Determining the Clinical Utility of the Merrill-Palmer-Revised Scales of Development in a Sample of Children with Autistic Disorder

Meaghan E. Peters
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in a Sample of Children with Autistic Disorder

by
Meaghan E. Peters

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at the

Graduate Department of Clinical Psychology

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Abstract

The aim of this study was to determine aspects of the clinical usefulness of the Merrill-Palmer-Revised Scales of Development (M-P-R) in children diagnosed with Autistic Disorder (AD). The revised developmental measure reports strong levels of reliability and validity in a standardization sample. While some clinical subsamples were included to help establish the test’s validity, the group of children with an Autism Spectrum Disorder (ASD) was limited to a sample size of 14. The present study recruited 50 children with Autistic Disorder (41 male, 9 female) ranging in age from 40 months to 78-months, along with a matched non-clinical sample that was obtained from the M-P-R standardization data. Each group’s performance was obtained from the Cognitive Battery, Gross Motor Battery, and supplemental language and parent rating forms. Observations were also made to the special groups outlined in the M-P-R Manual. The results suggested that the M-P-R is a tool sensitive in identifying developmental delay, but not specific in differentiating among children diagnosed with AD and other common early childhood
disorders. In part, the large variability in test performance across the AD sample contributed to this diagnostic weakness.
Acknowledgements

This research was made possible by the generous support and sacrifices of many individuals. I could not have completed this project without the unending love and encouragement from my husband, CW 2 Brent Peters. He has helped me accept that life’s Plan A is not always the right path. Plan B has forced me to embrace the reality of being a “non-traditional” student; finding balance between parenting and my career aspirations. I thank my daughter, Sadie, for her patience during this process and baby Eloise for pushing me to find the strength to complete this project. Uncle Pat, thank you for telling me to complete my degree. An enormous amount of gratitude is extended towards my dear family and friends for the much needed support and encouragement.

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Chapter 1

Introduction

Neurodevelopmental Disorders

Autism Spectrum Disorders (ASDs) are recognized as a group of neurodevelopmental disorders with phenotypic behaviors evident in early childhood development (Newsom & Hovanitz, 2006). At the present time, this group is classified under Pervasive Developmental Disorders in the Diagnostic and Statistical Manual of Mental Disorders (DSM; DSM, 4th ed., text revision; DSM-IV-TR (American Psychiatric Association [APA], 2000) and defined as severe and pervasive impairment in several areas of development. This includes reciprocal social interaction skills, communication skills, and stereotyped behavior, interests, and activities. Among the diagnoses within this category are Autistic Disorder (AD), Asperger’s Disorder, Rett’s Disorder, Childhood Disintegrative Disorder (CDD), and Pervasive Developmental Disorder Not Otherwise Specified (PDD NOS). Researchers suggest that Rett’s Disorder and CDD are diagnosed in far fewer cases when compared to Autistic Disorder (1:10,000 for Rett’s and <1:50,000 for CDD; Kozinetz, Skender, MacNaughton, Aimes, Schultz, Perus, & Glaze, 1993). As such, when the term Autism Spectrum Disorder (ASD) is employed it is referring to a diagnosis of AD, Asperger’s Disorder, or PDD, NOS; diagnoses with overlapping symptoms and etiology occurring along a continuum (Luyster, Kadlec, Carter, & Flusberg, 2008). Proposed revisions for the (DSM-V; APA, 2011) suggest that the term Pervasive Developmental Disorders will be changed to a single diagnostic category known as Autism Spectrum Disorders to increase the specificity of the diagnosis (APA, 2011). Currently, ASDs are recognized to be more
prevailent in childhood than diabetes, cancer, and spina bifida (Filipek et al., 2000; Centers for Disease Control [CDC], 2012). In addition to advances in early diagnosis the increase in prevalence may be due to an increased awareness of the etiology of ASDs on the part of both the general public and health care providers (Volkmar, Lord, Bailey, Schultz, & Klin, 2004).

