences

This dissertation, written by Jessica Weber, and entitled Evaluating the Role of Social Approach Behaviors in Children with Autism, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

Stefany Coxe

Leslie Frazier

Kyle Bennett

Anibal Gutierrez, Major Professor

Date of Defense: April 30, 2015

The dissertation of Jessica Weber is approved.

Dean Michael R. Heithaus
College of Arts and Sciences

Dean Lakshmi N. Reddi
University Graduate School

Florida International University, 2015

DEDICATION

I dedicate this dissertation to my boyfriend, Glen Mowatt. Thank you for always having faith in me even when I didn't have faith in myself. I couldn't have written this dissertation without your support, not to mention the macaroons and champagne you always brought me after a long day.

ACKNOWLEDGMENTS

I would first like to thank my committee, without your support I would not have been able to complete this dissertation. I specifically would like to express my gratitude to Dr. Anibal Gutierrez, for his excellent guidance and for providing me with an exceptional environment to do research in. I would also like to thank all the members of the Behavior Analysis Autism Research Lab for always being there to help out when I needed them. Lastly, I would like to thank the Organization for Autism Research who provided funding for this project.

ABSTRACT OF THE DISSERTATION

EVALUATING THE ROLE OF SOCIAL APPROACH BEHAVIORS IN CHILDREN
WITH AUTISM

by

Jessica Weber

Florida International University, 2015

Miami, Florida

Professor Anibal Gutierrez, Major Professor

Children diagnosed with autism show marked impairments in social and communicative behaviors. According to social motivation and social orienting models of autism, decreased social interest leads to less social input and fewer social learning opportunities (Chevallier et al., 2012; Mundy & Neal, 2001). These models suggest that the ability to initiate and participate in social interactions are important factors in language development. Research in this area has focused on the role of joint attention in language development however; the current study takes a broad view of social interest and posits that not only joint attention, but all socially mediated behaviors are important in language development. The aim of the current study was (1) to evaluate a novel behavioral-coding scheme of social approach behaviors and (2) evaluate the relationship between social approach behaviors and language development. The social approach coding scheme used frequency counts of seven social behaviors emitted during an administration of the ADOS. These behaviors were coded as being either initiated by the child or occurring in response to the parent or examiner, however, no distinction was made on the basis of on the function of the behavior. Social approach rates gleaned using

this novel coding scheme were correlated with existing measures of social motivation suggesting that social approach coding is capturing a similar construct as those of existing measures. Social approach rates were also used to evaluate the relationship between social behaviors and language development. The results indicated that both social initiations and social responses are important in language development. Overall, children with higher rates of both social initiations and social responses showed increased scores on language measures. The coding scheme presented provides an alternative way to quantify behaviors on the ADOS that may be used in treatment development and assessment. Given the relationship between social approach rates and language development, using this coding scheme may provide a way to determine those behaviors that are most challenging for a child so that they can be targeted in intervention to facilitate not only their social development but also language acquisition.

TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION	1
Diagnosing Autism	2
The Autism Diagnostic Observation Schedule (ADOS)	2
Theoretical Perspective	4
Theory of Mind	5
Social Motivation Theory	7
Social Orienting	8
Social Reward	9
Autism & Language Development	11
Joint Attention & Language	13
Social Impairments in Autism	15
Eye Gaze	16
Joint Attention & Social Interactions	18
Affective Development	19
The Importance of Social Interactions	20
Characterizing the Interactions of Children with Autism	23
Social-Emotional Approach Behaviors	24
Measuring & Quantifying Social Behavior	25
II. THE CURRENT STUDY	29
Coding Social Behaviors	29
Language Exposure	32
Summary	35
Purpose	37
Significance	37
Early Intensive Behavioral Intervention Programs	37
Predictors & Outcome Measures of EIBI	38
Mediators & Moderators	39
Theory Driven Measures	40
Summary	42
III. METHODS	43
Overview	43
Inclusion Criteria for Children	43
Participants	43
Measures	44
Autism Diagnostic Observation Schedule (ADOS)	45
Mullen Scales of Early Learning (MSEL)	45
Preschool Language Scale – 4 th Edition (PLS-4)	46
Social Responsiveness Scale (SRS)	47
Vineland Adaptive Behavior Scale (VABS)	47

Procedure	48
Social Approach Behavior	48
Coding Parent/Examiner Language	49
Reliability.....	50
IV. RESULTS	51
Study 1: Reliability & Validity.....	51
Reliability of Individual Items	51
Internal Consistency.....	52
Criterion Validity	53
Construct Validity	53
Social Approach Behavior Rates	54
Study 2: Language Development.....	55
Predictors of Receptive Language	57
Concurrent Language.....	58
Future Language	59
Predictors of Expressive Language.....	62
Concurrent Language.....	63
Future Language	65
Language Exposure.....	68
Behavioral Profiles	69
Receptive Language.....	70
Expressive Language	75
Overall Gains	79
V. DISCUSSION	85
Study 1: Reliability & Validity.....	85
Study 2: Language Development.....	89
Language Exposure.....	93
Significance: Influencing Interventions.....	94
The ADOS & ABA.....	98
Summary	100
VI. REFERENCES	102
VII. APPENDICES	114
VIII. VITA.....	143

LIST OF TABLES

TABLE	PAGE
Table 1. Participant Demographics.....	44
Table 2. Intraclass Correlations for All Social Approach Behaviors.....	52
Table 3. Mean Frequencies of Social Approach Behaviors.....	55
Table 4. Language Levels at Pre and Post.....	57
Table 5. Results of Paired Sample t-tests for MSEL and PLS-4.....	57
Table 6. Pearson Correlations for Concurrent Receptive Language Predictors.....	58
Table 7. Regression Coefficients and Standard Error for Concurrent Receptive Language Multiple Regression.....	59
Table 8. Hierarchical Regression Analyses for Chronological Age, Initial Language and Social Initiations/Responses as Predictors of Receptive Language Outcomes on the PLS-4 (N=39).....	61
Table 9. Hierarchical Regressions Analyses for Chronological Age, Initial Language, Social Responses and Social Initiations as Predictors of Receptive Language Outcomes on the PLS4 Auditory Comprehension Scale (N=39).....	62
Table 10. Pearson Correlations for Concurrent Expressive Language Predictors.....	64
Table 11. Regression Coefficients and Standard Error for Concurrent Language Multiple Regression.....	65
Table 12. Hierarchical Regression Analyses for Chronological Age, Initial Language and Social Initiations/Responses as Predictors of Expressive Language Outcomes (N=39).....	67
Table 13. Hierarchical Regression Analyses for Chronological Age, Initial Language, Social Responses and Social Initiations as Predictors of Expressive Language Outcomes (N=39).....	68

LIST OF FIGURES

FIGURE	PAGE
Figure 1. Receptive Language Profiles: Average Social Initiation Rates.....	72
Figure 2. Receptive Language Profiles: Average Social Response Rates	73
Figure 3. Receptive Language Profiles: Total Social Initiations	74
Figure 4. . Receptive Language Profiles: Total Social Responses	75
Figure 5. Expressive Language Profiles: Average Social Initiation Rates	76
Figure 6. Expressive Language Profiles: Average Social Response Rates	77
Figure 7. Expressive Language Profiles: Total Social Initiations.....	78
Figure 8. Expressive Language Profiles: Total Social Responses.....	79
Figure 9. Overall Language Profiles: Average Social Initiation Rates.....	81
Figure 10. Overall Language Profiles: Average Social Response Rates	82
Figure 11. Overall Language Profiles: Total Social Initiations	83
Figure 12. Overall Language Profiles: Total Social Responses	84

ABBREVIATIONS AND ACRONYMS

ABA	Applied Behavior Analysis
ABLBS	Assessment of Basic Language and Learning Skills
ADOS	Autism Diagnostic Observation Schedule
ASD	Autism Spectrum Disorder
DSM	Diagnostic and Statistical Manual for Mental Disorders
EIBI	Early Intensive Behavioral Intervention
ESCS	Early Social Communication Scales
HLR	Hierarchical Linear Regression
ID	Intellectual Disability
IES	Institute of Education Sciences
IJA	Initiating Joint Attention
IQ	Intelligence Quotient
JA	Joint Attention
MANOVA	Multivariate Analysis of Variance
MSEL	Mullen Scales of Early Learning
PLS	Preschool Language Scale
PRT	Pivotal Response Training
RJA	Responding to Joint Attention
SCQ	Social Communication Questionnaire
SEA	Social Emotional Approach
SMT	Social Motivation Theory
SRS	Social Responsiveness Scale

TEACCH	Treatment and Education of Autistic and Related Communication Handicapped Children
TD	Typically Developing
ToM	Theory of Mind
VBMAPP	Verbal Behavior Milestones and Placement Program
VABS	Vineland Adaptive Behavior Scales

I. INTRODUCTION

Autism is a neurodevelopmental disorder defined by three core areas: deficits in communication and social interactions and presence of restricted and repetitive interests. According to the diagnostic criteria outlined by the Diagnostic and Statistical Manual for Mental Disorders (DSM-V; American Psychiatric Association, 2013) Autism Spectrum Disorders (ASD) are characterized by:

- (a) Persistent deficits in social communication and social interaction across contexts, not accounted for by general developmental delays, (b) restricted, repetitive patterns of behavior, interests, or activities, (c) symptoms must be present in childhood (but may not become fully manifest until social demands exceed limited capabilities) and (d) symptoms together limit and impair everyday functioning.

The present study focused specifically on those behaviors described in the DSM-V as social communication and social interactions. Under the broad heading of persistent deficits in social interactions, the DSM-V provides clear definitions of the specific deficits exhibited by children with autism. The subheading (A1), reflects difficulties with social initiation and response and includes abnormal social approach, lack of normal back and forth conversation, reduced sharing of interests, reduced sharing of emotions/affect, lack of initiation of social interactions and poor social imitation (<http://www.psychiatry.org/autism>). Of particular concern for this study are those behaviors related to social initiations and abnormal social approach. A system of quantifying social communicative behaviors to measure the social approach of children

with autism and how these behaviors impact language development will be explored and evaluated.

Diagnosing Autism

Diagnosing autism is a challenging endeavor for clinicians since the autism phenotype differs among individuals with regard to severity and combinations of symptoms. There is a considerable range of abilities exhibited by children with autism and these skills may change over the course of development, further complicating the diagnostic process. Furthermore, there is no medical test for autism; diagnosis is made on the basis of clinical observations, history and current functioning. Designating an autism diagnosis requires a multidisciplinary assessment that includes a detailed developmental history, description of current behaviors, assessment of cognitive and language abilities and observations in a variety of settings (Le Couteur, Haden, Hammal & McConachie, 2008). The diagnostic process often also involves the use of standardized instruments designed to capture the core deficits of ASD. One such measure is the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 1999).

The Autism Diagnostic Observation Schedule (ADOS)

The ADOS is considered the gold-standard tool in the assessment and diagnosis of autism and autism spectrum disorders (Sikora, Hall, Hartley, Gerrad-Morris & Cagle, 2008). The ADOS provides a semi structured, play-based assessment that utilizes a series of standard contexts or activities to observe the social and communicative behaviors of individuals suspected of having autism. The ADOS is designed to encourage the individual with autism to engage with the examiner through specific social activities referred to as presses. Presses may include the examiners behavior (e.g., a verbal or non

verbal prompt for the child to engage in a behavior) or the context of the activity (e.g., the examiner has something the child wants). In other words, the presses used throughout the ADOS are activities and contexts in which social interactions and communication are likely to occur. The hierarchy of presses used in the ADOS is designed to create a social structure that allows the individual to emit a variety of spontaneous communicative and social behaviors. The presses during each activity begin with general statements (e.g., the examiner may say, “the baby is hungry” and wait for the child to feed the baby) and become more explicit (e.g., the examiner will hand the child the fork and say, “feed the baby”) depending on the level of prompting required for the individual to participate in the activity.

The ADOS includes five modules designed to evaluate children and adults on the basis of chronological age and expressive language level. Module 1 is designed for use with children who are nonverbal (i.e. have no expressive language) or use primarily single words. Activities presented during Module 1 (see appendix A) involve the playful use of toys that are appropriate for young children. The playful atmosphere of the administration allows the child ample opportunities to both initiate social interactions with the examiner and to respond to the examiners bids (e.g., answering the examiner’s questions or complying with the examiner’s demand). Considering that children assessed with Module 1 are typically very young, parents often remain in the room during the assessment to help create a comfortable and nonthreatening environment. The other modules (Toddler, 2, 3, & 4) are designed for individuals of varying ages and expressive language levels. Only children evaluated using Module 1 will be included in the proposed study.

The ADOS was designed not only as a diagnostic tool but also as a way to directly measure the quality of social and communicative behaviors associated with autism (Lord et al., 1989). Behaviors are coded on the basis of their observed frequency and quality during the assessment. Individual items on the ADOS are typically scored on a three-point scale, from 0 (no evidence of abnormality related to autism) to 2 (definite evidence of abnormality related to autism). A score of 3 is assigned when the severity of the behavior interferes with the administration of the assessment. For Module 1, the standard ADOS coding provides a diagnosis of autism, autism spectrum or non-spectrum.

Administrations of the ADOS are intended to be video recorded and thus offer a standardized context to further evaluate the behaviors of children with autism above the information provided by the standard coding conventions (Lord et al., 1989). Studies have selected specific codes from the ADOS to be used as a measure of restricted and repetitive behaviors (Kim & Lord, 2010) and social attention impairments (Dawson et al., 2004), however it appears that no other studies have used video recordings of the ADOS to evaluate behaviors not directly captured by the standardized coding conventions. The current study utilized video recorded administrations of the ADOS to evaluate the social approach behaviors of children with autism above those generated using the standard coding algorithm.

Theoretical Perspective

Given the pervasive nature of social impairments displayed by individuals with autism there is considerable interest in describing the development and effects of social dysfunction in autism. Several theories have been posited that provide varied accounts of the etiology and consequences of social abnormalities in autism. These theories vary with

regard to viewing deficits in social cognition as either a consequence of (e.g., theory of mind hypothesis) or cause of (e.g., social motivation theory) the social dysfunction in autism.

Theory of Mind

Theory of mind (ToM) refers to the ability of humans to infer a range of mental states including: beliefs, desires, intentions, imagination and emotions (Baron-Cohen, 2001). Theory of mind provides a modular perspective on understanding the social input provided by the environment that is distinct from processing nonsocial stimuli (Baron-Cohen, 1995). In accordance with the idea of modularity, ToM is described by an innate structure in the brain that has specialized systems that allow people to understand the actions and intentions of others. Baron-Cohen refers to this as “mindreading.” The innate structures that are used in modularity theories are different from all-purpose, general, cognitive machinery and are instead focused and specialized. The ToM module utilizes a special type of cognition, meta-representations, that allow an individual to represent not only their own thoughts and beliefs but also the thoughts and beliefs of others (Leslie, 1987). Evidence from studies using false belief, faux pas and other ToM tasks have demonstrated that children with autism struggle with problems that require them to think about the mental states of others (e.g. Baron-Cohen, Leslie & Frith 1985; Baron-Cohen, O’Riordan, Stone, Jones and Plaisted, 1999). Deficits in the meta-representational abilities of children with autism have been linked to impairments in pretend play (Baron-Cohen, 1987) and social skills (Baron-Cohen, 1988).

Theory of mind, as tested by typical laboratory experiments, begins to emerge around four years of age when children begin to have an understanding that the world

may not always be as it seems (Perner & Lang, 1999). For example, the task most commonly used in early ToM research is the Sally-Anne task. In this task, the child is told a story where Sally places an object in a basket and then goes out to play. While Sally is out playing, Anne takes the object from the basket and places it inside a box. The children are then asked where Sally will look for the object when she comes back. Responding that Sally will look for the object in the basket is taken as evidence of ToM. More recently however, an argument has been made for the inclusion of pointing and joint attention behaviors as early evidence for an emerging theory of mind (Baron-Cohen 1990; Leslie & Happe, 1989). Assuming that joint attention behaviors do in fact represent rudimentary ToM skills, the emergence of ToM begins at 8 – 10 months of age, when children first begin to share visual attention with another person (Bates, Camaioni & Volterra, 1975).

One criticism for the ToM hypothesis of social dysfunction is its inability to explain the early social deficits in autism. If ToM begins to emerge with the development of joint attention skills, then presumably children with autism should show typical development and patterns of social behaviors in first few months of life (Klin, Volkmar & Sparrow, 1992), however research has suggested that those processes responsible for the development of joint attention capabilities may begin in the first few months of life (Mundy & Sigman, 1989; Osterling & Dawson, 1994) calling into question the ToM account of social deficits. Further limiting the ToM position, recent research has shown that some children with autism are able to develop the necessary mental representations that allow them to pass typical ToM tasks, albeit at an older age (e.g., Bowler, 1992; Happe, 1995). The evidence suggesting that not all children with autism experience

persistent deficits in ToM abilities challenges the utility of the ToM hypothesis in explaining the atypical social behaviors of children who have acquired metarepresentational abilities.

As an alternative to the ToM hypothesis, the social motivation theory of autism (SMT; Chevallier, Kohls, Troiani, Brodtkin & Schultz, 2012) posits that the social dysfunction of individuals with autism is a result of limited social interest early in development that in turn leads to a dearth of social interactions. Social motivation theory argues that, unlike the ToM hypothesis where social cognition is responsible for deficits in social interaction, limited social motivation precedes and is responsible for impairments in social cognition evinced in children with autism. The rationale for the current study stems from evidence supporting the social motivation theory of autism.

Social Motivation Theory

From the social motivation perspective, the early social impairments of children with autism may have a cascading effect on developmental processes (Chevallier et al., 2012). According to the SMT framework, a lack of interest in social stimuli leads to a deprivation of social inputs (from both social stimuli sought out by the child and initiated by a social partner) and learning opportunities that in turn hinder the development of social cognition. Evidence for the SMT stems from behavioral and neuroscience research that suggests that social motivation, as indexed by social maintaining, social orienting, and social reward, is disrupted in children with autism (Chevallier, et al., 2012). The focus of the current study is on evaluating the role of those factors related to social orienting and social reward.

Social Orienting. Social orienting refers to aligning one's attention with a source of sensory input (Posner, 1980) that is social in nature (i.e., involves another person) by shifting eye gaze or turning the head. Social orienting begins to emerge around six to twelve months of age, in typical development, as children show a preference for human faces (Morton & Johnson, 1991) and speech (Klin, 1991) and are able to follow the gaze of another person (Morales, Mundy & Rojas, 1998). Children with autism, on the other hand, often show little interest in social stimuli and orient more towards nonsocial stimuli (Dawson, Meltzoff, Osterling, Rinaldi & Brown, 1998; Klin, Lin, Gorrindo, Ramsay & Jones, 2009). For example, Dawson et al., (2009) compared the orienting response of typically developing children, children with autism and Down syndrome children in two conditions; social (e.g., clapping hands or calling the child's name) and nonsocial (e.g., shaking a rattle or musical jack in the box). The results indicated that the children with autism generally oriented to the stimuli in both conditions less than children from the other two groups however, the failure to orient to the social stimuli was more extreme than for the nonsocial stimuli. These findings support the notion that while children with autism have a universal difficulty in shifting attention and orienting, these impairments are more pronounced for social stimuli. Dawson suggests that children with autism struggle with processing and representing the complex nature of social stimuli and therefore their attention is not typically gleaned by these stimuli.

During the first year of life, infants are learning about the world and show biases to those aspects of the environment that are most relevant to learning (Bahrick & Lickliter, 2000); most notably with regard to understanding and processing social information (Blass, 1999). These early attempts to make sense of the social world around

them allow infants to acquire the necessary skills (e.g., joint attention) that facilitate social interactions and social learning opportunities. Recent research has suggested that early deficits in social orienting and joint attention (i.e., sharing interest in an object or event with another person) may influence the types of social interactions a child engages in (Dawson, 1991; Mundy & Neal, 2001). The spontaneous social orienting response of typically developing infants that allows them to take advantage of incidental language learning opportunities in typical social interactions (Baldwin, 1993) is strikingly absent in children with autism. The social orienting model described by Mundy and Neal (2001) suggests that disturbances in the inclination to spontaneously orient to social information may negatively impact an early self-organizing process that actively organizes information and allows a child to initiate and participate in social learning opportunities.

Social Reward. As has been previously discussed, typically developing children begin to orient and attend to social stimuli early in life. The early attention to social stimuli may set the foundation for and impact later social interactions that have a number of developmental repercussions; for example, the formation of important neural connections and language acquisition (Dawson et al., 2004; Mundy, 1995; Mundy & Neal, 2001). Alternatively, when children do not show this attention to social stimuli there may be inappropriate neural connection formation and delayed language acquisition.

The impact of social interactions on development has generated great interest in the characterizing and understanding the social impairments of individuals with autism. Notably absent in the social exchanges of children with autism are those behaviors related to joint attention, that allow people to share in an experience with one another.

These interactions typically result in social consequences (e.g., smiling, laughing, vocalizations) that contribute to the shared enjoyment in the exchange. Thinking about the reinforcing effect of the social consequences, it may be the case that children engage in joint attention behaviors only to the extent that the resulting social consequences are reinforcing (Dawson et al., 2004; Mundy 1995). In other words, if the social stimuli that typically follow joint attention behaviors do not have any reinforcing value for a child they are unlikely to engage in those behaviors again in the future.

Mundy (1995) argues that children with autism do not assign rewarding value to social stimuli and as a result are less likely to engage in behaviors that result in these stimuli (e.g., social orienting and joint attention). Research on nonverbal communication has provided some evidence that children with autism engage in behaviors for instrumental purposes more frequently than using similar behaviors to share with others (Curcio, 1978; Wetherby & Prutting, 1984) For example, a child with autism is more likely to point at a toy to communicate that they want it rather than pointing at a toy because it is interesting and they want to share their excitement. While it may be inferred from findings like these that different mechanisms are involved in the processing of social and nonsocial stimuli, research to date has been inconsistent and more work is needed.

An alternative way to think about the differences between social and nonsocial stimuli is to consider the functions of rewards. Schultz (2000) outlines three basic functions that rewards may serve. First, it has been proposed that rewards in and of themselves can bring about feelings of pleasure and other positive emotions. Second, rewards may function as reinforcers for a behavior by increasing the future frequency of

that behavior. And lastly, rewards can function as goals that bring about behavior that aid in obtaining that goal (i.e., serve a motivational purpose). Thinking about these functions, one explanation for the difference between behaviors that result in social versus nonsocial stimuli may be in whether or not the stimuli functions as a reinforcer and the relative strength of that reinforcer. In other words, children with autism may be more likely to initiate an interaction that results in a nonsocial stimulus (e.g., a tangible or edible) than if the interaction results in a social stimulus (e.g., smiling or eye contact) because they find the nonsocial stimulus more reinforcing than the social stimulus.

The social motivation theory (SMT) of autism has emerged from evidence suggesting that social maintaining, social orienting and social reward processes are impaired in children with autism. Social motivation theory posits that the early manifestation of these social deficits in children with autism leads to atypical developmental trajectories in social cognition and communication. Given the emphasis placed on the importance of social interactions in language development by the SMT, it is important to directly assess the role of social behaviors in language acquisition for children with autism.

Autism & Language Development

Parents of children with autism often express concerns about their child's development and seek a diagnosis when he or she is not using any words to communicate by approximately 18 months of age (Kasari, Paparella, Freeman & Jahromi, 2008; Lord & Bishop, 2010; Horovitz & Matson, 2010). Language impairments, in the form of delayed and deviant speech, are one of the defining features of autism. However; recent research has suggested that the more subtle communicative actions of infants and young

children, often missed by parents and untrained observers, are also impaired in children with autism (Werner, Dawson, Osterling & Dinno, 2000; Zwaigenbaum et al., 2005). Typically developing infants, under the age of one year, use a variety of nonverbal communication methods (e.g. joint attention, gestures and eye gaze) to communicate their wants (Adamson & Bakeman, 1985; Bates, Camaioni & Volterra, 1975). These early, prelinguistic skills are essential in the development of later language acquisition (Adamson & Bakeman, 1985; Dawson & Adams, 1984; Iverson & Goldin-Meadow, 2005; Loveland & Landry, 1986; Mundy, Sigman & Kasari, 1990; Poon, Watson, Baranek & Poe, 2011) and are often absent in children later diagnosed with autism (Tager-Flusberg, Paul & Lord, 2005).

Early language acquisition has been identified as a primary prognostic factor for later outcomes among children with autism (Venter, Lord & Scholper, 1992), emphasizing the importance of understanding language development in autism. Several factors have been consistently associated with language development in both children with autism and typically developing children including joint attention (Dawson et al., 2004; Loveland & Landry, 1986; Mundy et al., 1990), imitation (Dawson & Adams, 1984; Poon et al., 2011; Stone & Yoder, 2001), and play (Mundy, Sigman, Ungerer & Sherman, 1987; Ungerer & Sigman, 1984). Given the significance of social interactions, it is important to further define those behaviors that contribute to reciprocal social interactions (i.e., joint attention and other nonverbal communicative behaviors) and evaluate their role in language development.

Joint Attention & Language

Joint attention refers to the ability to coordinate attention with another person with reference to an object or event (Mundy & Hogan, 1994). Joint attention behaviors typically include the coordination of eye gaze with pointing or showing an object or event to another person. Included in the definition of joint attention is that the function of this triadic relationship must be to share an experience (protodeclarative) and not to request (protoimperative; Kasari, Sigman, Mundy & Yirmiya, 1990; Mundy, Kasari & Sigman 1992; Tomasello, Carpenter & Liszowski, 2007). The use of joint attention behaviors (i.e. gestures combined with coordinated attention) begins to emerge between 8 and 13 months of age in typically developing children (Bakeman & Adamson, 1984; Bates et al., 1979). Studies comparing the joint attention behaviors of children with autism to the behaviors of children with intellectual disabilities (ID) have revealed that the joint attention deficits are unique to autism (Loveland & Landry, 1986; Mundy, Sigman, Ungerer & Sherman, 1986). For example, Mundy et al., (1986) used the Early Social Communication Scales (ESCS; Seibert & Hogan, 1982) to assess both indicating (i.e., joint attention) and requesting behaviors exhibited by children diagnosed with autism and children with ID. The indicating behaviors evaluated included pointing, showing or making eye contact with the examiner while holding an object or watching the object in motion. Results of the Mundy et al. (1986) study revealed that children with autism show significantly fewer joint attention behaviors that require shifting focus between a toy and a person than do children with ID. These results corroborated those of Loveland and Landry (1986), which demonstrated that differences in joint attention abilities between

children with autism and those with intellectual disabilities are not a function of mental age or level of language.

Joint attention has received a great deal of consideration in the autism literature, not only as reliable way to discriminate children with autism from other disorders but also because of the link between joint attention and language development (Loveland & Landry 1986; Mundy et al., 1990). The ability to coordinate attention between people and objects or events in the environment has been linked with social-cognitive skills that serve an important role in language acquisition (Bates et al., 1979; Bruner & Sherwood, 1983). For example, Mundy, Sigman, and Kasari (1990) utilized a longitudinal design to investigate the value of joint attention in later language development. In this study the ESCS was used to measure the frequency of social, joint attention and requesting behaviors. Results revealed that children with autism exhibited significantly fewer gestural joint attention skills than language matched and mental age matched intellectually disabled controls. Furthermore, the results showed that gestural joint attention behaviors were correlated with language at the time of testing as well as a significant predictor of later language acquisition (across a 13-month period).

Research on joint attention and language suggests that children with autism may experience both deficits in language and joint attention abilities. However, the relationship between the two factors may be more complex than one predicting the other. Social difficulties experienced by children with autism may further compound impairments in joint attention and language development. It has been suggested that language acquisition may be stunted by limitations in the social precursors of language

(Sigman & Ruskin, 1999). Given this evidence, more research is required in order to fully understand the relationship between social behaviors and language.

Social Impairments in Autism

Social impairments have been a defining feature of autism since Kanner (1943) first described the behavior of eleven children who exhibited “extreme aloneness from the very beginning of life, not responding to anything that comes to them from the outside world” (p.248). Kanner noted that while these children had a limited interest in the social environment, they were often very interested in idiosyncratic aspects of the environment. For example, a child may not recognize his or her parents when they came into a room but would become upset when the furniture in the room was rearranged. Since Kanner’s description, social deficits have been described time and time again in persons with autism (e.g., Lord & Hopkins, 1986; Mundy, 1995; Sigman & Ruskin, 1999; Wing & Gold, 1979). Howlin (1986) further described the social abnormalities of children with autism as both severe and persistent.

Children with autism are often described by others (e.g., parents) as aloof or disengaged (Wing & Gold, 1979). The description of the social interactions of individuals with autism is consistent with studies showing that children with autism show less positive affect than do typically developing children (Kasari et al., 1990; Loveland, 1987; Yirmiya, Kasari, Sigman & Mundy, 1989). Contributing to the feeling of social disengagement, children with autism tend to display more neutral and interest expressions that are less vivid than those of positive and negative affect (Yirmiya et al., 1989) and are less likely to smile while looking at another person (i.e., do not integrate smiling with eye gaze; Dawson, Hill, Spencer, Galpert & Watson, 1990). Although children with

autism display few instances of positive affect during social interactions with others, they often will exhibit positive affect expressions while playing alone (Snow, Hertzig & Shapiro, 1987), further highlighting their lack of interest in social exchanges.

As with other skills and deficits in autism, the pattern of social deficiencies varies greatly from one individual to the next. It is not the case that every person with autism is uninterested in other people (Lord, Storoschuk, Rutter & Pickles, 1993), however the social behavior of individuals with autism is rarely described as “normal” (Volkmar, 1987). While the degree of abnormality may vary individually, several social behaviors are impaired in the majority of individuals with autism. These behaviors include gaze, joint attention, play, attachment, peer relations and affective development (Carter, Davis, Klin & Volkmar, 2005). Behaviors that create a social learning opportunity for the child by fostering intersubjectivity, or a feeling of connectedness, in the interaction may play in an important developmental role (e.g., may contribute to language acquisition). Evidence suggests that the social behaviors most relevant to creating an interaction that is reinforcing to both the child and social partner are eye gaze, joint attention and affective development (Mundy et al., 1992).

