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Using the Autism Diagnostic Observation Schedule (ADOS) to discriminate between children with autism and children with language impairments without autism

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USING THE AUTISM DIAGNOSTIC OBSERVATION SCHEDULE (ADOS) TO DISCRIMINATE BETWEEN CHILDREN WITH AUTISM AND CHILDREN WITH LANGUAGE IMPAIRMENTS WITHOUT AUTISM

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ABSTRACT

The purpose of this study was to learn about the diagnostic accuracy of Module 1 of the ADOS-G. Specifically, this study was designed to determine how well the ADOS-G differentiates children with autism from children with language impairments without autism. Data for this study were obtained from 10 children who were recruited from speech, language and hearing clinics in the metropolitan area of Baton Rouge, Louisiana. Visual inspection and statistical analyses indicated that the means of the ADOS-G scores for all domains (*Communication*, *Social Interaction*, and *Communication + Social Interaction* Score) were higher for the autism group than for the non-autism group. The ADOS-G also yielded high sensitivity but low specificity values for correctly classifying the participants' clinical diagnoses. Visual inspection of individual items revealed that for four items in the *Communication* domain and three items in the *Social Interaction* domain, 50% or more of the participants with and without autism earned similar scores. Overall, this study suggests that the ADOS-G is able to differentiate between groups of children with autism and children with language impairment without autism; however, at the level of the individual, it has a tendency to over classify children as presenting with autism or ASD.

CHAPTER 1

REVIEW OF LITERATURE

The development of language is a complex process that is essential to acquiring adequate skills for successful communication. Development of many of these skills begins during infancy, typically before children reach 12 months of age or speak their first words. Language development can have a significant impact on children's social skills and academic success once they are old enough to go to school. Unfortunately, there is an alarmingly high rate of children diagnosed with autism and other developmental language disorders. Autism has been reported to affect 3.4 of every 1000 children who are between the ages of 3 to 10 years old (Autism Spectrum Disorders (n.d.) http://www.asha.org/public/speech/disorders/Autism.htm), and boys are four times more likely to be diagnosed than girls. Recently, in the field there has been a push for earlier diagnoses of autism; however as of now, adequate research has been done to support reliable diagnoses only after the age of three.

Progress toward making earlier diagnoses has been slow because there are limited assessment tools available to diagnose autism or autism spectrum disorders (ASDs) in very young children. However, the *Autism Diagnostic Observation Schedule –Generic* (ADOS-G; Lord, Rutter, DiLavore, & Risi, 2002) is a recently developed tool that clinicians and researchers are currently using to diagnose ASDs. This tool allows experienced clinicians to asses a child's skills in the areas of communication, social interaction, play and imaginative use of objects. A child's use of atypical, repetitive and/or restrictive behaviors can also be documented through the administration of this tool.

The purpose of the current study is to investigate the ability of Module 1 of the ADOS-G to accurately classify children with autism from children with language impairments without autism. Given that this study is looking at the ability of the ADOS-G to diagnose children with

autism, this literature review will first focus on characteristics of children with autism. In the second section, the development of the ADOS-G will be discussed, and in the third section, studies examining this tool's reliability and validity will be reviewed.

Children with Autism and Autism Spectrum Disorders

Autism is a developmental disorder that is characterized by problems in social interaction, communication, and restrictive and/or repetitive behavior and interests. (Noens & Van Berckelaer-Onnes, 2004). According to the American Psychiatric Association, behavioral traits associated with autism appear sometime before the child reaches three years of age.

The diagnosis of autism is often discussed under the umbrella of Autism Spectrum Disorders (ASDs). ASD is also used to refer to children diagnosed with Pervasive Developmental Disorders (PDDs), Pervasive Developmental Disorders-Not Otherwise Specified (PDD-NOS), and Aspberger Syndrome. ASDs can range from very severe, earning a diagnosis of autism, to milder, earning a diagnosis of Aspeberger Syndrome. If a child is being evaluated and does not meet the specific characteristics for either of those disorders, they are typically classified as having PDD-NOS. All of these disorders share some of the same characteristics, differentiated primarily by severity, and this makes diagnosis challenging.

There are numerous aspects of development that are disrupted if a child has autism or ASD. In addition to deficits in their communication and social skills, children with ASD often present atypical reactions to lights, sounds, and objects, and difficulties coordinating motor movements (Autism Spectrum Disorders, (n.d). http://www.asha.org/public/speech/ disorders /Autism.htm). In autism and ASD, it has been reported that pragmatic skills are more severely impaired in comparison to other components of language. However many children with autism

also present language deficits in the areas of semantics and syntax, and some never develop a productive language system. For many, their problems persist throughout life (Duchan, 1998).

As babies, some children may exhibit certain behaviors that could indicate the presence of autism or ASD, and these include a lack of babbling/cooing, a lack of interaction with people, a lack of imitation, and/ or a disinterest in social and vocal play games such as peek-a-boo and patty-cake. These characteristics of young children with autism are supported by Prizant's (1996) report of retrospective studies of older children with established diagnoses of autism or ASD. As children grow and enter the school setting, ASD may be noticed in their behaviors and interactions with other children. It is commonly reported that children with ASD have difficulty engaging in turn-taking and sharing with other children. They also may show a rigidity to change and may even lack the ability to monitor what they say aloud (Autism Information Center: Symptoms, 2007; http://www.cdc.gov/ncbddd/autism/symptoms.htm).

Throughout the years there has been a push for earlier diagnosis of children with autism or ASD. This is because within the last fifteen years, improved outcomes have been documented in some young children with ASD who receive therapy for at least two years. As mentioned earlier, though, the ability to make earlier diagnoses is complicated by the lack of assessment tools for diagnosing autism in young children. Some tools that are currently being used in research and practice include the *Gilliam Autism Rating Scale* (Gilliam, 1995), the *Childhood Autism Rating Scale* (Schopler, Reichler, & Renner, 1986), the ADOS-G (Lord et al., 2002) and its predecessors the *Autism Diagnostic Observation Schedule* (ADOS); (Lord et al., 1989) and *Pre-Linguistic-Autism Diagnostic Observation Schedule* (PL-ADOS); (DiLavore, Lord & Rutter, 1995). In the next section, literature on the ADOS-G is reviewed.

Autism Diagnostic Observation Schedule-Generic

The ADOS-G is an assessment tool that can be used with children and adults to determine presence of behaviors that are consistent with a diagnosis of autism or ASD. This tool assesses one's abilities and behaviors in the realms of social interaction, communication, play, and imaginative use of objects. In order to learn about an individual's social initiations and responses, social "presses" are used during the administration of the tool. Administration also includes a play component because this allows the examiner to see the individual's skills in the areas of social-role play and imaginative activities. Prior to developing this version of the tool, two other versions existed, the ADOS (Lord et al., 1989) and the PL-ADOS (DiLavore, Lord, & Rutter, 1995). The ADOS was originally designed for the assessment of children, aged 5 to 12 years who presented an expressive language level characteristic of a three year old, and the PL-ADOS was designed for nonverbal children who were under the age of 5 years.