**Etiology and Common Symptoms**

ASDs are understood to be a neurological disorder that affects the way the brain processes information, subsequently impairing behavioral development (Brimacombe, Pickett, & Pickett, 2007; Campbell, Schopler, Cueva, & Hollin, 1996). Severe impairment in social communication skills such as joint attention, shared affect, eye-contact, conventional and symbolic gestures, and skills associated with functional and symbolic play have been found to be consistent in pre-school age children diagnosed with an ASD (Veness et al., 2012). Numerous studies have also identified children with ASDs demonstrate greater difficulty in imitation skills, empathic responding, a disinterest in other children, and an absence in range of facial expressions when compared to children identified with varying developmental delays (Charman et al., 1998; Landry & Loveland, 1988; Lord, 1995; Rogers, Hepburn, Stackhouse, & Wehner, 2003; Trillingsgaard, Sorensen, Nemec, & Jorgensen, 2005. Furthermore, a delay or deficit in language acquisition was also found to be a common symptom in children identified with an ASD (Luyster, Kadlec, Carter, Tager-Flusberg, 2008). Research suggests that the level at which a child has the ability to express language by preschool age would determine his/her diagnosis on the autism spectrum (Kobayashi, Murata, Yoshinaga, 1992; Venter, Lord & Schopler, 1992; as cited in Lord et. al., 2000).
De Giacomo & Fombonne (1998) found that parents presented concerns regarding their child’s development and behavioral presentation to a primary care provider when the child was approximately 17-months of age. Most notably was the child’s failure to utter his or her “first words” and phrases. Conversely, the average age a child receives a definitive ASD diagnosis is approximately at the age of four-years or beyond (De Giacomo & Fombonne, 1998).

**Prevalence**

The CDC division of Autism and Developmental Disabilities Monitoring Network (ADDM) surveyed multiple areas of the United States and identified a rate of 1:88 eight-year-old children diagnosed with an ASD in 2008 (CDC, 2012). This has increased from the 2002 data which indicated a rate of 1:156 eight-year-old children. Although the surveillance summaries are exclusive to 14 specific sites, it is feasible to state that there has been a general increase in known cases of ASDs across the nation.

The increased rates of ASDs reinforce the necessity for precise diagnostic measures to ensure individually tailored intervention plans. Harris and Handleman (2000) have proposed that early detection of an ASD and subsequent early intervention can have a positive effect on prognosis. These effects include improved language skills, social relationships, adaptive functioning, and fewer maladaptive behaviors; all of which increase the opportunity of successful classroom inclusion. Unfortunately, determining a differential diagnosis can be difficult in very young children.

**Diagnostic Difficulties**

The behaviors in children with developmental delays or language delays demonstrate impaired social skills, resembling behaviors similar to a child with an ASD (Charman et al.,
Determining the Clinical Utility of M-P-R Scales

Although genetic research has advanced in regards to specific markers for autism susceptibility, current tests to determine an ASD diagnosis is not available. As such, diagnosis is weighted heavily upon clinical observation and parental report (Norbury & Sparks, 2012). Furthermore, the comorbidity of an ASD and intellectual disability has complicated the diagnostic process (Hartley & Sikora, 2010).

The *DSM-IV-TR* (APA, 2000) recognizes that intellectual disability (formerly known as mental retardation; ranging from mild to profound) may be associated with autism. Edelson (2006) surveyed 215 articles published between 1937 and 2003 in order to clarify previous indications that nearly 70% of individuals with a diagnosis of an ASD also met criteria for intellectual disability. Her findings suggested that approximately 50% of the cases were found to meet criteria for an ASD diagnosis and intellectual disability. Continued empirical evidence is necessary to determine the current prevalence rate of autism and intellectual disability. Corbett & Gunther (2011) suggest the importance of a comprehensive autism evaluation (which includes a measure of cognitive functioning) in order to fully understand an individual’s ability level and aid in diagnostic clarification. However, if the language demands of the diagnostic measure are greater than the ability of the child with suspected ASD, then the assessment results may not be representative of the child’s true abilities. Research suggests that children with ASDs are more socially competent, less anxious, and more flexible when the language demands are lowered to their level of ability (Mesibov, Schopler, & Hearsey, 1994; as cited in Lord, Risi, et al., 2000). In response to this, the need for a diagnostic measure in which the language demands are minimal may offer a more accurate estimation of a child’s ability and subsequently provide a guide for the
Determining the Clinical Utility of M-P-R Scales

appropriate treatment interventions. Conversely, an inaccurate diagnosis would likely result in lost opportunities for specialized, early intervention (Coonrad & Stone, 2005).