Eye Gaze

Children with autism often have two notable difficulties with eye gaze: following the gaze of others and integrating eye gaze with other communicative behaviors. Following the gaze of another person has implications for later language development and thus plays an important role in the social interactions of young children. At about 18 months of age, typically developing children predominantly rely on the speaker’s direction of gaze strategy in learning the labels for objects (Baron-Cohen, Baldwin &

Crowson, 1997). The speaker's direction of gaze strategy requires the child to follow the eye gaze of the speaker to determine to what a word refers. Baron-Cohen et al., (1997) found that children with autism instead use their own direction of gaze in determining the referent. In other words, children with autism will assign the label to the object that they are attending to without regard for where the speaker is looking. The authors propose that this may lead to the use of neologisms or idiosyncratic language in children with autism. Disregard for the speaker's direction of gaze may also lead to the child missing learning opportunities that are provided within social context. If the child remains focused on the objects for which he or she has a preference, it may not only lead to mislabeling these objects but also may inhibit the child's ability to learn the names for novel items in a naturalistic manner. In short, looking at the face or eyes of another person provides a learning context that may facilitate language acquisition and this skill appears to be attenuated in children with autism.

The other marked difficulty exhibited by children with autism with regard to eye gaze is in the combination of eye gaze and other verbal and nonverbal behaviors. In typical development, children will often emit gestures while making eye contact with a social partner or alternating their gaze between the social partner and the adult; these behaviors may also be accompanied by a vocalization (Iverson & Thal, 1998). Studies have shown that children with autism not only exhibit eye contact less often than typically developing children (Sigman et al., 1986; Stone, Ousley, Yoder, Hogan & Hepburn, 1997) but also use less complex combinations of behaviors (e.g., eye gaze with vocalizations and gestures) to communicate with others (Stone et al., 1997). Furthermore, in studies of peer interactions, it has been noted that children with autism are less likely

than controls to smile and coordinate other behaviors when giving something to or greeting another person (Lord & Hopkins, 1986; Lord & Magill-Evans, 1995). Hobson and Lee (1998) suggest that difficulties in initiating interactions and coordinating different behaviors may be representative of an individual's motivation (or lack thereof) to take part in an intersubjective interpersonal engagement. Limited attempts to initiate interactions and a paucity of complex coordinated behaviors often characterize the social interactions of children with autism may be indicative of specific social impairments that impact development.

Joint Attention & Social Interactions

Joint attention was described above with regard to language acquisition. However, these behaviors also help to create a sense of intersubjectivity in social interactions with others. Although diagnostic tools for autism have become more refined and early diagnosis is now possible, historically children did not receive an autism diagnosis until 2 to 3 years old (Johnson & Meyers, 2007; Werner, Dawson, Osterling & Dinno, 2000). To investigate those years before a diagnosis was given, researchers have utilized retrospective analyses of home videos and prospective studies with infants who are at risk of a later diagnosis (e.g., siblings of autistic individuals). In a retrospective review of video recordings from children's first birthday parties, Osterling and Dawson (1994) coded social (e.g., looking at a person, smiling at someone and imitating), affective (e.g. distress and tantrums), joint attention and communication behaviors (e.g., babbling and gestures). The results revealed that even before the age of one year, children with autism had difficulties with eye contact, joint attention behaviors and orienting to speech. Osterling, Dawson and Munson (2002), replicated these results, finding that

children later diagnosed with autism engaged in fewer social and joint attention behaviors than children who were later diagnosed with intellectual disabilities. Taken together, the results of these studies demonstrate that social and joint attention impairments are present in children with autism even before their first birthday. Impairments in social and joint attention behaviors at such early stages in development may affect a child's ability to engage with others and hinder their capacity to form social relationships (Carter, Davis, Klin & Volkmar, 2005) which may in turn, limit their social learning opportunities.

Affective Development

Like joint attention behaviors, the ability to share affective states (i.e., expressing emotions using vocalizations, gestures and facial expressions) with others develops within the first two years of life. Adamson and Bakeman (1982), posit that deficits in joint attention may be related to disturbances in affective sharing. Kasari, Sigman, Mundy and Yirmiya (1990), evaluated this hypothesis by examining the association of shared positive affect in the context of both joint attention and requesting behaviors. The results confirmed that typically developing children use a higher percentage of positive affect directed to the adult when engaging in joint attention behaviors when compared to requesting behaviors. That is to say, typically developing children more frequently shared positive affect (e.g., enjoyment or surprise) with an adult when indicating interest or sharing in an experience than when requesting help with obtaining or activating a toy. In contrast, children with autism did not show different rates of affect between the two contexts. In other words, children with autism showed similar rates of positive affect in both joint attention and requesting situations. Moreover, the children with autism showed less positive affect than typically developing children irrespective of the communicative

context. While it is evident that children with autism engage in fewer instances of both joint attention and sharing affect, the direction of this relationship is unclear. It may be the case that children with autism, in general, display less positive affect in their interactions with others, resulting in fewer instances of joint attention. However, the reverse is also plausible; deficits in joint attention abilities may lead to decreased sharing of positive affect. The authors do not specify the direction of the relationship but rather posit that affect and joint attention are integrated in development.

The Importance of Social Interactions

Numerous studies have called attention to the importance of social input via positive social interactions on developmental processes (e.g., language acquisition). The early nonverbal communication behaviors, especially those related to joint attention, have been implicated in facilitating social learning opportunities. A large body of research on the relationship between joint attention and other nonverbal communicative behaviors has demonstrated the importance of these behaviors in both typical and atypical development. For example, in a longitudinal study of young children (14 – 17 months old) the ability to follow the gaze and pointing of the examiner (i.e., responding to joint attention) was found to be a significant predictor of receptive language development and initiating joint attention predicted expressive language at follow-up (16 weeks after the initial assessment; Mundy & Gomes, 1998). Furthermore, joint attention behaviors may contribute to the sense of intersubjectivity that leads to the development of positive social relationships (Mundy & Willoughby, 1998). For example, Mundy & Hogan (1994) found that children who had more negative social behaviors, assessed via parent report on the Autism Behavior Checklist (Krug, Arick & Almond, 1980), engaged in fewer joint

attention interactions with an examiner during the ESCS. In light of recent research, Mundy and Neal (2001) have proposed a developmental model of autism that suggests that the early social impairments inherent to children with autism deprive the child of social input that is essential to development and that this deprivation affects normal brain and behavioral development.

The social orienting model described by Mundy and Neal takes into consideration the developmental impact of joint attention. From this perspective, joint attention behaviors contribute to the refinement of a self-organizing process that allows children to process stimulation that in turn allows them to initiate and participate in social learning opportunities. Viewing the child as an active participant contrasts with the ToM perspective which views joint attention not as self-organizing but rather as a single core deficit brought about by impairments in meta-representational abilities. The social orienting model thus highlights the long-term impact that early experiences have on behavior.

A crucial tenet of the social orienting model is that early experience drives postnatal brain development. This idea is based on the theory that over time neural mechanisms have evolved to take advantage of typical environmental stimulation (Golttlieb, 1991). In other words, the brain is organized in a way that makes it ready to process certain types of stimuli that are ubiquitous in typical human environments. The ability to process species typical environmental stimulation that then affects development is referred to as experience-expectant neural development (Greenough, Black & Wallace, 1987). Greenough et al., state that in order for experience-expectant development to occur there must be an excess of synaptic connections among neurons that are refined

based on an individual's experiences. During synaptogenesis, environmental stimulation activates functional synapses that are retained while those that are not activated are lost. The process of neural organization relies on an individual being exposed to species-typical stimulation, as it is during this time that the foundation for future development is formed. Abnormal patterns of stimulation during synaptogenesis may impact future neural and behavioral development.

During the experience-expectant process of development described above, the child is an active participant. Greenough et al. (1987) suggest that infant participation in acquiring and organizing experience is essential if this process is setting the stage for future experience-dependent processes. In other words, the stimulation required for some of the experience expectant processes of typical development rely on the infant producing that stimulation. The active role of the child in experience expectant processes has been utilized and described in social orienting models of social impairments in autism. Mundy and Neal (2001), propose that social orienting and joint attention may be infant self-organizing behaviors that are of critical importance to experience expectant processes. Furthermore, the authors suggest that early impairments in these behaviors seen in children with autism may lead to a deprivation of social information input that is necessary for the developing neurological system.

Mundy and Crowson (1997) also use the active role of the child in experience expectant processes to describe a negative feedback system whereby early deficits in social orienting lead to atypical experience expectant processes responsible for social behavior and social-cognition development. In this model the attenuation of social input represents an Initial Pathological Process (IPP) that gives rise to Secondary Neurological

Disturbances (SNP). The combined effects of the IPP and SNP feedback on the developing system move the child further from the path of typical development. In other words, the early social deficits of children with autism lead to atypical neuroanatomical development that in turn results in abnormal behaviors that further disturb the system. The negative feedback model described underscores the importance of characterizing the social interactions of children with autism. By identifying those social behaviors a child has difficulties with, it may be possible to intervene early before the child has drifted significantly from the typical developmental path.

Characterizing the Interactions of Children with Autism

In addition to deficits in social interactions and receptive and expressive language abilities, children with autism also typically show impairments in the use and understanding of nonverbal forms of communication. Research has shown that children with autism communicate for different reasons and use different nonverbal behaviors than do control groups. Interest in further defining the specific characteristics of children with autism has led to a vast amount of research evaluating the function and types of nonverbal behaviors used by children with autism.

Nonverbal communication behaviors have been separated into two distinct classes based on their function: those that function as requests and those that function to share enjoyment (i.e., joint attention). Although both requesting and joint attention bids may involve the use of the same nonverbal behaviors (e.g., pointing and eye gaze), a distinction is made between those behaviors that function as requests and those that are used to share enjoyment. Research on the communicative use of these behaviors has demonstrated that children with autism use nonverbal behaviors more for the purpose of

requesting than in the context of joint attention (Curcio, 1978; Mundy, Sigman & Kasari, 1994; Sigman et al., 1986; Stone & Caro-Martinez, 1990). For example, Mundy et al. (1986) found that children with autism engage in similar amounts of eye contact as controls while requesting but show less eye contact to coordinate attention between an adult and a toy.

To further characterize the behavior of children with autism, joint attention behaviors are broken down into two categories; responding to (RJA; attention following behaviors) and initiating (IJA; attention directing behaviors). Dichotomizing joint attention behaviors according to response and initiations has demonstrated that children with autism show greater impairments in IJA than RJA (Mundy, 1995; Mundy & Newell, 2007; Nation & Penny, 2008). Thinking about the consequences of these two forms of joint attention responses illustrates why IJA is more affected than RJA in children with autism. While both varieties of joint attention involve social stimuli, instances of RJA may result in the child's attention being drawn to some nonsocial stimulus that is reinforcing. On the other hand, IJA requires the child to begin an interaction with another person for purely social means and the resulting social consequence is presumably a less powerful form of reinforcement for the child's behavior.

Social-Emotional Approach Behaviors

As was previously mentioned, children with autism display an attenuation in initiating joint attention interactions, solely for the purpose of sharing, with others. In order to describe joint attention, the term social-emotional approach (SEA) behaviors has been used to refer to those behaviors that allow a child to initiate shared positive affect through joint attention bids (Fox, 1991; Mundy, 1995). Social-emotional approach

includes behaviors such as looking at the faces of others, expressing affect (e.g., smiling and laughing), reaching and commenting (Bates, Camaioni & Volterra, 1975; Mundy, 1995). Mundy (1995), distinguishes SEA behaviors from others behaviors that may be social in nature by highlighting the motivational processes for engaging in SEA behaviors.

In an effort to understand why typically developing children initiate bids for joint attention more frequently than do children with autism it is important to examine the motivational processes involved. As was mentioned above, the consequence of initiating joint attention bids with others is exclusively social in nature (e.g., affective sharing between the child and social partner). It has been suggested that these social responses are inherently rewarding to children and thus motivate them to emit SEA behaviors (Dawson et al., 2004; Moore & Corkum, 1994). From this line of thinking it may then be inferred that children with autism do not find the resulting social stimuli reinforcing and thus do not emit SEA behaviors with the same frequency as typically developing children. In other words, a child is only going to emit SEA behaviors to the degree that they find the resulting social stimuli reinforcing (Mundy, 1995).

Measuring & Quantifying Social Behavior

The concept of motivation is frequently employed to explain the behavior of children with autism. However, the concept of motivation is not well defined or empirically validated in the literature. Although social motivation has not been directly assessed in the literature, studies utilizing joint attention assessments and other behavioral coding schemes of interactions can shed light on how to measure and quantify behaviors that may be indicative of a child's social motivation.

A variety of qualitative and quantitative measures have been used to define the social interactions of children with autism. Findings from studies measuring qualitative aspects of interactions have indicated that children with autism may use different nonverbal communication behaviors with peers versus adults (Hauk et al., 1995), combine eye contact with other behaviors less frequently than typically developing children (Phillips, Gomez, Baron-Cohen, Laá & Rivière, 1995; Wetherby, Cain, Yonclas & Walker, 1988) and may use some behaviors more in one communicative context than in another (Mundy et al., 1986, Stone & Caro-Martinez, 1990). Studies measuring quantitative aspects of behavior have aided in determining the role of joint attention in language development and the developmental trajectory of nonverbal communication measures (Dawson et al., 2004; Loveland & Landry, 1986; Mundy et al., 1990; Siller & Sigman, 2008). Both qualitative and quantitative accounts of behavior have proven useful in characterizing the behavioral profile of children with autism and are important in understanding not only when and how children with autism use these behaviors but also how these behaviors impact developmental trajectories.

One way to measure joint attention behavior is to use structured assessments like the ESCS (Mundy et al., 2003). Measures of joint attention from the ESCS have been used to compare the behavior of typically developing children and children with autism and as well as to predict current and future language development. Specifically, behaviors are coded as joint attention, behavioral requests or social interaction behaviors (e.g., turn taking). These behaviors are further classified as either child initiated or as a response to the examiners prompt. The ESCS is among the most frequently used measures of nonverbal communication in children with autism but other naturalistic play sessions

have also been used to reliably measure IJA and RJA. Coding of the ESCS consist of counting the frequencies of behaviors based on their perceived function. For example, Roos, McDuffie, Weismer and Gernsbacher (2008), developed a coding scheme to measure IJA and RJA in the context of a naturalistic examiner-child play session. During the play session, the examiner and the child played with a standard set of toys, however the examiner did not provide any specific prompts or presses for the child but instead followed the child's lead and causally tried to engage the child in a variety of activities. The authors compared the frequencies of RJA and IJA behaviors emitted during the play session and standard ESCS administrations and found significant positive correlations between the two assessments. Results from this study provide evidence that joint attention behaviors can be coded from play sessions where the context is not specifically designed to elicit these types of behaviors.

Measures of IJA and RJA are commonly used to evaluate the nonverbal communicative behaviors of joint attention. However, engagement states have also been used to characterize the social interactions of children with autism. Bakeman and Adamson (1984) describe a system of coding engagement states in terms of the child's engagement with objects and people. The authors use six mutually exclusive categories to characterize engagement behavior: unengaged, onlooking, person, passive joint and coordinated joint. Measuring joint attention behaviors using engagement states provides another way to assess the qualitative aspects of joint attention interactions. Coding engagement states can also provide a sense of how much time children spend participating in different types of social and nonsocial interactions in play settings. For example, Lewy and Dawson (1992) used engagement state coding to evaluate child-

examiner play sessions. The results of this study were consistent with other studies indicating that children with autism show pronounced deficits in joint attention behaviors. Furthermore, the authors found that children with autism were more socially unengaged and spent more time directing their attention to objects. The authors suggest that children with autism may spend more time engaged with objects as opposed to with people because of the stimulation provided by object engagement is predictable whereas the social stimulation provided by person and joint engagement is novel and unpredictable. Alternatively, these findings could be interpreted as providing an indication of the reinforcing value of the stimulation provided by object versus person engagement.

II. THE CURRENT STUDY

Given the importance of social stimuli to language development, the current study aimed to evaluate a behavioral coding scheme of child approach behaviors that capture the degree to which children engage with others (study 1) and how these behaviors relate to concurrent and future language development (study 2). The focus of the current study was on behaviors used to both initiate and respond to the social bids of others to determine the extent to which interest in social stimuli impacts language development. Research has demonstrated that children with autism show a paucity of social behaviors compared to typically developing children and the current study aimed to further describe and evaluate the role of social behaviors in development.

Coding Social Behaviors

Motivational processes are commonly employed to explain the behavior deficits of children with autism (e.g., Dawson et al., 2004; Mundy, 1995; Mundy & Neal, 2001). However, no clear definition of social motivation has been presented. Furthermore, social motivation is rarely the direct focus of empirical investigations. There is a vast amount of research on motivation that implicates a variety of intrinsic and extrinsic factors that can influence an individual's behavior. With regard to the autism literature, motivation seems to be described most often by the effects the consequences of a class of behaviors (namely social behavior) have on the likelihood that the child will engage in those behaviors. In other words, it has been suggested that children with autism do not engage in social behaviors because they do not find the resulting social stimuli reinforcing (Dawson et al., 2004; Mundy, 1995). Dube, MacDonald, Mansfield, Holocomd and Ahearn (2004) provide a behavioral account of this interaction where an interesting event

in the child's environment functions as a motivating operation for the child to engage in behaviors that gain an adult's attention. The attention provided by the adult in this sequence may serve as a reinforcer or as a discriminative stimulus indicating that adult will engage in a social interaction with child that is presumably reinforcing. It is through this continued pairing that a history of reinforcement for joint attention behaviors begins to emerge and the likelihood that the child engages in these behaviors for the purpose of sharing attention increases (to the extent that the social consequences reinforce the child's behavior).

Social interest is another term that is frequently used interchangeably with social motivation in the autism literature. Social interest has been defined as an "interest that primes people to want to be with others, to look at others and to relate to others on a personal level" (Grelotti, Gauthier, Schultz, 2001). It is social interest that motivates people to look at the faces of others and a reduction in this interest has been used to explain why children with autism do not process faces in the same way as typically developing children (Klin et al., 1999). In an evaluation of an intervention to increase social interest in children with autism, Heiman, Laberg and Nordoen (2006), defined social interest using three behaviors: touch, looking at a person and requests. These behaviors were measured as frequencies during a still face interaction with an examiner and later summed to form a composite score of social interest. Defining social interest by including requests expands the idea of social behaviors beyond only those that function to elicit adult attention (i.e., joint attention behaviors). Expanding the definition in this manner is helpful in further defining the social behavior of children with autism. The inclusion of requests in the definition of social interest allows for the behavior of children

who even avoid social stimuli when the resulting consequence is nonsocial to be evaluated separately from children who do engage in social requesting behaviors. Children who avoid all social interactions (both joint attention and requesting) may demonstrate even greater language impairments than those children who engage in some social behaviors.

While social motivation and social interest have been used interchangeably at times, they are often defined in slightly different manners. Implied definitions of social motivation generally are defined by the function of a behavior (i.e., joint attention behaviors but not requests) whereas social interest definitions may include behaviors that serve both goals. What is common amongst both definitions is idea that the child initiates these behaviors. Difficulties in initiations have been reported in a variety of contexts and with a variety of social partners in the literature. The pronounced deficits in initiating behaviors that function to share enjoyment have led to the conclusion that these behaviors are most relevant to the idea of social motivation. Although children with autism use joint attention behaviors less often than requesting behaviors, a careful review of the literature reveals that there is also evidence that suggests that children with autism use requesting behaviors less than typically developing children with both parents and examiners (Mundy et al., 1986; Sigman et al., 1986). The maintaining consequences of joint attention and requesting behaviors (i.e., social versus nonsocial) may partially explain the differences between rates of these two forms of behaviors. However, requesting behaviors nevertheless also involve a social component that requires both partners to be attending to the same object (Adamson & Chance, 1998). Requesting behaviors involve initiating an interaction with another person that may, theoretically, foster some language

learning opportunities, which may contribute to language acquisition. Considering the social learning opportunities inherent in requesting behaviors, it is important to include these behaviors, as well as joint attention behaviors, when evaluating the role of social interactions in language development.

The current study utilized a behavioral coding scheme for social approach behaviors that quantified the social initiations and responses emitted by children without inferring the function of the behavior. In other words, behaviors that were initiated by the child were separated from behaviors that occurred in response to another person. All initiating and responding behaviors were coded regardless of function. Behaviors were not distinguished on the basis of perceived function (i.e., requesting behaviors were not separated from joint attention behaviors). As has been mentioned previously, the same nonverbal communication behaviors are often used for both joint attention and requesting and the child's intent may at times be ambiguous and difficult to decipher. Imagine the case where the examiner and child are playing with a wind up toy. The examiner winds up the toy; it begins to move, and the child points at the toy and looks at the examiner. These behaviors may be used to say, "Do you see that!" (shared enjoyment) or alternatively, "Can I have that?" (request). It is the hypothesis of this study that initiating behaviors that are socially mediated, irrespective of function, serve to provide a child with more exposure to shared language that will aid in language development.

Language Exposure

It has been emphasized that participation in social interactions results in learning opportunities that are important for language development, however, it is important to keep in mind that in order to benefit from social interactions the child must be an active

participant. Language learning opportunities require that a child not only be exposed to language but also that the child is attending to the language of a social partner and coordinating his or her attention with that of a communicative partner. The link between socialization and language learning has been demonstrated by numerous studies that have investigated how children with autism respond to auditory stimuli and the role of shared attention in language development (e.g., Dawson et al., 2004; Loveland & Landry, 1986). One notable finding is that children with autism show a paucity of orienting to auditory stimuli, including speech. For example, retrospective studies of home videos have found that children with autism rarely respond to their names being called (Baranek, 1999; Osterling & Dawson, 1994; Osterling, Dawson & Munson, 2002; Werner et al., 2000). Additionally, whereas typically developing children prefer the sound of child directed speech (i.e., motherese) children with autism prefer listening to non-speech sounds (Kuhl, Coffey-Corina, Padden & Dawson, 2005). With regard to language acquisition, attending to the speech of others provides an important first step from which more complex skills can emerge.

The second important component to language learning is shared attention between the child and a social partner. Adamson and Chance (1998) outline a developmental path of coordinated attention whereby infants first begin to attend to people in their environment who are behaving in ways that cultivate the child's interest. Next, as children begin to manipulate objects in their environment, their attention moves away from people to objects. When infants begin to show an increased interest in objects, parents and caregivers may insert themselves into their child's engagement with these objects, for example making a doll that their child is holding talk, but the child's attention

remains focused on the object. Finally, a developmental shift occurs as the child begins to coordinate his or her attention between people and objects by alternating their gaze between an object and a person. For children with autism, there appears to be an imbalance with regard to attention to objects and to people. Deficits in sharing attention, most notably in the context of joint attention, may limit the amount of information that a child receives during a social exchange which in turn impacts language acquisition (Adamson & Chance, 1998). It is in the context of shared attention that an adult's language can be meaningful for a child and aid in vocabulary acquisition.

According to the social motivation and social orienting models of autism, decreased social interest in children with autism leads to less social input and fewer social learning opportunities (Chevallier et al., 2012; Mundy & Neal, 2001). The ability to initiate and participate in social interactions has implications for the development of language and social cognition. There is a vast amount of research that has examined the role of attention to social stimuli (e.g., social orienting) and joint attention in language acquisition, but the way these behaviors affect the behavior of social partners has been relatively unexplored. The current study posits that when a child initiates an interaction, language acquisition may be facilitated since the child is being exposed to and attending to the language of a social partner. As was previously noted, the function of the child's behaviors (both initiations and responses) are not of importance; all behaviors that a child initiates with a social partner may lead to shared attention that provide language learning opportunities. Although children who do not engage in many social initiations may be exposed to a large amount of language, in terms of the amount of time a social partner spends talking, this language may serve a limited function for the child. It may be the

case that talking at a child who has not initiated an interaction may have limited utility in language learning, since he or she may not be attending to the auditory stimulation and/or have a context for what the words produced by the social partner refer to. A second aim of the current study was to investigate the relationship between amount of adult language, social approach behaviors and child language development. It was the hypothesis of this study that child social initiations moderate the relationship between language exposure and language acquisition.

Summary

Children with autism show marked impairments in social and communicative behaviors. Specifically, children with autism have trouble initiating social interactions with others in the context of joint attention. It has been suggested that the attenuation of IJA skills results from the fact that children with autism do not find the social consequences that typically follow these interactions reinforcing. While social motivational processes have been used to explain the social behavior of children with autism, social motivation is a construct that has received little empirical attention. Furthermore, although children with autism show a greater paucity of joint attention than requesting behaviors, some studies have found that children with autism also initiate requests less frequently than typically developing children, suggesting that all behaviors that are socially mediated may be attenuated in children with autism.

The current study aimed to evaluate the relationship between social initiation behaviors and language development of children with autism. It is the assumption of the current study that all child-initiated behaviors, irrespective of function, provide a social learning context for children that may lead to language acquisition. I refer to these

behaviors as social initiation behaviors. In order to code social behaviors, a novel behavioral coding scheme was devised that coded both social initiations and social responses during the course of an ADOS administration. The combined rate of both social initiations and social responses is referred to as social approach behaviors. The first part of this study assessed the reliability and validity of this coding scheme by comparing it to existing measures of socialization on the Social Responsiveness Scale (SRS; Constantino, 2002) and socialization subscale of the Vineland Adaptive Behavior Scales, Survey Edition (VABS; Sparrow, Balla & Cicchetti, 1984). Correlations between my coding of social approach behaviors and existing parent report measures of socialization will help establish the validity of the observational coding of child behaviors. The second part of the current study focused on social initiations and social responses separately to determine how these behaviors are related to language development. One purpose of this study was to determine if social initiations predict concurrent language. Theoretically, children who engage in more social initiations should have better language skills because they would have been exposed to more language learning opportunities. I also hypothesized that social initiation behaviors moderate the relationship between amount of language exposure and future language acquisition. Social initiations may make the language of a social partner more salient in that the child and social partner are attending to the same stimulus and the child is oriented to the auditory stimulation provided by the adult. When the child does not initiate a social interaction, the social partner may be talking at the child but the child may not be attending, limiting the learning value of the exchange.

Purpose

The current study aimed to (a) devise a behavioral coding scheme that captures a child's social approach behaviors; (b) assess the validity of the behavioral coding scheme by comparing it to existing parent report measures of socialization; (c) determine if social initiation behaviors predict concurrent receptive and expressive language abilities; (d) gauge the amount of language a child is exposed to during an administration of the ADOS; and (e) evaluate the relationship between social initiations, language exposure and language acquisition.

Significance

Early intervention programs have engendered hope in changing the developmental trajectory for children with autism. Preschool children with autism who participate in early intensive behavioral intervention (EIBI) programs have shown gains in IQ and other outcome measures (Mundy & Crowson, 1997). It should be noted however, that many of these differences are seen at the group level and individual progress varies greatly from one child to the next (Howlin, Magiati & Charman, 2009). Determining the child variables that contribute to success in early intervention programs is essential to tailoring these programs to meet the needs of each individual.

Early Intensive Behavioral Intervention Programs

The National Research Council (2001) recommends that children with autism, under the age of 8, receive educational services that include a minimum of 25 hours per week for 12 months a year. These services should include engaging the child in systematically planned activities that are aimed at achieving an identified objective. The National Standards Report extends these recommendations by suggesting that educational

programs should be using Established Treatments, based on the literature. Early intensive behavioral intervention programs have been identified as an established treatment and are often recommended to families of young children with autism (Reichow, Doehring, Cicchetti & Volkmar, 2009).

Metaanalyses of EIBI programs have demonstrated that treatment models vary slightly from one study to the next. Some factors however, remain fairly common amongst the majority of EIBI programs: (a) the treatment is comprehensive and addresses all skill domains focusing specifically on the individual skills and deficits of the child, (b) relies on behavior analytic procedures to increase functional behaviors and reduce maladaptive behaviors, (c) is directed and supervised by at least one person with advanced training in applied behavior analysis and specifically with implementing these procedures with children with autism, (d) developmental sequence is considered in the selection and order of treatment targets, (e) parents are active participants in the child's treatment, (f) a 1:1 student to therapist ratio is initially utilized before small group and large group instruction are introduced, (g) treatment takes place in the home and is then generalized to the classroom and other community settings, (h) instruction is intensive, meaning that the child takes part in direct instruction for 20 to 30 hours per week and continues in these treatments year round, and (i) children begin taking part in these interventions early in development, generally in the preschool years (Green, Brennan, & Fein, 2002).

Predictors & Outcome Measures of EIBI

Advancements in the fields of cognitive psychology, neuroscience, genetics and applied behavior analysis have lead to improved methods for early identification and

effective treatments which culminate in better prognosis for children with autism (Dawson, 2008). Recent research has suggested that children who participate in EIBI programs show gains in IQ, language abilities and adaptive behavior (Magiati, Tay & Howlin, 2012; Reichow, 2012; Reichow, Barton, Boyd & Hume, 2012). While these results are promising, these studies all show differences at the group level without accounting for the vast variability in responding across individuals (Howlin et al., 2009). Vivanti, Prior, Williams and Dissanayake (2014), suggest that research on EIBI programs align itself with procedures used in the evaluation of treatment effectiveness in medical research. In medical intervention studies, the focus is initially broad (i.e., does the treatment work for the condition) and then becomes more focused (i.e., what factors are associated with different outcomes). In other words, the treatment is first evaluated at the group level and then the individual factors responsible for differential responding to the treatment are assessed. In keeping with this progression, the time has come for EIBI research to focus on those specific abilities that lead some children to respond positively to treatments (“responders”) and others to show less significant gains (“non-responders”; Vivanti et al., 2014). These authors suggest that as research moves towards identifying the profiles of these two groups of children the focus must shift to identifying those factors that function as mediators or moderators of treatment and determining theory driven predictors and outcome measures that are less broad than the typical constructs employed (e.g., IQ).