According to Lord et al. (2000), diagnostic accuracy of the ADOS and the PL-ADOS was compromised due to the effect expressive language has on a child's social interactions and play. As a result, children with lower language abilities who could not complete tasks on the ADOS were being over-diagnosed, and children with higher language abilities who could complete all of the tasks on the PL-ADOS, but who nevertheless presented characteristics of autism, were being under-diagnosed. In other words, the original two tools created a "floating" population who could not be tested by either tool because they excluded those with substantial expressive language skills who exhibited signs of autism. The authors of the original ADOS also felt revisions were warranted to allow for the assessment of adolescents and adults and to improve the reliability of the tool. This led the authors to create the current version of the tool, which is referred to as the ADOS-G. Other revisions reflected in the ADOS-G include module-

specific scoring algorithms and the development of a classification system that is based on threshold scores in three domains: social, communication, and combined social-communication.

The current version of the ADOS-G includes four 30-minute modules allowing for the assessment of a range of ages and developmental levels, from a nonverbal child to an adult. During administration of the tool, only one module is given to an individual, and module selection is based on the individual's expressive language level rather than the individual's age (Lord et al., 2002). Use of expressive language was selected to determine the appropriate module for an individual because research has shown that expressive language is the strongest predictor of an individual's ASD profile (Kobayashi, Murata, & Yoshinaga, 1992; Venter, Lord & Schopler, 1992).

Module 1 includes ten activities that are appropriate for children who have an expressive language level of less than three years of age. Activities within this module focus on a child's ability to interact playfully with toys and other items appropriate for use with very young children. Module 2 includes 14 activities that are appropriate for use with children who speak in short phrases but with an expressive language level of less than four years. These activities focus on the child's ability to play with toys, books, and a greater number of items as compared to Module 1. For comparison purposes, a listing of the activities that are used with Modules 1 and 2 is presented in Table 1.

As can be seen by Table 1, some examples of activities in Module 1 include playing with toys on the floor or at the table, blowing bubbles, anticipating a routine (i.e. blowing up a balloon, letting it deflate, and waiting for child to request more), and functional and symbolic play skills during a "birthday party" scenario. The birthday party scenario allows for the examiner to observe the child, while eliciting a variety of behaviors. For this particular scenario,

Table 1

Module 1 and Module 2 Activities

Module 1 (Preverbal/single words/simple phrases)	Module 2 (Flexible Phrase Speech)
Anticipation of social routine	Construction task
Functional and symbolic imitation	
	Make-believe play
Free play	Joint interactive play
Snack	Free play
Response to name	Snack
Response to joint attention	Response to name
	Response to joint attention
Birthday party	Birthday party
Bubble play	Bubble play
Anticipation of a routine with objects	Anticipation of a routine with objects
	Demonstration task
	Conversation
	Description of picture
	Looking at a book

examiner to observe the child, while eliciting a variety of behaviors. For this particular scenario, the examiner observes whether or not the child has knowledge of and/or is able to participate in the "script" of a typical birthday party. This scenario also provides an opportunity for the examiner to observe how the child interacts with a baby doll, and to observe whether or not the child spontaneously contributes actions to the party, or imitates behaviors modeled by the examiner.

As can also be seen in Table 1, Module 2 shares some of the same activities as Module 1, but it also includes tasks that are slightly more complex. Some examples of activities include a

demonstration task, in which the examiner asks the child to demonstrate how they brush their teeth using gestures or words. This module also asks the child to tell a story from a picture book, converse with the examiner during free play, and put together a picture puzzle while looking at a picture of a completed model.

Regardless of the module administered, each item on the ADOS-G is scored on a three-point scale. A score of zero indicates no evidence of abnormal behaviors related to autism, a score of two indicates abnormal behaviors are present, and a score of three indicates the presence of severe abnormalities. During administration of Modules 1 and 2, the behaviors that are scored with this three-point system are listed in Table 2. The scoring of a subset of these behaviors are then summed for two domain scores and one combined score. These are: *Communication* domain, *Social Interaction* domain, and combined *Communication* and *Social Interaction* domain. For each of these, the ADOS-G provides cut-offs for behaviors consistent with autism and ASD. These cut-offs are listed in Table 3. Children who score lower than these cut-offs are interpreted as not presenting behaviors consistent with a diagnosis of autism or ASD.

Studies of Reliability and Validity of the ADOS and ADOS-G

Lord et al. (2000) examined the ability of the ADOS-G to differentiate children with autism, PDD-NOS, and other non-spectrum (NS) disorders. Participants for this study were selected from 381 consecutive referrals with assigned "consensus diagnoses" given by a child psychologist and child psychiatrist. Participants were divided into groups for each module based on verbal mental age equivalency. From those samples, 20-30 participants were selected for reliability analyses of each module, and half of these participants were diagnosed with autism. Additional groups of participants were then selected to form four groups (Lower Autism, Matched Autism, PDD-NOS, and NS), all with similar descriptive characteristics, to assess

Table 2

Behaviors Scored as Part of Modules 1 and 2

Module 1 (Preverbal/single words/simple phrases)	Module 2 (Flexible phrase speech)
Stereotyped/idiosyncratic words or phrases	Stereotyped/idiosyncratic words or phrases
Gestures	Descriptive, conventional, instrumental gestures
Unusual eye contact	Unusual eye contact
Facial expressions directed to others	Facial expressions directed to others
Quality of social overtures	Quality of social overtures
Response to joint attention	Amount of reciprocal social communication
Shared enjoyment	Quality of social response
Use of other's body to communicate	Conversation
Pointing	
Showing	Pointing to express interest
Frequency of vocalizations directed to others	Overall quality of rapport
Spontaneous imitation of joint attention	Amount of social overtures
	Spontaneous imitation of joint attention
Immediate echoing	Immediate echoing
Speech abnormalities	Speech abnormalities
Imagination/functional play	Imagination/ functional play
Mannerisms	Mannerisms
Unusual sensory behaviors	Unusual sensory behaviors
Repetitive interests and behaviors	Repetitive interests and behaviors
Overactivity	Overactivtity
Negative behavior	Negative behavior
Anxiety	Anxiety

validity. The NS group included children with diagnoses outside of the autism spectrum (i.e. mental retardation, receptive-expressive language disorder, attention-deficit hyperactivity disorder, oppositional defiant disorder) and children who were developing language typically. The twelve examiners administering the tool were blind to all details about the participants, except for level of verbal/nonverbal functioning. Results were determined by live scoring and by videotape scoring.