**Evaluation and Diagnosis**

Numerous diagnostic measures are used in a variety of settings to determine a child’s ASD. These include, but are not limited to, criteria set forth by the *DSM-IV-TR* (APA, 2000), the Autism Diagnostic Observation Schedule-Generic (ADOS-G; Lord, Rutter, DiLavore, & Risi, 2000), the Autism Diagnostic Interview-Revised (ADI-R; Rutter, Le Couteur, & Lord, 2003) the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1988), and the Vineland Adaptive Behavior Scales – Second Edition (Sparrow, Cicchetti, & Balla, 2005). Measures of cognition include the Wechsler Intelligence Scales for Children (WISC-IV; Wechsler, 2003) and the Stanford Binet-Fifth Edition (SB-5; Roid, 2003). Measures frequently used with young children and children unable to basal on the aforementioned measures include the Mullen Scales of Early Learning (Mullen, 1995) and the Bayley Scales of Infant Development, Third Edition (Bayley – III; Bayley, 2005). Despite the above instruments being utilized in a variety of educational and clinical settings, they are typically used in the initial diagnostic testing phase rather than in monitoring progress or as outcome measurement (Roid, & Sampers, 2006). Researchers in special education have called for there to be a stronger link between assessment measures and early intervention (Bagnato, Neisworth, & Munson, 1989; Meisels & Fenichel, 1996). In the same manner, research suggests that early intervention (between the ages of 18 months and 4 years) in children with autism often results in improvements of language, communication and cognition (Rogers & Vismara, 2008).
**Individuals with Disability Education Act**

The Individuals with Disabilities Education Act (IDEA; IDEA, 1990, 1997) is a law requiring specific services to be made available to children with disabilities. The specific services identified by the IDEA should be tailored to meet the needs of the child as indicated by an Individualized Education Plan (IEP) within academic settings (retrieved from http://www.autism-society.org/site/edu Oct 2008). The IEP identifies the special education plan outlining goals for the academic school year, the services needed to help meet those goals (i.e., speech, occupational, or physical therapy; specific area of academic assistance, etc.), and a method of evaluating progress within the least restrictive environment. The IDEA oversees how states and public agencies provide early intervention, special education and related services to over 6.5 million infants, toddlers, children and youth who meet eligibility requirements. IDEA is separated by two divisions to better assist children and their families. IDEA Part C serves children ages birth to 2 years, and IDEA Part B services children and youth ages 3-21. Under the IDEA legislation, the use of a progress monitoring assessment is vital for the verification of response to intervention (RTI). Which in turn, is the monitoring of treatment plans to ensure the child is responding to interventions identified by his/her strengths and weaknesses. The need for accurate and repeatable screening measures becomes more evident as the number of children with ASDs needing services continues to rise.

**Merrill-Palmer-Revised Scales of Development**

The Merrill-Palmer-Revised Scales of Development (M-P-R) was revised by Roid and Sampers (2004) to update and expand the original Merrill-Palmer-Scales (Stutsman, 1931) in order to meet the requirement established by federal and state legislation for early identification
of developmental delays and learning difficulties in children. It is an individually administered standardized measure of developmental functioning in young children from birth through 78 months. The M-P-R was designed to be used as a repeat measure to provide progress monitoring (skill mastery) within the areas addressed by the IDEA.

The unique structure of this predominately non-verbal, play based assessment allows for early identification of developmental delays, the assessment of pre-term infants, provides measurement of small increments of improvement in development, has a reliable and valid scale of development for children with limited expressive language ability, and aids with individual treatment planning for children with developmental delays (Roid & Sampers, 2004).

Early identification of developmental delays in the areas of cognitive, language, and motor assessments is essential for children who may later qualify for services under IDEA. Screening with a reliable preschool test can be efficient and cost effective when followed by comprehensive intervention planning (Gregory, 1996). The M-P-R also satisfies the need for evaluating small increments of progress. Unlike the Bayley Scales of Infant Development-Third Edition (Bayley, 2005), the M-P-R tasks were designed to measure the quality of performance as a child develops rather than the broad achievement of developmental milestones (Roid & Sampers, 2004). By utilizing a predominately non-verbal assessment, the likelihood of obtaining a more accurate ability assessment of children with ASDs increases.