Mediators & Moderators. The child variables typically used as predictors of response to treatment in EIBI programs are IQ and autism severity. Lord et al., (2005) suggest that these variables do not tell us about how a child will respond to treatment but

rather provide an indication about the relationship between these characteristics and developmental trajectories. The authors suggest that in order to discern those factors that lead some children to be responders, the statistical relationship between specific characteristics and treatment must be investigated. Mediation and moderation models may inform the type of child that will respond to different program models. For example, in a recent study evaluating the efficacy of different preschool models for children with autism spectrum disorders (ASD), Boyd et al., (2013), found that pretest scores on the Mullen Scales of Early Learning (Mullen, 1995), moderated the effects of the TEACCH model on children's autism severity. Specifically, children participating in TEACCH classrooms with lower cognitive abilities at pretest showed greater improvements in autism severity. The authors suggest that this finding may be a result of the fact that children with lower cognitive abilities also displayed greater autism severity at pre and therefore had more room to show improvement on this measure. Or alternatively, this finding may suggest that the environmental and behavioral supports used in TEACCH classrooms may be more beneficial to children who have greater cognitive impairments. While both explanations are plausible, this study begins to explore those individual variables that contribute to the effectiveness of a specific intervention.

Theory Driven Measures. Determining the variables that mediate or moderate treatment effectiveness is an important next step in evaluating and improving EIBI programs for children with autism. In order to identify those variables that may possibly function as either mediators or moderators, researchers need to focus on the proximal factors that have been shown to support learning; specifically those processes that are

related to social learning (e.g., social motivation) in typical development (Vivanti et al., 2014).

Various developmental theories of autism have posited that a child's early disinterest in social interactions, leads to a deprivation of social input which in turn pushes the child away from the path of typical development (Dawson, 2008; Mundy & Crowson, 1997; Mundy & Neal, 2001). These models suggest that early social interactions are essential to normal brain and behavioral development. Dawson (2008) hypothesizes that early risk processes (i.e., limited social interactions) mediate the relationship between early susceptibilities and later outcomes. Furthermore, Dawson suggests that interventions should target these risk processes involving the interaction of the child with a social partner in order to bring the child back toward to the path of typical development.

With such emphasis placed on the role of early social interactions in both typical and atypical development it follows that a measure of social interaction should be included in the assessment of EIBI programs. Recent studies using measures of social interactions such as, type of reinforcers (Klintwall & Eikeseth, 2012), joint attention skills (Kasari, Gulsrud, Freeman, Paparella & Helleman, 2012) and approach behavior (Sherer & Schreibman, 2005) have demonstrated promising results; suggesting that these factors may be indicative of those children who are "responders" and those who are "non-responders." For example, Sherer and Schreibman (2005) evaluated pivotal response training (PRT) for 6 children (3 responders and 3 non-responders). Children were designated as a responder or non-responder prior to intervention, based on the following behaviors: functional play, approach behavior, avoidant behavior, and self-stimulatory

behavior. The authors found that the two groups of children responded differently on all outcome measures (language, social behaviors and play behaviors) after exposure to the PRT intervention. These results suggest that it may be possible to identify children that will respond better to certain intervention models prior to choosing a treatment for that child.

Summary

The observational coding of social approach proposed in the current study uses a frequency count of social-communicative behaviors emitted by a child during an administration of the ADOS. This coding quantifies social approach behaviors in a way that is not easily discernable from the standardized ADOS coding. Frequency counts of a variety of socially mediated behaviors may yield more precise information about how often the child engages with a social partner throughout the course of an ADOS. This will aid in identifying individual differences in these behaviors amongst children on the autism spectrum that may influence behavior in a variety of other domains (e.g., response to intervention and language acquisition). The ADOS provides the ideal platform to assess these behaviors since it is generally part of a child's diagnostic or treatment evaluation. Coding the ADOS using a social approach behavioral coding scheme can further enhance the utility of the ADOS in the assessment of children with autism by providing a way to discern a child's social motivation and identify those behaviors that are most impaired.

III. METHODS

Overview

The parent project of the current study is a four-year, multi-site study that was federally funded by the Institute of Education Sciences (IES). The parent project was carried out in public school classrooms in four states including North Carolina, Florida, Colorado and Minnesota. The overarching goal of the larger project was to contribute to the improvement of cognitive, communicative, academic, social and behavioral outcomes of preschool-aged children identified with ASD and their families.

Inclusion Criteria for Children

In order to enroll in the study, children had to meet the following criteria: (a) between 3 and 5 years of age at the time of enrollment; (b) community diagnosis of ASD or educational label consistent with ASD or developmental delay; and (c) meet diagnostic criteria on the ADOS and/or Social Communication Questionnaire (SCQ; Rutter, Bailey & Lord, 2003). Children with significant uncorrected vision or hearing impairments, uncontrolled seizure disorder or traumatic brain injury were excluded from the study. Lastly, the child's parents had to be proficient enough in English in order to complete parent-rating scales.

Participants

Participants for the current study were ascertained from the completed multi-site study described above. Only those participants who had a video recorded administration of the ADOS Module 1, conducted during the initial testing (at the beginning of the academic year) were included in the current study. A total of 39 participants from the Miami site met the inclusion criteria. The sample consisted of 5 females and 34 males

between 3 and 5 years of age (mean age 48.1 months). The participant's parent reported the following ethnicities and races: non-Hispanic (n = 31; 79.5%); Hispanic (n = 8; 20.5%); White (n = 33; 84.6%); Black (n = 2; 5.1%); and Bi/Multi-Racial (n = 4; 10.3%).

Table 1

Participant Demographics

<u>Variable</u>	<u>Level</u>	<u>Number (N = 39)</u>
Age (months)	36 – 47	19
	48 – 59	19
	60 – 66	1
Gender	Male	34
	Female	5
Ethnicity	Non-Hispanic	31
	Hispanic	8
Race	White	33
	Black	2
	Bi/multi	4

Measures

As part of the parent study, participants were administered a variety of assessments at both the beginning (October – November) and end (April – June) of the academic year. The following assessments will be used as part of the current study:

Autism Diagnostic Observation Schedule (ADOS; Lord, et al., 1999), Mullen Scales of Early Learning (MSEL; Mullen, 1995, Preschool Language Scale, 4th Edition (PLS-4;

Zimmerman, Steiner & Pond, 2002), Social Responsiveness Scale (SRS; Constantino, 2002), and Vineland Adaptive Behavior Scale – Survey Edition (VABS; Sparrow, Balla & Cicchetti, 1984). Descriptions of the psychometric properties of all assessments can be found in appendix B.

Autism Diagnostic Observation Schedule (ADOS)

A research reliable assessor administered the ADOS, Module 1, in standardized format in a small session room. The ADOS was administered at the time of enrollment (the beginning of the school year) in order to confirm diagnosis of autism or ASD. The activities in the ADOS (see appendix A) provide a structured, playful context that presents the child with ample opportunities to both initiate and respond to social interactions, making the assessment an ideal candidate for coding social approach behaviors. The ADOS provides scores for social affect and restricted and repetitive behaviors that are used to generate an autism or ASD diagnosis. As scores on the ADOS increase, this is representative of increased symptom severity. In other words, children who present with symptoms that interfere with the administration of the ADOS will have higher scores than children who emit the same behaviors to a lesser degree. For the purpose of the current study, video recorded administrations of the ADOS were coded for both child social approach behaviors and examiner language (described below).

Mullen Scales of Early Learning (MSEL)

The MSEL is designed to evaluate the developmental functioning of children up to 68 months of age. The MSEL is composed of 5 subtests: gross motor, fine motor, visual reception, receptive language and expressive language. Each subtest yields a raw score, standard score (t-score; $M = 50$, $SD = 10$), percentile rank and age equivalent.

Additionally, an overall Early Learning Composite score ($M = 100$, $SD = 15$) is also determined on the basis of performance in the fine motor, visual reception, receptive and expressive language subtests. Of particular relevance to the current study are scores on the receptive and expressive language subtests. The majority of the items on the receptive subscale require the child to respond to the examiner's verbal instruction by pointing to the correct answer or following instructions (e.g., give me the box). The expressive language subscale evaluates a child's spontaneous vocalizations (including babbling) as well as their ability to label pictures, count, and answer questions. The MSEL was administered to participants at both the beginning and end of the academic year. Scores generated from these tests will be used as a measure of language abilities both concurrently (i.e., scores at the beginning of the year will be used as a measure of language at the time of the ADOS) and later language abilities (i.e., scores at the end of the year will be used to measure language gains over the course of the academic year).

Preschool Language Scale – 4th Edition (PLS-4)

The PLS-4 is designed to measure the receptive and expressive language abilities of children birth to 6 years 11 months. The PLS-4 yields raw scores, standard scores, percentile ranks and age equivalents for auditory comprehension and expressive communication subscales. The auditory comprehension subscale evaluates how much language a child understands. Tasks include responding to name, understanding gestures, understanding single words and following simple instructions. The expressive language subscale is designed to assess a child's ability to effectively communicate using vocal and non-vocal means. As with the MSEL, the PLS-4 was administered at both the

beginning and the end of the school year and will be used as a measure of concurrent and later language abilities.

Social Responsiveness Scale (SRS)

The SRS is a 65-item rating scale that assesses a child's social initiations and reciprocity. Individual items are based on the child's behavior over the last three months and are rated as not true, sometimes true, often true or almost always true. The SRS yields a total score that is indicative of symptom severity as well as 5 subscale scores; social awareness (e.g., the ability to pick up on social cues), social cognition (e.g., the ability to interpret social cues), social communication (e.g., using gestures to communicate), social motivation (e.g., the extent to which the child is interested in engaging in social-interpersonal behavior), and autistic mannerisms (e.g., stereotypic behaviors or restricted interests). Higher scores indicate greater severity and severe interference in everyday social interactions. For the current study, both parent and teacher ratings on the SRS were considered. Scores on the SRS social motivation subscale were used to validate the observational coding of social approach behaviors during the ADOS.

Vineland Adaptive Behavior Scale (VABS)

The VABS provides a measure of adaptive and social behavior in children and adults. The interview form of the VABS uses a semi-structured interview format to gather information from parents about their child's behavior in a variety of settings. The VABS is broken down into five domains of adaptive functioning: communication (receptive, expressive and written), daily living skills (personal, domestic and community), socialization (interpersonal relationships, play and leisure time and coping skills), motor skills (fine and gross) and maladaptive behaviors (internalizing, externalizing and other).

Each domain yields a V- scale score ($M = 15$, $SD = 3$), percentile rank and age equivalent. Additionally, an overall Adaptive Behavior Composite score ($M = 100$, $SD = 15$) is also generated. Of relevance to the current study are scores on the socialization domain. As with the SRS, the socialization domain of the VABS was used to validate social approach coding.

Procedure

Recall that all behaviors, both child and examiner, will be coded from video-recorded administrations of the ADOS Module 1.

Social Approach Behavior

Seven social communicative behaviors make up the coding of social approach behavior: gaze to a person, directed vocalizations, directed smiling, directed laughing, showing, pointing and giving (see appendix C) for operational definitions of each behavior). These behaviors were chosen, in part, based on the behaviors typically coded during the social interactions of children with autism (Sigman et al., 1986; Mundy et al., 1986; Ozonoff et al., 2010; Werner & Dawson, 2005). All instances of each of these behaviors were coded without distinguishing between those behaviors that serve as requests and those that function to share enjoyment. However, behaviors were differentiated based on whether they were child initiated or occurred in response to the examiner. Any of the behaviors listed above were coded as a response when they occurred within 3s from the time the examiner provided a verbal or gestural attempt to evoke a social-communicative behavior from the child. For example, if the examiner asked the child, “what do you want” and the child pointed to a ball, this behavior was coded as a pointing response. Alternatively, if the examiner held out his or her hand and

the child gave them a toy, this behavior was coded as a giving response. All other instances of social approach behaviors were coded as initiations. For example, if the examiner was sitting and watching the child and the child looked up at the examiner, this was coded as initiating gaze. Every instance of a social approach behavior was coded as either a response or initiation.

The frequency of each of these behaviors was coded using Observer XT software. The frequencies of all the individual behaviors were summed and divided by the length of the observation to yield 3 composite rates: social initiations (Σ [*frequencies of initiations*] / *length of observation*), social responses (Σ [*frequencies of responses*] / *length of observation*) and social approach (Σ [*frequencies of initiations* + *frequencies of responses*] / *length of observation*).

Coding Parent/Examiner Language.

The amount of time either the parent or examiner spent talking to the child throughout the course of the ADOS administration was determined. Speech had to be directed at the child but may include either delivering a demand (e.g., “give me the ball”) or commenting on what the child was doing (e.g., “you found elmo!”). Observer XT was used to code the duration of parent and examiner talking. Coding began when the parent or examiner started talking to the child and ended when they had not said anything for 2s. The durations of each utterance were added together to yield the total amount of time (in seconds) the child was exposed to directed language throughout the course of the observation. Total duration was then divided by the length of the observation to generate a percentage of time the child was exposed to language during the course of the ADOS

administration. Instances of the parent and examiner talking to each other were not included.

Reliability

Interobserver reliability for this observational coding scheme was assessed for both child social approach behaviors and parent/examiner language. Raters were initially trained to 80% reliability using alternate training recordings of the ADOS. Two independent raters coded 56.8% of the observations for child behaviors and 28% of the observations for parent/examiner language. Interobserver agreement was assessed using a two-way mixed, absolute agreement, average measures intraclass correlation (ICC; McGraw & Wong, 1996) to assess the degree to which coders provided the same frequencies of social initiations and social responses. The resulting ICCs indicated that coders displayed a high degree of agreement (ICC = .954 and ICC = .962, respectively). Reliability for the amount of time the child was exposed to language during the course of the assessment (combination of both examiner language and parent language) was moderate (ICC = .776).

IV. RESULTS

Study 1: Reliability & Validity

Social approach coding provided a quantifiable measure of behaviors typically emitted during a social interaction within the context of the ADOS. These behaviors were divided based on initiations and responses and were used as an indication of the child's interest in participating in social interactions. Existing measures of socialization were used to corroborate scores obtained from social approach coding of an administration of the ADOS Module 1.

Reliability of Individual Items

The social approach coding scheme utilized by this study was comprised of seven social behaviors that were further classified as either initiated by the child or emitted as a response to either the examiner or parent. Raters independently coded the number of times a child engaged in each of these behaviors from video recorded administrations of the ADOS. Interrater reliability for individual items and totals, calculated using a two-way mixed, absolute agreement intraclass correlation, was high (ICC range, .702 - .979) for all behaviors except initiating give and initiating laugh (ICC = .395 and ICC = .192, respectively). Intraclass correlations for all behaviors in both initiating and responding subscales are indicated in Table 2.

Table 2

Intraclass Correlations for All Social Approach Behaviors

	<u>Behavior</u>	<u>ICC</u>	<u>95% Confidence Interval</u>
Social Initiations	Gaze	.702	0.3 – 0.875
	Give	.395	-0.505 – 0.752
	Laugh	.192	-0.736 – 0.647
	Point	.938	0.854 – 0.974
	Smile	.931	0.833 – 0.971
	Show	.970	0.962 – 0.988
	Vocalizations	.844	0.59 – 0.938
	Total	.954	0.89 – 0.981
Social Responses	Gaze	.803	0.535 – 0.918
	Give	.774	0.47 – 0.905
	Laugh	.652	0.173 – 0.855
	Point	.979	0.949 – 0.991
	Smile	.886	0.752 – 0.952
	Show	.889	0.736 – 0.954
	Vocalization	.959	.0902 – 0.983
	Total	.962	0.908 – 0.984

Internal Consistency

Cronbach's alpha was used to assess internal consistency (Cronbach, 1951) of the social approach observational coding scheme. Alpha coefficients were determined for

social initiations and social responses separately ($\alpha = .701$ and $\alpha = .713$, respectively). Given that the range of the frequency scores for each of the behaviors was free to vary and was thus quite different across behaviors, standardized alphas are being reported. Alpha scores for both social initiations and social responses indicated that there was good agreement between items on each scale.

Criterion Validity

Total social approach scores were calculated by adding together the frequencies for all behaviors (both initiations and responses) and dividing by the length of the observations ($social\ approach = \Sigma [frequencies\ of\ initiations + frequencies\ of\ responses] / length\ of\ observation$). Social approach scores were related to the social affect score generated from the standard coding of the ADOS. A significant correlation was found between the two indices ($r(37) = -.652, p < .01$). The negative correlation was expected since increased scores on the ADOS are indicative of greater impairment and fewer instances of the behavior, which is in contrast to social approach coding where increased frequencies are representative of the child engaging in these behaviors often. Results of the negative correlation suggest that the observational coding scheme of social approach behaviors described above provides a quantitative way to assess those behaviors captured by the social affect subscale score of the ADOS.

Construct Validity

Social approach coding provides a way to directly quantify a child's level of interest in or motivation to engage in social interactions. Strong correlations between social approach rates and indices of social motivation on the SRS, completed by parents, ($r(37) = -.528, p < .01$) and socialization scores on the VABS ($r(37) = .596, p < .01$)

indicate that these measures are yielding similar conclusions with regard to a child's motivation to engage in social interactions. These correlations were in the expected directions. A negative correlation was expected on the SRS, since increased scores on the SRS are representative of decreased social motivation and a positive correlation was expected between the VABS and social approach rates since increased scores on the VABS are indicative of more adaptive social behaviors. Social approach behaviors were not correlated with teacher ratings of social motivation on the SRS ($r = -.181$).

Social Approach Behavior Rates

Social approach behavior totals consisted of both those behaviors that were child initiated and those that occurred as a response to the parent or examiner. This social approach composite was divided into social initiation and social response subscales. Rates for each subscale were determined by combining the frequencies of each of the 7 behaviors and dividing by the total length of the observation ($M = 25.6$ minutes). Mean frequencies for each behavior are listed in Table 3. Results of a paired samples t-test revealed that, in general, children were engaging in more responsive behaviors than initiating behaviors ($t(40) = 5.719, p < .01$).

Table 3

Mean Frequencies of Social Approach Behaviors

	<u>Behavior</u>	<u>M</u>	<u>SD</u>
Social Initiations	Gaze	3.93	4.644
	Give	2.07	2.630
	Laugh	0.78	2.351
	Point	0.41	0.774
	Smile	0.78	1.333
	Show	0.44	1.05
	Vocalizations	6.51	6.603
	Total	14.927	13.717
Social Responses	Gaze	5.29	4.308
	Give	1.02	1.332
	Laugh	1.27	2.324
	Point	0.68	1.404
	Smile	0.66	1.196
	Show	0.1	0.3
	Vocalization	29.8	29.395
	Total	111	33.242

Study 2: Language Development

To examine the development of language over the course of the academic year age equivalents from the MSEL expressive language scale and raw scores from the PLS4

auditory comprehension and expressive language scales were used. Scores from the MSEL receptive language subscale were excluded from these analyses due to lack of normality. Means for each of the subscales are listed in Table 4. The mean interval between pre and post-tests of the MSEL and PLS4 was 6.2 months ($SD = 0.19$) and 6.1 months ($SD = 0.15$), respectively. Paired sample t-tests indicated that there was a significant difference between measures of language on both the MSEL and PLS4 from pre to post-tests. These results suggest that, in general, the participant's language improved over the course of the academic year. Results from paired sample t-tests for each subscale are shown in Table 5. MSEL and PLS4 pretest scores were used as an indicator of concurrent language abilities since these assessments occurred at approximately the same time as the ADOS (MSEL & ADOS: $M = 13.3$ days; PLS4 & ADOS: $M = 14.1$ days). Posttest scores were used as a measure of later language abilities. Post tests were administered, on average, 6 months after pretests for both the MSEL and PLS (range, 5.6 – 6.5 months).

The relationship between language development and social approach behaviors was analyzed using rates of social initiations and rates of social responses. It is the hypothesis of this study that social initiations play a significant role in the language abilities of children with autism.

Table 4

Language Levels at Pre and Post

	Pre		Post	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
MSEL (age equivalents)				
Receptive Language	16.51	8.599	21.95	10.106
Expressive Language	17.90	9.936	22.92	11.902
PLS4 (raw scores)				
Auditory Comprehension	20.44	7.857	25.64	8.481
Expressive Communication	20.77	10.322	25.77	10.150

Table 5

Results of Paired Sample t-tests for MSEL and PLS4

	<u>M</u>	<u>t</u>	<u>p</u>	<u>95% CI</u>
MSEL (age equivalents)				
Receptive Language	5.436	5.061	< .001	3.262 – 7.610
Expressive Language	5.026	4.475	< .001	2.752 – 7.299
PLS4 (raw scores)				
Auditory Comprehension	5.205	5.741	< .01	3.370 – 7.041
Expressive Communication	5.0	5.701	< .01	3.224 – 6.776

Predictors of Receptive Language

Raw scores on the PLS4 auditory comprehension scale were used as an index of concurrent receptive language level and raw scores on the posttest were used as an

indicator of future language. Raw scores were considered a more sensitive index of language abilities because t scores on the PLS4 have a floor of 50 and many of the participants in this sample did not obtain raw scores high enough to calculate a t-score for their age.

Concurrent Language. Zero order correlation analyses were used as an initial step in exploring the relationship between chronological age, ADOS social affect scores, social initiation rates, social response rates and concurrent receptive language scores (see appendix D for full correlation matrix and scatterplots). Results of these analyses (see Table 6) revealed that chronological age was not a significant predictor of receptive language scores ($r = .278, p = .087$) but that the remaining three variables were significant predictors. Multiple regression was used to determine the relative contribution of each of these variables. The three-predictor model significantly predicted concurrent receptive language abilities, accounting for 57.2% of the variance ($F(3,35) = 17.915, p < .001$) however, only social responses significantly contributed to this relationship. Regression coefficients and standard errors can be found in Table 7.

Table 6

Pearson Correlations for Concurrent Receptive Language Predictors

<u>Predictor</u>	<u>r</u>
Chronological age	.278
ADOS Social Affect	-.578*
Social Initiations	.621*
Social Responses	.767*

* $p < .01$

Table 7

Regression Coefficients and Standard Error for Concurrent Receptive Language Multiple Regression

<u>Predictor</u>	<u>B</u>	<u>SE_B</u>	<u>β</u>
Constant	19.707	6.062	
ADOS Social Affect	-0.356	0.34	-0.148
Social Initiations	0.95	2.711	0.058
Social Responses	3.582	0.966	0.631*

* $p < .001$

Future Language. Hierarchical Linear Regression (HLR) analyses were conducted to further investigate the role of initiations and responses in receptive language development. Separate analyses were run for both social initiations and social responses. The dependent measure in these analyses was posttest raw scores on the auditory comprehension scale of the PLS4. Chronological age and initial raw scores were entered simultaneously on the first step of the equation. Social initiation rates or social response rates were entered on the second step. This analysis was designed to test the hypothesis that social initiations and social responses share a unique association with receptive language development apart from: a) variance associated with age and b) variance in initial receptive language abilities.

Results of these analyses support the hypothesis that social initiations have a unique association with receptive language development. Based on ΔR^2 estimates adjusted for sample size, social initiations account for an additional 5.4% of the explained variance on the PLS4 auditory comprehension subscale. Similar results were found when

social response rates were used in the second step of the equation ($\Delta R^2 = .076$). See Table 8 for standardized partial regression coefficients (β) for these analyses.

The role of social initiations in receptive language development was further explored by adding a step to the regression equation; chronological age and pretest scores were entered in step 1, social response rates in step 2 and social initiations rates in step 3. This analysis tested the hypothesis that social initiations contribute to the development of receptive language abilities in a distinct manner, apart from the variance associated with social responses. Results of these analyses did not support the hypothesis that social initiations play a unique role in language development (see Table 9). Social initiations did not make a significant contribution to the prediction of PLS4 scores when social responses were added to the equation on the second step.

Table 8

Hierarchical Regression Analyses for Chronological Age, Initial Language and Social Initiations/Responses as Predictors of Receptive Language Outcomes on the PLS4 (N=39)

		<u>B</u>
<i>Social Initiations</i>		
Step 1		F(2,36) = 24.976, $p < .001$ Adjusted R ² = .558
Chronological age		-.006
Pre scores		.764**
Step 2		$\Delta F(1,35) = 5.128, p = .030$ $\Delta R^2 = .054$
Chronological age		.028
Pre scores		.569**
Social Initiations		.298*
<i>Social Responses</i>		
Step 1		F(2,36) = 24.976, $p < .001$ Adjusted R ² = .558
Chronological age		-.006
Pre scores		.764**
Step 2		$\Delta F(1,35) = 7.793, p = .008$ $\Delta R^2 = .076$
Chronological age		-.034
Pre scores		.440**
Social Responses		.443**

* $p < .05$; ** $p < .01$

Table 9

Hierarchical Regressions Analyses for Chronological Age, Initial Language, Social Responses and Social Initiations as Predictors of Receptive Language Outcomes on the PLS4 Auditory Comprehension Scale (N=39)

	β
Step 1	$F(2,36) = 24.976, p < .001$ Adjusted $R^2 = .558$
Chronological Age	-.006
Pre Scores	.764**
Step 2	$\Delta F(1,35) = 7.793, p = .008$ $\Delta R^2 = .076$
Chronological Age	-.034
Pre Scores	.440**
Social Responses	.433**
Step 3	$\Delta F(1,34) = .836, p = .367$ $\Delta R^2 = .008$
Chronological Age	-.012
Pre Scores	.421*
Social Responses	.335
Social Initiations	.142

** $p < .01$, * $p < .05$

Predictors of Expressive Language

As was done with receptive language, PLS4 raw scores at pre were used as a measure of concurrent language abilities and scores at post were used as a measure of future language abilities. For these analyses raw scores on the PLS4 expressive communication scale were used as an indicator of expressive language abilities. Age

equivalent measures on the expressive language subscale of the MSEL at pre and post were used as an additional measure of concurrent and future expressive language skills. Again raw scores and age equivalents were used in place of t-scores because many participants did not achieve high enough raw scores to calculate a t-score for their age.

Concurrent Language. Zero order correlations revealed that age was not a significant predictor of expressive language abilities on the PLS4 but, as expected, was correlated with age equivalent scores on the MSEL (see Table 10). Three predictors, ADOS scores, social initiations and social responses were used in the multiple regression for PLS4 scores (see appendix E for full correlation matrix and scatter plots). For the MSEL chronological age was also included as a predictor in the model, yielding a total of 4 predictors (see appendix E for full correlation matrix and scatter plots). Results of the multiple regression for the PLS4 dependent variable indicated that the model significantly predicted expressive communication scores on the PLS4 ($F(3,35) = 16.166$, $p < .001$), however, only social responses significantly contributed to this relationship. Regression coefficients and standard errors can be found in Table 11. Similar results were found for the MSEL age equivalent scores, the model significantly predicted expressive language abilities, ($F(4,34) = 19.424$, $p < .001$), but only social responses contributed to this relationship (see Table 11).

Table 10

Pearson Correlations for Concurrent Expressive Language Predictors

PLS4	<i>r</i>
Chronological age	.275
ADOS Social Affect	-.565**
Social Initiations	.571**
Social Responses	.752**
MSEL	
Chronological age	.325*
ADOS Social Affect	-.494**
Social Initiations	.596**
Social Responses	.827**

* $p < .05$, ** $p < .01$

Table 11

Regression Coefficients and Standard Error for Concurrent Language Multiple Regression

PLS4	<u>B</u>	<u>SE_B</u>	<u>β</u>
Constant	19.707	6.062	
ADOS Social Affect	-0.356	0.34	-0.148
Social Initiations	0.95	2.711	0.058
Social Responses	3.582	0.966	0.631*
MSEL			
Constant	-.624	10.212	
Chronological Age	.155	.145	.109
ADOS Social Affect	.150	.388	.049
Social Initiations	-.155	3.155	-.008
Social Responses	5.981	1.1.35	.833*

* $p < .001$

Future Language. Separate HLR analyses were performed for social initiations and social responses for the PLS4 and MSEL. For these analyses expressive language raw scores at post on PLS4 or age equivalent scores at post on the MSEL were used as the dependent variable. Chronological age and initial pretest scores on the respective assessment were entered simultaneously in the first step. Either social initiations or social responses were entered in the second step to determine the variance accounted for by these variables independent of the variance explained by a) chronological age and b) initial expressive language abilities.

Results of these analyses for social initiations support the hypothesis that children who initiate interactions with others more frequently show greater language development. Social initiations accounted for an additional 4.3% of the variance on the PLS4 and 5% on the MSEL. Comparable results were found when social response rates were entered into the second step of the equation. Social responses accounted for an additional 3.4% of the explained variance on the PLS4 and 5.3% on the MSEL.

Again the unique role of social initiations was investigated by adding a step to the regression equation. HLR analyses were used to determine if social initiations accounted for any of the explained variance above not only that associated with chronological age initial scores and variance accounted for by social responses. For these analyses again, chronological age and initial pre scores were entered simultaneously on the first step, social responses were entered on the second step and social initiations were entered on the third step. These results indicated that social initiations did not make a significant contribution when social responses were included on the second step of the equation (see Table 13).

Table 12

Hierarchical Regression Analyses for Chronological Age, Initial Language and Social Initiations/Responses as Predictors of Expressive Language Outcomes (N=39)

	PLS4	MSEL
	β	β
<i>Social Initiations</i>		
Step 1	$F(2,36) = 50.404, p < .001$ Adjusted $R^2 = .722$	$F(2,36) = 34.486, p < .001$ Adjusted $R^2 = .638$
Chronological age	-.051	-.063
Pre scores	.871**	.829**
Step 2	$\Delta F(1,35) = 6.929, p = .013$ $\Delta R^2 = .043$	$\Delta F(1,35) = 5.956, p = .020$ $\Delta R^2 = .050$
Chronological age	-.027	-.023
Pre scores	.718**	.648**
Social Initiations	.256*	.282*
<i>Social Responses</i>		
Step 1	$F(2,36) = 50.404, p < .001$ Adjusted $R^2 = .722$	$F(2,36) = 34.486, p < .001$ Adjusted $R^2 = .638$
Chronological age	-.051	-.063
Pre scores	.871**	.829**
Step 2	$\Delta F(1,35) = 5.267, p = .028$ $\Delta R^2 = .034$	$\Delta F(1,35) = 6.453, p = .016$ $\Delta R^2 = .053$
Chronological age	-.072	-.065
Pre scores	.664**	.490**
Social Responses	.283*	.411*

* $p < .05$; ** $p < .01$

Table 13

Hierarchical Regression Analyses for Chronological Age, Initial Language, Social Responses and Social Initiations as Predictors of Expressive Language Outcomes (N=39)

	<u>PLS4</u>	<u>MSEL</u>
Step 1	$F(2,36) = 50.404, p < .001$ Adjusted $R^2 = .722$	$F(2,36) = 34.486, p < .001$ Adjusted $R^2 = .638$
Chronological Age	-.051	-.063
Pre Scores	.871**	.829**
Step 2	$\Delta F(1,35) = 5.267, p = .028$ $\Delta R^2 = .034$	$\Delta F(1,35) = 6.453, p = .016$ $\Delta R^2 = .053$
Chronological Age	-.072	-.065
Pre Scores	.664**	.490**
Social Responses	.283*	.411*
Step 3	$\Delta F(1,34) = 2.283, p = .140$ $\Delta R^2 = .014$	$\Delta F(1,34) = 1.467, p = .234$ $\Delta R^2 = .012$
Chronological Age	-.044	-.041
Pre Scores	.657**	.496**
Social Responses	.141	.272
Social Initiations	.186	.170

** $p < .01$, * $p < .05$

Language Exposure

The total amount of time that either the examiner or parent spent directly talking to the child (i.e., language exposure) was investigated as a predictor of language gains on both the MSEL and PLS4. Zero order correlations revealed that language exposure was

not correlated with gains on either the MSEL or PLS4 and was therefore not included in any further analyses. These results do not support the hypothesis that language exposure, as measured in the context of the ADOS, is an important predictor of language development.