Table 3

Cut-Off Scores of Module 1 of the ADOS-G

	Autism Cut-Off	**ASD Cut-Off**
Communication	4	2
Social Interaction	7	4
Combined Communication + Social Interaction	12	7

For Module 1 items, inter-rater reliability was 91.5% for all of the items, except *behavior when interrupted.* Also, when looking at scores from Module 1, the *Communication* totals of each group were significantly different from each other. These group means are presented in Table 4. When individual subtests were examined, they also found that the mean scores of the groups with autism and PDD-NOS differed from the NS group in the domains of *Communication* and *Restricted and Repetitive Behaviors*. From these findings, the researchers concluded that the ADOS-G was able to differentiate between children with autism, PDD-NOS, and NS disorders.

Table 4

Mean Scores of ADOS-G Domains for Module 1

	Lower Autism	*Matched Autism*	*PDD-NOS*	*NS*
Communication domain cutoffs (autism=4, ASD=2)				
M scores	7.00	5.85	4.65	1.29
Social domain cutoffs (autism= 7, ASD=4)				
M scores	11.45	10.75	8.06	1.29
Restricted & Repetitive domain (no cutoff)				
M scores	3.50	3.05	2.53	0.53

In addition, the diagnostic accuracy of the tool, as measured by indices of sensitivity and specificity, were high across all comparisons. Sensitivity refers to the percentage of children with autism who present with a positive test result (+ autism) and specificity refers to the percentage of children without autism who present with a negative test result (- autism). As seen in Table 5, the sensitivity and specificity rates of the ADOS-G were above .90 for all analysis. These findings led the authors to conclude that the ADOS-G is an effective tool for differentiating children with autism from children with NS disorders.

Table 5

Diagnostic Sensitivities and Specificities of Module 1

	Sensitivity	Specificity
Autism versus NS	100	100
PDD-NOS versus NS	94	94
Autism & PDD-NOS versus NS	97	94
Autism versus PDD-NOS &NS	100	100

Chawarska et al. (2007) also completed a study of the ADOS-G along with the ADI-R (Rutter, Lord, & Le Couteur, 2003), a parent checklist. In this study, they examined the agreement of these two tools using data from 19 children with autism and 9 children with PDD-NOS. The children ranged in age from 14 to 25 months. To complete this study, the authors collected data at two separate times. For Module 1, they found 95% agreement between the ADOS-G classifications and the clinical diagnoses of the children with autism; however only 33% agreement between the ADOS-G classifications and the clinical diagnoses of the children with PDD-NOS. For both the children with autism and the children with PDD-NOS, the ADI-R showed poor agreement with the children's clinical diagnoses.

Another study by Ventola et al. (2006) compared the diagnostic validity of the ADOS-G, and ADI-R. Again clinical judgments were used as their gold standard for diagnosing ASDs. They did this by looking at 45 children between the ages of 16-31 months. They found good diagnostic sensitivity for the ADOS-G (.90), but not for the ADI-R (.53), and relatively low levels of diagnostic specificity for the two tools (.67 for the ADOS-G and .61 for the ADI-R). They then compared the groups with ASD (autism and PDD) and Non-ASD and discovered similar results. They found good diagnostic sensitivity for the ADOS-G (.97) but not the ADI-R (.56), and low, but equivalent diagnostic specificities (.67) for both tools.

The most recent study of the ADOS-G was conducted was by Gray, Tonge, and Sweeney (2007). This study included 209 children, aged 20 to 55 months; 120 of these children presented a diagnosis of autism, 23 were diagnosed with PDD-NOS, and 66 were diagnosed with developmental delay or language impairment without ASD. To conduct this study, the authors compared diagnoses made by clinical consensus and test outcomes of Module 1 or 2 of the ADOS-G and the ADI-R.

Results showed that higher scores (which indicate autism) on all domains of the ADOS-G were obtained by the children diagnosed with autism when compared to the non-autism group. Also, regardless of age, group differences between children with and without autism were significant. However, this tool was less successful in differentiating children with PDD-NOS from children with non-ASD impairments. The autism group consistently scored higher in all domains compared to the PDD-NOS and non-ASD groups; however, when comparing performance of the PDD-NOS group and non-ASD group on the repetitive domain, no significant differences were found between the two groups. On the ADI-R, the autism group also scored significantly higher than the non-autism group, and all differences were significant across

all domains. When the combined results of Modules 1 and 2 of the ADOS-G were compared with the children's clinical diagnoses, good diagnostic sensitivity and diagnostic specificity were reported. Specifically, the ADOS-G showed a diagnostic sensitivity of .85, a specificity of .89, and an overall correct classification rate of .87. In contrast, the ADI-R showed a sensitivity of .77, a specificity of .70, and an overall correct classification rate of .74. In other words, there was "high" agreement between clinical diagnoses and the ADOS-G, and "moderate" agreement between clinical diagnoses and the ADI-R.

In summary, the results from four studies support the use of the ADOS-G in clinical practice. The purpose of this is study was to learn more about the diagnostic accuracy of this tool when it is given by a novice clinician within a community that does not have an established multi-disciplinary center for children with autism. To do this, the study focused on Module 1 of the ADOS-G, and the participants were children with autism and children with language impairment without autism. The main question that guided the research was:

1. Do the scores obtained on the ADOS differ between children diagnosed with autism and children with language impairment without autism?

Predictions

Due to the limited amount of research that has been done on the ADOS-G, information to help guide predictions about the results of the current study is limited. Nevertheless, based on the results of Lord, et al. (2000), the current study should show that the ADOS-G is able to differentiate children with autism from children with language impairments without autism with a high level of accuracy (>80%). Based on the results of Ventola et al. (2006), the diagnostic sensitivity of the tool may be higher than its diagnostic specificity. Recall, in the Ventola et al. study, diagnostic sensitivity values ranged from .90 to .97, but diagnostic specificity was .67.

Chawarska et al. (2007) also reported low specificity rates (.33) but Lord et al. (2000) and Gray et al. (2007) both reported specificities above .89.

CHAPTER 2

MATERIALS AND METHODS

Research Design

This study utilized a group comparison design. The independent variable was the clinical diagnoses of the children (+/- autism or ASD). The dependent variable was the children's score on Module 1 of the ADOS-G.

Participants

A total of 10 children participated in this study. They were recruited from speech, language, and hearing clinics in the metropolitan area of Baton Rouge, Louisiana using purposive sampling. All of the children were receiving therapy by a speech-language pathologist and had a diagnostic report available as part of their clinical records. To confirm the limited language skills of the participants, the researcher completed a caregiver interview using the CSBS-DP Infant-Toddler Questionnaire and a five-minute examiner-child play session, using age-appropriate toys (i.e. wind-up toy). All were nonverbal or were only able to speak in one-word utterances with minimal use of simple phrases.

