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EARLY DIAGNOSIS OF AUTISM SPECTRUM DISORDER VIA A TRANSDISCIPLINARY CLINIC

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EARLY DIAGNOSIS OF AUTISM SPECTRUM DISORDER VIA A
TRANSDISCIPLINARY CLINIC

Proposal for a Dissertation

Presented to

The Department of Psychology

DePaul University

BY

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OVERVIEW

Autism Spectrum Disorder (ASD) has gained much attention in the last few decades. ASD is described as qualitative impairments in social-emotional reciprocity, language and communication, and presence of restricted or repetitive patterns of behavior or interest.

ASD is typically not diagnosed until after the age of three, although some research indicates that a diagnosis may be given sooner and that symptoms are often present within the first year of life. It is important to diagnose ASD early in life because research has found that early treatment (before the age of four) leads to more positive and more stable treatment gains.

The leading “gold standard” instruments for diagnosing ASD are the Autism Diagnostic Observation Schedule (ADOS; Lord, et al., 2000) and the Autism Diagnostic Interview- Revised (ADI-R; Le Couteur, Lord, & Rutter, 2003). However, these instruments have been standardized on children over the age of three, and research has indicated that ASD diagnoses assigned by these instruments prior to the age of three have significant variability in their reliability and accuracy. As such, clinicians and researchers should strive to find alternative methods for the early diagnosis of ASD.

One such method is through a transdisciplinary clinic, in which various clinicians from a variety of clinical backgrounds assess a child and combine their impressions to achieve a consensus on a diagnosis. Though this approach appears promising, no systematic research has been conducted to determine the reliability

and accuracy of ASD diagnoses by a transdisciplinary clinic before the age of three.

The current study seeks to explore whether a transdisciplinary clinic is accurate in their diagnosis of ASD prior to the age of three. Participants in the current study consist of 34 children aged 13 to 36 months who were evaluated by a transdisciplinary clinic between 2007 and 2009. Participants were reassessed using the ADOS and ADI-R once the child is over the age of three. The diagnoses from the two time points was compared to determine the accuracy and reliability of the diagnosis assigned by the transdisciplinary clinic prior to the age of three.

Overall, diagnostic stability was high between the different time points and diagnostic methods. Specifically, inter-rater reliability was found to be 82.35% with a Kappa coefficient of .62. This suggests that the transdisciplinary clinic is a reliable and valid method of diagnosing ASD prior to the age of 3.

CHAPTER I

INTRODUCTION

Leo Kanner (1943) first described Autism Spectrum Disorder over 70 years ago (Filipek, et al., 1999; Lyons & Fitzgerald, 2007; Volkmar & Klin, 2005; Ward, 1970). Based upon his first documentation and recent research, the core features of Autism Spectrum Disorder or Autism have been defined as delays or qualitative deficits in the following areas of functioning: social interaction or reciprocity, language, and the presence of restricted or repetitive patterns of behavior or interests. These delays in functioning must be present within at least one of these areas of functioning prior to the age of three (American Psychiatric Association, 2000; Ward, 1970), and clinicians argue they may appear as early as the first year of life (Chawarska & Volkmar, 2005; Filipek, et al., 1999; Werner, Dawson, Osterling, & Dinno, 2000). These impairments translate into life-long difficulties with social interactions, behavior, and independent functioning for the individual diagnosed with the disorder (Bromley, Hare, Davison, & Emerson, 2004; Kuhn & Carter, 2006).

Core Deficits of Autism Spectrum Disorder

The following section will outline the defining features and symptoms of Autism Spectrum Disorder. This section is intended to give the reader a more in-depth view of the disorder.

Social communication

The first area of diagnostic concern for Autism Spectrum Disorder is in social interaction and reciprocity. Within the social interaction domain,

impairments can consist of deficits in the use of nonverbal communicative behaviors (e.g., eye contact, body postures, gestures), failure to establish developmentally- or age-appropriate peer relationships, lack of spontaneous behaviors used to share enjoyment or interest, and deficits in social/emotional-reciprocity (American Psychiatric Association, 2013; Chawarska & Volkmar, 2005; Filipek, et al., 1999).

Additional impairments in social interaction have been demonstrated in children later diagnosed with ASD as early as the first year of life. These delays include a limited ability to anticipate being picked up by others, lower frequency of looking at other people (“social gaze”), lower engagement in following another’s gaze to reference something in the environment (“joint attention”), less interest in participating in interactive games with others, lower interest in spoken language, less affection towards familiar people and family members, and these infants are often content to be left alone (Carter, Davis, Klin, & Volkmar, 2005; Chawarska & Volkmar, 2005; Filipek, et al., 1999; Werner, et al., 2000). As the child develops during the ages of two to three, additional deficits are observed as their intellectual, social, and communicative abilities mature and expand.

Examples of such delays seen during these years are diminished eye contact, lower interest in peers, limited frequency of looking at parents referentially (“social referencing”), less use of smiling at others as a tool for social interaction (“social smile”), deficits in spontaneous seeking of others’ attention to share affect or enjoyment, limited or flat range of facial expressions, restricted or limited imitation of others’ actions, and delays in play skills, such as limited

functional play (i.e., purposeful play or playing with objects as they are intended to be played with), little pretend or imaginative play, and diminished interest in interactive play or games with others (Carter, et al., 2005; Chawarska & Volkmar, 2005).

Delays in the social interaction domain are considered by some to be the “sine qua non” of ASD (Volkmar & Woodbury-Smith, 2007, p. 6). This means that without observable deficits or delays in the Social Interaction domain, a diagnosis of ASD is unwarranted. Therefore, impaired social skills or interest are the crux of diagnosis of ASD, which parents of children with ASD are often cognizant of early in life (De Giacomo & Fombonne, 1998).

Another major area of diagnostic concern in ASD is in the realm of language and social communication. In ASD, language delays include delay or lack of spoken language without an attempt to engage in alternative methods of communication (e.g., gestures, sign language), impairments in the abilities to initiate or sustain conversation in individuals who do have spoken language, repetitive or idiosyncratic language, and lack of self-initiated imaginative or social-imitative play (American Psychiatric Association, 2000; Mitchell, et al., 2006; Tager-Flusberg, Paul, & Lord, 2005).

Similarly to social impairments, some delays in language and communication can be observed as early as the first year of life (Mitchell, et al., 2006). Specifically, infants later diagnosed with ASD demonstrated delayed preverbal skills, such as poor response to their name being called (i.e., looking at the person who called their name) and demonstrate understanding of fewer words

(Chawarska & Volkmar, 2005; Mitchell, et al., 2006). Between the first and second year of life, children later diagnosed with ASD understand fewer spoken phrases and produce fewer communicative gestures and single words (Mitchell, et al., 2006). As the child ages, they continue to have a poor response to their name being called, they demonstrate a low frequency of verbal and nonverbal (i.e., gestures, pointing) communicative behaviors, as well as often failing to respond appropriately to communication attempts by others (Chawarska & Volkmar, 2005; Mitchell, et al., 2006; Tager-Flusberg, et al., 2005). Further, in children who do develop spoken language, they often engage in unusual vocalizations (e.g., screaming, echolalia, and making abnormal noises) or display odd qualities in their speech patterns, such as abnormal volume, rate, rhythm, or pitch (Tager-Flusberg, et al., 2005).