Behavioral Profiles

The pre and post raw subscale scores on both the MSEL and PLS4 were further examined to determine how gains on these assessments were related to social approach behaviors. Normality was not a concern in these analyses; therefore raw scores on both assessments for all four subscales were used. Gain scores were calculated for all subscales by subtracting the participant's raw score on the pretest from their raw score on the posttest. Differences between pre and post raw scores were used as an indicator of language improvements and as a measure of the participant's response to instruction. Although no treatment was provided as part of the current study, all participants were included in the parent study that included a treatment component.

Examination of gain scores revealed several different patterns across the four subscales. With the exception of one participant, who regressed on three subscales and showed no change on the other, all participants made improvements on at least one of the subscales. As expected, some children improved on all four subscales ($N = 15$) and others showed improvements in one domain but not the other, for example showed improvements on expressive language subscales but not receptive language (expressive subscales, $N = 4$; receptive subscales, $N = 7$). The remainder of participants showed discrepant patterns of responding, improving on one expressive or receptive subscale but not the other. For example, some children showed improvement on the PLS4 expressive

communication scale and not the MSEL expressive language scale. Gain score profiles for all participants can be found in appendix F.

Gain scores were further explored to determine if children who made progress (referred to as responders) differed from those who did not make progress (referred to as non-responders) in the number of social approach behaviors they engaged in. Three groupings were examined, receptive language, expressive language and overall gains. Within each of these groups two subgroups were formed, responders and non-responders. The responder group was made up of those individuals who made the most progress (average increases of at least 9 points) and the non-responder group included individuals who did not make any progress (< 1 point). Responder and non-responder groups were determined in a similar manner as that described by Sherer and Schreibman (2005). Groups were divided based on extreme scores to highlight the differences between individuals who showed gains and those who did not, most participants fell in between these two groups. Visual inspection of the scores was used to determine if there were any differences in the rates of social approach behaviors between the responder and non-responder groups.

Receptive Language. The receptive language group was based on average gains from the MSEL receptive language and PLS4 auditory comprehension subscales. Average gains for the responder group (N =10) were 11.15 points (range, 9 – 14) and average gains for the non-responder group (N = 10) were -0.85 points (range, -5 – 0.5). Figure 1 depicts the rates of each of the individual social initiation behaviors and figure 2 shows each of the social response behaviors. From these graphs it appears that there are differences between responder and non-responder groups on rates of initiating gaze,

initiating give, initiating vocalizations and responding using vocalizations. Participants in the responder group initiate gaze and vocalizations more often than individuals characterized as non-responders. The responder group also responds to others using vocalizations more often than non-responders. In contrast, it appears that non-responders spontaneously give objects to another person more often than responders.

Figures 3 and 4, respectively, show the cumulative rates of social initiations and social responses for the responder and non-responder groups. These results suggest that individuals characterized as responders are engaging in more social initiation and social response behaviors compared to non-responders. A large amount of variability is seen for the rate of social responses for the responder group suggesting that rates of these behaviors are quite variable for the responder group.

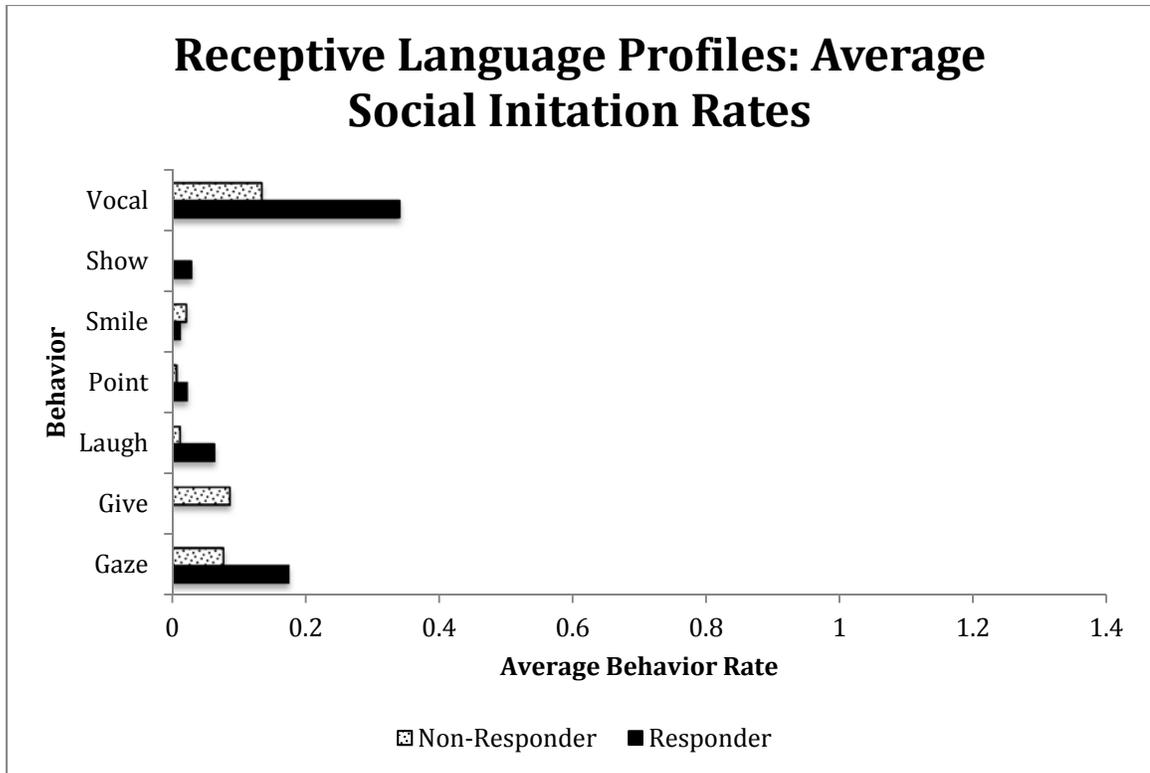


Figure 1. Receptive Language Profiles: Average Social Initiation Rates. This figure illustrates the average rate of social initiation behaviors for the responder and non-responder groups.

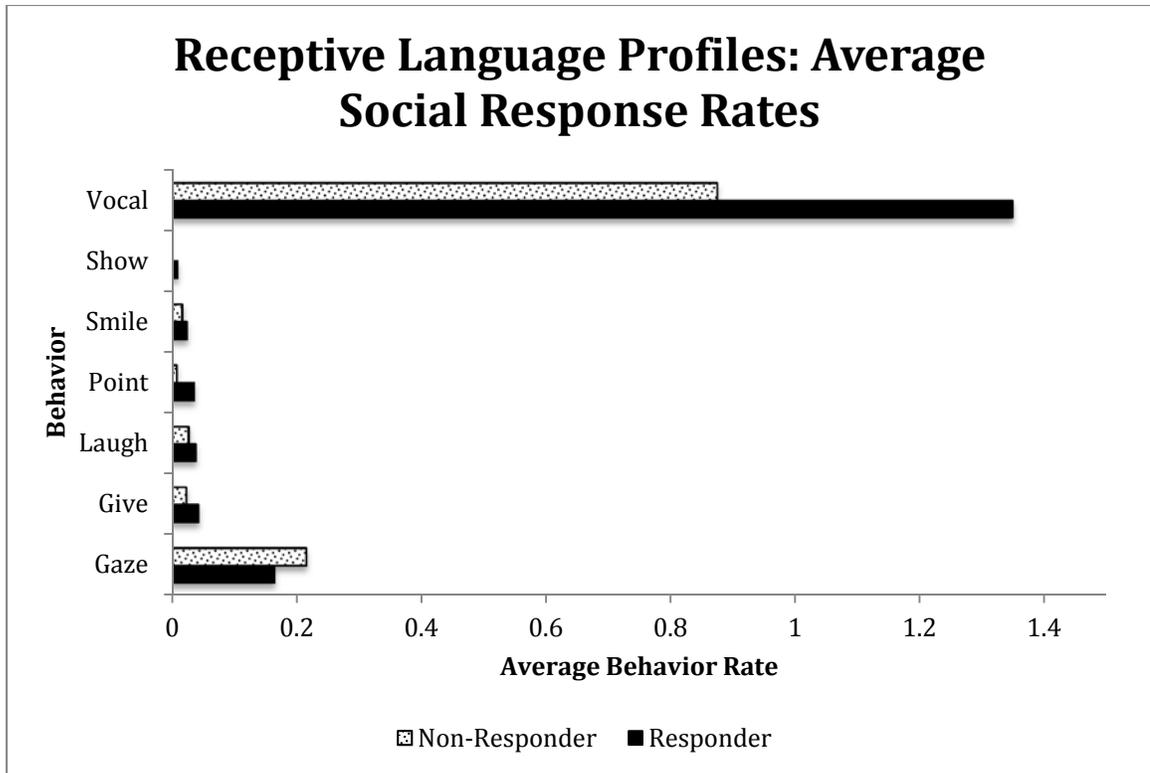


Figure 2. Receptive Language Profiles: Average Social Response Rates. This figure depicts the average rate of social response behaviors for the responder and non-responder groups.

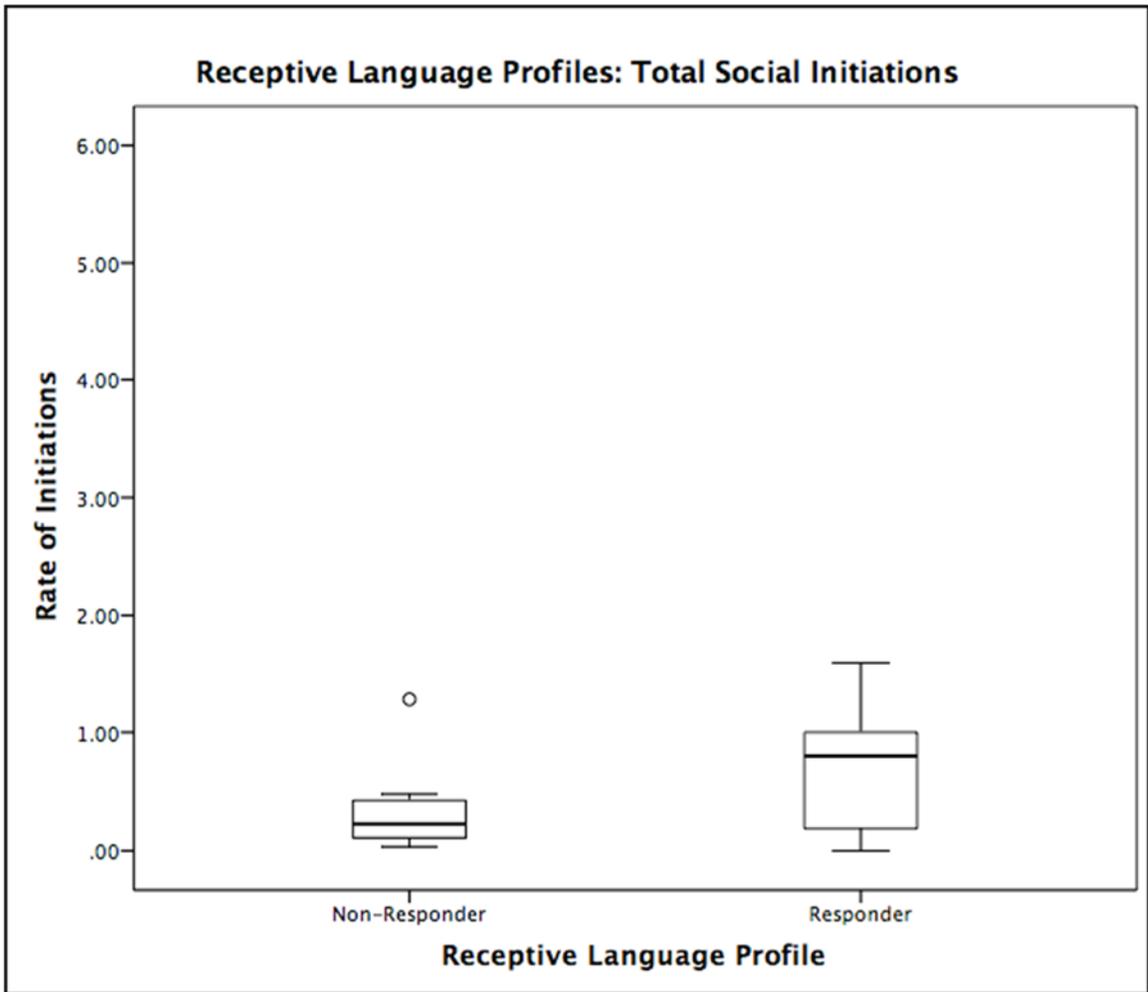


Figure 3. Receptive Language Profiles: Total Social Initiations. This figures shows the cumulative rates of social initiations for both the responder and non-responder groups.

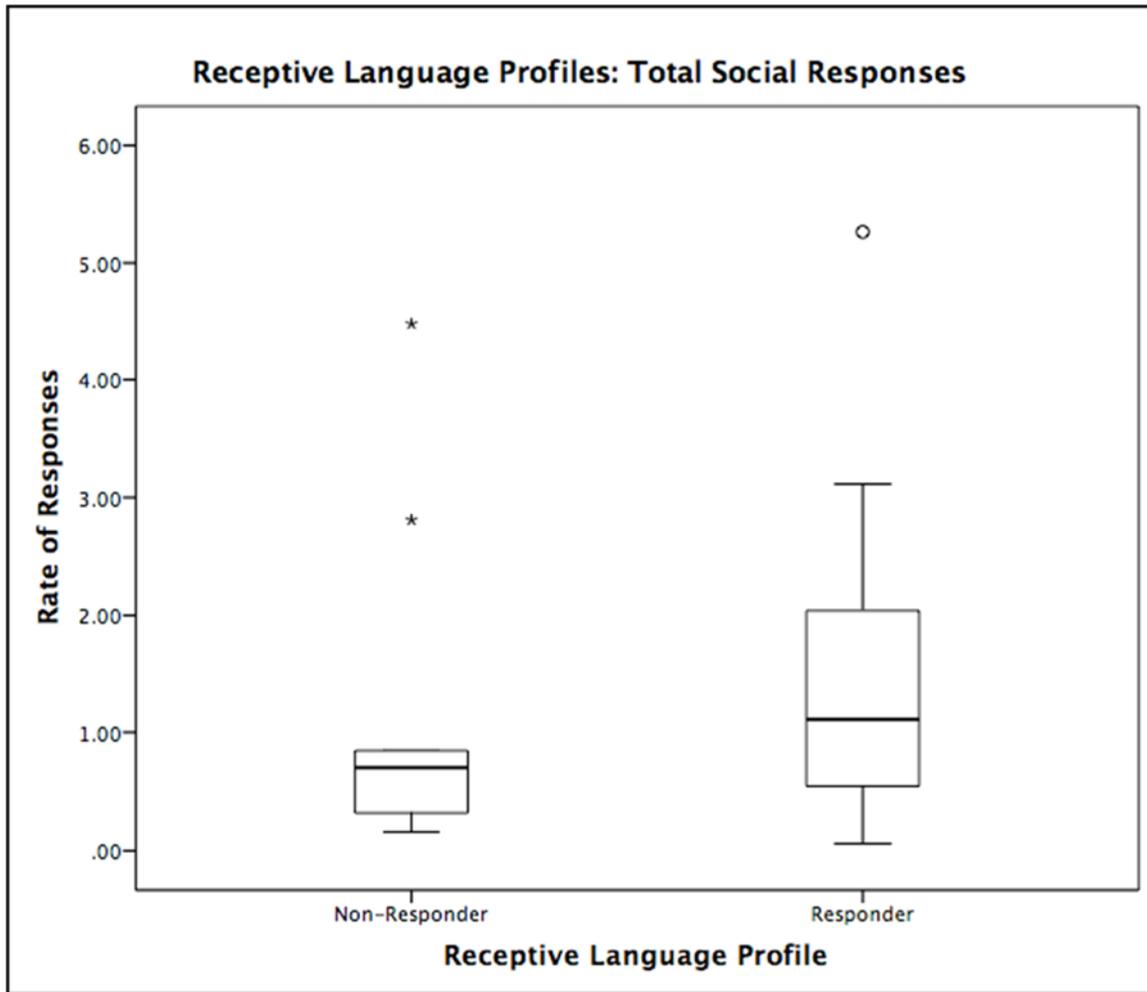


Figure 4. Receptive Language Profiles: Total Social Responses. This figure displays the cumulative rates of social responses for both the responder and non-responder groups.

Expressive Language. The expressive language group was established using average gains on the MSEL expressive language and PLS4 expressive communication subscales. Average gains for the responder group (N = 6) were 13.8 points (range, 9 – 26.5) and average gains for the non-responder group (N = 7) were -1.14 (range, -2.5 – 0.5). Figures 5 and 6, respectively, illustrate the rates of individual social initiation and social response behaviors for the responder and non-responder groups. These graphs suggest that there are differences between rates of initiating gaze, initiating vocalization and responding using vocalizations between the two groups. Those individuals

characterized as responders, spontaneously use gaze and vocalizations more often than individuals described as non-responders. The responder group also responds to others using vocalizations more than does the non-responder group.

Cumulative rates of social initiations and social responses for the responder and non-responder groups can be seen in figures 7 and 8, respectively. These results suggest that the responder group engages in higher rates of social initiations and responses compared to the non-responder group however, there does not appear to be a large difference between the two groups on either type of behavior.

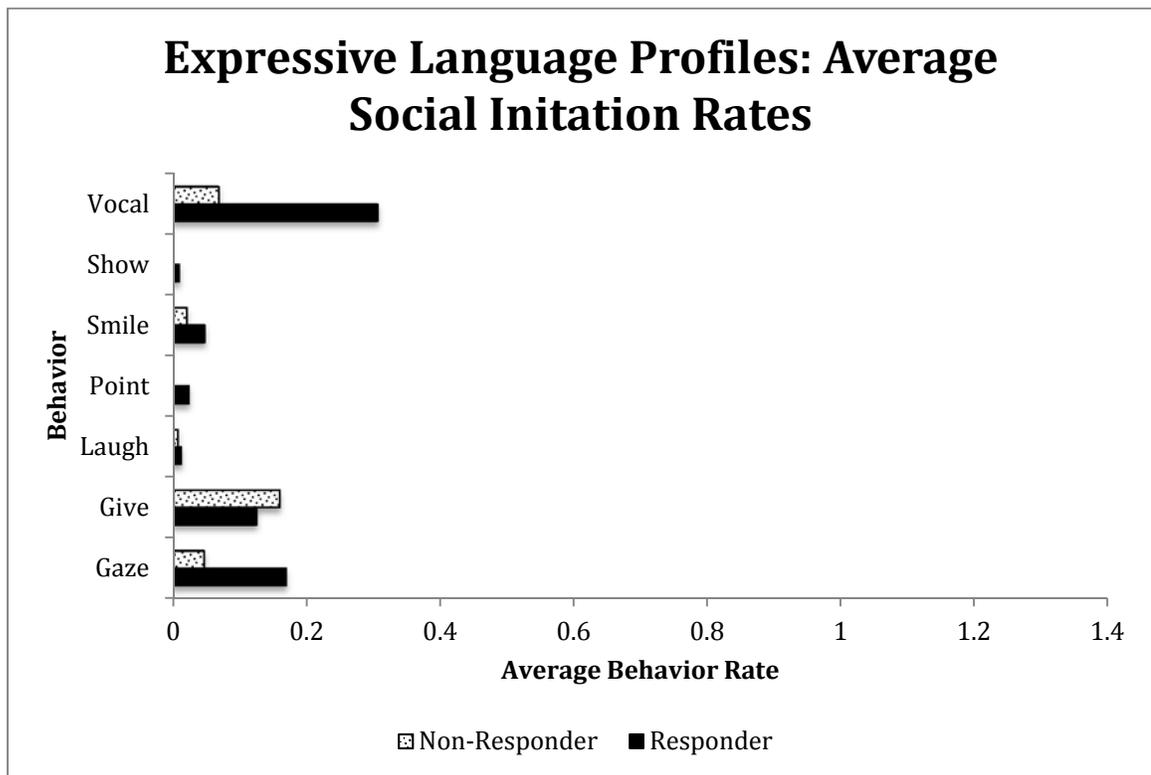


Figure 5. Expressive Language Profiles: Average Social Initiation Rates. This figure shows the average rate of social initiation behaviors for the responder and non-responder groups.

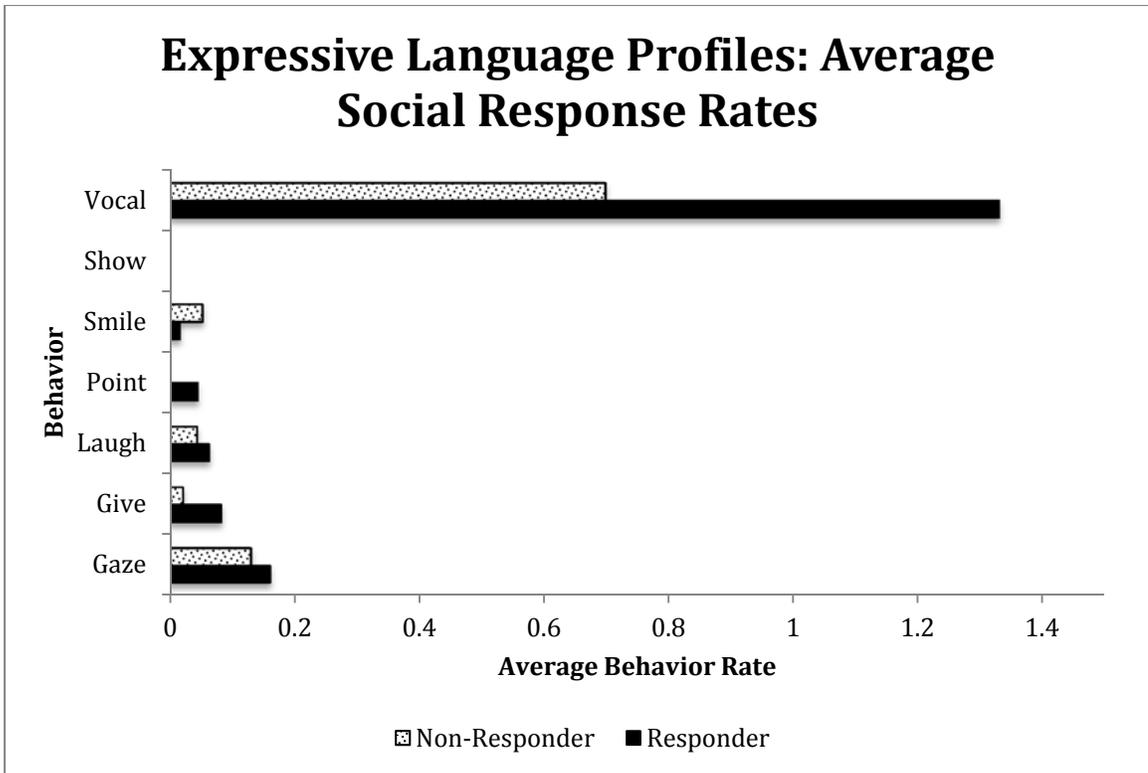


Figure 6. Expressive Language Profiles: Average Social Response Rates. This figure shows the average rate of social response behaviors for the responder and non-responder groups.

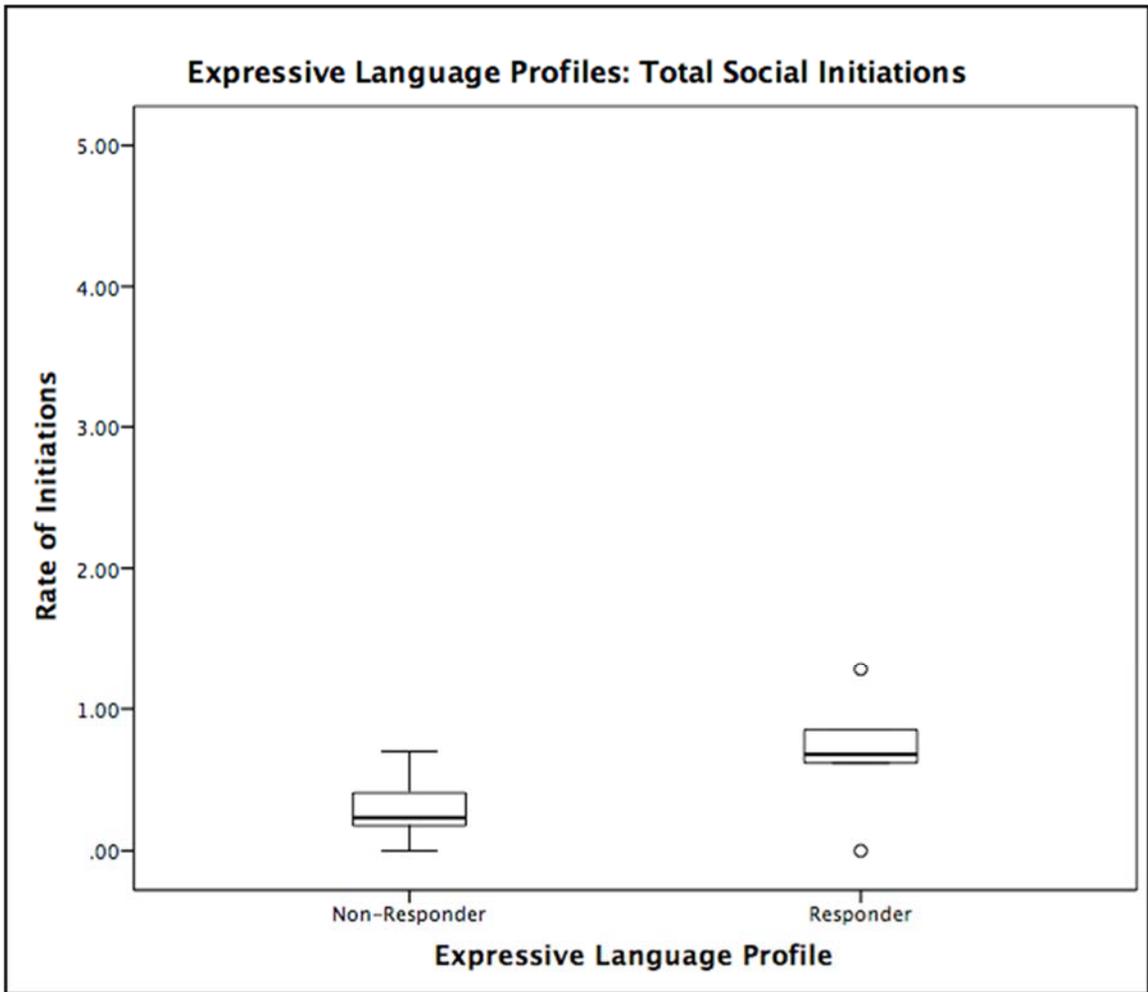


Figure 7. Expressive Language Profiles: Total Social Initiations. This figure depicts the cumulative rates of social initiation behaviors for the responder and non-responder groups.

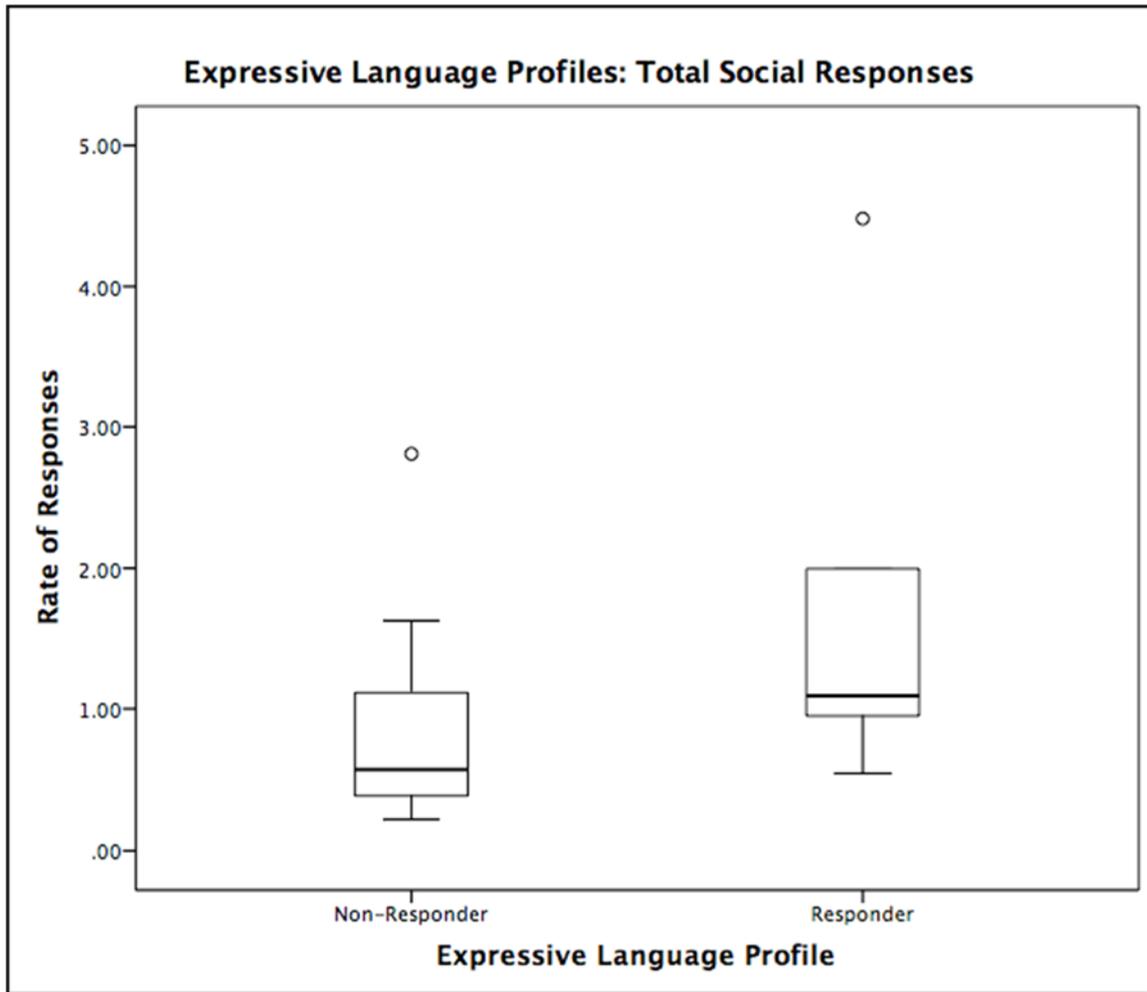


Figure 8. Expressive Language Profiles: Total Social Responses. This figure illustrates the cumulative rates of social response behaviors for the responder and non-responder groups.