The children, 2 female and 8 male, ranged in age from 3 years 10 months to 8 years 8 months. All of the participants had hearing within normal limits bilaterally, except for two whose hearing statuses were questionable or reported to be inconsistent on a daily basis. See Table 6 for individual profiles of the participants.

A review of the participants' case histories and diagnostic reports revealed that six of the ten participants were not diagnosed with autism, three were diagnosed with autism, and one was diagnosed with PDD-NOS; for the purposes of this study this participant was included in the autism group due to the diagnosis of PDD-NOS falling onto the lower end of the autism

Table 6

Participant Details

Participant Number	Gender	Age (in months)	Hearing Status
Diagnosed with autism			
1	F	63	WNL
2	M	75	WNL
3	M	75	WNL
4	F	53	WNL
Not Diagnosed with autism			
5	M	50	WFL[a]
6	M	104	WNL
7	M	69	WNL[b]
8	M	46	WNL
9	M	44	WNL
10	M	46	WNL

[a] WFL= Within Functional Limits (case history didn't define), [b] Hearing WNL in right ear, status unknown in left ear

spectrum.

Interestingly, not all participants diagnosed with autism were assessed previously with an assessment tool that has been designed for the identification of autism. In fact, only two out of the ten participants were assessed with tools of this type. These two children had four tools listed in their case histories; these were the *Behavior Assessment for Children- Second Edition* (BASC-2); (Reynolds & Kamphaus, 2004), the *Gilliam Autism Rating Scale- Second Edition* (GARS-2); (Gilliam, 1995), the *Childhood Autism Rating Scale* (CARS) (Schopler, Reichler, & Ro, 1980), and the *Modified Checklist for Autism in Toddlers* (MCHAT) (Robins, Fein, & Barton, 1999).

A review of the case histories and diagnostic reports also showed that all of the participants were assessed with tools that have been normed on typically developing children. Two of these tools were used to assess the participants' general development. These tools were the *Bayley Scales of Infant Development* (BSID-3; Bayley, 1993), and the *Vineland Adaptive Behaviors Scale-Second Edition* (Vineland-II; Sparrow, Cicchetti, & Balla, 1984). Eleven other

tools were used to assess the participants' language abilities. See Table 7 for a detailed listing of these language assessment tools. It is also important to note that some of participants' chronological ages exceeded the appropriate age ranges for some of these language tools. When this occurred, the test data were only used to obtain performance levels rather than to rank skills relative to those of same-aged peers. Table 8 shows the test information that was available for each participant.

Table 7

Language Assessment Tools used with Participants Prior to the Study

Language Assessment
Ages and Stages Questionnaire (ASQ) (Bricker & Squires, 1999).
Battelle Developmental Inventory- Second Edition (BDI-2) (Newborg; 2005).
Bayley Scales of Infant Development-Third Edition (BSID-III) (Bayley; 1993).
Communication and Symbolic Behavior Scale- Developmental Profile (CSBS-DP) (Wetherby & Pizant, 2002).
Developmental Assessment of Children (DAYC) (Voress & Maddox, 1998).
MacArthur Bates Communicative Development Inventory: Words and Gestures (CDI) (Fenson et al., 2007).
Mullen Scales of Early Learning (Mullen) (Mullen; 1995).
Preschool Language Scale- Fourth Edition (PLS-4) (Zimmerman, Steiner, & Pond, 2002).
Receptive-Expressive Emergent Language Test-Second Edition (REEL-2) (Bzoch, League, & Brown, 1991).
Sequenced Inventory of Communication Development- Revised (SICD-R) (Hedrick, Prather, & Tobin, 2002).
The Rossetti Infant-Toddler Language Scale (Rossetti) (Rossetti; 1990).
Westby Symbolic Play Scale (Westby) (Westby, 1980).

Table 8

Previous Assessment of Individual Participants

Participant Number	Autism ID Test	Developmental Test	Language Test
Diagnosed with autism			
1	-	-	REEL-2
2	GARS-2	-	REEL-2, BDI-2
3	-	-	REEL-2
4	CARS, BASC-2, MCHAT	Vineland-II	REEL-2, Mullen, BDI-2
Not Diagnosed with autism			
5	-	BSID-III	PLS-4, SICD-R, CSBS-DP, CDI, Rossetti
6	-	-	BDI-2, REEL-2
7	-	-	BDI-2, REEL-2, CDI, PLS-4, Westby
8	-	-	PLS-4, Rossetti
9	-	-	Westby, GFTA-II, DAYC, CDI, ASQ
10	-	-	CSBS-DP, ASQ, PLS-4

Materials

Required test protocols for the study included all of the manipulatives and scoring sheets that are needed for Module 1 of the ADOS-G. Some of these items include food for snack, juice pop, water, bottle, paper plates and paper cups. To administer the ADOS-G, the testing rooms included a table and chairs and/or room for floor play. Testing manipulatives were covered with blankets to reduce distractions. A video recorder was used to tape the sessions for later scoring of the ADOS-G and to examine reliability.

Procedure

Prior to administration of the ADOS-G, the examiner read the ADOS-G manual and watched three ADOS-G training videos. These training videos showed three administrations of each module and provided verbal instructions on how to appropriately code behaviors. The

examiner also practiced administering Module 1 the ADOS-G to two children with language impairments prior to beginning the study.

Consent was obtained by asking clinicians to inform parents about the study. If parents were interested they were given a consent form with a recruitment flyer. Following parental consent, the researcher conducted a parent interview using the CSBS-DP Infant-Toddler Questionnaire. Next, the examiner-child play session was completed for five minutes to further confirm the limited language skills of the child. Following this play session, the ADOS-G was administered. Prior to the administration of the ADOS-G, the researcher was blind to the participant's clinical diagnoses. Only after the ADOS-G was administered did the researcher review the participants' case histories and diagnostic reports. Unfortunately, during this phase of the study the diagnoses of two of the children were accidentally revealed to the researcher.

For seven of the ten children, the caregiver or the child's speech-language clinician was present for the administration of the ADOS-G. For these seven children, the caregiver/speech-language clinician was advised to not direct or answer for their child too quickly and was reminded not to do so because the purpose of the assessment was to see what their children could do independently.

Upon completion of the ADOS-G, the researcher immediately coded/scored each child's performance. Then the video recorded session was reviewed and final scoring of the tool was completed following directions given in the ADOS-G manual. Following administration and scoring of the ADOS-G, the participants' case histories were reviewed, and additional diagnostic and treatment information was gathered from the participants' speech-language clinicians

Data Coding

Scoring of the ADOS-G followed the guidelines in the test manual. The majority of the ratings

range from 0 (not abnormal), 1(mildly abnormal), 2 (definitely abnormal/severity varies), and 3 (markedly abnormal/interferes with interview). Scoring was recorded on each page of the protocol.