Restricted and Repetitive Behaviors or Interests

Restricted/repetitive behaviors and interests are defined as preoccupations and restricted patterns of interests and activities that are either abnormal or have an intense focus, adhering inflexibly to nonfunctional routines or rituals, repetitive or stereotyped motor mannerisms and self-stimulating behaviors (e.g., hand-flapping, body rocking), and nonfunctional preoccupation with parts of objects (American Psychiatric Association, 2000; Chawarska & Volkmar, 2005).

Often more pronounced restricted/repetitive interests develop later in life as the child gains more functional abilities as they develop. However, in infants and toddlers the beginnings or precursors of these restricted/repetitive behaviors can be observed. These include repetitive finger or hand mannerisms (e.g., hand-

flapping, repetitive motions with fingers), inappropriate use of objects or preoccupations with parts of objects (e.g., repeatedly pressing a single button on a toy that has multiple buttons), and unusual response to certain sensory stimuli, such as an aversion to being touched by others (Chawarska & Volkmar, 2005).

Additional Features

There are a number of additional features and symptoms associated with the core deficits in ASD that often hinder functioning and behavior. These additional features include issues with sensory integration (Baranek, Parham, & Bodfish, 2005; Baranek, Wakeford, & David, 2008) and aggressive behaviors, including self-injurious behaviors (Matson & LoVullo, 2008; Matson & Nebel-Schwalm, 2007a). Another area of major concern is mental retardation or intellectual disability, as well as global delays in functioning (Zero to Three, 2005). Studies indicate that as many as 75% of individuals diagnosed with an ASD show at least some level of intellectual disability, or deficits in cognitive abilities (Croen, Grether, & Selvin, 2002; Matson & Nebel-Schwalm, 2007b). These additional features often affect the development and functioning of the child diagnosed with an ASD, as well as have significant impact on diagnosis, prognosis, and treatment (Baranek, et al., 2005; Croen, et al., 2002; Matson & Nebel-Schwalm, 2007b).

Epidemiology and Prevalence of ASD

ASD has received growing attention in recent years due to the rising prevalence rates of these disorders. Early epidemiological studies estimated the prevalence of ASD in children and infants to be as low as four to five cases per

10,000 individuals in the population (Lotter, 1966). In recent years those rates have risen drastically. Throughout the 1980's and 1990's, the prevalence of ASD rose from 10-20 cases per 10,000 individuals (Filipek, et al., 1999), to 60 cases per 10,000 individuals (or approximately one in 167) worldwide (Chakrabarti & Fombonne, 2001, 2005; Fombonne, 2005). The most recent epidemiological studies conducted by the Center for Disease Control indicate that ASD is now diagnosed in 14.7 cases per 1,000 individuals, or approximately one in 68 individuals (Center for Disease Control, 2014). ASD occurs more often in males than in females at approximately a four to one ratio, although females diagnosed with ASD are more likely to have lower IQ scores and to be diagnosed with comorbid Mental Retardation or Intellectual Disability (Center for Disease Control, 2007; Fombonne, 2005).

Intervention with ASD

Studies have demonstrated that individuals with ASD benefit from early and intensive interventions, especially behavioral strategies and curriculum- or classroom-based therapies (Arick, Krug, Fullerton, Loos, & Falco, 2005; Campbell, Herzinger, & James, 2008; Corsello, 2005; Lovaas, 1987). Benefits of interventions for ASD include higher IQ and academic success, decreases in problematic behavior and aggressive tendencies, increases in functional communication (verbal and nonverbal), decreases in restricted/repetitive behaviors and rigid adherence to nonfunctional routines, and increased social engagement and reciprocity skill acquisition and utilization (Corsello, 2005; Lovaas, 1987; Margolies, 1977). Although the majority of research that has been

conducted on the effectiveness of treatment for individuals with ASD has focused on the school-aged population (four to five and older) it appears that early (birth to three) interventions have positive benefits as well (Corsello, 2005; Lovaas, 1987; Margolies, 1977). Studies have shown that children with ASD who enter intervention services before age four often have more positive outcomes and more stable maintenance of treatment gains than children who begin behavioral-based services after the age of four or five (Harris & Handleman, 2000; Sheinkopf & Siegel, 1998).

These findings suggest that individuals with ASD and their families would benefit from earlier interventions (before the age of four) and clinicians should aim to diagnose and begin treating ASD early in life (Bryson, Rogers, & Fombonne, 2003; Corsello, 2005). However, this is not always possible with our current diagnostic and treatment practices. In most cases of ASD, a diagnosis is not given until the age of three or later (Filipek, et al., 1999). Additionally, there can be a lengthy amount of time between the point when a diagnosis is made to when the intervention is implemented, depending on services available, service provider catchment areas, wait-lists for treatment, parent readiness, and other mitigating factors (Bromley, et al., 2004; Chakrabarti, Haubus, Dugmore, Orgill, & Devine, 2005; Charlop-Christy, Malmberg, Rocha, & Schreibman, 2008; Coonrod & Stone, 2005; Corsello, 2005; Samms-Vaughan & Franklyn-Banton, 2008). Given that early intervention can lead to more positive and longer-lasting outcomes, it is essential that effective assessment tools be developed to ensure that children are diagnosed as early as possible (Bryson, et al., 2003).

Early Diagnosis of ASD

Although ASD is typically not diagnosed until age three or later (Howlin & Moore, 1997; Mandell, Novak, & Zubritsky, 2005), research has suggested that it may be diagnosed earlier in life (Chakrabarti, et al., 2005; Chawarska, Klin, Paul, & Volkmar, 2007; Lord, 1995; Osterling, Dawson, & Munson, 2002; Zero to Three, 2005). Between 12 and 18 months of age, parents are often aware of developmental delays that are often early markers for a later diagnosis of ASD, such as lack or deficits in pointing, showing objects to others, gazing at other people, and turning when his or her name is called (De Giacomo & Fombonne, 1998; Osterling & Dawson, 1994). Studies have found that clinicians and trained coders are able to correctly differentiate children later diagnosed with an ASD from typically developing children and children with intellectual disabilities with an accuracy of approximately 85% by reviewing home videotapes retrospectively to screen for early diagnostic signs of ASD in children 12 months of age (Osterling & Dawson, 1994; Osterling, et al., 2002). Such findings indicate that it might be possible to diagnose ASD much earlier than is typically done in current practice.

Previously, 13 studies have systematically examined the validity and reliability of an ASD diagnosis before the age of three. These studies have differed in their methodology and had varying rates of success in a reliable and accurate early ASD diagnosis. All 13 of the studies utilized either previously standardized measures or were attempting to standardize such measures through their research. These measures included observation-based measures, parent

interviews, and level one screening checklists that are often completed by a pediatrician during a regular pediatric screening.