Overall Gains. The overall gain group was formed based on gain scores on all four subscales (MSEL receptive language and expressive language and PLS4 auditory comprehension and expressive communication). Responder and non-responder subgroups were formed based on average gains across all subscales and may be viewed as representing overall language gains. On average responders (N = 6) increased 11.8 points across all four subscales (range, 9 – 18) and non-responders (N = 6) showed -0.5 point increases (range, -2.75 – 0.5). Figures 9 and 10, respectively, show the individual rates

of social initiation and social response behaviors for the responder and non-responder groups. Consistent with findings from the receptive language and expressive language groups, those individuals who showed the greatest overall gains initiate gaze and vocalizations and respond using vocalizations more than do those children who do not show any overall gains.

Cumulative rates of social initiations and social responses are illustrated in figures 11 and 12, respectively. These graphs show that children who make the most overall gains show higher rates of social initiations than do children who do not show any overall gains. Children in both groups, responder and non-responder, are engaging in more social response behaviors than social initiation behaviors but again those children characterized as responders are engaging in a higher rate of social response behaviors than non-responders. More variability is also seen in the rate of social response behaviors used by the two groups compared to social initiation behaviors.

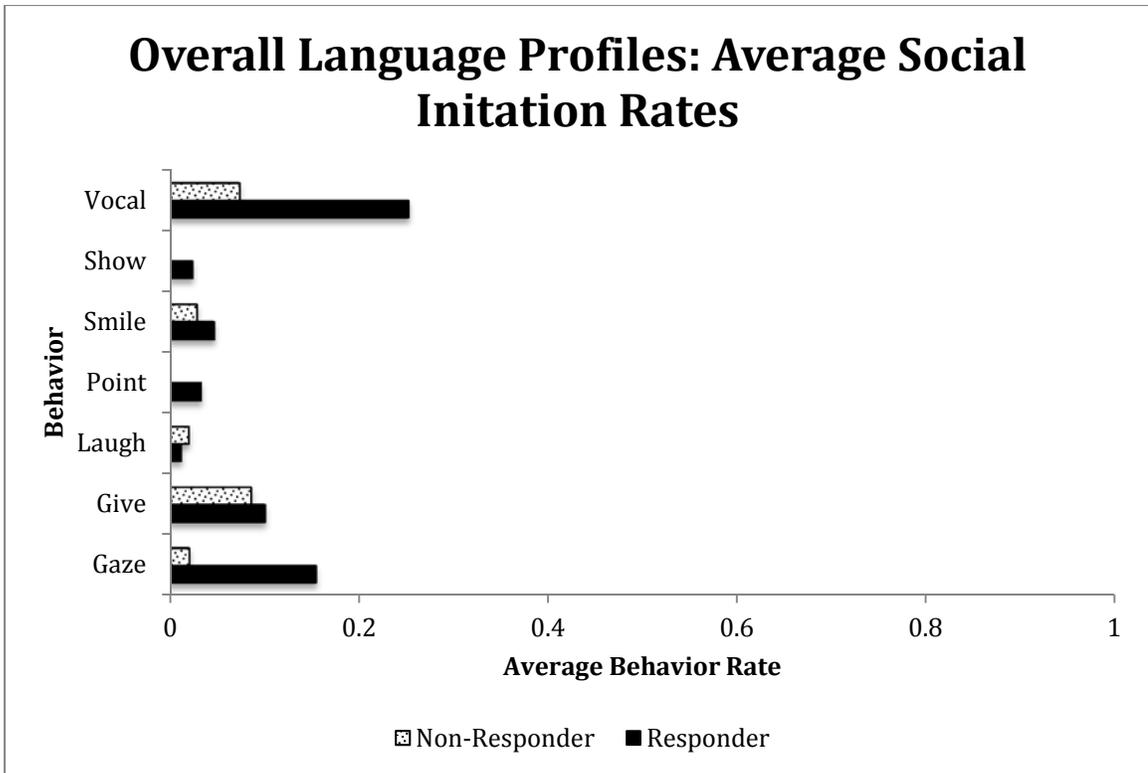


Figure 9. Overall Language Profiles: Average Social Initiation Rates. This figure depicts the average rate of social initiation behaviors for the responder and non-responder groups.

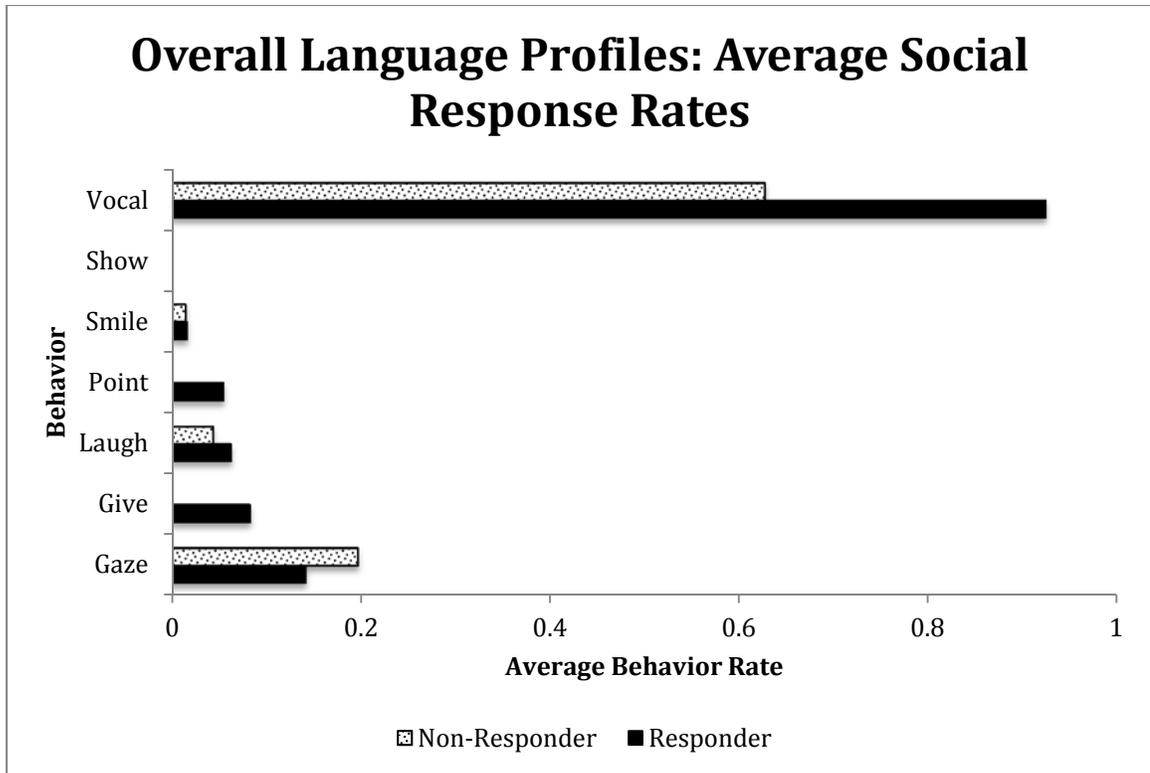


Figure 10. Overall Language Profiles: Average Social Response Rates. This figure shows the average rate of social response behaviors for the responder and non-responder groups.

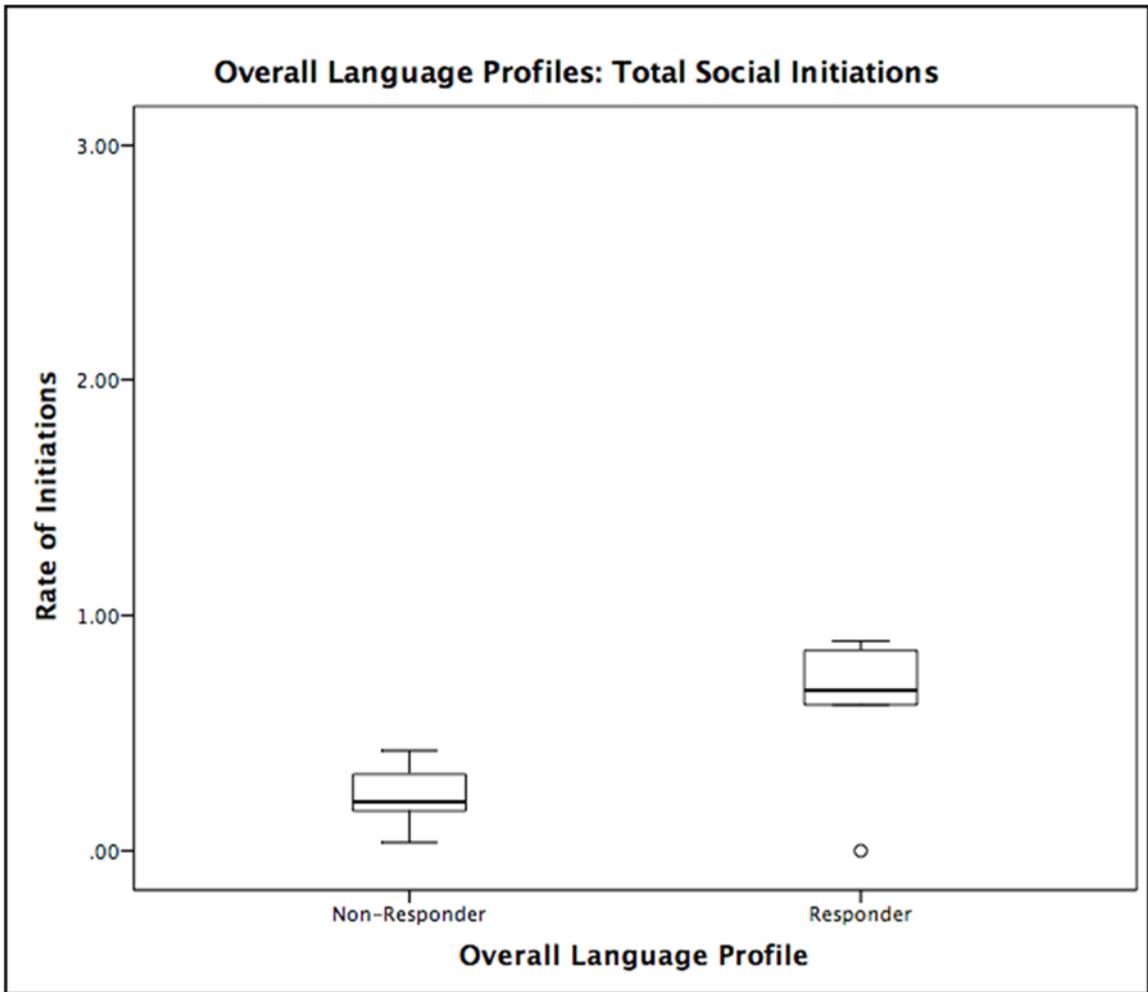


Figure 11. Overall Language Profiles: Total Social Initiations. This figure illustrates the cumulative rates of social initiation behaviors for the responder and non-responder groups.

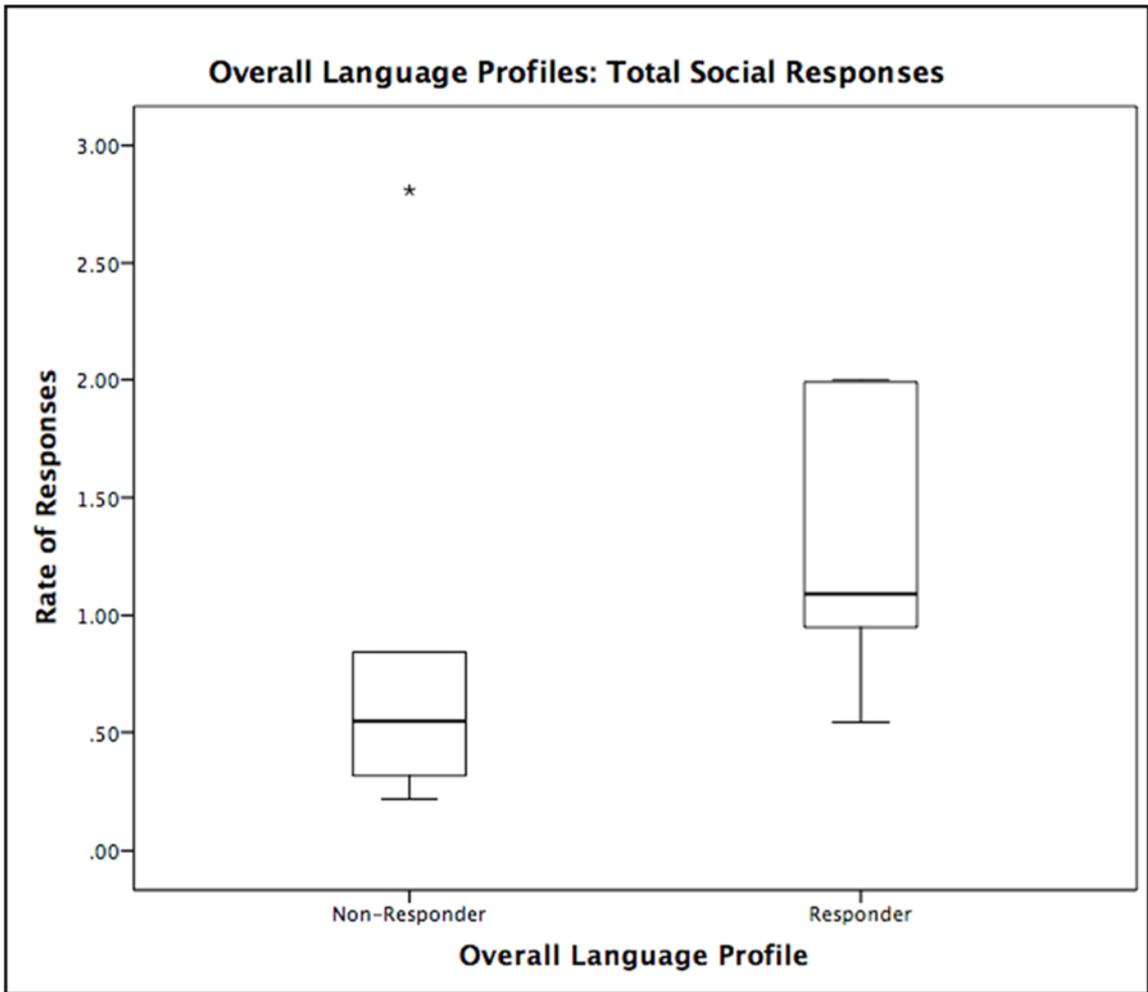


Figure 12. Overall Language Profiles: Total Social Responses. This figure shows the cumulative rates of social response behaviors for the responder and non-responder groups.

V. DISCUSSION

Study 1: Reliability & Validity

The ADOS is the “gold standard” instrument for diagnosing autism spectrum disorders (Sikora et al., 2008). The algorithm scores have demonstrated success in discriminating those children who have symptoms consistent with an autism diagnosis from children who are intellectually disabled, typically developing and children with other developmental delays (Lord et al., 2000). While the standard coding of the ADOS has proven to be invaluable, there is much more information to be gleaned from video recorded administrations of the ADOS. The ADOS provides an excellent platform to explore the social and communicative behaviors of children with autism beyond the information provided by the standard Likert-type summary scores. The current study focused on coding frequencies of individual social approach behaviors emitted throughout the course of an ADOS administration. These behaviors were coded based on operational definitions that did not focus on the function of the behavior (e.g., request or joint attention); however, behaviors were separated based on whether they were child initiated or occurred in response to the parent or examiner, given that this distinction may be important in evaluating social interest.

Interrater reliability for individual social approach behaviors was high for the majority of the behaviors, suggesting that the behaviors were being coded consistently across participants. Two behaviors, initiating laugh and initiating give, had low interrater reliability values, suggesting that the definitions for these behaviors may need to be more clearly defined or removed from the coding scheme. Social approach coding was dependent on the quality of the video recording of the ADOS administration and coding

live administrations may have yielded more accurate results. This speaks to the importance of ensuring that video recorded assessments allow for raters not only to be able to hear both the child and the examiner but also be able to see where the child is looking and what they are doing with their hands (e.g., pointing or showing).

In order to administer the ADOS, examiners must attend standardized training workshops and obtain reliability with the instructor. Additionally, examiners are expected to become reliable using video recorded administrations provided by the ADOS developers before being considered proficient in the ADOS. Even after extensive training, the use of the ADOS is related to the skill of the examiner (Lord et al., 2000). Interobserver reliability of the standard ADOS coding is adequate amongst trained observers however, the intensive training itself limits the number of individuals who are competent to provide standard ADOS codes for either live or video recorded administrations. Recent research has focused on providing operational definitions for codes on the ADOS that use language such as, “rarely,” “occasionally” or “largely consists of.” Guercio and Hahs (2014) found that after providing more precise definitions that included the number of behaviors the child emitted instead of more vague definitions (e.g., replacing “uses poorly modulated eye contact to initiate, terminate or regulate social interaction” with “uses eye contact in durations of less than 2s each to initiate, terminate or regulate social interaction during 70% of the session”), coder provided more accurate scores of the child’s behavior and interobserver reliability increased. One benefit of the social approach coding scheme described in this study is that it requires less intensive training than the standard ADOS coding. Undergraduate research assistants can be trained to identify the behaviors of interest using the operational definitions provided and

reliability with a trained observer is relatively easy to achieve. Furthermore, coding each behavior as a frequency during the course of the ADOS will aid in operationalizing the coding definitions by providing some indication of how often a child engages in each behavior that can be used to justify ratings of rare or persistent. Social approach coding is not designed to replace the standard ADOS coding but rather to provide an ancillary measure of behaviors that can aid in describing and defining the qualitative features of a child's behavior. Social approach coding may be used when the primary goal is descriptive and not diagnostic.

Measures of validity for the proposed observational rating scale of social approach behaviors reflect that this coding is consistent with other measures of social motivation (i.e., ADOS, SRS and VABS). As would be expected, given that social approach ratings used in this study provide frequencies of individual behaviors that encompass the ADOS standard coding, the social approach ratings were highly correlated with social affect scores provided by the ADOS. These results suggest that social approach coding may be used to quantify the classification codes provided by the ADOS, yielding more specific behavioral profiles of individuals diagnosed with an autism spectrum disorder. Additionally, social approach coding was correlated with social motivation scores on the SRS and socialization scores on the VABS. These results help to delineate those behaviors that make up the ill-defined constructs of social motivation and social interest. Moreover, directly coding social approach behaviors provides a way to objectively assess these behaviors without relying on parent or teacher report. Given the discrepant results with regard to parent and teacher reported measures of social motivation on the SRS, direct measurement of those behaviors that contribute to a child's

social motivation/interest may provide a more objective and parsimonious account of a child's desire to engage with others. The results of the current study are limited to behaviors directed at a parent and unfamiliar adult (i.e., the examiner) and future research may round out the construct of social motivation by including a measure of social approach behaviors during peer interactions, with both familiar and unfamiliar peers.

While the ADOS provides a context that is highly conducive to coding social approach behaviors, as this instrument is designed to elicit the abnormalities in these behaviors exhibited by children with autism, using a less structured play setting with both an examiner and parent separately may provide a different picture of a child's social interactions. The coding of any behavior is limited by the context in which those behaviors were observed and it is imperative to assess behavior in a variety of settings in order to grasp the full scope of the behavior(s) of interest. Kover, Davidson, Sindberg and Weismer (2014), found that expressive language was reduced when coded in the context of free play during the ADOS compared to a less structured play activity. The authors found that children had fewer total utterances, lower intelligibility, fewer different words, fewer requests and comments and engaged in less turn-taking during the ADOS compared to alternate play setting. Considering the differences found in this study, the current results should be interpreted with caution given that other settings may provide a different idea about these behaviors.

The results of this coding scheme, while promising, are limited by the lack of a control group. Children without an autism diagnosis were not included in the sample and therefore no conclusions can be drawn about the rate of social approach behaviors emitted by typically developing children or children with intellectual disabilities or other

developmental delays. Correlations with other measures indicate that rates of social approach behaviors are consistent with how parents rate their child's social motivation but more work is needed in order to classify children as being high or low in social motivation. The current study is a first step in quantifying social motivation and future studies should compare the social approach behaviors of children with different diagnoses to better classify motivational aspects of behavior and yield a range of scores that may be indicative of high or low social motivation.

Study 2: Language Development

Language development is a primary concern for children with autism and has been identified as a primary prognostic factor for later outcomes for this population (Venter et al., 1992). Given the important role language plays in a child's development, it is imperative that those factors that contribute to language acquisition are carefully evaluated so that they can then inform targeted treatment plans for children with autism. Joint attention has received much consideration in the autism literature for its role in language development; more recent theories have placed emphasis not only on declarative social behaviors, but on the importance of social interactions in general, specifically in initiating these interactions (Chevallier et al., 2012; Mundy & Crowson, 1997; Mundy & Neal, 2001). It was the hypothesis of this study that all behaviors, both joint attention and requests, that are mediated by another person provide a social learning opportunity for children by capitalizing on those moments when the child and social partner are focusing their attention on the same object or event. The current study focused on a more global measure of social interest than that of previous studies, which have primarily used the standard ESCS coding of joint attention and behavior regulation.

The ADOS provided an ideal platform to measure behaviors indicative of social interest as it is designed to provide children with ample opportunities to both initiate and respond to interactions with the examiner and parent.

Consistent with research on joint attention behaviors that has found that children with autism show greater impairments in initiating joint attention compared to responding to joint attention (Mundy 1995; Mundy & Newell, 2007; Nation & Penny, 2008), participants in this study engaged in more behaviors that were classified as responses than initiations. These results suggest that children with autism have a global difficulty with initiating interactions with others even when the resulting consequence is non-social (i.e., requesting behaviors). Future research may further investigate social initiations by including measures of requesting behaviors that are both adaptive and maladaptive forms of initiations. The current study was focused only on adaptive, non-verbal communication behaviors that are commonly employed in both requesting and joint attention exchanges. It is conceivable that children with autism may engage in behaviors such as crying, throwing or other maladaptive means in order to elicit the help of others in lieu of common social methods. It may also be beneficial to evaluate how often children turn away from or avoid social interactions during the course of an ADOS administration. Having a measure of maladaptive initiations and avoidance would provide a counter coding to social approach that may provide a more robust picture of a child's social interest.

By design, social initiations and responses did not specifically take into account the function of the behavior (i.e., declarative or instrumental) however, the focus was on those behaviors that aid in the diagnosis of autism based on the ADOS algorithm;

specifically items related to frequency of vocalizations directed to others, pointing, unusual eye contact, shared enjoyment in interaction, and showing. Similarly, these behaviors have proven to be impaired relative to intellectually disabled and typically developing children with both parents and examiners (Sigman et al., 1986). Coding the frequency of these behaviors throughout the course of the ADOS provided a way to quantify the summary scores provided by standard coding of the ADOS. Moreover, quantifying these behaviors also proved to be significant predictors of language development on scales where summary ADOS scores were not significant, namely scores provided by the PLS4 subscales. Results from the current study indicate that both social initiations and social responses are important in language development. Social responses predicted concurrent language abilities as well as later language acquisition and social initiations predicted later language skills. These results suggest that engaging in behaviors that are mediated by another person, even to request, provide a learning context that is beneficial to language development. Since the results of the hierarchical linear regression indicated that social initiations were not associated with any unique variance above what was already accounted for by social responses no conclusions can be drawn about the specific role of each of type of behavior.

Although the focus of the current study was not on the function of the behaviors being measured, many of the behaviors targeted are behaviors that are exhibited during bids for joint attention, specifically with regard to social initiations. As part of the current coding scheme, pointing, showing and eye gaze were coded as initiations when the child engaged in these behaviors without any gestural or verbal prompt from the parent or examiner. Given that these behaviors may be used in the context of joint attention and

requesting scenarios, it is possible that the current coding may include some instances of initiating joint attention that cannot be disentangled from instances of requesting. Correlations between initiating joint attention scores on the ADOS and social initiation rates provided by the current coding scheme were moderate suggesting that there was in fact some instances of joint attention captured by the social initiations composite, limiting the conclusions that can be drawn from these analyses. It has been suggested that measures of IJA may be indicative of child's social motivation (Mundy, 1995; Mundy & Gomes, 1998) and this increased interest in social interactions aids in language development. The current study expanded the definition of social motivation beyond only instances of IJA and included all instances of a child initiating some interaction with a social partner with the presumption that any instance where a child initiates an interaction with another person is representative of that child's interest in other people. These interactions, in turn, provide language-learning opportunities for the child since the social partner is able to comment on items the child is already attending to. Future studies may explore the role of social initiations in language development while taking into account the role of IJA to determine if social motivation may in fact include these other instrumental child initiated behaviors.

The same concerns are not present with regard to instances of responding to joint attention (RJA) being included in the social response composite. RJA is typically measured by how often a child turns their head or shifts their gaze in order to follow another person's point or gaze. In other words, the child is turning to look at what another person is pointing out. In contrast, the social response composite provided by the current study focused on how often a child responds (within 3s) to an examiner's request or

comment. In this case, the child may hand over an object the examiner has asked for or look up at the examiner when they comment on a toy the child is playing with. In keeping with these differences no correlations were found between RJA scores on the ADOS and the social response composite. The results indicate that responsiveness to others is indicative of both concurrent language and future language skills, highlighting the importance of responding to others as a skill to target in intervention. Responding to the requests of others and acknowledging when others are talking by shifting gaze or answering questions may also be representative of a child's interest in engaging with others to some degree. While initiating interactions may be more representative of a child's desire to partake in a social interaction, initiations may also represent more difficult or higher order behaviors. Responding to others may be one way for children to engage socially and take part in some social learning opportunities without the added effort of initiating these interactions.

Language Exposure

Research has shown that adult language that follows a child's attentional focus is an important predictor of language development (Carpenter, Nagell, Tomasello, Butterworth & Moore, 1998; McDuffie & Yoder, 2010; Siller & Sigman, 2008). In other words, talking to a child about something they are attending to or playing with is more beneficial than trying to change their focus to some other stimuli. The current study hypothesized that social initiations would play a role in language development by providing a context for the adult to comment on something to which the child was already attending while simultaneously being engaged with a partner. No correlations were found between the amount of language exposure and language gains on either

subscale of the MSEL or PLS4. These results suggest that some other mechanism may be responsible for why children learn better in contexts of shared attentional focus. As was previously mentioned with regard to social approach coding, these results are also limited to the context in which they were observed. The amount of language each child was exposed to remained relatively consistent across participants. This may be due to the fact that the ADOS utilizes standard contexts and prompts that do not change greatly from one administration to the next, thus constraining the measure of language exposure. The distinction between talking to a child and talking at a child was not represented by the results of the current analyses. In other words, coding language exposure in the context of the ADOS may not be representative of how much language the child is exposed to in more natural settings. Future research may explore differences in language exposure in a more naturalistic context where language is free to vary greatly.

Significance: Influencing Interventions

Global outcome measures, such as IQ, are typically employed to assess the effectiveness of intervention programs. Results from several studies have provided evidence that children who participate in established interventions (e.g., EIBI) show marked improvements in measures of IQ, language abilities and adaptive skills (Magiati et al., 2012; Mundy & Crowson, 1997; Reichow, 2012; Reichow et al., 2012). This macro view of improved outcomes for children who participate in interventions is a promising first step in determining the right treatment for children with autism, however, it is important to now turn attention to those individual child variables that lead some children to improve more than others. As we begin to evaluate the micro level of treatment response, the focus has moved away from the one-size fits all approach and

into a realm where individual differences are highlighted and evaluated. Research is beginning to hone in on variables that lead some children to be responders (i.e., children who demonstrate gains following intervention) and others non-responders (i.e., children who do not display significant gains after intervention). The current study used methods similar to those of Sherer and Schreibman (2005), where improvements on standardized assessments were used to divide participants into two groups, exceptional responders and non-responders. These groups were then evaluated to determine if they engaged in different behaviors. Sherer and Schreibman used the behavioral profiles generated from these two groups to evaluate response to a pivotal response treatment. The authors found that those children who had behavioral profiles consistent with responders showed improvements after the intervention and non-responders did not show these same gains. These results lend support to the notion that children respond differently to treatments and that pre-treatment behaviors may affect how a child responds to a particular intervention. The authors note that the non-responder group was reportedly (anecdotally) making gains using other intervention strategies, further highlighting the importance of initial behavioral profiles in selecting the appropriate treatment for a child.

Results of the current study showed that there were differences between children demonstrating exceptional outcomes across all four subscales and those that made no progress from pre to post. The responder group showed higher rates of gaze initiations and giving response compared to the non-responder group. The responders were also engaging in more initiating behaviors overall than the non-responders. Similar results have been observed in other studies investigating the role of child initiations as an important component of treatment response (Koegel, Carter & Koegel, 2003; Koegel,

Koegel, Shoshan & McNeerney, 1999; Sherer & Schreibman, 2005). These results should be interpreted with caution since the current study did not control for the types of intervention each child was receiving or the type of pre-school classroom they participated in. Future research should investigate the roles of these behaviors by using them to create responder and non-responder groups and evaluating how each child responds to different intervention strategies. This line of research will help parents determine the best intervention for their child based on their current behavioral repertoire. It may also indicate if some behavioral profiles do not respond well to treatment in general and social approach behaviors can be targeted as a foundational skill that will facilitate learning.