**Scales**

The M-P-R includes four assessment components: (a) Cognitive Battery which assesses Cognitive, Fine Motor, Receptive Language scales, in addition to supplementary scores for Memory, Speed and Visual-Motor ability; (b) Gross Motor Development which assesses gross
motor, unusual movements, and atypical movement patterns; (c) Parent Rating Forms which assess Social-Emotional Development, Social-Emotional Temperament, and Self-Help/Adaptive Behaviors; 4) Supplemental examiner and parent rating scale to assess Expressive Language. Please refer to Appendix A for test item examples.

**Test Construction**

The M-P-R utilizes the hierarchical model formulated by the Cattell-Horn-Carroll (CHC) theory of cognitive abilities. Table 1 displays the CHC model as identified in chapter one of the M-P-R technical manual (McGrew & Woodcock 2001; as cited in Roid & Sampers, 2004). Stratum I is the general intelligence or “g” factor. Stratum II identifies seven broad factors, which include fluid and crystallized factors and represent the hierarchical nature of cognitive factors (Roid, Shaughnessy, & Greathouse, 2005). Stratum III includes the “sub-skills” of intelligence. Roid et. al. (2005) state that the benefit of the CHC theory fulfills two concepts “(a) the multifaceted nature of intelligence and (b) the benefit of using individual subtests across batteries to measure theory-based cognitive factors” (p. 496). Additionally, the M-P-R includes an optional scoring system (sensitive to change) referred to as Rasch analysis. As outlined in the *Manual*: The “growth scores” used in the M-P-R are a linear transformation of the values produced by the Rasch model. This model predicts both the ability of the child and the difficulty of the items and allows for the child’s ability to be positioned on an interval scale. This approach provides a “map” that can aid in treatment planning and depict a more precise view of the abilities in a child with disabilities. Specifically with the M-P-R, items missed below the child’s overall ability level can be used to target intervention by identifying skills to be as well as determining the instructional ability level of the child (Roid & Sampers, 2004, p. 247).
Table 1

Cattell-Horn-Carroll Model of Cognitive Abilities and the Abilities Measured in the M-P-R

<table>
<thead>
<tr>
<th>Stratum I</th>
<th>Stratum II</th>
<th>Stratum III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Reasoning (gF)</td>
<td>Spatial Rotations (SR)</td>
<td></td>
</tr>
<tr>
<td>Crystallized Ability (gC)</td>
<td>Visualization (VZ)</td>
<td></td>
</tr>
<tr>
<td>Short-term Memory (gSM)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Ability (&quot;g&quot; factor)</td>
<td>Visual Spatial (gV)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visual Memory (VM)</td>
<td></td>
</tr>
<tr>
<td>Auditory Processing (gA)</td>
<td>Closure Flexibility (CF)</td>
<td></td>
</tr>
<tr>
<td>Long-term Retrieval (gLR)</td>
<td>Length Estimation (LE)</td>
<td></td>
</tr>
<tr>
<td>Processing Speed (gS)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As stated in Roid and Sampers (2004), Rasch-based scores have been used on other published tests to obtain age equivalences including all of the editions of the Woodcock-Johnson Psychoeducational Battery (Woodcock & Johnson, 1977; 1989; Woodcock, McGrew & Mather, 2001), the Leiter-R (Roid & Miller, 1997), and the Stanford Binet Intelligence Scales, Fifth Edition (SB5, Roid, 2003).

**Reliability**

Reliability results for each of the domains assessed by the M-P-R are provided in the technical manual (Roid & Sampers, 2004) including internal consistency, test-retest reliability, and standard errors of measurement. Both classical test theory and item response theory (IRT) approaches were employed. Internal consistency values across age groups for the Developmental
Index was found to be .98, Cognitive .94, Receptive Language .94, Fine Motor .91, Memory .77, Speed .77, and Visual Motor .91.

As stated in the M-P-R technical manual:

Each of the scales spans a large range of ages, but each estimate was calculated on the children within the designated age group of normative sample. Thus, the reliability estimates are not inflated by developmental growth, as they would if calculated on the entire normative sample (Roid & Sampers, 2004, p. 127).

The internal consistency estimates for Gross Motor Battery, the Social-Emotional Scale, Self-Help/Adaptive and the Language scales are averaged across age groups. The average reliability for the Gross Motor Battery is .93. Social-Emotional Development Index is .93, Self-Help/Adaptive .94, Language .98, and Expressive Language, .97.