Only seven of the 13 studies (54%) utilized a test-retest design in which all participants were evaluated prior to age three and after age three (Baron-Cohen, Allen, & Gillberg, 1992; Brian, et al., 2008; Cox, et al., 1999; Eaves & Ho, 2004; Gray, Tonge, Sweeney, & Einfeld, 2008; Lord, 1995; Wetherby, Brosnan-Maddox, Peace, & Newton, 2008). These designs are useful in that researchers are able to not only examine true positives and false positives in the diagnosis of ASD, but also examine rates of false negatives (children who were not originally given a diagnosis, but meet criteria for an ASD later in life) because all children were reevaluated regardless of diagnostic category after age three. Three (30%) studies screened all participants prior to age three, but only conducted follow-up analyses with children who met criteria for an ASD or were thought to be “at-risk” based on these screening measures (Gray, et al., 2008; Robins, 2008; Robins, Fein, Barton, & Green, 2001). Unfortunately because these studies did not follow up with all participants, they were unable to examine the rates of false negatives. One study followed and repeatedly assessed only children who had received an ASD diagnosis by the age of two and did not include a control sample (Charman, et al., 2005). The remaining study used retrospective analyses for children who had diagnoses of either an ASD or ADHD. Parents were instructed to fill out a screening measure recalling their child’s development when they 14 months of age (Swinkels, et al., 2006). At the time this study was conducted, however, children in the ASD category ranged

from 14 to 226 months of age ($m = 87$ months) and children diagnosed with ADHD ranged from 34 to 201 months of age ($m = 76$ months). The design of this study is questionable due to its sole utilization of retrospective reporting from parents, sometimes requiring them to remember their child's development up to 18 years prior to when they completed the measure.

The rates of children whose ASD diagnosis remained stable prior to the age of three to once they reached three or older varied significantly between studies. Specifically, reliability of an ASD diagnosis ranged from as low as 25% (Dietz, Swinkels, van Daalen, Buitelaar, & van Engeland, 2006), to 50 to 57% (Brian, et al., 2008; Cox, et al., 1999; Robins, 2008), 67 to 85% (Charman, et al., 2005; Eaves & Ho, 2004; Gray, et al., 2008; Robins, et al., 2001), and to over 90% (Baron-Cohen, et al., 1992; Lord, 1995; Stone, et al., 1999; Swinkels, et al., 2006; Wetherby, et al., 2008). Additionally, Wetherby and colleagues (2008) found that reliability and stability of diagnosis were lowered significantly the younger the child was. Specifically, they found that stability of an ASD diagnosis was only 20% in children aged six to eight months, 77% in children nine to 11 months, and rose above 90% for children aged 12 to 24 months. This finding suggests a child's chronological age at the time of the assessment significantly affects clinicians' ability to give a correct diagnosis.

Six of the studies (46%) found significant rates of false positive diagnoses. Specifically, rates of false positives ranged from 22 to 75% of participants who screened positive for an ASD before the age of three (Dietz, et al., 2006; Gray, et al., 2008; Lord, 1995; Robins, 2008; Robins, et al., 2001; Wetherby, et al., 2008).

A few of these studies noted that using existing standardized measures to screen for ASD prior to age three presented significant difficulty differentiating an ASD from global developmental delays or intellectual disabilities and language disorders (Dietz, et al., 2006; Lord, 1995; Robins, et al., 2001; Wetherby, et al., 2008). Therefore, it appears that mental age and other mitigating factors such as language development can significantly impact a measure or checklist's ability to provide an accurate diagnosis early in life.

Possibly more problematic and potentially detrimental to families, of the seven studies that tested for possible false negatives, three of these (43%) found significant rates of false negatives. These studies had rates of 11 to 44% of participants who were thought not to have an ASD prior to the age of three, who did in fact meet diagnostic criteria later in life (Cox, et al., 1999; Gray, et al., 2008; Lord, 1995). These findings are important because they suggest that it is possible that significant percentages of children who may have an ASD may be missed by existing screening instruments prior to the age of three, and therefore may not receive early intervention services that could be beneficial to their development and functioning.

Based on this line of research, it appears clinicians and researchers have varying levels of success diagnosing ASD prior to the age of three using currently employed measures. One reason for this variability in validity and reliability is due to limited speech and language in children under the age of three (Paul, 2005; Volkmar & Klin, 2005). Another possible explanation is thought to be the fact that development and functioning in children with a mental age of under two

years is often non-specific or global; functioning and development across various domains is significantly intertwined and difficult to tease apart (Chawarska, et al., 2007). These related and intertwined areas of functioning make it difficult to differentiate possible delays in development that are attributed to social deficits, cognitive deficits, language deficits, or global delays instead of deficits which are directly related to an ASD. Thus, early symptoms at this developmental level may be subtle and hard to differentiate when using standardized measures developed for older children that are used specifically to screen for ASD and not other possible disorders of childhood (Chawarska, et al., 2007; Lord, et al., 2000).

Additionally, based on the findings of these studies it appears that the diagnostic tool used did not solely account for the variability in reliability and validity of an ASD diagnosis. For example, the study with the lowest reliability in diagnosis with a 25% accuracy rate (Dietz, et al., 2006) used the same screening measure (The Early Screening of Autistic Traits Questionnaire) as a study that had a 94% accuracy rate (Swinkels, et al., 2006). Studies using the Autism Diagnostic Interview- Revised ranged in reliability of ASD diagnosis from 50-57% (Brian, et al., 2008; Cox, et al., 1999), to 85% (Charman, et al., 2005), to nearly 94% (Lord, 1995), and studies using versions of the Checklist for Autism in Toddlers ranged from 51% (Robins, 2008), to 67% (Robins, et al., 2001), to 100% (Baron-Cohen, et al., 1992). These findings suggest that reliability of an ASD diagnosis prior to the age of three does not solely rely on the existing measure used, but rather some interaction between the measure and another possible variable or variables.

Common Diagnostic Tools for ASD

Currently, there are two instruments predominantly used for the diagnosis of ASD: the Autism Diagnostic Observation Schedule (ADOS; Lord, et al., 2000) and the Autism Diagnostic Interview-Revised (ADI-R; Le Couteur, et al., 2003). The ADOS is a standardized observation measure that consists of placing the child in a variety of play or social contexts and observing how he/she interacts with the environment, the examiner, and parents or caregivers (Lord, et al., 2000). The ADI-R is a parent interview in which the clinician asks questions about the child's developmental history, social skills, language abilities, as well as interests and behaviors (Le Couteur, et al., 2003). Each of these measures scores the child's behaviors or information obtained from the parent based on DSM-IV-TR criteria of ASD. These scores are then entered into an algorithm that places the child in various diagnostic categories (i.e., Autism Spectrum Disorder, autism spectrum disorder, non-spectrum).

Due to the reliability and validity as well as the structure of the ADOS, this instrument is one of the most popular and widely used instruments for diagnosing ASD (Lord & Corsello, 2005; Lord, et al., 2000). However, researchers have noted that it is not often appropriate to diagnose an individual with an ASD based on one observation conducted by a single examiner during a single time point (Le Couteur, Haden, Hammal, & McConachie, 2008). For this reason, researchers and clinicians recommend using the ADOS in conjunction with ADI-R to get a more accurate view of the individual and to provide an appropriate diagnosis (Le Couteur, et al., 2008). This is recommended because

diagnostic criteria for ASD is dependent in part on developmental history, and an interview with the parent or caregiver, like the ADI-R, can provide such information that would otherwise not be available during an observational assessment (Le Couteur, et al., 2008). Further, during a single time-point, an individual's behavior may vary greatly and can change due to the situation, the demands placed on him/her, the setting, and who else might be present. By incorporating a parent interview, the examiner has an opportunity to determine whether or not the behavior that may have been observed during the ADOS was "typical" of the individual's level and functioning (Klin, Saulnier, Tsatsanis, & Volkmar, 2005; Le Couteur, et al., 2008). If the assessment or observation setting did not give an accurate portrayal of the individual's behavior, an inaccurate or even inappropriate diagnosis might be given (Klin, Saulnier, et al., 2005). The ADOS and ADI-R are often considered the "gold standards" of standardized measurements in the diagnosis of ASD when used in combination with one another (Chawarska, et al., 2007; Le Couteur, et al., 2008).