Children with autism are a heterogeneous group, displaying different forms of behaviors and showing vast differences in language abilities. Participants in this study showed varying levels of pretest language abilities, rates of social initiations and responses and gains in language scores on the two standardized assessments used. Between-individual differences on language gains across the four scales were expected however; there was also a vast amount of within-child differences in performance. Several participants showed overall gains on only one type of language measure (i.e., receptive or expressive) or made gains on one subscale of expressive or receptive language but not the other. For those individuals that showed discrepant results on expressive or receptive subscales, these differences may be a result of testing conditions or the type of questions asked on the respective assessments. Future research may further investigate the type of receptive and expressive language gains by evaluating the types of responses required on each of the assessments. It is possible that while assessing the same

construct, the two assessments are focusing on different aspects of receptive and expressive language.

Research on social interventions has shown that social engagement is a pivotal response, leading to improvements in others areas (e.g., language abilities and decreases in inappropriate behavior) without these skill areas being directly trained (Rogers, 2000). Studies have focused on increasing interactions with familiar and unfamiliar adults and peers with promising results however, translating these findings into a treatment program that is ecologically valid for children with autism continues to pose a problem. One obstacle that remains is that there is not a good way to measure the outcome of social interventions. Those outcome methods that have been proposed are typically cumbersome and not easily employed (Bell & Barnett, 1999; McConnell & Odom, 1999). The social approach coding presented in this study may provide a way to not only identify those specific social behaviors that a child has difficulties with, but also may also be used as a way to assess intervention effectiveness. As has been previously mentioned, more research is needed with other populations and in a variety of settings in order to determine how often social approach behaviors occur in other situations however, this information can provide a standard by which to compare intervention effectiveness between groups. Social approach behaviors of typically developing children can provide a realistic norm of what a child's social interactions actually look like with different people and in different environments. Social approach coding can also be used as a within-subject measure of treatment effectiveness by being employed at different points in intervention to determine if children are increasing the frequency with which they engage in these behaviors. Social approach coding may be adopted in a variety of

situations by using time-sampling methods to capture these behaviors in a efficient and effective manner.

The ADOS & ABA

Applied behavior analysis (ABA) is the application of principles, methods and procedures of the science of behavior to the treatment of socially relevant behaviors.

ABA has garnered much attention in the treatment of children with autism since studies have shown that children who participate in intensive, long-term ABA interventions demonstrate improvements on cognitive, language and adaptive measures (e.g., Lovass, 1987; McEachin, Smith & Lovaas, 1993; Sheinkopf & Siegel, 1998). As was previously noted, it is important to consider that autism interventions should not take a one-size fit all approach and individual child centered variables should be used to guide treatment.

ABA is a dynamic approach that allows a child's goals to be tailored to his or her individual needs throughout development. This flexibility has contributed the widespread use of ABA methodology in autism treatment programs. However, a question remains as to how to best choose the behaviors to target in ABA intervention.

There are a limited number of manuals that guide practioners in generating treatment programs for children with autism. Two commonly used manuals are the Assessment of Basic Language and Learning Skills – Revised (ABLLS-R; Partington, 2008) and the Verbal Behavior Milestones and Placement Program (VBMAPP; Sundberg, 2008) These manuals provide an easy to follow sequence of target behaviors with an emphasis on those skills that increase functional communication and decrease inappropriate behaviors. While these programs provide an excellent starting point, the principal focus is on language and not necessarily the core deficits of autism. More

research is required to determine the best sequence for introducing target behaviors while taking into account not only typical developmental sequence but also the core deficits of autism. One possible place to begin this line of investigation is to use the ADOS to inform ABA interventions.

The ADOS is designed to assess both the frequency and quality of behaviors related to the core deficits of autism. ADOS codes provide a descriptive measure of how often a child engages in a particular behavior as well as qualitative aspects of that behavior. For example, the ADOS provides a description of how often a child uses eye gaze and whether eye gaze is used in combination with other behaviors. These ADOS codes can be used to provide a comprehensive picture of a child's communication, social and repetitive or stereotyped behaviors. Summary codes of the ADOS can provide a macro view of the child's functioning as it relates to the core deficits in autism and this can help to guide treatment targets that are most beneficial for each child. Given the limitation of summary scores based on the examiners clinical judgment it is advantageous to follow-up with direct measures of the child's behavior. Social approach coding can provide the next step in an ADOS based intervention. Social approach codes would provide a direct measure of each behavior highlighting the strengths and weaknesses of each child and illuminating those behaviors that should be targeted in intervention. Taken together the standard ADOS coding and ancillary social approach coding combined can provide a basis for autism treatments that takes into account each child's individual strengths and weaknesses while focusing on those behaviors that are notably deficient in children with autism. Future research should evaluate using the ADOS and social approach coding in this manner. Focus should be placed on improvements in both the

qualitative and quantitative aspects of a child's behavior and this combined coding may be an ideal guide for program development.

Summary

The current study evaluated the utility of a novel behavioral-coding scheme designed to capture the social interest of children with autism in a quantitative way. This coding scheme was further used to assess the relationship between social interest, as measured by social initiations and social responses, and language development. The results of the current study revealed that social initiations and social responses both play a role in language development, indicating that children who engage in more social behaviors show increased language scores on the MSEL and PLS-4. The results of this study represent an alternative way to use the ADOS to quantify and describe the specific social behaviors that are difficult for children with autism. Given that the results demonstrate that these behaviors are in fact important in language development, this coding scheme provides a way to directly measure and assess social behaviors that are meaningful in their own right as well as to the development of both receptive and expressive language abilities. The information gleaned from the behavioral coding scheme described has vast potential in aiding in the development and assessment of intervention programs for children with autism. A quantitative measure, such as the one described, will aid in not only providing an indication of those behaviors that are most difficult for a child and may need to be targeted in intervention but also as a way to assess progress through an intervention program. Future research on the use of this coding scheme as a direct outcome measure for early intervention programs will help direct our

focus to the individual variables that may determine a child's success in an intervention program and aid in tailoring these programs to meet the unique needs of each child.

REFERENCES

- Adamson, L., & Bakeman, R. (1982). Affectivity and reference: Concepts, methods, and techniques in the study of communication development of 6-to-18-month-old infants. In T. Field & A. Fogel (Eds.), *Emotion and early interaction* (pp. 213-236). Hillsdale, NJ: Erlbaum.
- Adamson, L. B., & Bakeman, R. (1985). Affect and attention: Infants observed with mothers and peers. *Child Development*, *56*, 582-593.
- Adamson, L. B., & Chance, S. E. (1998). Coordinating attention to people, objects and language. In A. M. Wetherby, S. F. Warren & J. Reichle (Eds.), *Transitions in prelinguistic communication (Vol 7, pp. 15-38)*. Baltimore, MD: Paul H. Brooks Publishing Co.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*. Arlington, VA: American Psychiatric Publishing.
- Bahrnick, L., & Lickliter, R. (2000). Intersensory redundancy guides attentional selectivity and perceptual learning in infancy. *Developmental Psychology*, *36*, 190-201.
- Bakeman, R., & Adamson, L. (1984). Coordinating attention to people and objects in mother-infant and peer-infant interaction. *Child Development*, *55*, 1278-1289.
- Baldwin, D. (1993). Early referential understanding: Infants' ability to recognize referential acts for what they are. *Developmental Psychology*, *29*, 832-843.
- Baranek, G. T. (1999). Autism during infancy: A retrospective video analysis of sensory-motor and social behaviors at 9-12 months of age. *Journal of Autism and Developmental Disorders*, *29*(3), 213-224.
- Baron-Cohen, S. (1987). Autism and symbolic play. *British Journal of Developmental Psychology*, *5*, 139-148.
- Baron-Cohen, S. (1988). Social and pragmatic deficits in autism: Cognitive or affective. *Journal of Autism and Developmental Disorders*, *18*, 379-402.
- Baron-Cohen, S. (1995). *Mindblindness*. Cambridge, MA: MIT Press.
- Baron-Cohen, S. (2001). Theory of mind in normal development and autism. *Prisme*, *34*, 174-183.

- Baron-Cohen, S., Baldwin, D. A., & Crowson, M. I. (1997). Do children with autism use the speaker's direction of gaze strategy to crack the code of language?. *Child Development, 68*(1), 48-57.
- Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have theory of mind? *Cognition, 21*(1), 37-46.
- Baron-Cohen, S., O'Riordan, M., Stone, V., Jones, R., & Plaisted, K. (1999). Recognition of faux pas by normally developing children and children with asperger syndrome or high-functioning autism. *Journal of Autism and Developmental Disorders, 29*(5), 407-418.
- Bates, E., Benigni, L., Bretherton, I., Camaioni, L., & Volterra, V. (1979). The emergence of symbols: Cognition and communication in infancy. New York: Academic Press.
- Bates, E., Camaioni, L., & Volterra, V. (1975). The acquisition of performatives prior to speech. *Merrill-Palmer Quarterly of Behavior and Development, 21*, 205-226.
- Bell, S. H., & Barnett, D. W. (1999). Peer micronorms in the assessment of young children methodological review and examples. *Topics in Early Childhood Special Education, 19*(2), 112-122.
- Blass, E. (1999). The ontogeny of human face recognition: Orogustatory, visual and social influences. In P. Rochat (Ed.), *Early Social Cognition: Understanding Others in the First Months of Life* (pp. 35-66). Mahwah, NJ: Erlbaum.
- Bowler, D. M. (1992). "Theory of mind" in Asperger's syndrome. *The Journal of Child Psychology and Psychiatry, 33*(5), 877-893.
- Boyd, B. A., Hume, K., McBee, M. T., Alessandri, M., Gutierrez, A., Johnson, L., ... & Odom, S. L. (2014). Comparative efficacy of LEAP, TEACCH and non-model-specific special education programs for preschoolers with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 44*(2), 366-380. doi: 10.1007/s10803-013-1877-9.
- Bruner, J., & Sherwood, V. (1983). Thought, language and interaction in infancy. In J. D. Call, E. Galenson & R. L. Tyson (Eds.), *Frontiers of Infant Psychiatry* (pp. 38-55). New York: Basic Books.
- Carpenter, M., Nagell, K., Tomasello, M., Butterworth, G., & Moore, C. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the society for research in child development, 63*(4), 1-143.

- Carter, A. S., Davis, N. O., Klin, A., & Volkmar, F. R. (2005). Social development in autism. In F.R.Volkmar, R. Paul, A. Klin, & D. Cohen. (Eds.), *Handbook of Autism and Pervasive Developmental Disorders (Vol 1)*, pp. 312-334). Hoboken, NJ: John Wiley & Sons.
- Chevallier, C., Kohls, G., Troiani, V., Brodtkin, E. S., & Schultz, R. T. (2012). The social motivation theory of autism. *Trends in Cognitive Science*, *16*(4), 231-239.
- Constantino, J. N. (2002). *The social responsiveness scale*. Los Angeles: Western Psychological Services.
- Couteur, A. L., Haden, G., Hammal, D., & McConachie, H. (2008). Diagnosing autism spectrum disorders in pre-school children using two standardized assessment instruments: The ADI-R and the ADOS. *Journal of Autism and Developmental Disorders*, *38*, 362-372. doi: 10.1007/s10803-007-0403-3.
- Curcio, F. (1978). Sensorimotor functioning and communication in mute autistic children. *Journal of Autism and Childhood Schizophrenia*, *8*, 282-292.
- Dawson, G. (1991). A psychobiological perspective on the early socioemotional development of children with autism. In S. Toth & D. Cicchetti (Eds.), *Rochester Symposium on Developmental Psychopathology (Vol. 3)*, pp. 207-234). Mahwah, NJ: Erlbaum.
- Dawson, G. (2008). Early behavioral intervention, brain plasticity, and the prevention of autism spectrum disorder. *Development and Psychopathology*, *20*, 775-803.
- Dawson, G., & Adams, A. (1984). Imitation and social responsiveness in autistic children. *Journal of Abnormal Child Psychology*, *12*, 209-226.
- Dawson, G., Meltzoff, A. N., Osterling, J., Rinaldi, J., & Brown, E. (1998). Children with autism fail to orient to naturally occurring social stimuli. *Journal of Autism and Developmental Disorders*, *28*, 479-485.
- Dawson, G., Hill, D., Spencer, A., Galpert, L., & Watson, L. (1990). Affective exchanges between young autistic children and their mothers. *Journal of Abnormal Child Psychology*, *18*, 335-345.
- Dawson, G., Toth, K., Abbott, R., Osterling, J., Munson, J., Estes, A., & Liaw, J. (2004). Early social attention impairments in autism: Social orienting, joint attention and attention to distress. *Developmental Psychology*, *40*, 271-283. doi: 10.1037/0012-1649.40.2.271.

- Dube, W.V., MacDonald, R.P.F., Mansfield, R.C., Holcomb, W.L., & Ahearn, W. H. (2004). Toward a behavioral analysis of joint attention. *The Behavior Analyst*, 27, 197-207.
- Fox, N. A. (1991). If it's not left, it's right. *American Psychologist*, 46, 863-872.
- Gottlieb, G. (1991). Experiential canalization of behavioral development: Theory. *Developmental Psychology*, 27, 4-13.
- Greenough, W. T., Black, J. E., & Wallace, C. S. (1987). Experience and brain development. *Child Development*, 58, 539-559.
- Grelotti, D. J., Gauthier, I., & Schultz, R. T. (2002). Social interest and the development of cortical face specialization: What autism teaches us about face processing. *Developmental Psychobiology*, 40(3), 213-225.
- Guercio, J. M., & Hahs, A. D. (2014). Applied behavior analysis and the autism diagnostic observation schedule (ADOS): A symbiotic relationship for advancements in services for individuals with autism spectrum disorders (ASDs). *Behavior Analysis in Practice*, 1-4. doi: 10.1007/s40617-014-0034-z
- Happe, F. (1995). The role of age and verbal ability in the theory of mind tasks performance of subjects with autism. *Child Development*, 66(3), 843-855.
- Hauck, M., Fein, D., Waterhouse, L., & Feinstein, C. (1995). Social initiations by autistic children to adults and other children. *Journal of Autism and Developmental Disorders*, 25, 579-595.
- Heimann, M., Laberg, K. E., & Nordøen, B. (2006). Imitative interaction increases social interest and elicited imitation in non-verbal children with autism. *Infant and Child Development*, 15(3), 297-309.
- Hobson, R. P., & Lee, A. (1998). Hello and goodbye: A study of social engagement in autism. *Journal of Autism and Developmental Disorders*, 28(2), 117-127.
- Horovitz, M., & Matson, J. L. (2010). Communication deficits in babies and infants with autism and pervasive developmental disorder—not otherwise specified (PDD-NOS). *Developmental Neurorehabilitation*, 13(6), 390-398.
- Howlin, P., Magiati, I., & Charman, T. (2009). Systematic review of early behavioral interventions for children with autism. *American Journal on Intellectual and Developmental Disabilities*, 114(1), 23-41.

- Howlin, P., (1986), An overview of social behavior in autism. In E. Schopler & G. B. Mesibov (Eds), *Social behavior in autism* (pp, 103-131), New York: Plenum,
- Iverson, J. M., & Goldin-Meadow, S. (2005). Gesture paves the way for language development. *Psychological Science*, *16*(5), 367-371.
- Johnson, C.P. & Meyers, S.M. (2007). Identification and evaluation of children with autism spectrum disorders. *Pediatrics*, *120*(5), 1183-1215. doi: 10.1542/peds.2007-2361.
- Kanner, L. (1943). Autistic disturbance of affective contact. *Nervous Child*, *2*(3), 217-250.
- Kasari, C., Gulsrud, A., Freeman, S., Paparella, T., & Hellemann, G. (2012). Longitudinal follow-up of children with autism receiving targeted interventions on joint attention and play. *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*(5), 487-495. doi:10.1016/j.jaac.2012.02.019.
- Kasari, C., Sigman, M., Mundy, P., & Yirmiya, N. (1990). Affective sharing in the context of joint attention interactions of normal, autistic, and mentally retarded children. *Journal of Autism and Developmental Disorders*, *20*, 87-100.
- Kim, S. H., & Lord, C. (2010). Restricted and repetitive behaviors in toddlers and preschoolers with autism spectrum disorders based on the autism diagnostic observation schedule (ADOS). *Autism Research*, *3*, 162-173.
- Klin, A. (1991). Young autistic children's listening preferences in regard to speech: a possible characterization of the symptom of social withdrawal. *Journal of Autism and Developmental Disorders*, *21*, 217-250.
- Klin, A., Lin, D. J., Gorrindo, P., Ramsay, G., & Jones, W. (2009). Two-year-olds with autism orient to nonsocial contingencies rather than biological motion. *Nature*, *459*, 257-261. doi: 10.1038/nature07868.
- Klin, A., Sparrow, S. S., de Bildt, A., Cicchetti, D. V., Cohen, D. J., & Volkmar, F. R. (1999). A normed study of face recognition in autism and related disorders. *Journal of Autism and Developmental Disorders*, *29*(6), 499-508.
- Klin, A., Volkmar, F. R., Sparrow, S. S. (1992). Autistic social dysfunction: Some limitation of the theory of mind hypothesis. *Journal of Child Psychology and Psychiatry*, *33*, 861-876.

- Klintwall, L., & Eikeseth, S. (2012). Number and controllability of reinforcers as predictors of individual outcome for children with autism receiving early and intensive behavioral intervention: A preliminary study. *Research in Autism Spectrum Disorders, 6*(1), 493-499. doi:10.1016/j.rasd.2011.07.009.
- Koegel, L. K., Carter, C. M., & Koegel, R. L. (2003). Teaching children with autism self-initiations as a pivotal response. *Topics in Language Disorders, 23*(2), 134-145.
- Koegel, L. K., Koegel, R. L., Shoshan, Y., & McNerney, E. (1999). Pivotal response intervention II: Preliminary long-term outcome data. *Journal of the Association for Persons with Severe Handicaps, 24*(3), 186-198
- Kover, S. T., Davidson, M. M., Sindberg, H. A., & Weismer, S. E. (2014). Use of the ADOS for assessing spontaneous expressive language in young children with ASD. *Journal of Speech, Language, and Hearing Research, 57*, 2221-2233. doi: 10.1044/2014_JSLHR-L-13-0330.
- Krug, D. A., Arick, J. R., & Almond, P. J. (1980). Behavior checklist for identifying severely handicap individuals with high levels of autistic behavior. *Journal of Child Psychology and Psychiatry, 21*, 221-229.
- Kuhl, P. K., Coffey-Corina, S., Padden, D., & Dawson, G. (2005). Links between social and linguistic processing of speech in preschool children with autism: behavioral and electrophysiological measures. *Developmental Science, 8*(1), F1-F12.
- Leslie, A. (1987). Pretense and representation: The origins of "theory of mind." *Psychological Review, 94*, 412-426.
- Lewy, A. L., & Dawson, G. (1992). Social stimulation and joint attention in young autistic children. *Journal of Abnormal Child Psychology, 20*(6), 555-566.
- Lord, C. & Hopkins, J. M. (1986). The social behavior of autistic children with younger and same-age nonhandicapped peers. *Journal of Autism and Developmental Disorders, 16*, 249-262.
- Lord, C., & MaGill-Evans, J. (1995). Peer interactions of autistic children and adolescents. *Development and Psychopathology, 7*(4), 611-626.
- Lord, C., Rutter, M., DiLavore, P. C., & Risi, S. (1999). The autism diagnostic observation schedule (ADOS). Los Angeles: Western Psychological Corporation.

- Lord, C., Rutter, M., Goode, S., Heemsbergen, J., Jordan, H., Mawhood, L., & Schopler, E. (1989). Autism diagnostic observation schedule: A standardized observation of communicative and social behavior. *Journal of Autism and Developmental Disorders, 19* (2), 185-212.
- Lord, C., Storoschuk, S., Rutter, M. & Pickles, A. (1993). Using the ADI-R to diagnose autism in preschool children. *Infant Mental Health Journal, 14*, 234-252.
- Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology, 55*(1), 3.
- Loveland, K. A., & Landry, S. H. (1986). Joint attention and language in autism and developmental language delay. *Journal of Autism and Developmental Disorders, 16*(3), 335-349.
- Magiati, I., Tay, X. W., & Howlin, P. (2012). Early comprehensive behaviorally based interventions for children with autism spectrum disorders: a summary of findings from recent reviews and meta-analyses. *Neuropsychiatry, 2*(6), 543-570.
- McConnell, S. R., & Odom, S. L. (1999). A multimeasure performance-based assessment of social competence in young children with disabilities. *Topics in Early Childhood Special Education, 19*(2), 67-74.
- McDuffie, A., & Yoder, P. (2010). Types of parent verbal responsiveness that predict language in young children with autism spectrum disorder. *Journal of Speech, Language, and Hearing Research, 53*(4), 1026-1039. doi: 10.1044/1092-4388(2009/09-0023).
- McEachin, J. J., Smith, T., & Ivar Lovaas, O. (1993). Long-term outcome for children with autism who received early intensive behavioral treatment. *American Journal of Mental Retardation, 97*, 359-359.
- Moore, C., Corkum, V. (1994). Social understanding at the end of the first year of life. *Developmental Review, 14*, 349-372.
- Morales, M., Mundy, P., & Rojas, J. (1998). Following the direction of gaze and language development in 6-month-olds. *Infant Behavior & Development, 21*, 373-377.
- Morton, J., & Johnson, M. H. (1991). CONSPEC and CONLERN: A two-process theory of infant face recognition. *Psychological Review, 98*, 164-181.

- Mullen, E. M. (1995). *Mullen Scales of Early Learning (AGS Edition)*. Los Angeles: Western Psychological.
- Mundy, P. (1995). Joint attention and social-emotional approach behavior in children with autism. *Development and Psychopathology*, 7, 63-82.
- Mundy, P., & Crowson, M. (1997). Joint attention and early social communication: Implications for research on intervention with autism. *Journal of Autism and Developmental Disorders*, 27, 653-676.
- Mundy, P., & Gomes, A. (1998). Individual differences in joint attention skill development in the second year. *Infant Behavior & Development*, 21, 469-482.
- Mundy, P., & Hogan, A. (1994). Joint attention, intersubjectivity and autistic psychopathology. In D. Cicchetti & S. Toth (Eds.), *Rochester Symposium on Developmental Psychopathology: Disorder and Dysfunction of the Self* (pp. 1-31). Rochester, NY: University of Rochester Press.
- Mundy, P., Kasari, C., & Sigman, M. (1992). Nonverbal communication, affective sharing and intersubjectivity. *Infant Behavior and Development*, 15, 377-381.
- Mundy, P., & Neal, R. (2001). Neural plasticity, joint attention, and a transactional social-orienting model of autism. *International Review of Research In Mental Retardation*, 23, 139-168.
- Mundy, P. & Newell, L. (2007). Attention, joint attention, and social cognition. *Current Directions in Psychological Science*, 16(5), 269-274.
- Mundy, P., & Sigman, M. (1989). The theoretical implications of joint-attention deficits in autism. *Development and Psychopathology*, 1, 173-183.
- Mundy, P., Sigman, M., & Kasari, C. (1990). A longitudinal study of joint attention and language development in autistic children. *Journal of Autism and Developmental Disorders*, 20, 115-128.
- Mundy, P., Sigman, M., & Kasari, C. (1994). Joint attention, developmental level, and symptom presentation in autism. *Development and Psychopathology*, 6, 389-401.
- Mundy, P., Sigman, M., Ungerer, J., & Sherman T. (1987). Nonverbal communication and play correlates of language development in autistic children. *Journal of Autism and Developmental Disorders*, 17, 349-364.

- Mundy, P., & Willoughby, J. (1998). Nonverbal communication, affect, and social emotional development. In A. M. Wetherby, S. F. Warren & J. Reichle (Eds.), *Transitions in prelinguistic communication (Vol 7, pp. 111-134)*. Baltimore, MD: Paul H. Brooks Publishing Co.
- Nation, K. & Penny, S. (2008). Sensitivity to eye gaze in autism: is it normal? Is it automatic? Is it social? *Development and Psychopathology, 20*, 79-97.
- Osterling, J., & Dawson, G. (1994). Early recognition of children with autism: A study of first birthday home videotapes. *Journal of Autism and Developmental Disorders, 24*, 247-257.
- Osterling, J., Dawson, G., & Munson, J. A. (2002). Early recognition of 1-year-old infants with autism spectrum disorder versus mental retardation. *Development and Psychopathology, 14*, 239-251.
- Partington, J. W. (2008). *The Assessment of Basic Language and Learning Skills-Revised (The ABLLS-R)*. Behavior Analysts.
- Perner, J., & Lang, B. (1999). Development of theory of mind and executive control. *Trends in Cognitive Sciences, 3 (9)*, 337-344.
- Phillips, W., Gómez, J. C., Baron-Cohen, S., Laá, V., & Rivière, A. (1995). Treating people as objects, agents or "subjects": How young children with autism make requests. *Journal of Child Psychology and Psychiatry, 36(8)*, 1383-1398.
- Poon, K. K., Watson, L. R., Baranek, G. T., & Poe, M. D. (2012). To what extent do joint attention, imitation and object play behaviors in infancy predict later communication and intellectual functioning in ASD? *Journal of Autism and Developmental Disorders, 42*, 1064-1074.
- Reichow, B. (2012). Overview of meta-analyses on early intensive behavioral intervention for young children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 42(4)*, 512-520.
- Reichow, B., Barton, E. E., Boyd, B. A., & Hume, K. (2012). Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD). *Cochrane Database Syst Rev, 10*. doi:10.1002/12651858.CD009260.pub2
- Rogers, S. J. (2000). Interventions that facilitate socialization in children with autism. *Journal of autism and developmental disorders, 30(5)*, 399-409.

- Roos, E. M., McDuffie, A. S., Weismer, S. E., & Gernsbacher, M. A. (2008). A comparison of contexts for assessing joint attention in toddlers on the autism spectrum. *Autism, 12*(3), 275-291.
- Rutter, M., Bailey, A., & Lord, C. (2003). *Social Communication Questionnaire (SCQ)*. Los Angeles, CA: Western Psychological Services.
- Schultz, W. (2000). Multiple reward signals in the brain. *Nature Reviews Neuroscience, 1*(3), 199-207.
- Seibert, J. M. & Hogan, A. E. (1982). *Procedures Manual for Early Social Communication Scales (ESCS)*. Mailman Center for Child Development, University of Miami, Florida.
- Sheinkopf, S. J., & Siegel, B. (1998). Home-based behavioral treatment of young children with autism. *Journal of Autism and Developmental Disorders, 28*(1), 15-23.
- Sherer, M. R., & Schreibman, L. (2005). Individual behavioral profiles and predictors of treatment effectiveness for children with autism. *Journal of Consulting and Clinical Psychology, 73*(3), 525. doi: 10.1037/0022-006X.73.3.525.
- Sigman, M., Mundy, P., Sherman, T., & Ungerer, J. (1986). Social interactions of autistic, mentally retarded and normal children and their caregivers. *Journal of Child Psychology and Psychiatry, 27*(5), 647-656.
- Sigman, M. & Ruskin, E. (1999). Continuity and change in the social competence of children with autism, down syndrome and developmental delays. *Monographs of the Society for Research in Child Development, 64*, 1-109.
- Sikoara, D. M., Hall, T. A., Hartley, S. L., Gerrad-Morris, A. E., & Cagle, S. (2008). Does parent report of behavior differ across ADOS-G classifications: Analysis of scores from the CBCL and GARS. *Journal of Autism and Developmental Disorders, 38*, 440-448. doi: 10.1007/s10803-007-0407-z.
- Siller, M., & Sigman, M. (2008). Modeling longitudinal change in the language abilities of children with autism: parent behaviors and child characteristics as predictors of change. *Developmental Psychology, 44*(6), 1691.
- Snow, M. E., Hertzig, M. E., & Shapiro, T. (1987). Expression of emotion in young autistic children. *Journal of the American Academy of Child and Adolescent Psychiatry, 26*, 836-838.

- Sparrow, S., Balla, D., & Cicchetti, D. (1984). *Vineland adaptive behavior scales*. Circle Pines, MN: American Guidance Service.
- Stone, W. L., & Caro-Martinez, L. M. (1990). Naturalistic observations of spontaneous communication in autistic children. *Journal of Autism and Developmental Disorders, 20*, 437-453.
- Stone, W. L., Ousley, O. Y., Yoder, P. J., Hogan, K. L., & Hepburn, S. L. (1997). Nonverbal communication in two- and three-year-old children with autism. *Journal of Autism and Developmental Disorders, 27*, 677-296.
- Stone, W. L., & Yoder, P. J. (2001). Predicting spoken language level in children with autism spectrum disorders. *Autism, 5*(4), 341-361.
- Sundberg, M. L. (2008). *VB-MAPP Verbal Behavior Milestones Assessment and Placement Program: a language and social skills assessment program for children with autism or other developmental disabilities: guide*.
- Tager-Flusberg, H., Paul, R., & Lord, C. (2005). Language and communication in autism. In F.R. Volkmar, R. Paul, A. Klin, & D. Cohen. (Eds.), *Handbook of Autism and Pervasive Developmental Disorders (Vol 1, pp. 335-364)*. Hoboken, NJ: John Wiley & Sons.
- Tomasello, M., Carpenter, M., & Liskowski, U. (2007). A new look at infant pointing. *Child Development, 78*(3), 705-722.
- Ungerer, J. A. & Sigman, M. (1981). Symbolic play and language comprehension in autistic children. *American Academy of Child Psychiatry, 20*, 318-337.
- Venter, A., Lord, C., & Schopler (1992). A follow-up study of high functioning autistic children. *Journal of Child Psychology and Psychiatry, 33*, 489-507.
- Vivanti, G., Prior, M., Williams, K., & Dissanayake, C. (2014). Predictors of outcomes in Autism Intervention: Why don't we know more?. *Child and Neurodevelopmental Psychiatry, 2*, 1-10. doi: 10.3389/fped.2014.00058.
- Volkmar, F.R. (1987). Social development. In D. Cohen & A. Donnellan (Eds.), *Handbook of Autism and Pervasive Developmental Disorders* (p. 4160). New York: Wiley.