The Cognitive Battery Scales Standard Error of Measurement varies within the domains. The Developmental Index SEM ranges from 2.12-2.60, Cognitive ranges from 3.00-4.24, Receptive Language ranges from 3.00-4.50, Fine Motor ranges from 3.67-5.71, Memory ranges from 6.00-8.26, Speed ranges from 6.00-8.26, and Visual Motor ranges from 3.35-6.36. Conventional Standard Errors of Measurement for the Gross Motor Battery range from 3.00-4.74, Social-Emotional Development ranges from 3.67-4.74, Self-Help/Adaptive ranges from 3.67-3.97, Language Total ranges from 2.12-2.60, and Expressive Language ranges from 2.60-3.00.

The Test-retest reliability coefficients depict little change from the first test administration to the second administration, which were three weeks apart. Correlation for the
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Developmental Index is .89, Cognitive .87, Receptive Language .90, Fine Motor .90, Visual Motor .90, Speed .84, Memory .89, Gross Motor .88, Social-Emotional .89, and Self-Help .84.

Validity

The authors of the M-P-R extensively field tested content and construct validity. Cross battery correlations with the Bayley Scales of Infant Development (Bayley, 2005), Stanford-Binet 5th Edition (Roid, 2003), and Leiter-R (Roid & Miller, 1997) were used to verify the existence of expected construct and content dimensions.

The authors state:

content-related evidence of validity was established by a combination of careful item-response theory analysis; item selection or item development based on review of the literature; scaling verification (to establish consistency with development theory); expert review, and empirical studies of internal consistency (Roid & Sampers 2004, p. 137).

Means, standard deviations, and standard score correlations were calculated between performance on the M-P-R and the Bayley Scales of Infant Development, 2nd Edition Mental Scale (Bayley, 1993). The Bayley is the most widely used developmental instrument in North America and the correlation that exists with the M-P-R provides strong criterion-related evidence of validity (Roid & Sampers 2004). The correlation between the Bayley Mental Scale and the M-P-R four cognitive domains were strong. The Developmental Index of is .92, Fine Motor is .86, Receptive Language is .92, Expressive Language is .98, and Memory scores is .85.
The M-P-R demonstrates consistent evidence of validity from content-analysis studies with extensive item analysis data. Criterion-related studies showed excellent results for concurrent correlations and the classification accuracy in identifying cognitive delays.

**Clinical Utility**

Sattler (2001) described clinical utility as, “the extent to which a test agrees with a criterion measure in classifying individuals as to their membership in a category” (p 116). To determine the clinical utility of the M-P-R in children suspect of an ASD, further investigation is necessary. Because this measure is play based and less language dependent than other developmental measures it may be beneficial for children with ASD. The M-P-R may assist in the development of appropriate treatment planning which would increase the significance of early intervention. This study investigated important aspects related to the validity of the M-P-R and its ability to identify skill sets in children who have been previously identified with AD. Published research for the M-P-R is limited to the try-out edition which included data on the general population and several clinical populations detailed in the testing manual. Fourteen children with an unspecified ASD (aged 36 to 75 months) were administered the M-P-R. Unfortunately, limited information is provided on autism symptom severity or a discussion differentiating their abilities from a non-clinical sample. Furthermore, because the normative sample utilized a group comprising ASDs rather than one specific diagnostic criterion (i.e., AD) the skill levels represent a broad range of functioning levels.

**Study Purpose and Hypotheses**

This study assessed important aspects related to the clinical utility of the M-P-R in the assessment of children diagnosed with Autistic Disorder. It was hypothesized that this instrument
would demonstrate consistent aspects of a psychometrically sound measure for estimating cognitive abilities. An independent analysis of the criterion related validity was performed within a population of children diagnosed with AD. Collectively, this group has demonstrated difficulty performing on more traditional language based measures of intelligence (Tsatsanis et al., 2003). Research indicates that children with developmental delays appear more socially competent, less anxious, and more flexible in situations where the language demands are low (Mesibov, Schopler, & Hearsey, 1994). Because the M-P-R was designed to minimize language demands it was presumed that children with AD would have a greater chance of participation and thereby provide a representation of their true abilities. The profiles of the M-P-R Cognitive Battery, Gross Motor Scale, Language Scales, Social-Emotional Development and Self-Help/Adaptive Behavior parent rating forms were observed in children diagnosed with AD. It was hypothesized that children with Autistic Disorder would obtain different scores and thereby the battery would be shown to discriminate between a non-clinical group and several clinical groups previously identified during the standardization of the M-P-R (i.e., cognitive delay, premature infants, speech and language delay, deafness, and severe motor delay).
Chapter 2