Reliability

Inter-rater reliability was completed by having two randomly selected videotaped sessions of the ADOS-G administrations coded independently by a second examiner. The second examiner had previously been trained on how to score the ADOS-G Module 1, according to test manual procedures. She had also administered the ADOS-G to one child as part of a previous study. The second examiner independently coded 20% of the protocols, and the results were compared to the results of the researcher. Reliability was checked by comparing the *Communication* scores, *Social Interaction* scores, combined *Communication* and *Social Interaction* scores, and the seventeen sub-total scores. The seventeen sub-total scores were comprised of the following: 5 sub-scores were under *Communication*, 7 sub-scores were under *Social Interaction*, 2 sub-scores under *Play*, and 3 sub-scores under *Stereotyped Behaviors and Restricted Interests*. Inter-rater reliability was found to be low (65% for both participants), but *Communication* totals of the two examiners were identical for Participant A and within 2 points for Participant B (4 versus 6). Also, *Social Interaction* totals were identical for Participant A and within 3 points for Participant B (16 versus 19). When looking at the ADOS-G final scores, Participant A was identified by both examiners as being below the autism and ASD cut-offs and Participant B was identified by both examiners as meeting or exceeding the autism and ASD cut-offs.

Intra-reliability was also examined in the current study by having the researcher score the videotaped sessions of Participant A and B's ADOS-G administrations six weeks after the date

of the original data collection. When this was done, intra-rater reliability was found to be higher than the earlier reported inter-reliability. Specifically, for Participant A, intra-rater agreement was high at the item level (90%) and relatively high at the summary score level (88%). For Participant B, intra-rater agreement was somewhat low at the item level (74%), but relatively high at the summary score level (82%).

CHAPTER 3

RESULTS

Table 9 lists the means, standard deviations and ranges for the four children with autism and the six children without autism. As can be seen, the autism group consistently scored higher than the non-autism group in the total scores for *Communication*, *Social Interaction*, and the combination of *Communication and Social Interaction*.

Table 9

ADOS-G Group Means

Group	**Communication Score**	**Social Interaction Score**	**Total**
Autism			
n=4			
Mean	5.75	12.00	17.75
SD	1.7	.82	1.26
Range	4-8	11-13	16-19
No Autism			
n=6			
Mean	2.33	4.67	7.00
SD	1.506	2.733	4
Range	1-5	1-8	2-12

Although the sample sizes of the groups in this study were low and unequal in number, an ANOVA was run to examine differences between the groups' scores. When this was done, differences between the groups' *Communication* scores, *Social Interaction* scores, and combined *Communication* and *Social Interaction* scores were found to be statistically significant, $F(1,8) = 11.16$, $p = .01$, $eta^2 = .58$, $F(1,8) = 26.25$, $p = .001$, $eta^2 = .77$, and $F(1,8) = 26.18$, $p = .001$, $eta^2 = .77$

respectively. These results indicated that the autism and non-autism group were significantly different on all three scores.

Next, the diagnostic accuracy rates of the ADOS-G were examined. Typically, when diagnostic accuracy rates of a tool are examined, the scores of children without impairment are compared to those with impairment. In the current case, there are two groups of individuals with impairments. Recall that three participants were diagnosed with autism and one was diagnosed with ASD (participant 4 who presented with PDD-NOS). Given this, the diagnostic accuracy of the ADOS-G was examined in two ways. First, accuracy was examined by identifying the number of children who scored below and above the ASD cut-off. According to the ADOS-G manual, in order for a participant to be classified as consistent with the diagnosis of ASD or autism, they must meet or exceed the ASD cut-offs for all three domains. When this was done, all four children who presented an autism or ASD diagnosis scored above the ASD cut-off and two of the six children without autism scored below this cut-off. This resulted in a sensitivity rate of 100%, a specificity rate of 33%, and a diagnostic accuracy rate of 60%.

Next, accuracy of the ADOS-G was examined by identifying the number of children who scored below and above the autism cut-off. According to the ADOS-G manual, in order for a participant to be classified as consistent with the diagnosis of autism or ASD, they must meet or exceed the cut-offs for all three domains. Again, when this was done, all three children who presented an autism diagnosis scored above the autism cut-off, and four out of seven without autism scored below the autism cut-off. This resulted in a sensitivity of 100%, a specificity rate of 57%, and a diagnostic accuracy rate of 70%. Table 10 lists the sensitivities and specificities of both analyses.

Table 11 lists the cut-off scores provided as part of the ADOS-G to help a clinician

Table 10

Diagnostic Accuracies of Both Participant Groupings

Autism (PDD-NOS included) versus Non-autism	
Sensitivity	1.00
Specificity	.33
Accuracy	.60
Autism versus Non-autism (PDD-NOS included)	
Sensitivity	1.00
Specificity	.57
Accuracy	.70

determine if a child's behavior is consistent with the diagnosis of autism or ASD. This table also lists the scores of the individual participants. As can be seen, five of the children met or exceeded the cut-off scores for autism, three met or exceeded the cut-off scores for ASD, and three did not meet or exceed the cut-off scores for autism or ASD.

Table 12 lists the participants' scores for the five items on the *Communication* domain of the ADOS-G. As can be seen, on this subtest the cut-off score for ASD was 2 and the cut-off score for Autism was 4. Eight out of the 10 participant's *Communication* scores met or exceeded the ASD cut-off and 5 out of 10 participant's totals met or exceeded the autism cut off. Upon visual inspection of the data, some common trends were observed in the participants' scores obtained on certain items. These items are shaded in the table. For example, 5 out of 10 participants scored the same on Frequency of Vocalization Directed to Others; 7 out of 10 participants scored the same on Stereotyped/Idiosyncratic Use of Words or Phrases; and 9 out of 10 participants scored the same on Use of Other's Body to Communicate. Recall, a score of 2

Table 11

Participants' Scores on the ADOS-G

	Communication Score	Social Interaction Score	Total
Cut-offs			
Autism	4	7	12
ASD	2	4	7
Participant Number			
Autism			
1	5	13	18
2	6	12	18
3	4	12	16
4	8	11	19
Not Diagnosed with Autism			
5	3	8	11
6	1	3	4
7	2	6	8
8	5	7	12
9	1	1	2
10	2	3	5

indicates that the child's behavior is definitely abnormal; a score of 1 indicates the child's behavior is mildly abnormal, and a score of 0 shows no evidence of abnormality.