- Werner, E., Dawson, G., Osterling, J., & Dinno, N. (2000). Brief report: Recognition of autism spectrum disorder before one year of age: A retrospective study based on home videotapes. *Journal of Autism and Developmental Disorders*, 30(2), 157-162.
- Wetherby, A. M., Cain, D. H., Yonclas, D. G., & Walker, V. G. (1988). Analysis of intentional communication of normal children from the prelinguistic to the multiword stage. *Journal of Speech, Language, and Hearing Research*, 31(2), 240-252.
- Wetherby, A. M., & Prutting, C. A. (1984). Profiles of communicative and cognitive-social abilities in autistic children. *Journal of Speech, Language and Hearing Research*, 27(3), 364-377.
- Wing, L. & Gold, J. (1979). Severe impairments of social interaction and associated abnormalities in children: Epidemiology and classification. *Journal of Autism and Developmental Disorders*, 9, 11-29.
- Yirmaya, N., Kasari, C., Sigman, M., & Mundy, P. (1989). Facial expressions of affect in autistic, mentally retarded and normal children. *Journal of Child Psychology and Psychiatry*, 30, 725-735.
- Zimmerman, I.L., Steiner, V.G., & Pond, R.E. (2002). *Preschool Language Scale (Fourth Edition)*. San, Antonio: Pearson Assessments

APPENDICES

- A. Description of ADOS Module 1 Activities
- B. Psychometric Properties of Measures
- C. Operational Definitions of Social Approach Behaviors
- D. Full Correlation Matrix and Scatter Plots for Concurrent Receptive Language
- E. Full Correlation Matrix and Scatter Plots for Concurrent Expressive Language
- F. Gain Profiles for All Participants

Appendix A: Description of ADOS Module 1 Activities

ADOS Module 1 Activities

<u>Activity</u>	<u>Description</u>
Free Play	Usually done in the beginning of the assessment. Free play is designed to give the child a chance to “warm up” and play without any demands or intrusions. Facilitates the assessment of the child’s independent use of toys, presence of repetitive behaviors and spontaneous engagement with the examiner or parent.
Response to Name	Assesses the child’s response to their name when it is deliberately called in order to get their attention.
Response to Joint Attention	Assesses the child’s response to the examiners use of gaze coordinated with facial orientation, vocalization and pointing in order to draw the child’s attention to an object (remote controlled bunny) in the distance.
Bubble Play	The examiner blows bubbles without saying anything to the child to evaluate how the child responds to the bubbles. The child may use eye contact, vocalizations and/or pointing in order to direct the parent or examiners attention to the bubbles or request more bubbles. Unusual sensory behaviors may also be observed during this activity.
Anticipation of a Routine with Objects	The examiner blows up a balloon, holds up it and says, “Ready, set, go!” and lets the balloon go so that it flies around the room. This activity is designed to assess the child’s anticipation and initiation of the routine.
Responsive Social Smile	The examiner gets the child’s attention and tries to elicit a smile by smiling at the child and making a positive statement, silly face or funny noise. This activity assesses the child’s smiling in response to a purely social overture.
Anticipation of Social Routine	The examiner attempts to engage the child in peek-a-boo or tickling game to assess the child’s anticipation of, request for and participation of a

social routine.

Functional & Symbolic Imitation

The child's ability to imitate simple actions with real objects and a non-meaningful placeholder is evaluated. For example, the examiner will present a cup and pretend to drink for it then ask the child to do it.

Birthday Party

The examiner tells the child that it is the baby's birthday and they are going to have a birthday party for the baby. During this activity the child may engage in symbolic and functional play by making a cake from play-doh, feeding the baby some of the cake, blowing out the candles, etc.

Snack

The examiner gives the child a choice of 2 snack foods and waits for the child to request more. This activity provides an opportunity for the child to request in a familiar context.

Appendix B: Psychometric Properties of Measures

Psychometric Properties of Measures

<u>Measure</u>	<u>Brief Description of Use</u>	<u>Psychometric Properties</u>
<i>Autism Diagnostic Observation Schedule</i> (ADOS; Lord, Rutter, DiLavore & Risi, 1999)	Determine child social approach behaviors and examiner language	Internal consistency is high: Alpha coefficients are 0.86–0.91 for the social domain (across modules), 0.74–0.84 for communication, and 0.63–0.65 for repetitive behaviors (modules 1 and 2) (Lord et al., 2000).
<i>Mullen Scales of Early Learning</i> (MSEL; Mullen, 1995)	Measure of child's receptive and expressive language abilities	Internal reliability ranges from .71 to .83 across MSEL subtests, and .91 for the overall developmental score
<i>Preschool Language Scale, 4th Edition</i> (PLS-4; Zimmerman, Steiner & Pond, 2002)	Measure of child's receptive and expressive language abilities	Internal consistency reliability coefficients range from .66 to .96
<i>Social Responsiveness Scale</i> (SRS; Constantino, 2002)	Existing measure of parent and teacher report of social behaviors, including social initiations and social motivation	Internal consistency is .93 for overall score
<i>Vineland Adaptive Behavior Scale – Survey Edition</i> (VABS; Sparrow, Balla & Cicchetti, 1984)	Existing measure of child's adaptive socialization	Internal consistency is .98 for overall score

Appendix C: Operational Definitions of Social Approach Behaviors

Operational Definitions of Social Approach Behaviors

<u>Behavior</u>	<u>Definition</u>
Gaze to a person	The child shifts their gaze toward the parent or examiner
Vocalizations	Child vocalizes, using either words or sounds, while interacting with the parent or examiner (e.g., looking at, showing, pointing, etc.)
Smiling	Child displays a smile, at least one corner of the mouth upturned, while looking at the parent or examiner
Laughing	Child laughs while interacting with the parent or examiner
Showing	Child holds up an object in front of the parent or examiner to direct their attention to it
Pointing	Child uses their index finger to reference an object they are not touching
Giving	The child hands an object to the parent or examiner; must let go of the object

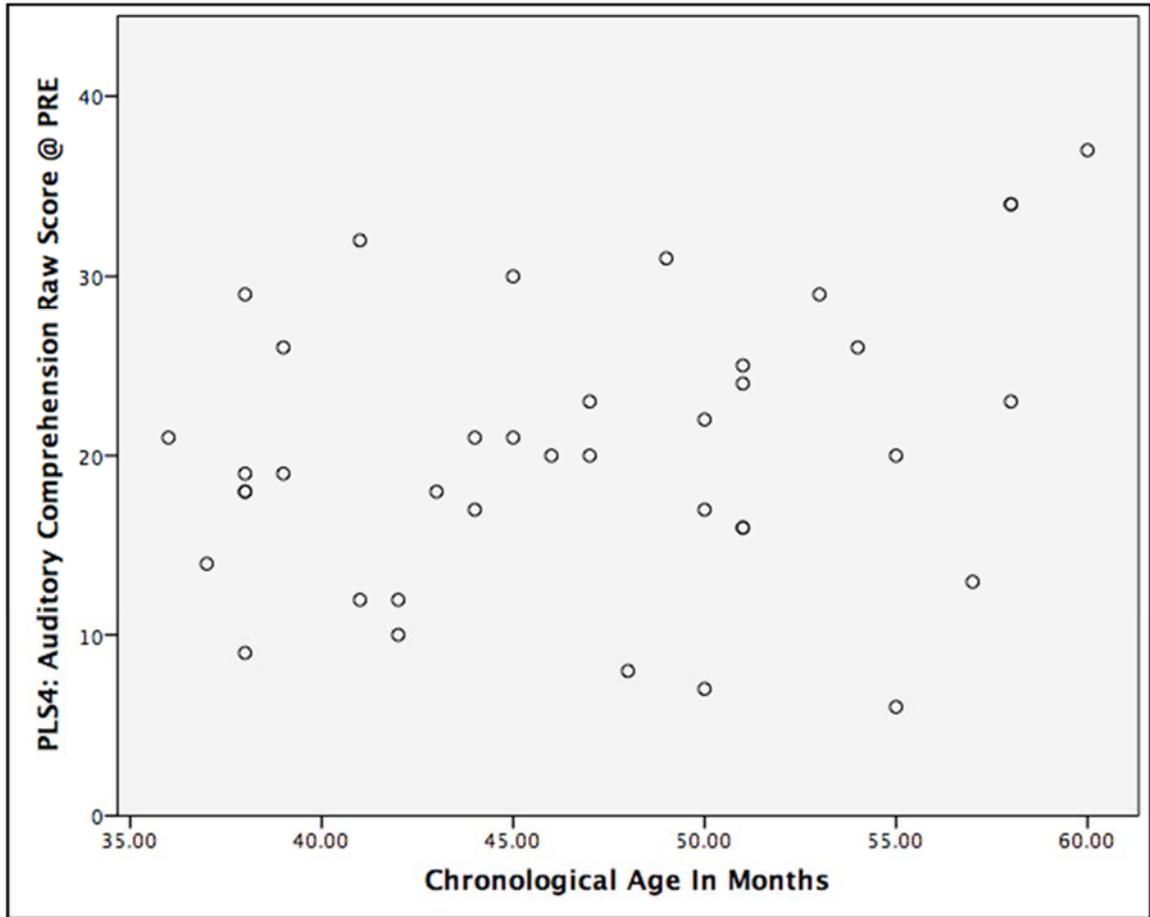
Appendix D: Full Correlation Matrix and Scatter Plots for Concurrent Receptive
Language

All Pearson Correlations for Concurrent Receptive Language on PLS4 Auditory Comprehension Scale

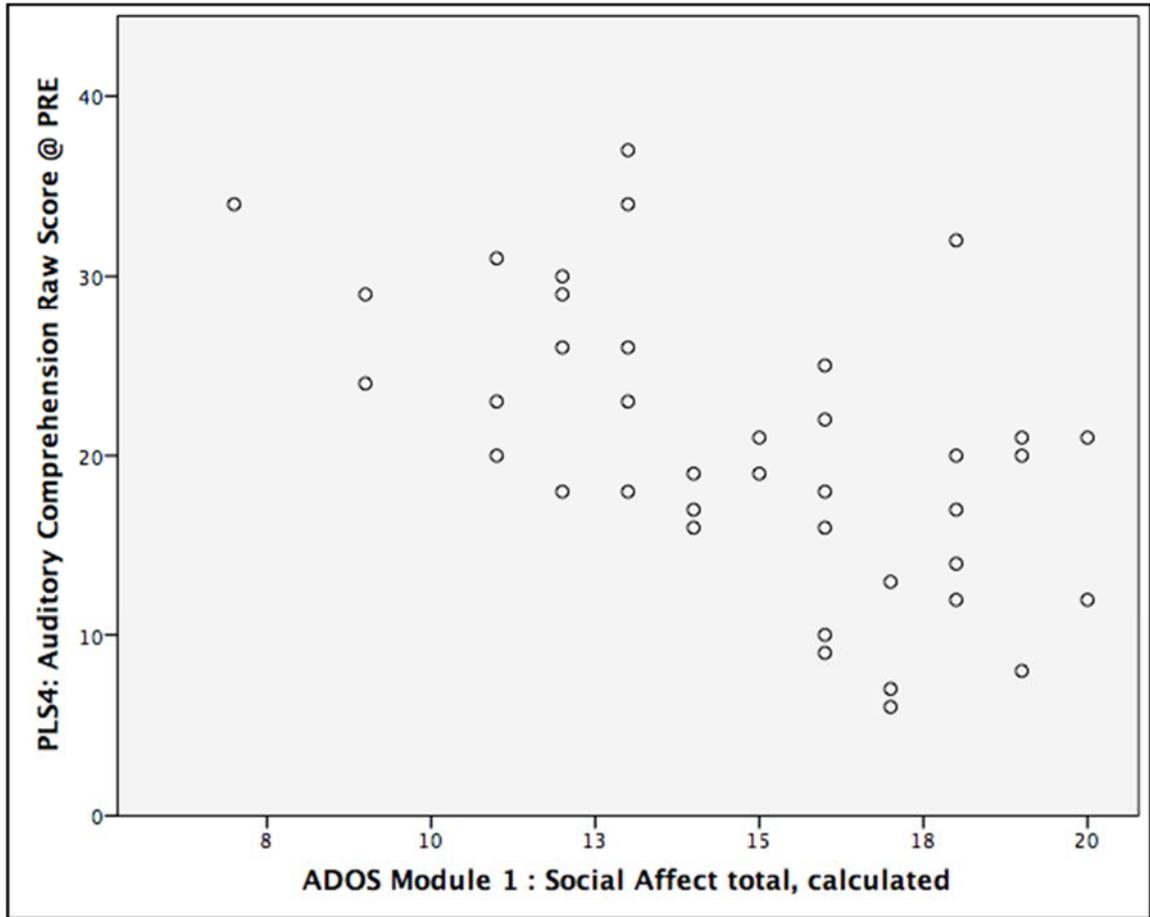
	PLS4: Auditory Comprehension	Chronological Age	ADOS: Social Affect	Social Responses	Social Initiations
PLS4: Auditory Comprehension	1	.278	-.578**	.767**	.621**
Chronological Age	.278	1	-.234	.273	.067
ADOS: Social Affect	-.578**	-.234	1	-.626**	.603**
Social Responses	.767**	.273	-.626**	1	.751**
Social Initiations	.621**	.067	-.603**	.751**	1

$p < .01$

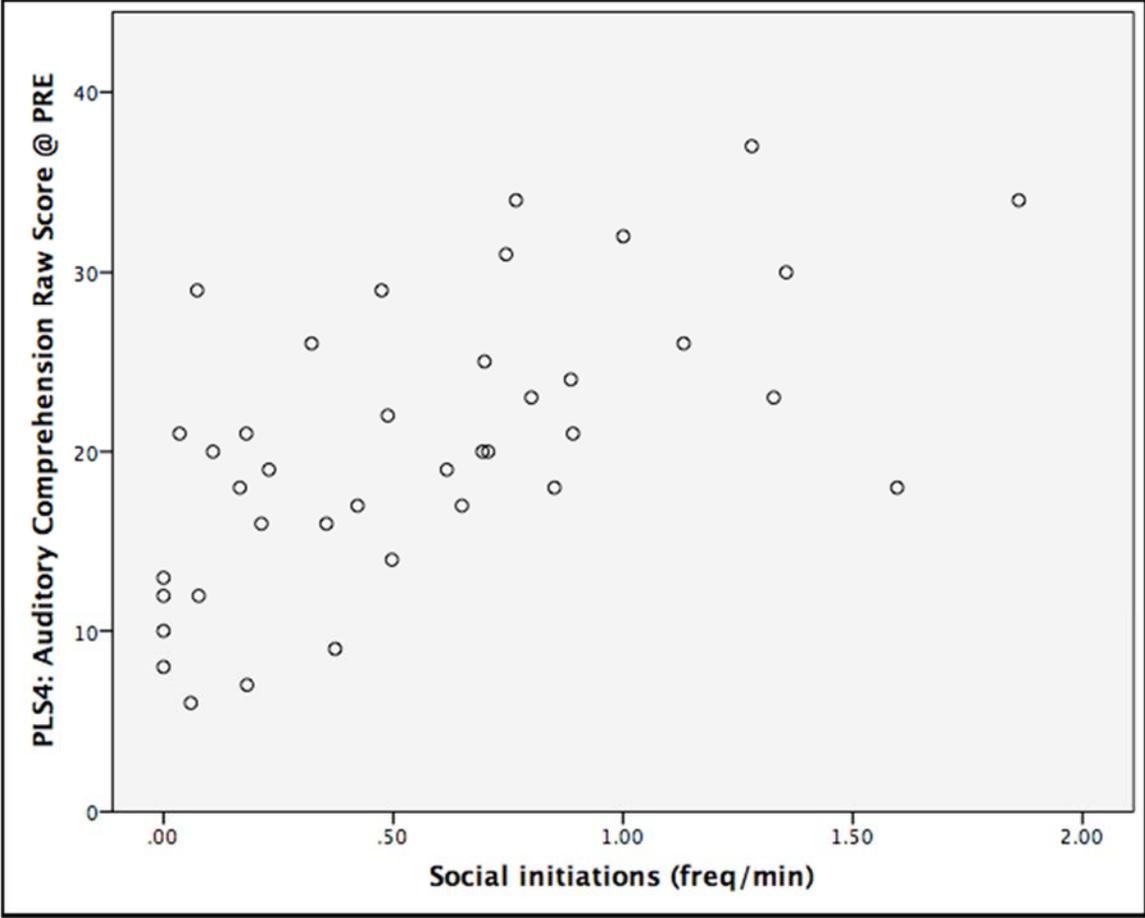
Relationship Between Chronological Age and PLS4: Auditory Comprehension Pre-Test Scores



Relationship Between ADOS Social Affect Scores and PLS4: Auditory Comprehension Pre-Test Scores



Relationship Between Social Initiations and PLS4: Auditory Comprehension Pre-Test Scores



Appendix E: Full Correlation Matrix and Scatter Plots for Concurrent Expressive
Language

All Pearson Correlations for Concurrent Expressive Language on PLS4 Expressive Communication Scale

	PLS4: Expressive Communication	Chronological Age	ADOS: Social Affect	Social Responses	Social Initiations
PLS4: Expressive Communication	1	.275	-.565**	.752**	.571**
Chronological Age	.275	1	-.234	.273	.067
ADOS: Social Affect	-.565**	-.234	1	-.626**	-.603**
Social Responses	.752**	.273	-.626**	1	.751**
Social Initiations	.571**	.067	-.603**	.751**	1

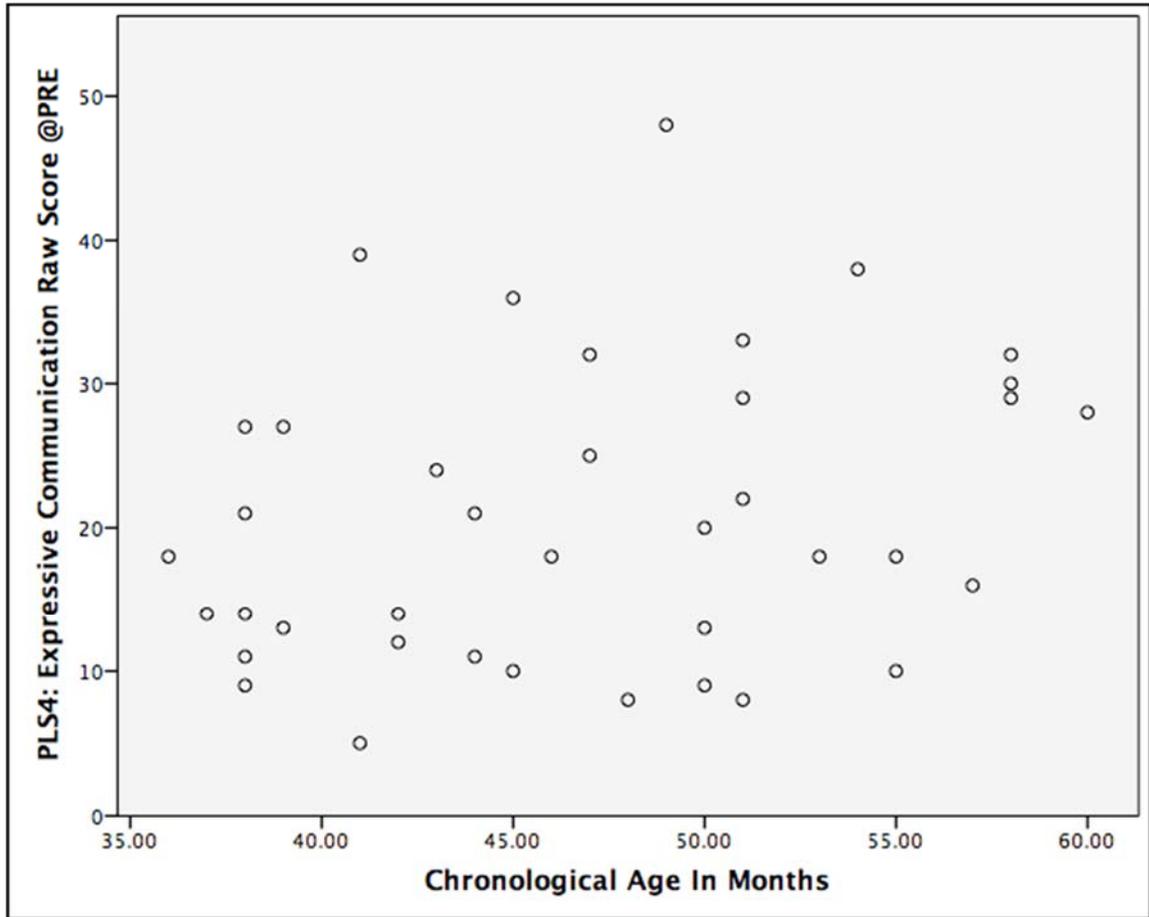
$p < .01$

All Pearson Correlations for Concurrent Expressive Language on MSEL Expressive Communication Scale

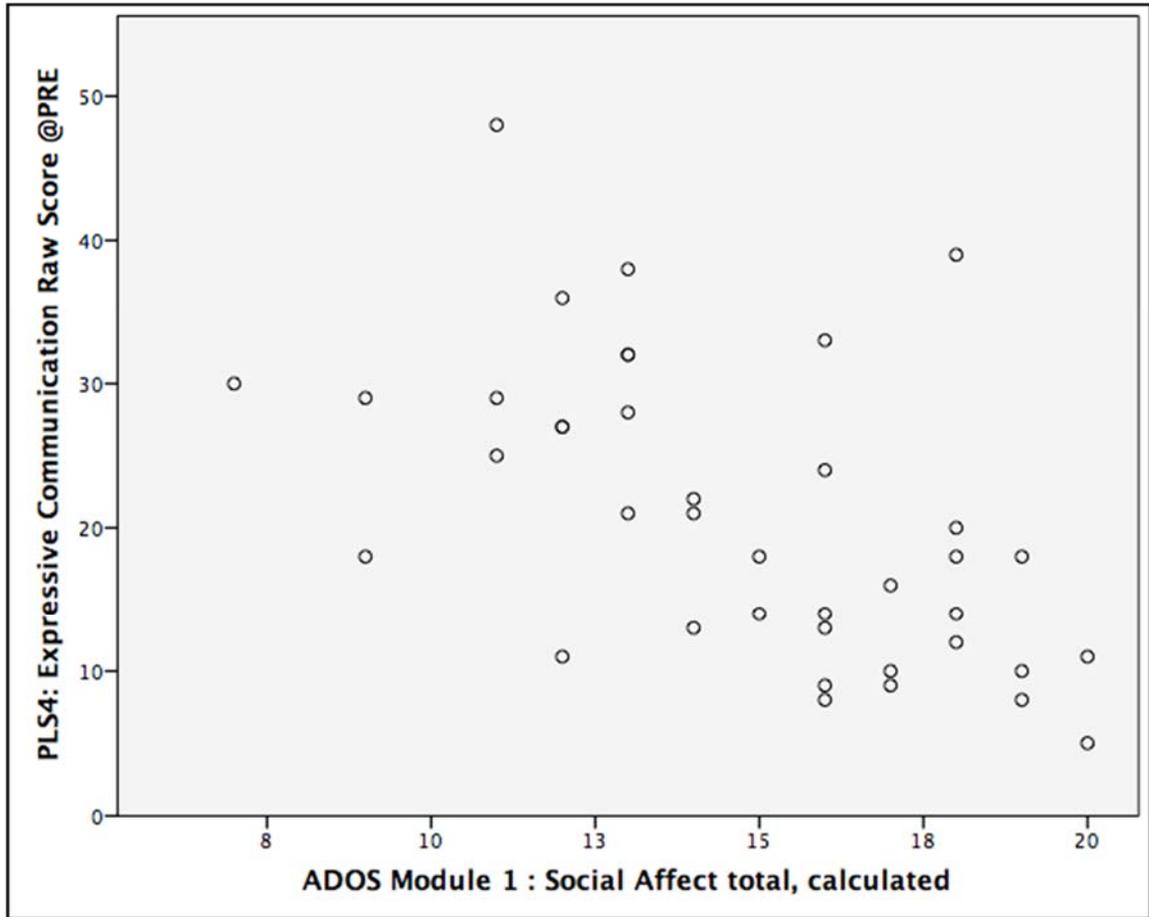
	MSEL: Expressive Communication	Chronological Age	ADOS: Social Affect	Social Responses	Social Initiations
MSEL: Expressive Communication	1	.325*	-.494**	.827**	.596**
Chronological Age	.325*	1	-.234	.273	.067
ADOS: Social Affect	-.494**	-.234	1	-.626**	-.603**
Social Responses	.827**	.273	-.626**	1	.751**
Social Initiations	.596**	.067	-.603**	.751**	1

$p < .01$

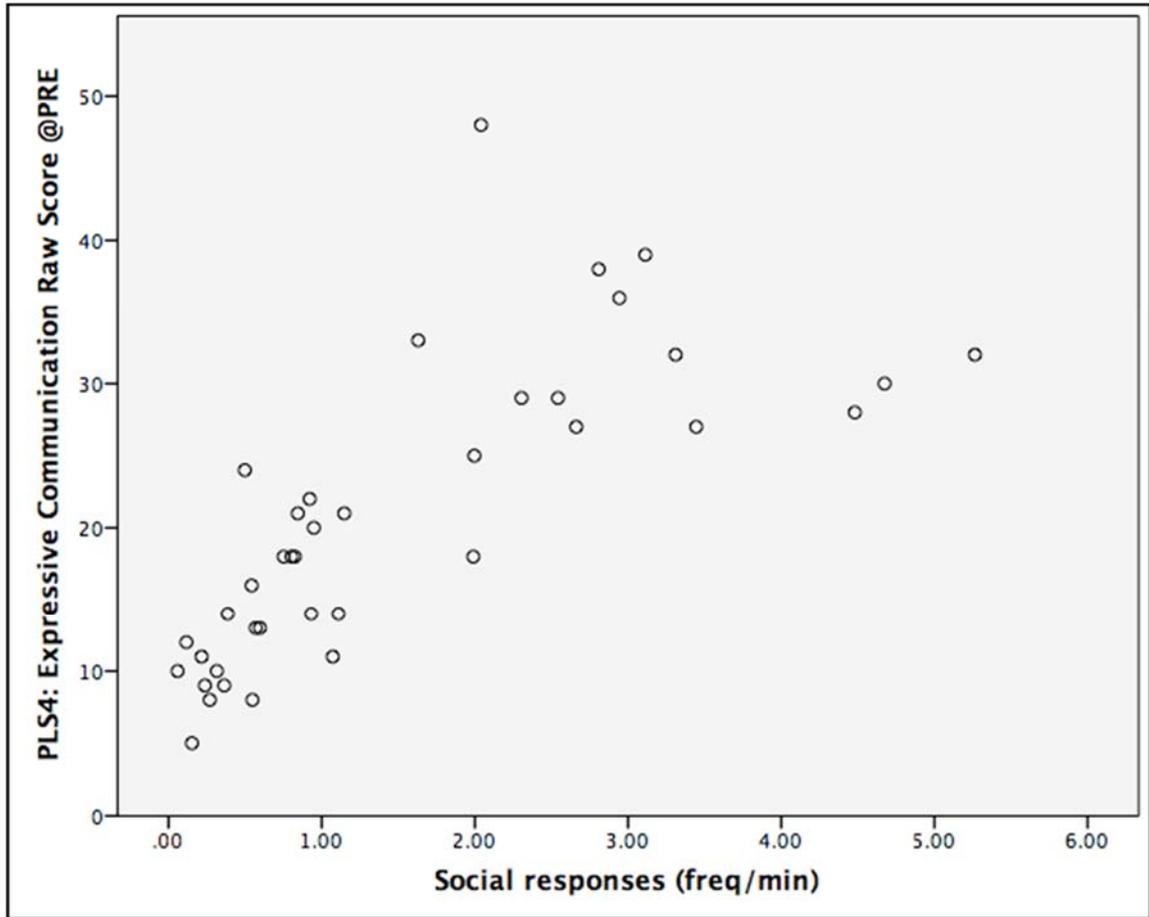
Relationship Between Chronological Age and PLS4: Expressive Communication Pre-Test Scores



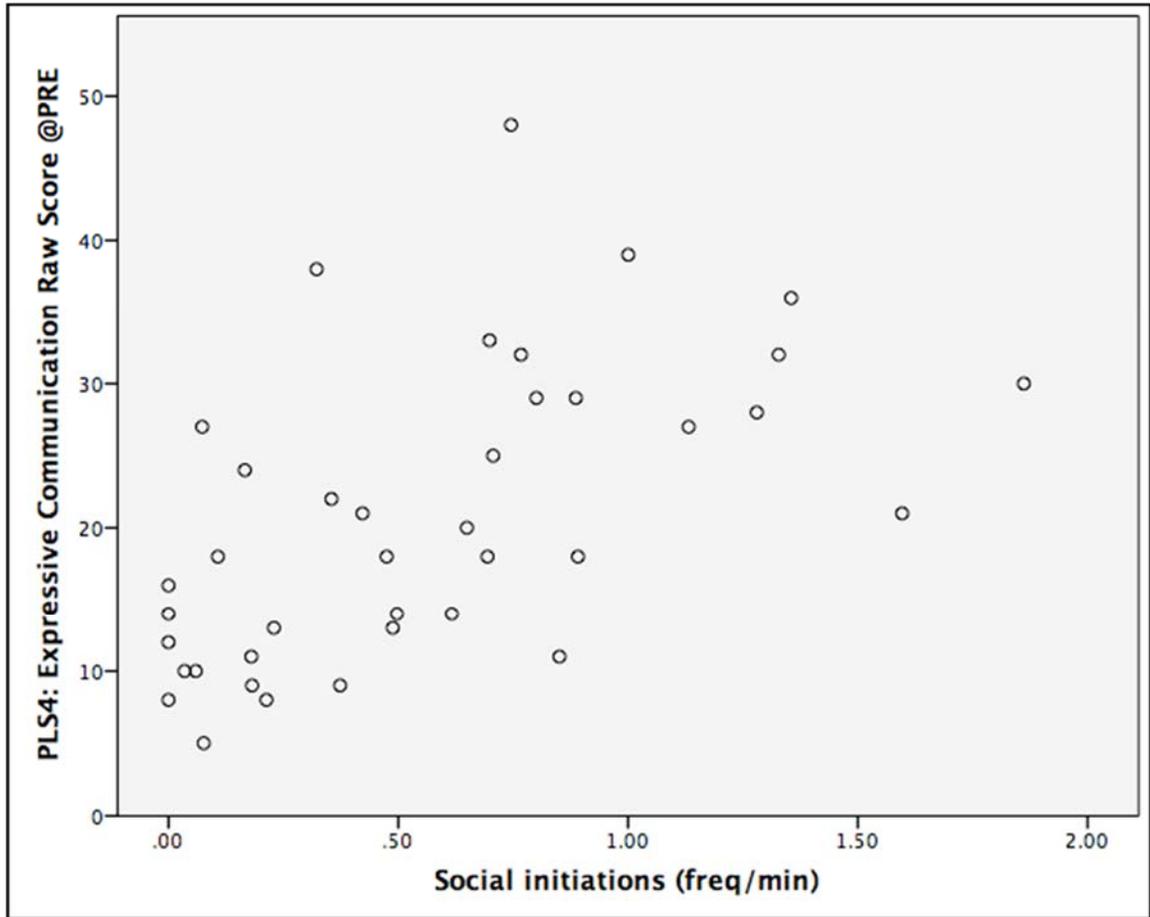
Relationship Between ADOS Social Affect Scores and PLS4: Expressive Communication Pre-Test Scores