Method

Participants

The participants for this study were obtained from either a parent study conducted within the Children’s Development and Rehabilitation Center (CDRC) at Oregon Health and Science University (OHSU) or from the greater Portland, Oregon area. The OHSU participants were those seen by a multidisciplinary team evaluation through the Autism Clinic at OHSU and who had agreed to be involved in a study investigating cholesterol metabolism in children diagnosed with Autistic Disorder. This OHSU study was also investigating correlations between neurocognitive/neurobehavioral variables and sterol metabolism. The M-P-R was one of the measures used to assess cognitive abilities of young children (under the age of 6) in that larger study. The subsample examined in this study included 50 children ages 3-years, 4-months through 6-years, 6-months of age (M = 5.1 years, SD = 10.2) who had been diagnosed with Autistic Disorder according to the DSM-IV-TR diagnostic criteria either by a multidisciplinary assessment team at OHSU or by a private developmental pediatrician. The DSM-IV-TR (APA, 2000) criteria are found in Table 2. Please refer to Appendix B for an example of the diagnostic checklist. Participants were excluded if the child’s age exceeded 6-years, 6-months at time of testing, if the child had a co-morbid genetic disorder such as Down Syndrome, Rett’s Disorder, Fragile X Syndrome, or were diagnosed with Pervasive Development Disorder Not Otherwise Specified or Asperger’s Disorder. Children diagnosed with Mental Retardation or Global Developmental Delay were not disqualified. Additionally, for each child included, the Total
Table 2

DSM-IV-TR Diagnostic Criteria for Autistic Disorder

A. A total of six (or more) items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3):

(1) Qualitative impairment in social interaction, as manifested by at least two of the following:
   (a) Marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction
   (b) Failure to develop peer relationships appropriate to development level
   (c) A lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by lack of showing, bringing, or pointing out objects of interest)
   (d) Lack of social or emotional reciprocity

(2) Qualitative impairments in communication as manifested by at least one of the following:
   (a) Delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)
   (b) In individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
   (c) Stereotyped and repetitive use of language or idiosyncratic language
   (d) Lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level

(3) Restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:
   (a) Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
   (b) Apparently inflexible adherence to specific, nonfunctional routines or rituals
   (c) Stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)
   (d) Persistent preoccupation with parts of objects

B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years; (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.

C. The disturbance is not better accounted for by Rett’s Disorder or Childhood Disintegrative Disorder
Score from the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, et al. (2000) fell above the cut-off score for Autism Spectrum and above the cut-off score for Autism (combined Communication total score plus the Social Interaction total score).

Following a phone conversation, 82 parents of 129 eligible children agreed to participate in the cholesterol metabolism study. Sixty-eight children were scheduled for a blood draw and the M-P-R assessment; however 18 of these children chose not to proceed because of the required blood draw. Therefore, 47 completed the M-P-R.

The larger study’s investigators had hoped to enroll 80 participants and so additional community participants were recruited thru online listings (e.g., Yahoo Autism support groups, web forums, etc.) and flyers posted in local pediatrician, speech pathologist, and occupational therapist offices. All community respondents were screened for eligibility using the same criteria as enumerated above for the OHSU sample. Twelve parents responded to community recruitment efforts; seven children met all inclusion criteria and were entered into the study; three completed the study. This resulted in a combined sample of 50 participants, 41 (82%) of whom were male and nine (18%) were female. Additionally, a non-clinical age matched sample comprised of eighty children ($M$ age = 59.6 months) was obtained from the M-P-R co-author, Gale Roid, Ph.D. Demographic characteristics of the clinical and non-clinical samples are provided in Table 3. Please refer to Appendix C for demographic information and Appendix D for the consent form.