However, there are a few drawbacks to using these gold standard instruments when diagnosing ASD, particularly in young children. The majority of research using the ADOS and ADI-R has focused on children ages three and older and on children without significant cognitive delays (Lord & Corsello, 2005; Lord, et al., 2000; Lord, Rutter, & Le Couteur, 1994). Research conducted with younger children has found that reliability and validity of the ADOS and ADI-R decrease for young children, specifically for children less than 30 months of chronological age (Brian, et al., 2008; Lord, 1995; Lord, et al., 2000; Lord,

Storoschuk, Rutter, & Pickles, 1993). Of the 13 studies examining accuracy of diagnosis of ASD's prior to age three that were discussed earlier in this paper, those using the ADI-R alone (Cox, et al., 1999; Lord, 1995) or using the ADI-R in conjunction with the ADOS (Brian, et al., 2008; Charman, et al., 2005) demonstrated significant variability in the accuracy and reliability of an ASD diagnosis. Specifically, Brian and colleagues (2008) and Charman and colleagues (2005) used the ADOS and ADI-R in conjunction with one another to assign a diagnosis for children under the age of three. However, this method was only able to correctly identify 57% of the children who were later diagnosed with an ASD in Brian and colleagues' study (2008), whereas nearly 85% of children were correctly identified in Charman and colleagues' study (2005). Cox and colleagues (1999) and Lord (1995) used the ADI-R alone to assign a diagnosis to children under age three. Upon re-testing the diagnosis after the age of three, these two studies had significant variability in the accuracy of diagnosis. Although Lord (1995) demonstrated nearly 94% accuracy in diagnosis of ASD, Cox and colleagues (1999) were able to accurately identify only 50% of children with an ASD prior to age three. These studies demonstrate that the ADOS and ADI-R vary significantly in their ability to reliably diagnose ASD prior to the age of three.

Additionally, The ADI-R tends to under-diagnose children under three years who are more verbal or who are higher-functioning cognitively or developmentally, even if they later meet criteria for an ASD (Lord, 1995; Lord, et al., 1993). It has also been found that children who have an intellectual disability

or have delays in their developmental age (under 20 months of mental age) tend to be over-included in those diagnosed with an ASD as measured by the ADOS and ADI-R, even if these children do not meet criteria for an ASD later in life (Lord, 1995; Lord, et al., 2000; Lord, et al., 1993). Because many children who are diagnosed with an ASD have developmental delays or intellectual disability, using these measures that are over-inclusive of individuals with developmental or cognitive delays may lead to inaccurate diagnoses for young children or those with cognitive/developmental delays.

This area of research suggests that although there is some utility for current diagnostic procedures utilized in research and clinical settings for the early diagnosis of ASD, mitigating factors such as the child's chronological age, mental age or cognitive abilities, language functioning, and possible differential diagnoses impact the validity and reliability of early diagnosis of ASD using currently utilized procedures. Therefore, alternative models for early diagnosis of ASD should be studied in order to develop reliable and valid diagnostic techniques in children under the age of three.

Transdisciplinary Diagnostic Team

One model that has been suggested for the diagnosis of ASD is diagnosis through a transdisciplinary team approach, in which a variety of clinicians from various disciplines evaluate the child across various dimensions and discuss their findings together to reach a consensus on a diagnosis. ASD is a developmental disorder that impact various areas and domains of development and functioning, including social engagement, language and communication, sensory and motor

development (Klin, Saulnier, et al., 2005). For this reason, a team of professionals from a variety of disciplines and different backgrounds might be best equipped to provide a multidimensional and comprehensive view of the individual (Klin, Saulnier, et al., 2005). Klin and colleagues (2005) recommend that a transdisciplinary assessment should include a psychological examination that evaluates current developmental or cognitive levels, speech, language, and communication abilities, levels of adaptive functioning, sensory regulation and motor skills (Klin, Saulnier, et al., 2005). Each of these areas of assessment should be examined by a professional with expertise in that area. For example, a psychologist or developmental pediatrician knowledgeable about ASD should conduct the psychological or developmental evaluation, a speech and language pathologist should assess the speech/language of the individual, and an occupational or physical therapist should evaluate sensory and motor development (Klin, Saulnier, et al., 2005).

It is useful for individuals and families to receive an earlier diagnosis in order to receive earlier treatment and support for the family (Bryson, et al., 2003), and therefore techniques or approaches that may lead to an early, accurate diagnosis of ASD should be utilized where and when applicable. Due to previous research based on standardized measurements and single clinician judgments having mixed reliability and validity in the early assessment of ASD, alternative methods of assessment should be researched.

Theoretically, a transdisciplinary team approach to evaluating ASD may provide many advantages. This approach may give an in-depth and

comprehensive view of the child by integration of assessments of clinicians who have examined various domains of functioning. Thus the transdisciplinary approach may provide a more accurate view and diagnosis by incorporating knowledge from multiple sources (Klin, Saulnier, et al., 2005). Further, the team approach may aid diagnosis in situations in which differential diagnoses may be possible, such as a child with significant language or sensory issues and/or global developmental delays (Klin, Saulnier, et al., 2005).

Additionally, such approaches may be cost effective due to the incorporation of information across several disciplines and from multiple reporters, which could be valuable to the family. By using more traditional assessment methods (i.e., ADOS and ADI-R) that are often conducted by a psychologist, a family may not receive useful information and recommendations regarding areas of development that are not within a psychologist's domain of expertise. For example, if a child who has significant language or sensory difficulties was evaluated by a psychologist, a referral would most likely be made for subsequent evaluations from speech and occupational therapists, costing the family additional time and resources. With a transdisciplinary approach, however, these professionals would have already participated in the evaluation and would be able to provide appropriate recommendations (Klin, Saulnier, et al., 2005). Additionally, transdisciplinary clinics may provide an assessment in a shorter period of time than typically provided using more traditional methods, such as the ADOS and ADI-R. A transdisciplinary clinic may take one to two hours for the full evaluation as well as feedback for the family, whereas the

combined ADOS and ADI-R approach can last three to four hours simply for the evaluation, and even longer to score these measures and provide appropriate feedback. Therefore, using the transdisciplinary approach could possibly provide the family with a more comprehensive and accurate evaluation and recommendations within a shorter amount of time and with fewer visits than is typical of current methods (Klin, Saulnier, et al., 2005).

In spite of the promise of the transdisciplinary approach in the early diagnosis of ASD, there has been no systematic investigation of the accuracy or validity of this approach. Given the hypothesized interpretations for lack of consistent evidence of reliable and valid diagnosis of ASD in children younger than three, using current typical assessment methods (i.e., ADI-R and ADOS) a transdisciplinary approach might provide a method that offers more valid and reliable early diagnosis of ASD. Most studies on early diagnosis of ASD have utilized standardized measures and have demonstrated significant variability in accuracy of diagnosis. Although there has been no research to determine how accurate transdisciplinary approaches are in the diagnosis and early detection of ASD, similar approaches have been shown to be valuable in the diagnosis of developmental disorders, such as intellectual disability and cerebral palsy as early as the first year of life (Farber, Shapiro, Palmer, & Capute, 1985).