Table 13 illustrates the participants' scores for the seven items on the *Social Interaction* domain of the ADOS-G. Seven of the 10 participants exceeded the ASD cut-off on this subscale, and 6 of the 10 participants met or exceeded the autism cut-off. Upon visual inspection of the data, some common trends were observed in the participants' scores obtained on certain items (These items are shaded in the table). For example, 5 out of 10 participants scored the same on Facial Expression Directed to Others and on Showing and Response to Joint Attention, and 7 of 10 participants scored the same on Unusual Eye Contact.

Interestingly, the one item that seemed to differentiate the children well was Spontaneous Initiation of Joint Attention. This is evident by all of the participants in the autism group earning

higher scores than the participants in the non-autism group. In a number of studies, deficits in joint attention have not only been shown to be a hallmark deficit of children with autism (Baron-

Table 12

Participants' Scores for Items from the Communication Domain

Communication Behaviors										
Participant Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Freq. of Vocalization Directed to Others	2	2	2	2	2	0	0	1	0	0
Stereotyped/Idiosyncratic Use of Words or Phrases	0	0	0	2	0	0	1	0	0	1
Use of Other's Body to Communicate	0	0	0	0	0	0	0	2	0	0
Pointing	1	2	2	2	1	1	0	1	0	0
Gestures	0	2	0	2	0	0	1	1	1	1
Communication Total	3	6	4	8	3	1	2	5	1	2

Cohen, Baldwin, & Crowson, 1997; Mundy, Sigman, & Kasari, 1990; Prizant, Schuler, Wetherby & Rydell, 1997), but also an important an important predictor of these children's later language skills (Rollins, 1999; Rollins & Snow, 1998; Smith, Mirenda & Zaidman-Zait, 2007; Yoder, 2006).

In summary, visual inspection and statistical analyses showed that the ADOS-G scores for the autism group were higher in all domains than the ADOS-G scores for the non-autism group. Results also showed the ADOS-G to have high sensitivity but low specificity values. Finally, visual inspection of the individual items on the ADOS-G revealed that in both the *Communication* and *Social Interaction* domains, participants with and without autism or ASD scored the same on at least three items on the *Communication* domain and four items on the

Social Interaction domain. These specific items were not good for differentiating participants diagnosed with autism from participants with language impairment not diagnosed with autism.

Table 13

Participants' Scores for Items from the Social Interaction Domain

Social Interaction Behaviors										
Participant Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Unusual Eye Contact	2	2	2	2	2	2	0	0	0	2
Facial Expression Directed to Others	2	2	1	1	1	0	1	1	0	0
Shared Enjoyment in Interaction	1	1	1	1	0	0	0	0	0	0
Showing	2	2	2	2	1	0	1	2	1	0
Spontaneous Initiation of Joint Attention	2	2	2	2	1	1	1	1	0	0
Response to Joint Attention	2	1	2	2	1	0	2	2	0	1
Quality of Social Overtures	2	2	2	1	2	0	1	1	0	0
Social Interaction Total	13	12	12	11	8	3	6	7	1	3

CHAPTER 4

DISCUSSION

The purpose of this study was to learn about the diagnostic accuracy of Module 1 of the ADOS-G. Specifically, the study was designed to determine how well the ADOS-G differentiates young children with autism from young children with language impairments without autism. Data were obtained from 10 children who were recruited from speech, language and hearing clinics in the metropolitan area of Baton Rouge, LA. All children were part of clinical caseloads and were nonverbal or spoke in only one word utterances with minimal use of simple phrases. Thus, their expressive language levels deemed them appropriate participants for Module 1.

This discussion chapter is divided into five sections. The first section discusses the results as they relate to the research question. The second section compares the findings of this study to previous research. The third section discusses the limitations of the study. Section four discusses the clinical implications of this study. Finally, section five outlines possible directions for future research.

Application of Results to the Research Question

The research question that guided this study asked if the scores obtained on Module 1 of the ADOS-G would differ between children diagnosed with autism and children with language impairments without autism. Visual inspection and statistical analyses indicated that the mean total scores were higher for the autism group than for the non-autism group in all domains: *Communication* totals, *Social Interaction* totals, and combined *Communication + Social Interaction* totals. Results also showed the ADOS-G to yield high sensitivity but low specificity values for the diagnoses of autism and ASD. Finally, there were at least three items on the

Communication domain and four on the *Social Interaction* domain on which children from both groups earned the same scores. These specific items were not successful in differentiating participants diagnosed with autism from participants with language impairment not diagnosed with autism.

Comparison to Previous Literature

The results of this study showed that the mean scores for the autism group were consistently higher in all domains than the mean total scores of the non-autism group. These results are consistent with the data of Lord et al. (2000) and Gray et al. (2007). See Table 14 for a comparison of means between these three studies.

Table 14

Comparison of Means of the ADOS-G Module 1

	Current Study	**Lord et al., (2000)**	**Gray, Tonge, & Sweeny, (2007)**
		Autism	
Communication	5.75	5.85	5.49
Social Interaction	12.00	10.75	10.89
Communication + Social Interaction	17.75	16.60	16.38
		Not Diagnosed with autism	
Communication	2.33	1.29	2.97
Social Interaction	4.67	1.29	3.53
Communication + Social Interaction	7.00	2.59	6.52

The second way the results of the current study can be compared to others relates to the diagnostic accuracy of the tool. Recall that in the current study the ADOS-G was found to have a

high rate (1.00) of accurately classifying children with autism, but its ability to accurately classify children with language impairment without autism was found to be low (.33 and .57). As seen in Table 15, these specificity rates are lower than those reported by Lord et al. (2000), Gray et al. (2007), and Ventola et al. (2006). Nevertheless, all three studies show the general trend of having a higher accuracy rate of classifying children with autism than classifying children without autism.

Table 15

Comparison of Diagnostic Accuracies of Module 1 across Four Studies

	Current Study	Lord et al., (2000).	Gray, et al., (2007).	Ventola et al., (2006).
Autism and PDD versus nonspectrum				
Sensitivity	1.00	.97	.97	.97
Specificity	.33	.94	.67	.67
Autism versus PDD and nonspectrum				
Sensitivity	1.00	1.00	.89	.89
Specificity	.57	.79	.67	.67

It is also interesting to consider the results of Participant 4, who presented with a diagnosis of PDD-NOS. Recall, that on the ADOS-G this participant scored above the autism cut-off. Lord et al. (2000) also report that 53% of their participants with PDD-NOS scored above the autism cut-off. Similarly, Grey et al. (2007) reported that 6 of their 10 false positives for autism had a clinical diagnosis of PDD-NOS. Together these findings further show limitations of the ADOS-G to differentiate children with autism from children with ASD. In all of these studies, the direction of misclassification leads to a greater number of children scoring above the autism cut-off rather than a greater number of children scoring below this cut-off.