**Measures**

**Autism Diagnostic Observational Schedule (ADOS; Lord, Rutter, et al., 2000).** The ADOS is a semi-structured, standardized, play-based measure designed to assess communication
Determining the Clinical Utility of M-P-R Scales

Table 3

Demographic Characteristics of Each Autism Subsample and a Non-Clinical Sample

<table>
<thead>
<tr>
<th>Study Samples</th>
<th>Community Recruited Subsample (n = 3)</th>
<th>OHSU Study Subsample (n = 47)</th>
<th>Combined Clinical Sample (n = 50)</th>
<th>Non-Clinical Sample (n = 80)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age and (SD) [months]</td>
<td>52.3 (13.3)</td>
<td>60.8 (10.1)</td>
<td>60.4 (10.3)</td>
<td>59.2 (9.7)</td>
</tr>
<tr>
<td>Gender (% male)</td>
<td>66.6</td>
<td>82.9</td>
<td>82.0</td>
<td>77.5</td>
</tr>
<tr>
<td>Ethnicity (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>66.7</td>
<td>63.8</td>
<td>64.0</td>
<td>77.5</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2.1</td>
<td>2.0</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>African-American</td>
<td>2.1</td>
<td>4.0</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>33.3</td>
<td>2.1</td>
<td>2.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Other</td>
<td>10.6</td>
<td>10.0</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>Not self-identified</td>
<td>19.1</td>
<td>18.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. OHSU = Oregon Health and Science University

abilities and social interactions for individuals presenting with symptoms consistent with an autism spectrum disorder. The ADOS is comprised of four modules. The module used is determined based upon the individual’s expressive language ability. Given the age and functioning level of the participants Modules 1, 2, or 3 were used in this study. Module 4, designed for adolescents and adults was not used during this study. Individuals received item scores based upon an algorithm within each domain. 0 = no evidence of abnormal behavior, 1 = abnormal behavior present but not severe, or 2 = behavior present and a degree of severity is observed (Lord et al., 2000). Diagnostic algorithms within the domains of Communication, Social Interaction, and a combined Communication + Social Interaction are used to determine if
a child met criteria for Autism, Autism Spectrum, or non-autism spectrum. The inter-rater reliabilities reported by the authors for the respective domains are: .84 for Communication, .93 for Social Interaction, and .92 for Communication + Social Interaction. The test-retest reliabilities for the domains are .73 for Communication, .78 for Social Interaction, and .82 for Communication + Social Interaction .82 (Lord, Rutter, et. al. 2000).

**The Merrill-Palmer-Revised Scales of Development (M-P-R; Roid & Sampers, 2004).** The M-P-R is a developmental measure for ages 1 month to 78 months (6 years, 6 months). It yields a Developmental Index score which consists of the overall Cognitive Battery score. The Cognitive Battery consists of separate domain scores for Cognitive, Fine Motor, Receptive Language, Memory, Speed, and Visual motor skills. The M-P-R also includes supplemental scales for Gross Motor abilities, Expressive Language abilities, and parent report measures of the child’s Social-Emotional Development and Self-Help/Adaptive Behaviors. Standard scores can be converted to Growth Scores to highlight strengths and weaknesses for the purpose of intervention planning and reassessment. Information regarding the reliability and validity of this measure is reported in Chapter 1.

**Procedure**

As this investigation was part of a larger OHSU study, approval from the OHSU’s Internal Review Board (IRB) had already been obtained, and parents had already given consent for the M-P-R testing of their children. Approval by the GFU IRB committee was also obtained for the M-P-R component of the investigation. Once signed and dated, a copy of the consent form was given to each child’s parent/guardian. Then the child received a standardized administration of the M-P-R which lasted 30 to 60 minutes. During the testing, the parents and/or
guardian were/was given the opportunity to complete all M-P-R rating scales, including the Social-Emotional Temperament, Expressive Language, Social-Emotional Behavior and the Self-Help/Adaptive Behavior rating forms. As was noted in the consent document, following test completion, a $20 gift card from a local merchant was given to the participant’s family as a token of appreciation.
Chapter 3

Results

Data were analyzed using the Statistical Package for the Social Sciences (SPSS). This study assessed important aspects of the M-P-R Cognitive Battery, Gross Motor domain, Expressive language domains, and the parent rating forms (Social-Emotional Development and Self-Help/Adaptive Behavior) in the assessment of children diagnosed with AD. It was hypothesized that this instrument would demonstrate characteristics consistent with a psychometrically sound measure for estimating cognitive abilities when used with this population. It was also hypothesized that the M-P-R would differentiate between a non-clinical group and several clinical groups previously identified during the standardization of the M-P-R (specifically, those with autism, cognitive delay, those experiencing premature births, speech and language delay, deafness, and severe motor delay).