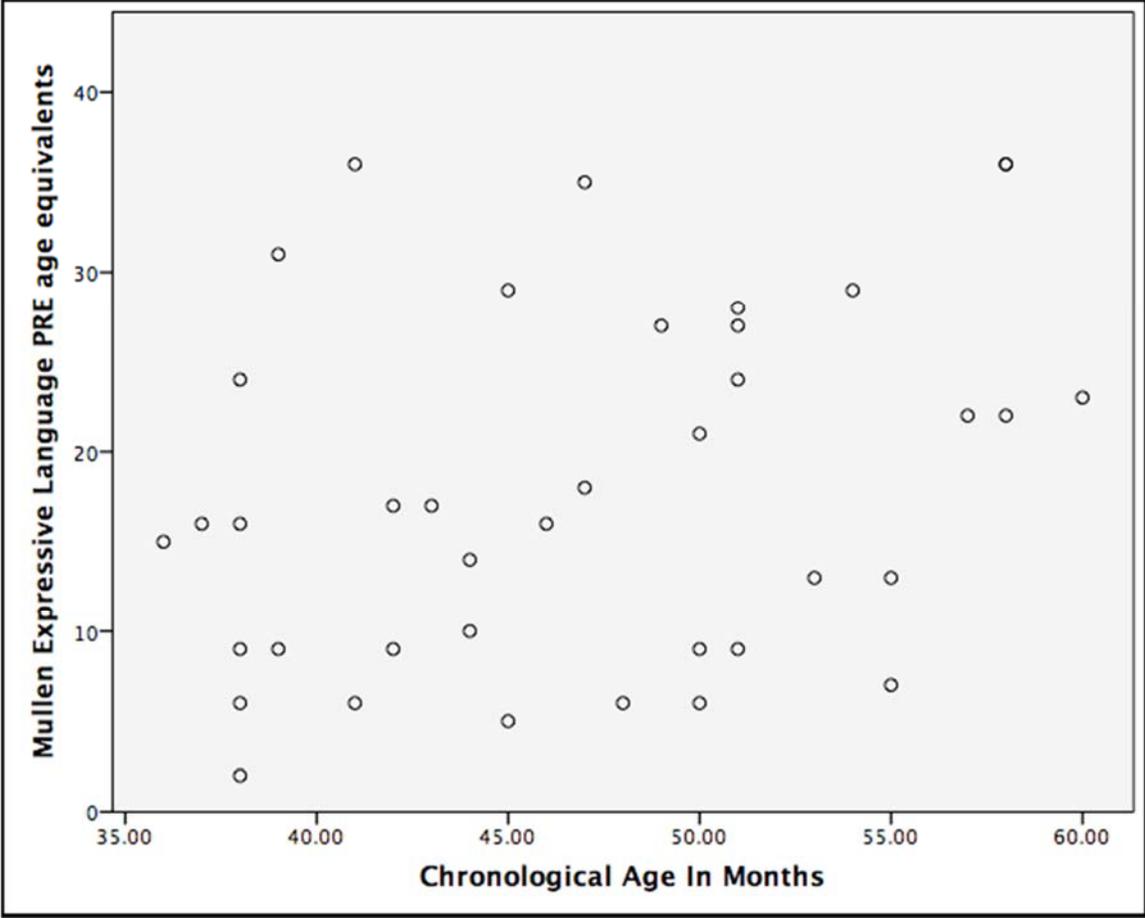
Relationship Between Social Responses and PLS4: Expressive Communication Pre-Test Scores



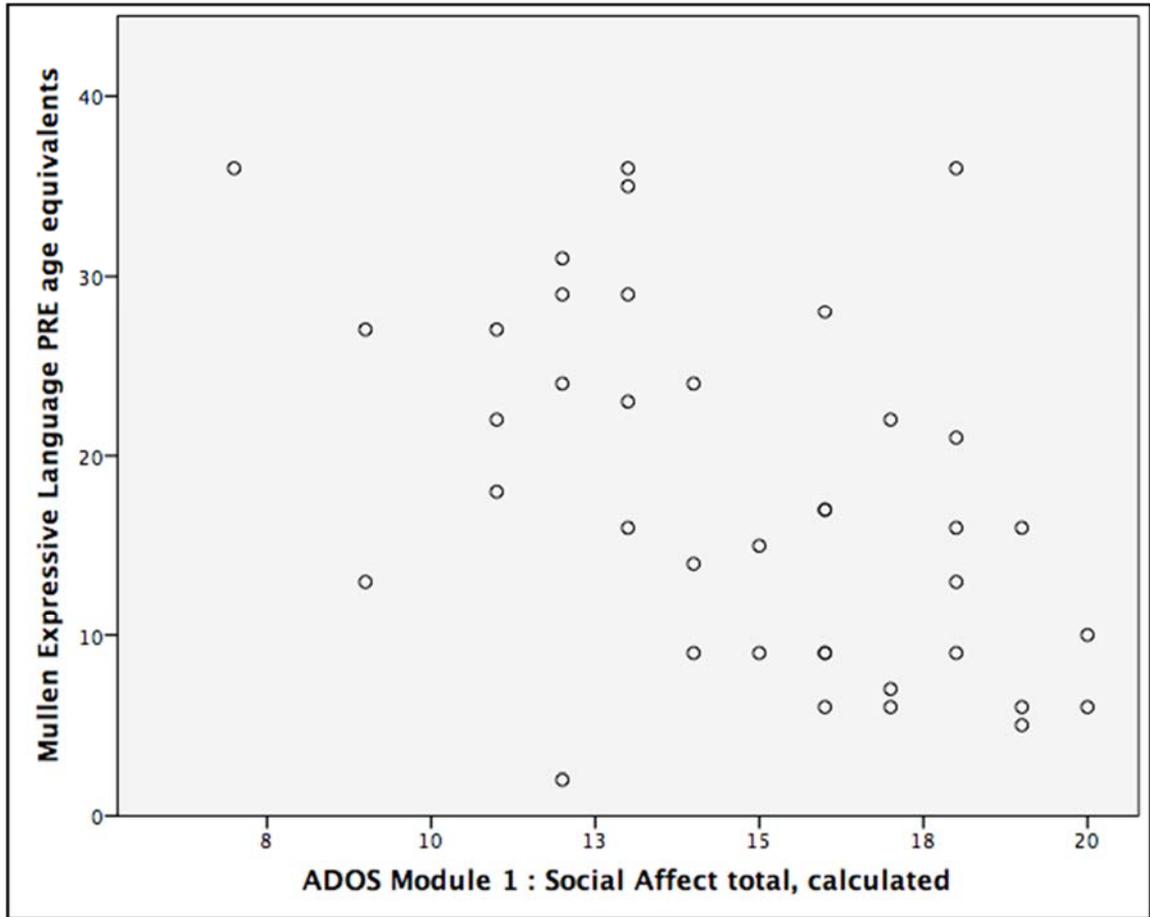
Relationship Between Social Initiations and PLS4: Expressive Communication Pre-Test Scores



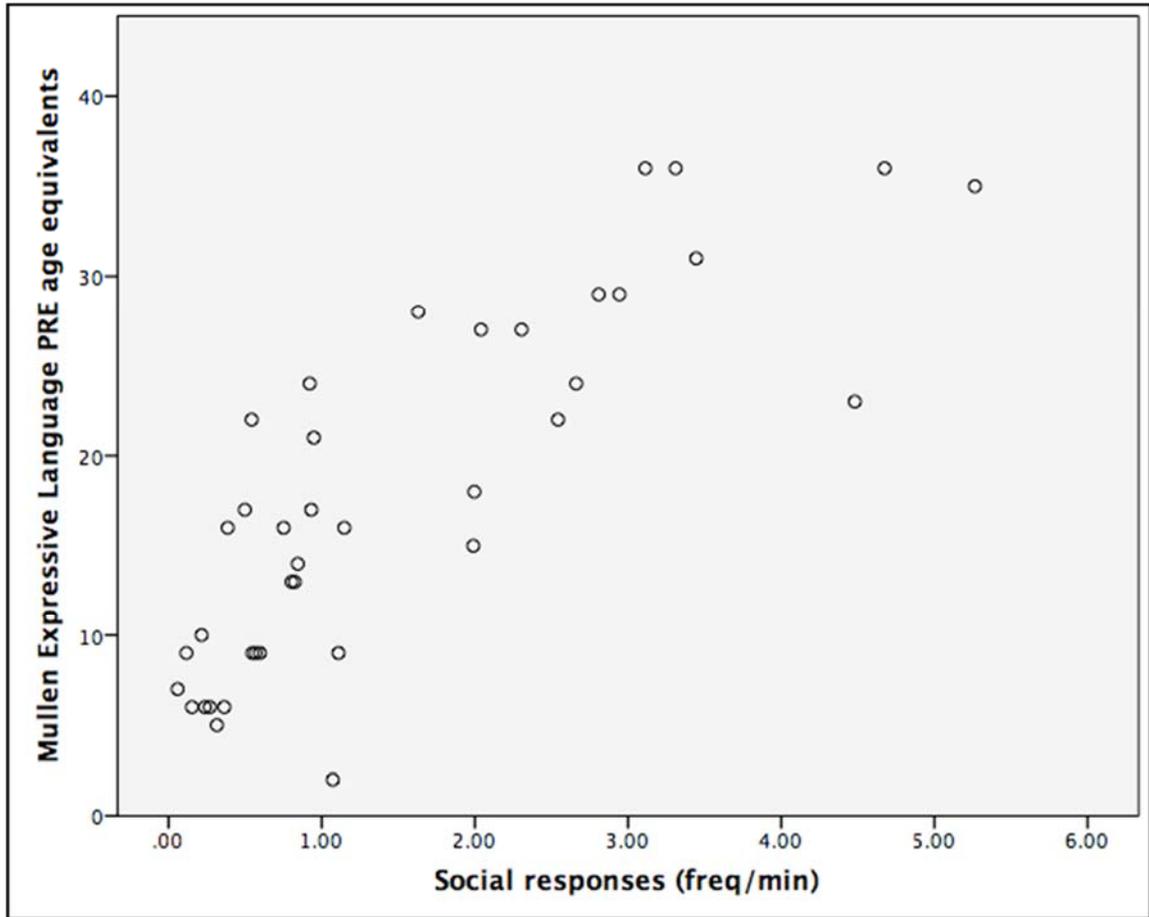
**Relationship Between Chronological Age and MSEL: Expressive Communication
Pre-Test Scores**



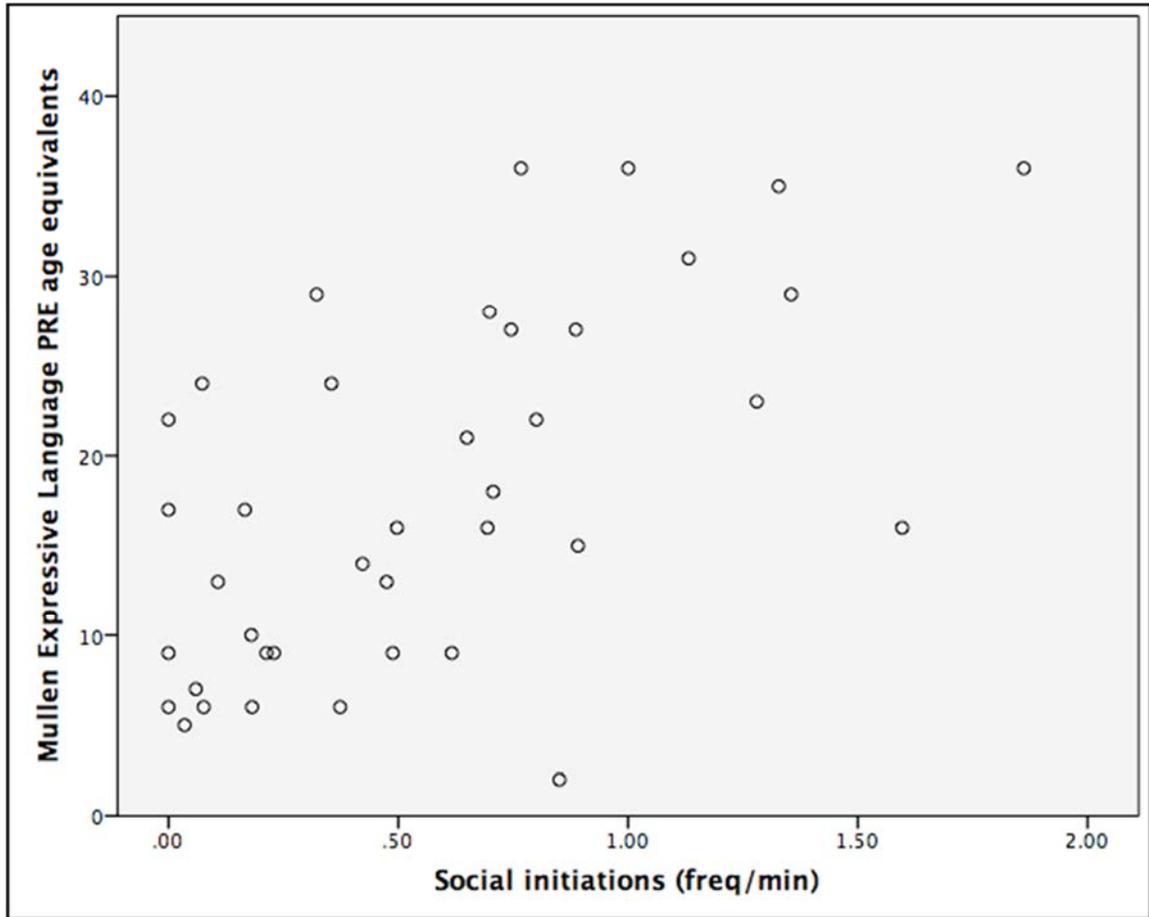
Relationship Between ADOS Social Affect Scores and MSEL: Expressive Communication Pre-Test Scores



**Relationship Between Social Responses and MSEL: Expressive Communication
Pre-Test Scores**

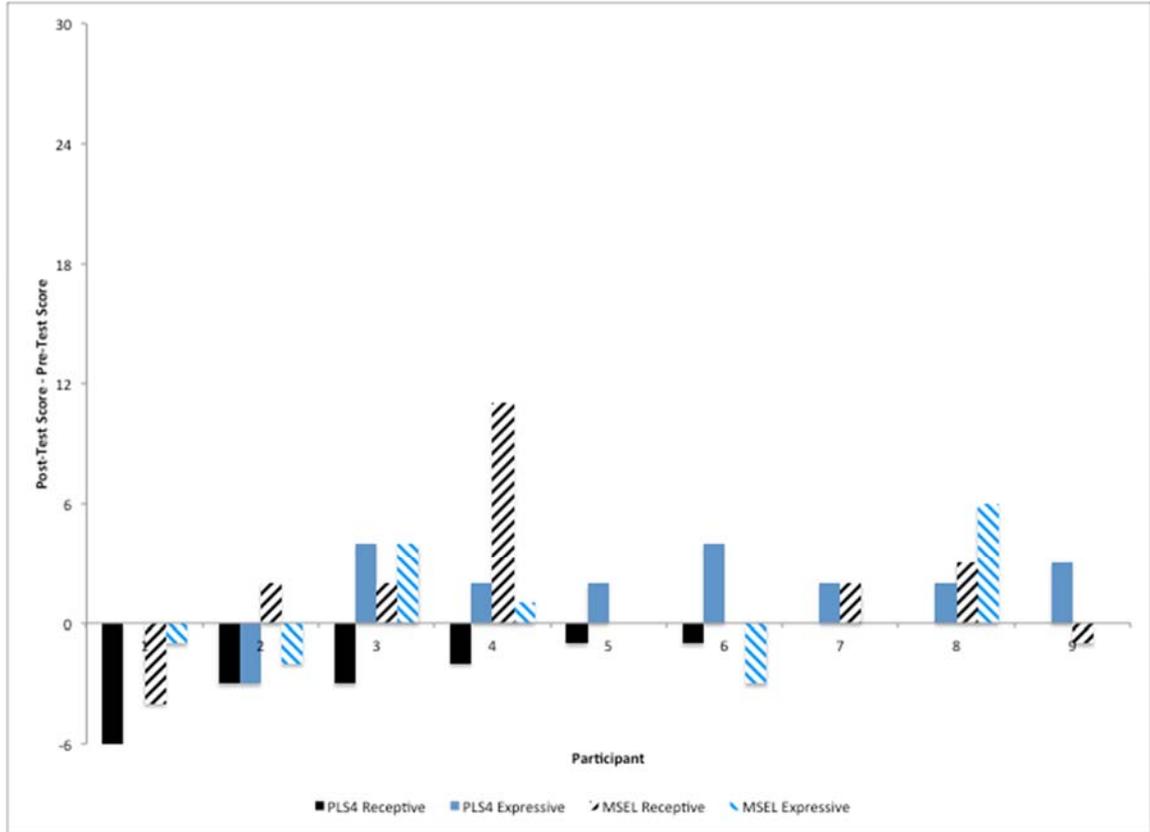


**Relationship Between Social Initiations and MSEL: Expressive Communication
Pre-Test Scores**

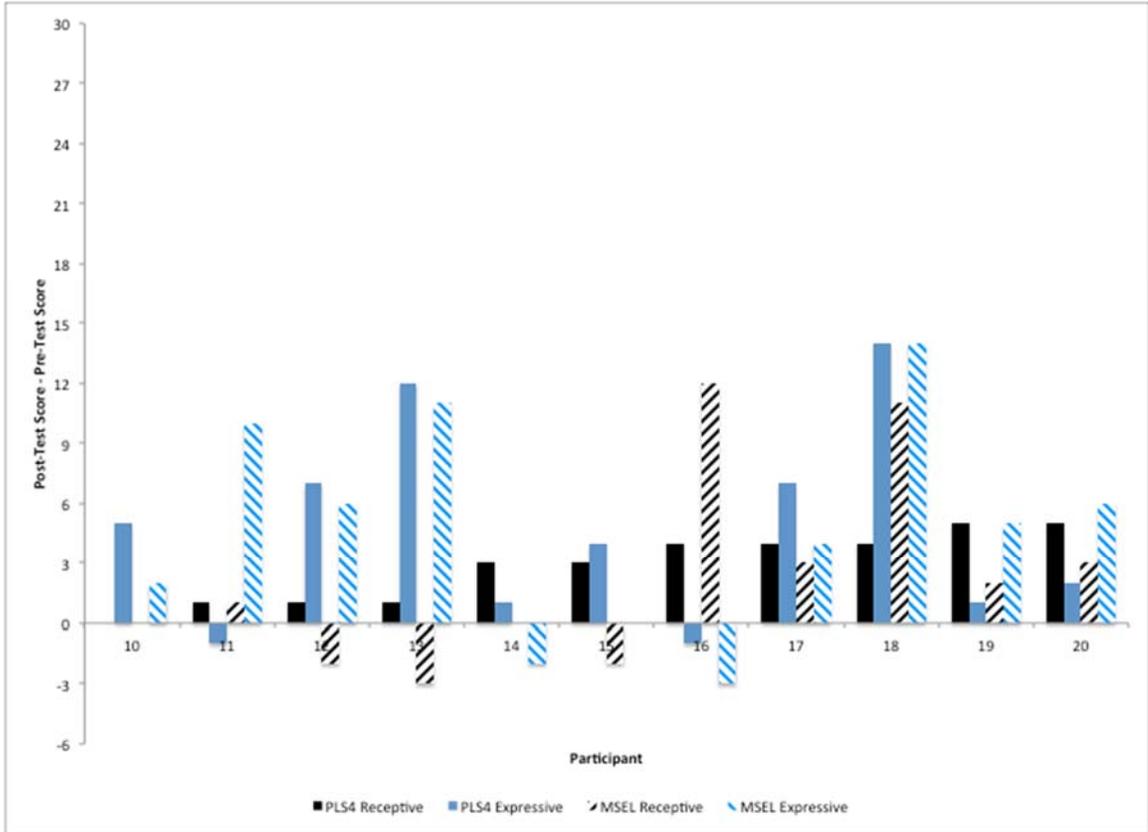


Appendix F: Gain Profiles for All Participants

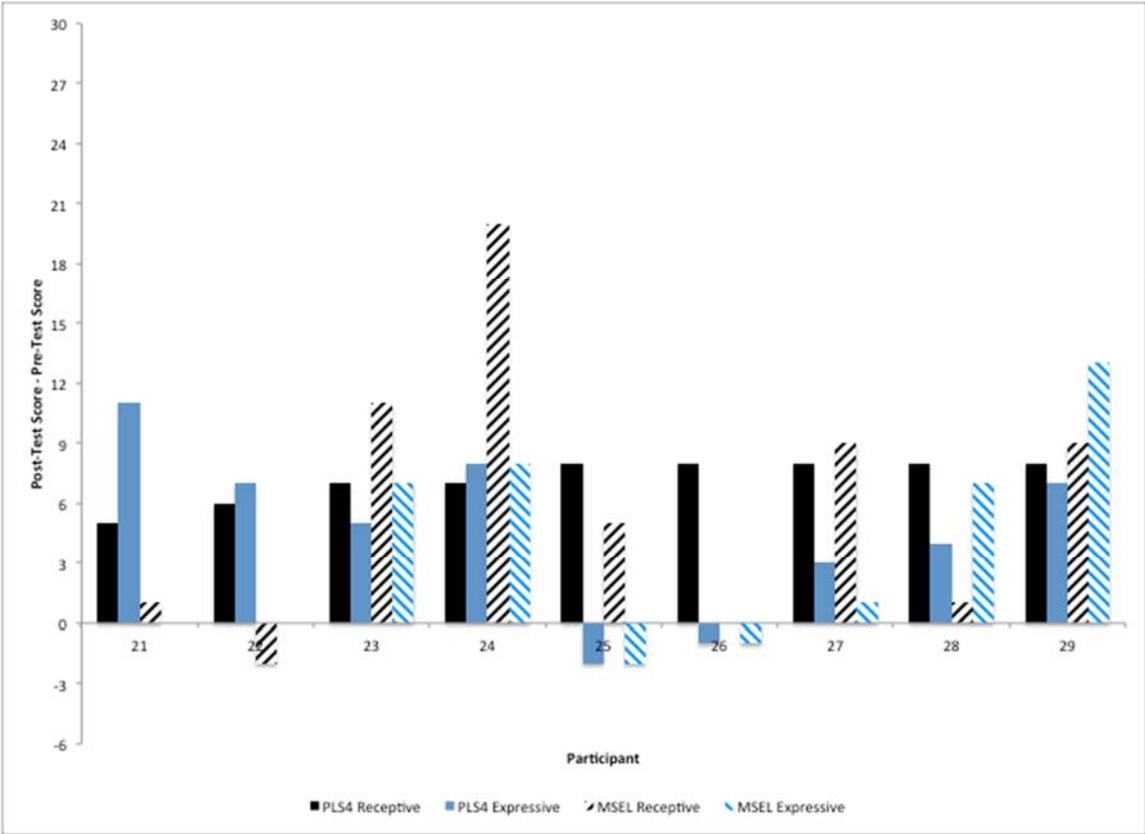
Language Gains Participants 1 – 9



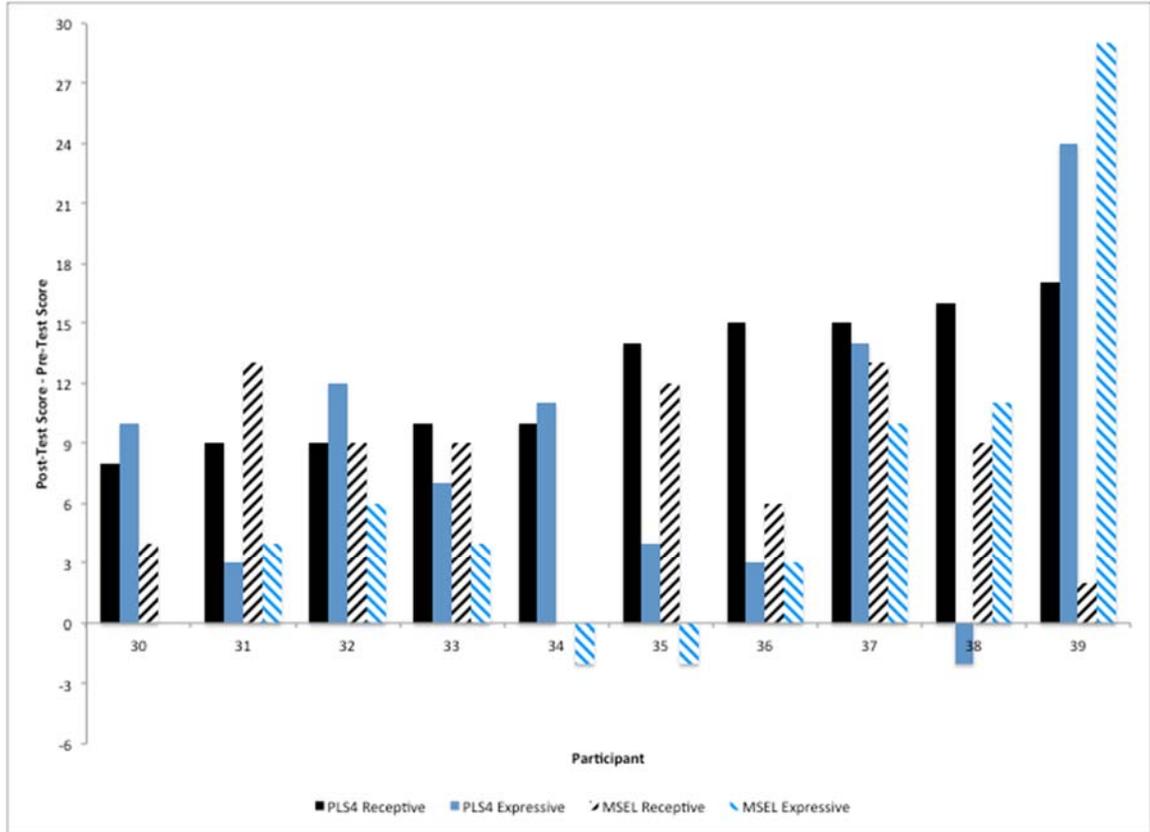
Language Gains Participants 10 – 20



Language Gains Participants 21 – 29



Language Gains Participants 29 – 39



VITA

JESSICA MARIE WEBER

Born, Miami, Florida

- 2003-2007 B.S., Psychology
Florida State University
Tallahassee, Florida
- 2007-2010 Clinical Research Specialist
Hussman Institute for Human Genomics
University of Miami
Miami, FL
- 2010-2012 M.S., Psychology
Florida International University
Miami, FL
- 2011-2012 Intern
Center for Autism and Related Disabilities
University of Miami
Miami, FL
- 2012-2015 Graduate Research Assistant
Project: Assessing Social Communication and Play
Florida International University
Miami, FL
- 2013-2014 Assistant Director
Summer Treatment Program – ASD
Florida International University
Miami, FL
- 2014-2015 Teaching Assistant
Course: Introduction to Experimental Analysis of Behavior
Florida International University
Miami, FL

PUBLICATIONS AND PRESENTATIONS

Gutierrez, A., Weber, J., Coman, D., Maharej, A., Bagner, D., Alessandri, M., Boyd, B., Hume, K., Johnson, L., Sperry, L., & Odom, S. (2013) The impact of problem

behavior on language outcomes for preschool aged children with ASD. Poster at the International Meeting for Autism Research. San Sebastian, Spain.

Sleiman, A., Gutierrez, A., & Weber, J. (2013). Evaluating single-operant and paired-stimulus free-operant preference assessments for social stimuli. Poster at Florida Association for Behavior Analysis. Daytona, Beach, FL.

Weber, J., Uriate, D. & Gutierrez, A. (2012). Using a transfer of stimulus control procedure to increase appropriate responding. Poster at Florida Association for Behavior Analysis. Jacksonville, FL

Weber, J., Sleiman, A. Martinez, G. & Gutierrez, A. (2012). Evaluating the use of technology in parent training procedures. Talk at Florida Association for Behavior Analysis. Jacksonville, FL

Weber, J. & Gutierrez, A. (2013). Evaluation of a shaping procedure to increase food acceptance in children with autism. Talk at Florida Association for Behavior Analysis. Dayton Beach, FL.

Weber, J., & Gutierrez, A. (2014). Skill acquisition in a university based EIBI program. Talk at Florida Association for Behavior Analysis. Bonita Springs, FL.

Weber, J., & Gutierrez, A. (2014). Manipulating establishing operations to evaluate mand training with iPod touch. Poster at Association for Behavior Analysis International 40th Annual Convention. Chicago, IL.

Weber, J. & Gutierrez, A. (2014). Increasing food acceptance in picky eaters. Talk at Center for Autism and Related Disorders Conference. Orlando, FL.

Weber, J., & Gutierrez, A. (In-Press). A treatment package without escape extinction to address food selectivity. *Journal of Visualized Experiments*.