Rationale

The purpose of the proposed study will be to determine if a transdisciplinary approach is accurate and valid in the early diagnosis of ASD. Specifically, this study will seek to examine whether this approach is accurate and reliable in diagnosis of ASD early in life (birth to before three years of age) and if these diagnoses remain stable over time (three years of age and older) and as measured by more conventional measures. This will be tested by having children participate in a transdisciplinary diagnostic clinic before the age of three, and then returning to be evaluated using more conventional diagnostic tools (i.e., ADOS and ADI-R) after they have reached the age of three.

Statement of Hypotheses and Research Questions

Hypothesis I. A transdisciplinary diagnostic clinic will provide an accurate diagnosis of children birth to age three who may be suspected to have an ASD. Specifically, it is hypothesized that the diagnosis as assessed first through a transdisciplinary clinic, and then after the child has reached age three using conventional diagnostic measures appropriate for children older than three (ADOS and ADI-R) will fall within the same diagnostic category (ASD, Non-ASD).

CHAPTER II

METHOD

This section will outline the research methodology used for the current study. Information and demographic characteristics regarding the participants, the procedure for the study, and any materials that may be needed will be outlined and described.

Research Participants

The total sample size for the current study consists of 34 participants who were previously assessed by a transdisciplinary diagnostic clinic between 2009 and 2013. These 34 participants were selected out of 188 total children assessed by the transdisciplinary clinic during this time period. Of the total 34, 29 (85.29%) were male and 5 (14.7%) were female. Children's names and potentially identifying information were removed from the data sets utilized in this study to keep their identities and information private and confidential.

Procedure

Children birth to age three who were suspected to have an ASD previously took part in a transdisciplinary assessment through the Pediatric Developmental Center in Chicago, IL. The transdisciplinary clinic at this center is known as the Medical Diagnostic Clinic (MDC). The MDC follows the principles outlined by Klin and colleagues (2005), and includes psychological/developmental, speech/language, and sensory/motor assessments, as well as a medical examination to screen for any possible biomedical, genetic, or neurological disorders. Each member of the MDC team assesses the child's development in

accordance with his or her own area of expertise. For example, a psychologist conducts a psychological examination, a speech and language pathologist assesses the child's language abilities, an occupational therapist evaluates sensory and motor development, and a developmental pediatrician evaluates medical and developmental history. Each member of the MDC team is knowledgeable in ASD and other developmental disorders of childhood.

In phase two of the study, the 34 participants were invited to return to the clinic. Families received a letter from the medical doctor who oversaw their MDC evaluation instructing them to call the researcher if they were interested in participating in the current study. Upon being contacted, the family was instructed not to reveal any diagnoses the child may have to the researcher who is assessing their child so as to keep the researcher blind to the child's diagnostic category as assessed by the MDC. The family was told that if they did reveal the child's diagnostic status to the researcher, they could complete the evaluation but their child's data would not be able to be used for the study.

During the second stage of the study, the researcher assessed each participant using the ADOS and ADI-R, the most conventional measures in the diagnosis of ASD for children aged three years and above. The researcher has been trained in administration of the ADOS and ADI-R and is "research reliable" on these measures. The process of becoming research reliable involves first being trained in the administration and scoring of these instruments. This step is followed by videotaping subsequent administrations of the instruments and sending these videos as well as the researcher's scoring to a professional clinician

or researcher who trains others in the use of the ADOS and ADI-R. This professional then views these administrations and checks the researcher's scoring to determine if the researcher's administration and scoring are reliable and accurate. A researcher is considered "research reliable" only when his or her administration and scoring of the ADOS has reached at least 80% agreement and his or her administration and scoring of ADI-R has reached at least 90% agreement with the trained professional. This procedure is done in order to increase reliability and accuracy in the administration and scoring of the ADOS and ADI-R among clinicians and researchers who utilize these measures.

The algorithms for the ADOS and ADI-R were combined to give a diagnosis to the child at the second stage of the study. If the diagnoses assigned by the ADOS and ADI-R were inconsistent, the primary researcher and a licensed clinical psychologist used clinical judgment to decide upon a final diagnosis using information from both measures. The diagnoses at the first time point (MDC) and second time point (evaluation with ADOS and ADI-R) will then be recorded and compared. This will help to determine if the original diagnostic category was accurate in relation to the later diagnosis that is established at a time point when ASD is generally diagnosed (three or older) using conventional measures for assessment of ASD.

Materials

Materials for Time One. The MDC utilizes a variety of measures to aid in diagnosis. The Social-Emotional subscale of the Hawaii Early Learning Profile (HELP) is used to guide the observation of a variety of social interaction and

reciprocity behaviors (Parks, 1994). The HELP is an education-based assessment that screens for development and skills to help guide academic curricula for children with special education needs. The HELP assesses six developmental and academic areas: Cognitive, Language, Gross Motor, Fine Motor, Social, and Self-Help (Parks, 1994), though only the Social-Emotional portion is used in the MDC. The HELP is conducted by making observations of the child's behaviors and functioning while placing him or her in a variety of situations including interactions with strangers, exposure to particular toys, and interactions with or separations from caregivers. Parents/caregivers may also be questioned about how their child behaves in certain situations or about the presence or absence of behaviors in their child. The HELP is described as a curriculum-based assessment and is not a standardized measure; no reliability and validity information has been established for the HELP (Parks, 1994). Behaviors assessed by the HELP are rated as "present," "not present," "emerging," "atypical/dysfunctional," or "not applicable." Example items from the Social-Emotional section include "Establishes eye contact," "Recognizes parents visually," "Shows anxiety over separation from parent," and "Explores environment enthusiastically." The HELP is generally conducted by the clinical psychologist through the MDC.

The Childhood Autism Rating Scale (CARS) is a measure that includes 15 items that rate behavior on a seven-point continuum in which higher scores indicate abnormal behavior given the child's chronological age (Coonrod & Stone, 2005; Schopler, Reichler, & Renner, 1988). Items on the CARS are based

on direct observation, parent report, and review of the child's history. The CARS was developed for children over the age of two years to discriminate between children with ASD and those with other developmental disorders (Coonrod & Stone, 2005; Schopler, et al., 1988). Inter-rater reliability for the CARS has been found to be generally moderate to very good, with average coefficients ranging from of .68 to .80, although there is some variability with some coefficients as high as .93 and some as low as .62 (Sevin, Matson, Coe, & Fee, 1991). Test-retest reliability has been found to be very good, with coefficients of .88 (Schopler, et al., 1988). Sample items from the CARS include Imitation, Adaptation to Change, Verbal Communication, and Nonverbal Communication. The CARS is often completed by either the psychologist or a social worker as a parent interview through the MDC.

Some children who were evaluated via the MDC were assessed with the Screening Tool for Autism in Two-Year Olds (STAT) instead of the CARS. The MDC elected to use the STAT over the CARS midway through the first time point of the study because recent research has evaluated it to be more consistently reliable and valid than the CARS (Stone, Coonrod, Turner, & Pozdol, 2004).