Lastly, it is interesting to look at the variation in diagnostic sensitivities and specificities when PDD-NOS participant(s) is taken out of the autism group and included in a non-autism

group. When examining Grey et al. (2007) and Ventola et al. (2006), diagnostic accuracies were lower when children with PDD-NOS were included in the group with the nonspectrum participants. This was also true of the current study. However, the results of Lord et al. (2000) showed the opposite effect when PDD-NOS was included in the group without autism. Although the results of the current study are similar to the results of the other studies, it is important to highlight that the specificities found in the current study were significantly lower than the specificities found in Lord et al. (2000), Gray et al. (2007), and Ventola et al. (2006). This could be due to the fact that the researcher in the current study was a novice clinician whereas researchers in the other studies were more experienced, or it could be due to under-diagnosis of autism in the children who were classified as not presenting autism. Recall that prior to the start of the study only two out of the ten participants in the current study were assessed with tools that have been designed for identifying the presence of autism.

Limitations of this Study

There were at least three limitations to this study. The first was related to the low (~60%) inter-rater reliability documented in this study. This may have been due to the researcher's inexperience. Although the researcher practiced administering and scoring the ADOS-G according to recommended guidelines, the researcher was unable to complete all of the training recommended in the ADOS-G manual. For example, the manual states that the examiner should have experience working with and without children with autism, train directly with someone who is experienced with the ADOS-G, compare practice ratings with those of other experienced clinicians, and attend a standardized training workshop to learn how to use the ADOS-G. For the current study, the researcher did not practice the ADOS-G with others to obtain consensus ratings, and she was unable to find other clinicians in the area who had been trained with the

ADOS-G. Also, as a graduate student researcher, attending the standardized training workshop was not feasible. Nevertheless, to improve the reliability in a future study, researchers should practice administering and scoring the ADOS-G with more children prior to the start of data collection. More training should also be provided to the second examiner who completed the tests of reliability. Finally, the two examiners should have scored a few practice tapes together to establish a consensus in scoring. These procedures should lead to higher rates of inter-rater reliability in the future.

A second limitation of the study related to researcher bias. Recall that, prior to the administrations of the ADOS-G, clinical diagnoses of two of the participants (Participant 2 and Participant 3) were revealed to the researcher accidentally by another speech-language pathologist. This caused the researcher to be un-blind to these participants' previous diagnoses. This knowledge could have caused the examiner to be biased in her observations and scoring of these participants' behaviors. Interestingly, though, when these two children are removed from the analyses, the results remain unchanged.

The third limitation is related to the small and unequal number of participants in the two groups. Although group comparison studies can be beneficial for clinicians to use as a reference in a clinical setting, large and equal numbers of participants are needed to conduct these types of research studies. In the current study, four participants were diagnosed with autism or ASD and six were not diagnosed with autism or ASD. In addition, gender was not equivalent across the groups because only two out of the 10 participants were female. Although valuable and useful information was discovered in this study, larger groups of participants containing more equivalent characteristics would have lead to greater statistical power to detect group differences.

Clinical Implications

The results of this study indicate that Module 1 of the ADOS-G is a useful tool for assessing communication, social interaction, play and imaginative use of objects in a standardized fashion in young children who may have autism or ASD. Based on the findings of the current study, the ADOS-G was able to correctly identify children with autism, however it exhibited weakness in its ability to differentiate children with autism from children with ASD or children with language impairments without autism. In addition, when the ADOS-G misclassified a child, the error related to the specificity of the tool. In other words, the ADOS-G errors in over-classifying children as presenting behaviors that are consistent with autism when they may not actually present with this clinical condition.

These findings indicate that the ADOS-G should not be used in isolation to make clinical decisions or clinical recommendations. Instead, this tool should be used in conjunction with other tools to adequately assess a child's speech and language abilities. Some recommended tools include parent interview, classroom or home observation, and other traditional speech and language tests. It is also important to note that speech-language pathologists do not diagnose autism or ASD. Instead they refer children for further evaluation when a diagnosis is suspected or they provide treatment to children who have already been identified as presenting these clinical conditions. The ADOS-G (if used with other tools and after adequate training) may help a clinician decide whether a referral is necessary.

Future Directions/Further Research

Based on the findings of the current study, there is a need for further research to improve the diagnostic specificity of the ADOS-G. One way to do this would be to examine the use of the ADOS-G with other measures. Also, further research is needed to follow children for a period of

time to see if their ADOS-G scores remain consistent. Finally, future research is needed to fully evaluate the effect the researcher's skill level has on the reliability of the ADOS-G. This type of work would ideally compare the ADOS-G scores of a novice speech-language pathologist or researcher to the scores of a more experienced speech-language pathologist or researcher. Currently, the effect of the clinician's skill level is unknown. Intuitively, clinicians with more experience should be able to use a tool more effectively than a novice clinician, but this hasn't been empirically tested.

REFERENCES

American Speech-Language Hearing Association. (n.d.). Autism (Autism Spectrum Disorders). Retrieved June 12, 2008 from http://www.asha.org/public/ speech/ disorders/ Autism.htm.

Akshoomoff, N., Corsello, C., & Schmidt, H. (2006). The Role of the Autism Diagnostic Observation Schedule in the Assessment of Autism Spectrum Disorders in School and Community Settings. *California School of Psychology, 11*. Retrieved June 5, 2008 from NIH Public Access database.

Baron-Cohen, S., Baldwin, D., & Crowson, M. (1997). Do children with autism use the speaker's direction of gaze strategy to crack the code of language? *Child Development, 68*, 48-57.

Bayley, N. (1993). Bayley scales of infant development-second edition. San Antonio, TX: Pearson Education Inc.

Bricker, D. & Squires, J. (1999). Ages and Stages Questionnaire. Baltimore: Paul H. Brookes Publishing Co.

Bzoch, K.R., League, R., & Brown, V.L. (1991). Receptive-Expressive Emergent Language Test. Austin: PRO-ED Inc.

Centers for Disease Control and Prevention. (2007). Autism Information Center: Symptoms. Retrieved June 12, 2008 from http://www.cdc.gov/ncbddd/autism/symptoms. htm

Crais, E., Douglas, D.D., & Campbell, C.C. (2004).The Intersection of the Development of Gestures and Intentionality. *Journal of Speech, Language and Hearing Research, 47*, 678-694.

Cox, A., Klein, K., Charman, T., Baird, G., Baron Cohen, S., & Swettenham, J., et al. (1999). Autism spectrum disorders at 20 and 42 months of age: Stability of clinical and ADI-R diagnosis. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 40 (5), 719-732.

DiLavore, P., Lord, C., & Rutter, M. (1995). Pre-Linguistic Autism Diagnostic Observation Schedule (Pl-ADOS). *Journal of Autism and Developmental Disorders, 25, 355-379.*

Duchan, J.F. (1998). Describing the Unusual Behavior of Children with Autism. *Journal of Communication Disorders, 31,* 93-112.