The STAT is an interactive assessment tool used to differentiate children with ASD from children with other developmental concerns or disabilities (Coonrod & Stone, 2005; Stone & Ousley, 1997). The measure was developed for children aged 24 to 36 months and consists of 12 items that are delivered in a play-based context. The 12 items are scored pass/fail according to specific criteria across four items: Play (whether or not the child is able to engage in turn

taking with a car toy or ball with the examiner), Requesting (how the child behaves when presented with a sealed snack jar), Directing Attention (does the child look for a noisemaker/toy that is out of sight), and Motor Imitation (whether or not the child is able to imitate moving a toy car across a table; Coonrod & Stone, 2005; Stone & Ousley, 1997). The STAT takes approximately 20 minutes to administer. Studies have demonstrated excellent inter-rater reliability with a Cohen's kappa of 1.00, test-retest reliability with a Cohen's kappa of .90, and concurrent validity with the ADOS with a Cohen's kappa of .95 (Coonrod & Stone, 2005; Stone, et al., 2004; Stone & Ousley, 1997). The STAT is conducted by the psychologist on the MDC team.

The Mullen Scales of Early Learning (Mullen, 1995) is a standardized measure of cognitive functioning that assesses five areas of development in infants and children as old as 68 months of age. The five domains assessed by the Mullen are Gross Motor skills (being able to hop two times), Fine Motor skills (ability to copy drawn objects or forms), Visual Reception (being able to match objects or forms based on spatial details), Expressive Language (ability to use four-word sentences to respond to questions), and Receptive Language (being able to identify colors when asked by the examiner; Mullen, 1995). The MDC uses the Visual Reception subscale from the Mullen to obtain a base level of non-verbal cognitive abilities in the child. The Mullen has been found to have a median split-half internal consistency coefficient of .91 and test-retest reliability for all domains ranging from .71 to .96. Further, inter-rater reliability has been demonstrated to be excellent with agreement ranging from .91 to .99 (Mullen,

1995). Further, studies have shown that the concurrent validity of the Mullen with other measures of global development is adequate to good (Mullen, 1995).

A psychologist typically conducts the Mullen as part of the MDC.

The Rossetti Infant Toddler Language Scale (Rossetti, 1995) is utilized to give a broad measure of verbal and preverbal communication skills based on direct observation and parent-report. The Rossetti assesses Language Comprehension (child's ability to understand verbal and nonverbal cues), Language Expression (level of child's spontaneous language), Pragmatics (child's ability to engage in a short dialogue), Gestures (functional use of nonverbal communication), Interaction-Attachment (the child's behavior when separated from a caregiver for an extended period of time), and Play Skills (presence or absence of symbolic representation in play) in infants and children from birth to 36 months (Rossetti, 1995). The Rossetti has not been standardized, therefore neither reliability nor validity information has been established (Rossetti, 1995). The Rossetti is conducted by a speech and language pathologist and typically takes between ten and 30 minutes to complete.

The Peabody Developmental Motor Scales- Second Edition (PDMS-II) is used to determine gross and fine motor skills in the child (Folio & Fewell, 2000). The PDMS-II consists of six subtests, including Stationary Sitting (child's ability to sustain control of his/her body while sitting), Grasping (ability to hold an object in one hand), Reflexes, Locomotion (ability to walk or crawl from one area to another), Object Manipulation (being able to throw or kick an object), and Visual-Motor Integration (ability to build objects or patterns with blocks) (Folio &

Fewell, 2000). This measure has been demonstrated to have excellent test-retest reliability as well as inter-rater reliability, with correlation values ranging from .84 to .99 (van Hartingsveldt, Cup, & Oostendorp, 2005). Further, discriminant validity and convergent validity with other measures of motor development have been found to be excellent (van Hartingsveldt, et al., 2005). An occupational or physical therapist conducts the PDMS-II assessment as part of the MDC.

Once the evaluation is complete, the clinicians present during the assessment discuss the results of their various measures and observations as well as their clinical impressions of the child. These results and impressions are then compared, and a diagnosis is given to the child based on the findings of the MDC.

Materials for Time Two. During phase two of the study, participants will be administered the ADOS and ADI-R by the principal researcher. These instruments are among the most conventional means for diagnosing ASD in individuals. It is often recommended to combine information from the ADOS and ADI-R to get a more accurate and comprehensive picture of the individual (Kleinman, et al., 2008; Lord & Corsello, 2005).

The ADOS is a standardized observation protocol that involves setting up situations or “presses” to observe various social, communication, and repetitive behaviors that are included in the diagnostic classification of ASD (Lord & Corsello, 2005; Lord, et al., 2000). Examples of presses include holding bubbles in front of the child and seeing if they request the examiner to blow them, calling the child’s name to see if they will turn or respond, and asking the child to describe a picture or story book with little to no words. Ratings for individual

items are assigned to the child's various behaviors based on his or her interactions or reactions during the various presses. Behaviors are rated on a 0-2 or 0-3 point scale, with higher scores denoting atypicality or behavior indicative of an ASD. Some items on the ADOS also include a score of 8, which means the particular behavior was not observed or the child's functioning is too limited to judge. Examples of individual items on the ADOS include frequency of vocalization directed to others, immediate echolalia, unusual eye contact, responsive social smile, functional play with objects, and unusually repetitive interests or stereotyped behaviors (Lord, et al., 2000).

After the administration, behaviors are scored based on DSM-IV-TR diagnostic criteria for ASD. The behaviors are coded in one of four categories: Language and Communication, Reciprocal Social Interaction, Play, and Stereotyped Behaviors or Restricted Interests. These scores are entered into an algorithm that gives an overall score placing the individual into one of three categories: Autism, Autism Spectrum, and Nonspectrum (Lord & Risi, 1998; Lord, et al., 2000).

The ADOS consists of four separate modules, one of which is administered to the individual based on his/her language or communication skills. Module one is administered to individuals with little or no consistent spontaneous phrase speech; module two is intended for individuals who have some consistent spontaneous phrase speech, but who are not verbally fluent; module three is administered to individuals who are verbally fluent, but still young enough or at a developmental level in which playing with toys is appropriate; module four is

intended for individuals who are verbally fluent and are not interested in playing with toys (Lord & Corsello, 2005; Lord & Risi, 1998; Lord, et al., 2000).

Administration of the ADOS requires extensive training for clinical and research use. Typically, a trained examiner can administer a module of the ADOS within 30 to 45 minutes.

The ADOS has been found to have good to excellent reliability and validity. Inter-rater reliability coefficients across the domains that comprise the ADOS algorithm have been found to range from .82 to .93 (Lord, et al., 2000). Test-retest reliability coefficients as measured over a 9-month span were .78 for the Social domain, .73 for the Communication domain, and .59 for the Restricted/Repetitive Behaviors or Interests domain (Lord, et al., 2000). The sensitivity and specificity of diagnosis as measured by the ADOS have been found to be valid. Specifically, the ADOS has been found to have specificity and sensitivity scores of .87 to .97 across the modules for differentiating children with Autism Spectrum Disorder from those without an ASD, .93 to 1.00 for differentiating children with Autism Spectrum Disorder from non-spectrum children, and .80 to .94 for differentiating children with Autism from non-spectrum children (Lord, et al., 2000).

The ADI-R is a semi-structured interview for parents or caregivers of individuals for whom an ASD is suspected. The ADI-R consists of 93 items that can be administered by a trained interviewer in approximately two hours (Le Couteur, et al., 2008; Le Couteur, et al., 2003). The items on the ADI-R fall within six broad categories: early development (first symptoms to arouse parental

concern, acquisition of bladder/bowel control), acquisition and loss of language/other skills (age at first single words/phrases, loss of spontaneous use of at least five meaningful words), language and communication functioning (use of other's body to communicate, inappropriate questions or statements), social development and play (seeking to share enjoyment with others, appropriateness of social responses), interests and behaviors (circumscribed interests, unusual preoccupations, resistance to trivial changes in the environment), and general behaviors (aggression towards caregivers or family members, self-injury). Similar to the ADOS, each item is scored on a 0-2, 0-3, or 0-4 scale based on whether or not it is commensurate with diagnostic criteria, with higher scores indicating greater disruption in typical functioning. Scores of 8 indicate that the score for that particular item is "not applicable" and a score of 9 indicates the question was not asked. These scores are entered into an algorithm in which individual items are placed in one of four categories: Qualitative Abnormalities in Reciprocal Social Interaction; Qualitative Abnormalities in Communication; Restricted, Repetitive, and Stereotyped Patterns of Behavior; or Abnormality of Development Evident at or Before 36 Months. The child is then assigned a diagnostic category (Autism or Nonspectrum) based on his/her total algorithm score (Le Couteur, et al., 2008; Le Couteur, et al., 2003).

Reliability and validity for the ADI-R have been shown to range from adequate to excellent. For the ADI-R, multi-rater weighted kappa coefficients for inter-rater reliability have been shown to range from .62 to .89 (Lord, et al., 1994). Internal consistency of items on the ADI-R have also been found to be

good with Cronbach's alphas ranging from .69 to .95 for the separate domains (Lord, et al., 1994). Research has also indicated that scores on the ADI-R have good test-retest reliability over time (two to three months) conducted by different interviewers, with an average weighted kappa coefficient of .72 (Lord, et al., 1994). Further, ADI-R has been shown to have good discriminant validity. Specifically, scores on the ADI-R across domains have been found to be significantly different between children who meet DSM criteria for an ASD versus those who have a language impairment or "mental handicap" but not an ASD (Lord, et al., 1994).

CHAPTER III

RESULTS

This section will outline results of analyses conducted in the current study.

Descriptive Statistics

Age of the participants at Time One ranged from 13 months to 36 months, with an average age of 29 months. At Time Two, children's ages ranged from 31 months to 70 months with an average age of 49.36 months. The length of time in months between Time One and Time Two varied between participants. Time in months ranged from 5 months to 45 months, with an average difference of 20.26 months between the time points.

Preliminary Analyses

A regression analysis was conducted to determine if length of time between Time One and Time Two had a significant impact on stability of diagnosis. Regression analyses revealed there was no significant difference based on length of time between the time points and diagnostic stability ($R^2 = .002$, $F(1, 33) = .058$, $p = .81$).

In regards to agreement between the ADOS and ADI-R at Time Two, there was complete agreement between these two measures in determining whether a child fell in the ASD or Non-ASD category, therefore additional clinical judgment was not required.

Major Analyses

After being assessed by the transdisciplinary clinic at Time One, 20 of the 34 participants (58.82%) received an ASD diagnosis and 14 (41.18%) did not receive an ASD diagnosis.

Hypothesis I. Diagnosis at Time One (MDC) and diagnosis at Time Two (ADOS and ADI-R) were compared to determine whether the initial diagnosis made using the transdisciplinary approach would be confirmed using the gold standard assessment protocol for children over three years of age. Specifically, percent agreement was used to determine whether children in the ASD category at Time One still met criteria for an ASD at Time Two and if children in the Non-ASD category continued to not meet criteria for an ASD at Time Two. An additional variable was created for each participant that identifies his/her initial diagnosis as “Stable ASD” when he/she received an ASD diagnosis at Time One and continued to meet criteria at Time Two and “Stable Non ASD” for children who did not meet criteria for an ASD during either Time One or Time Two. “False Positive” was assigned to those who met criteria for an ASD at Time One but no longer met criteria at Time Two, and “False Negative” was assigned for children who did not meet criteria for an ASD at Time One but who subsequently met criteria for an ASD at Time Two. The first two categories were considered “Stable” and the second two were considered “Not Stable.”

Overall, percent agreement between Time One and Time Two was found to be 82.35% indicating a high level of agreement on ASD vs. Non-ASD diagnoses between these time points. Of the 20 children diagnosed with ASD at Time One, 19 (95%) continued to meet criteria for ASD at Time Two (“Stable

ASD”), whereas 1 (5%) no longer met criteria (“False Positive”). Of the 14 children who did not meet criteria for ASD at Time One, 9 (64.29%) continued to not meet criteria for ASD at Time Two (“Stable Non-ASD”), whereas 5 (35.71%) proceeded to meet criteria for ASD at Time Two (“False Negative”). Of these five children, three were previously diagnosed with a Global Developmental Delay and two were diagnosed with a Mixed Receptive/Expressive Language Disorder.

Cohen kappa coefficients were then calculated to determine the inter-rater reliability of the diagnosis given by the MDC at Time One and the diagnosis at Time Two while accounting for chance agreement on these diagnostic categories. Chance agreement of randomly assigning participants to the ASD category was found to be 41.52% and chance agreement of randomly assigning participants to the Non-ASD category was 12.11%. Kappa was then calculated using the original percent agreement and factoring out the random chance agreements. Using Cohen’s (1960) formula for calculating kappa, the kappa coefficient for the current study was found to be .62. A kappa value of .62 is considered to be, “substantial agreement,” as outlined by Vierra and Garrett (2005), indicating a high level of agreement in diagnosis of ASD between Time One and Time Two.

Supplemental Analyses

Of the 34 participants for the current study, less than half (16) were administered the STAT as part of their Time One transdisciplinary assessment. Of those 16 administered the STAT, 15 (93.75%) were assigned to a diagnostic category that remained stable between the two time points and assessment

methods. In contrast, of the 18 individuals who were not administered the STAT, 13 (72.22%) were in a stable diagnostic category over time. A Chi-squared test was conducted to determine if there was a significant difference between diagnostic stability of children who received the STAT versus those who did not receive the STAT. Results of this analysis revealed that there was no significant difference between these groups ($p = .10$). As mentioned previously, the change of utilizing the STAT was made within the transdisciplinary clinic when the STAT became more widely available and accepted as a valid and reliable measure.

CHAPTER IV

DISCUSSION

ASD is defined by qualitative impairments in social communication skills and presence of repetitive patterns of behavior or interest (Volkmar & Klin, 2005). Deficits must be present by the age of three but can be observed earlier in childhood (American Psychiatric Association, 2013; Filipek, et al., 1999).

As the prevalence of ASD continues to rise (Center for Disease Control, 2014), it is important to help researchers and clinicians find effective and reliable methods for assessment and diagnosis. It is particularly important to find methods of early assessment of ASD, as early diagnosis often leads to earlier treatment which has been shown to be beneficial for individuals with ASD and their families (Bryson, et al., 2003; Corsello, 2005; Harris & Handleman, 2000).