Fenson, C., Marchman, V.A., Thal, D.J., Dale, P.S., Reznick, J.S., & Bates E. (2007). MacArthur Bates Communicative Development Inventories. Baltimore: Paul H. Brookes Publishing Co.

Gilliam, J.E. (1995). Gilliam Autism Rating Scales. Austin, TX: PRO-ED.

Gray, K.M., Tonge, B.J., & Sweeney, D. J. (2007). Using the Autism Diagnostic Interview-Revised and the Autism Diagnostic Observation Schedule with Young Children with Developmental Delay: Evaluating Diagnostic Validity. *Journal of Autism and Developmental Disorders, 38, 657-667.*

Hedrick, D.L., Prather, E.M.& Tobin, A.R. (2002). Sequenced Inventory of Communication Development-Revised. Los Angeles: Western Psychological Services.

Kobayashi, R., Murata, T., & Yoshinga, K. (1992). A follow-up study of 201 children with autism in Kyushu and Yamaguchi areas, Japan. *Journal of Autism and Developmental Disorders, 22, 395-411.*

Lord, C., Rutter, M., DiLavore, P.C., & Risi, S. (2002). Autism Diagnostic Observation Schedule -Generic. Los Angeles: Western Psychological Services.

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, 185-212.*

Lord, C., Risi, S., Lambrecht, L., Cook, E. Jr.H., Leventhal, B.L., DiLavore, P.C., et al. (2000). The Autism Diagnostic Observation Schedule-Generic: A Standard Measure of Social and Communication Deficits Associated with the Spectrum of Autism. *Journal of Autism and Developmental Disorders, 30.* Los Angeles: Western Psychological Services.

Mullen, E. (1995). Mullen scales of early learning. Cranston, RI: T.O.T.A.L. Child, Inc.

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.

National Institute on Deafness and Other Communication Disorders. (2006-2008). Strategic Plan. 1-17.

National Institute of Mental Health. (2008). Autism Spectrum Disorders (Pervasive Development al Disorders). Retrieved June 12, 2008 from http://www.nimh.nih.gov/ health/ publications/ auti sm/complete-publication.shtml.

Newborg, J. (2005). Battelle Developmental Inventory- Second Edition. Hasca, IL: Riverside Publishing.

Paul, R. (2001). Language Disorders: *From infancy through adolescence: Assessment and Interv ention*. St Louis: Mosby, Inc.

Prizant, B.M. (1996). Brief Report: Communication, Language, Social, and Emotional Develop ment. *Journal of Autism and Developmental Disorders*, *26*, 173-178.

Prizant, B., Schuler, A., Wetherby, A., & Rydell, P. (1997). Enhancing language and communication: Language approaches. In D. Cohen & F. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders* (2nd ed., pp.572-605). New York: John Wiley & Sons.

Reynolds, C.R., & Kamphaus, R.W. (2004). Behavior assessment system for children- second edition. Bloomington, MN: Pearson Assessments.

Robins, D., Fein, D., & Barton, M. (1999). The Modified Checklist for Autism in Toddlers: An initial study investigating the early detection of autism and pervasive developmental disorders. *Journal of Autism and Developmental Disorders*, 31 (2), 131-144.

Rollins P., & Snow, C. (1998). Shared attention and grammatical development in typical

children and children with autism. *Journal of Child Language, 25,* 653-673.

Rollins, P. (1999). Early pragmatic accomplishments and vocabulary development in preschool children with autism. *American Journal of Speech-Language Pathology, 8,* 181-190.

Rossetti, L. (1990). Rossetti Infant-Toddler Language Scale. East Moline, IL: Linguisystems.

Schopler, E. Reichler, R.J., & Rochen Renner, B. (1988). The childhood autism rating scale. Los Angeles: Western Psychological Services.

Smith, V., Mirenda, P., & Zaidman-Zait, A. (2007). Predictors of expressive vocabulary growth in children with autism. *Journal of Speech, Language, and Hearing Research, 50,* 149-160.

Sparrow, S.S., Balla, D.A., & Cicchetti, D.V. (1984). The Vineland Adaptive Behavior Scales. Circle Pines, MN: American Guidance Services.

Ventola, P.E., Kleinman, J., Pandey, J., Barton, M., Allen, S., Green, J., Robins, D. & Fein, D. (2006). Agreement Among Four Diagnostic Instruments for Autism Spectrum Disorders in Toddlers. *Journal of Autism and Developmental Disorders, 36,* 839-847.

Voress, J.K., & Maddox, T. (1998). Developmental assessment of young children. Autstin, TX: PRO-ED.

Wetherby, A.M., Prizant, B.M., & Hutchinson, T.A. (1998). Communicative, Social/Affective, and Symbolic Profiles of Young Children With Autism and Pervasive Developmental Disorders. *American Journal of Speech-Language Pathology, 7,* 79-91.

Wetherby, A.M. & Prizant, B.M. (2002). Communication and Symbolic Behavior Scales: Developmental Profile. Baltimore: Brookes Publishing Co.

Wetherby, A.M. & Prizant, B.M. (2002). Communication and Symbolic Behavior Scales: Infant-Toddler Questionnaire. Baltimore: Brookes Publishing Co.

Westby, C. (1980). Assessment of Cognitive and Language Abilities Through Play. Language, Speech, and Hearing Services in Schools, 11, 154-168.

Yoder, P. (2006). Predicting lexical density growth rate in young children with autism spectrum disorders. *American Journal of Speech-Language Pathology, 15,* 378-388.

Zimmerman, I.L., Steiner, V.G., & Pond, K.E. (2002). Preschool Language Scale-Fourth Edition. San Antonio: Psychological Corporation.

VITA

Whitney Dolan was born and raised in the New Orleans, Louisiana area. She graduated from Academy of the Sacred Heart in 2003 and decided to attend Louisiana State University Agricultural and Mechanical College in Baton Rouge, Louisiana. During her freshman year and after encountering situations throughout her life in which the services of a speech-language pathologist were necessary and greatly appreciated, she declared her major communication sciences and disorders. She earned a Bachelor of Arts degree in communication sciences and disorders in May of 2007.

After earning her bachelor's degree in 2007, Whitney knew she wanted to continue her education to pursue a Master of Arts degree in communication sciences and disorders. After completing her first year of the coursework and clinical assignments in the master's program at LSU, Whitney was intrigued by children with language disorders. To further explore this population, she decided to pursue a thesis under the guidance of Dr. Janna Oetting. After graduating in May of 2009, Whitney hopes to complete her clinical fellowship year at a facility that would allow her to work with children; her ideal job would be one that would allow her to work with children who present with autism or autism spectrum disorders.