With most current diagnostic practices, however, ASD is often not diagnosed until the age of three or later (Filipek, et al., 1999). The literature review for the current study examined previous research on the validity of early diagnosis of ASD. Specifically, 13 previously conducted studies that systematically examined the validity of early diagnostic methods for ASD were found. Among these studies, reliability of diagnosis varied considerably, ranging from 25% (Dietz, et al., 2006) to over 90% (Baron-Cohen, et al., 1992; Lord, 1995; Stone, et al., 1999; Swinkels, et al., 2006; Wetherby, et al., 2008). All 13 of these studies used previously standardized measures normed with older children or were attempting to standardize new measures. These measures included

observation-based assessments, parent interviews, and level one screening checklists.

Based on the literature review, there was significant variability in the reliability of diagnosis between studies that used different standardized measures as well as among those studies that used the same standardized measures. For example, studies using The Early Screening of Autistic Traits Questionnaire ranged from 25% (Dietz, et al., 2006) to 94% (Swinkels, et al., 2006). Those that used the ADI-R ranged from 50% (Brian, et al., 2008) to 94% (Lord, 1995). Additionally, studies that used the Checklist for Autism in Toddlers ranged from 51% (Robins, 2008) to 100% (Baron-Cohen, et al., 1992). It should be noted that these studies, even if they used the same measure, varied considerably in their methodologies. Differences in methodologies among studies included chronological age of the child during the initial assessment, length of time between assessments, and criteria for participants who were reassessed and those who were not reassessed (i.e., those who were considered “at risk” versus those who were not). Based on the literature review, it appears that an interaction between assessment measure and methodology impacts the validity and reliability of early diagnosis of ASD.

Previous research has demonstrated the value of utilizing standardized measures, such as the ADOS and ADI-R, with children age three and older (Le Couteur, et al., 2008; Lord & Corsello, 2005), though these measures have been found to be less effective at diagnosing children under the age of three (Lord, 1995). These findings suggest that although standardized measures can be helpful

in diagnosing ASD in young children, there are significant difficulties with the reliability and validity of diagnosis when solely relying on such measures. The current study evaluated an alternative method for assessment.

One alternative assessment method, an evaluation by a transdisciplinary diagnostic team, has been found to be a possible source of reliable and valid diagnosis of ASD in younger children (Klin, Saulnier, et al., 2005). In this method, a variety of medical and developmental specialists meet with the child and family, observe his/her behavior and functioning, use a number of diagnostic assessment measures, and provide feedback to the family (Klin, Saulnier, et al., 2005). Prior to this study, this diagnostic method had not been systematically tested in children with ASD, but has been found effective in diagnosing other developmental disorders, such as cerebral palsy and intellectual disability (Farber, Shapiro, Palmer, & Capute, 1985).

The current study sought to examine the validity and reliability of diagnosing ASD in children under the age of three using the transdisciplinary diagnostic approach. Children were evaluated before the age of three as part of a medical diagnostic evaluation and then were invited to return to be re-evaluated using the “gold standards” of assessing ASD, the ADOS and ADI-R (Chawarska, et al., 2007; Le Couteur, et al., 2008) once they reached the age of three or older.

The current study found a high rate of agreement between the transdisciplinary clinic and the “gold standard” measurements for assessing ASD over time. Specifically, the initial clinic and the gold standard measurements agreed approximately 82% of the time with a Cohen’s kappa coefficient of .62,

which takes into account chance agreement on diagnostic category, indicating “substantial agreement” between these diagnostic methods.

Out of 34 participants, 28 were correctly identified by the transdisciplinary clinic. Nineteen of these 28 had ASD whereas the other 9 did not have ASD. The rate of “False Positives” was very low, with only one child across the time points being labeled with ASD at Time One and then no longer meeting criteria for ASD at Time Two. This suggests that the transdisciplinary clinic had very few incidents of incorrectly labeling a child under the age of three with an ASD.

Five children were considered to be “False Negatives,” who did not meet criteria for ASD at Time One, but were diagnosed with ASD using the “gold standard” measurements of the ADOS and ADI-R at Time Two. Three out of these five children were previously diagnosed with Global Developmental Delay and the remaining two were previously diagnosed with a Mixed Receptive/Expressive Language Disorder. These findings are commensurate with previous research that found that global or intellectual delays as well as language deficits may impact a clinician or researcher’s ability to correctly assess ASD in young children (Dietz, et al., 2006; Lord, 1995; Robins, et al., 2001; Wetherby, et al., 2008). Research indicates that young children with ASD and those global delays and/or language deficits are difficult to differentiate (Lord, 1995; Lord, et al., 2000; Lord, et al., 1993). This is likely due the fact that early signs of ASD, including deficits in pointing, gazing at others, and early language development are deficits also often present in children with delays in global development or language impairments (De Giacomo & Fombonne, 1998; Osterling & Dawson,

1994; Paul, 2005; Volkmar & Klin, 2005). Additionally, development and functioning in children with a mental age under two years often is global or non-specific, making it difficult to differentiate between deficits in specific developmental domains, including social, cognitive, or language abilities (Chawarska, et al., 2007).

Results of the current study indicate that the STAT is highly effective in helping to assess ASD in young children and should continue to be utilized in conjunction with transdisciplinary clinics when ASD is suspected. Specifically, the current study found that of those who were administered the STAT at Time One, 93.75% had a steady diagnosis over time, whereas only 72.22% of those who were not administered the STAT remained in a stable diagnostic category. Previous research has found excellent inter-rater and test-retest reliability with the STAT, as well as a concurrent validity with the ADOS at a Cohen's kappa value of .95 (Coonrod & Stone, 2005; Stone, et al., 2004; Stone & Ousley, 1997). These results further demonstrate the usefulness of the STAT in assessment of ASD. Clinicians and researchers assessing ASD in children under the age of three would benefit by incorporating the STAT in their assessment methods.

There were limitations to the current study. This project relied on a relatively small sample size. This was primarily due to difficulties with the recruitment method of the current study, which relied on families of participants to initiate contact with the researcher before becoming involved in the research. This small sample size impacted the power analysis of the kappa coefficient in the current study, although a high level of percent agreement still lead to a kappa

value that was considered to be “substantial agreement.” Future research should be conducted using larger samples of participants to improve power. This could result in a higher kappa coefficient.

Overall, using a transdisciplinary clinic to diagnose ASD before the age of three appears to be a valid and reliable method of assessment in this population. Such methodologies have previously been shown to be helpful in diagnosing other developmental disorders (Farber, Shapiro, Palmer, & Capute, 1985), and the current study suggests that it is also helpful in diagnosing ASD. Given these findings, transdisciplinary clinics should be utilized in cases where ASD is suspected in young children.

Results of the current study suggest that using a transdisciplinary clinic such as the medical diagnostic clinic is a valid and reliable method of assessing ASD at an early age. As previously outlined, the transdisciplinary approach also has a number of other benefits. These additional benefits include the ability to incorporate a number of viewpoints across various disciplines in one assessment, which not only can aid with possible differential diagnoses, but also lay the foundation for intervention recommendations from various perspectives for a holistic treatment approach (Klin, Saulnier, et al., 2005). The high level of agreement found, along with other benefits outlined supports the use of multidisciplinary clinics in assessing ASD before the age of three (Farber, Shapiro, Palmer, & Capute, 1985).

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