Demographic Characteristics

Demographic characteristics of the three samples used for this study are summarized in Table 3. A one-way ANOVA was conducted on age across the three samples (community recruited subsample, OHSU study subsample, and non-clinical sample) to determine if significant age differences existed. No significant age difference was obtained ($F(2, 127) = 1.21$, $p = .30$). Likewise, Chi-Square tests were conducted on gender and ethnicity proportions found in Table 3. No significant gender difference was obtained ($2 (2) = .84$, $p = .66$). However, significant ethnicity proportions were identified across the three groups ($2 (10) = 31.72$, $p = .03$).
<.001) with the Caucasian participants for both the hospital sample and the non-clinical sample comprising a greater proportion than found with the Community sample. While there was a difference in ethnicity proportion, any difference contributed by aggregating the community autistic sample \((n = 3)\) with the OHSU autistic sample \((n = 47)\) would have negligible impact. Plus, there is no evidence that would suggest that different ethnicities manifest autistic symptomatology differently. The M-P-R Cognitive Battery provides an overall Developmental Index score. An independent t-test indicated no significant M-P-R Developmental Index mean difference between the hospital group and the community group \((t(48) = 1.02, p = .31)\).

Therefore, it was decided that since there were no age, gender, or overall mean differences between the community and OHSU samples, the data from these two autistic samples would be combined; all analyses reported below reflect this pooling of the two samples.

The demographic characteristics of the two samples were analyzed. An independent t-test indicated no age difference between the clinical sample and the non-clinical group \((t(128) = .61, p = .54)\). Similarly, when a Chi Square analysis between the clinical sample and the non-clinical group was conducted, no significance in gender \((\chi^2(1) = .38, p = .54)\) resulted. Therefore, the two groups were found to have similarly age and gender matched participants. Any differences found between the two samples will not be attributed to age or gender.

**Internal Consistency**

As stated previously, the Developmental Index score is the summary score of the Cognitive Battery of the M-P-R. Because the focus on treatment planning is typically determined by the Developmental Index score, internal consistency among items which comprise the Developmental Index was computed for the clinical group to determine if the items were
consistent within the domain measured (i.e., cognitive, fine motor, receptive language, memory, speed, and visual motor) and similar to information provided in the M-P-R Manual. Internal consistency results for the items of the various M-P-R Cognitive Domains using an autistic sample, have not been reported in the literature. Cronbach’s Alpha coefficients are found in Table 4, and indicate that the test items within each respective domain have excellent internal consistency. The internal consistency coefficients found in the M-P-R Manual (Roid & Sampers, 2004) are included in Table 5. While the age divisions are not identical, nonetheless the reliability coefficients of the clinical sample are uniformly higher than those associated with the standardization sample. The greatest difference in correlations can be observed in the Fine Motor, Memory, and Speed domains. These differences may reflect the greater age range in the non-clinical sample. Nonetheless, if a criterion is used that coefficient alpha should be at or above .80, then for both age groups and across all of the M-P-R Cognitive Battery domains for the clinical sample there is strong internal consistency for important decision-making.

Table 4

<table>
<thead>
<tr>
<th></th>
<th>Cognitive I = 82</th>
<th>Fine Motor I = 44</th>
<th>Rec. Lang. I = 68</th>
<th>Memory I = 27</th>
<th>Speed I = 19</th>
<th>Visual Motor I = 41</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ages (months)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36-48 (n=21)</td>
<td>.98</td>
<td>.97</td>
<td>.98</td>
<td>.95</td>
<td>.95</td>
<td>.97</td>
</tr>
<tr>
<td>60-72 (n=29)</td>
<td>.98</td>
<td>.97</td>
<td>.99</td>
<td>.97</td>
<td>.95</td>
<td>.96</td>
</tr>
</tbody>
</table>

Note. M-P-R = Merrill-Palmer-Revised Test; Rec. Lang. = Receptive Language; I = Total number of items within each domain.
Determining the Clinical Utility of M-P-R Scales

Table 5

**Internal Consistency for M-P-R Non-Clinical Sample**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chronbach’s Alpha Coefficients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ages (months)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-48 (n = 340)</td>
<td>.95</td>
<td>.92</td>
<td>.96</td>
<td>.84</td>
<td>.84</td>
<td>.90</td>
</tr>
<tr>
<td>Ages (months)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>49+ (n = 372)</td>
<td>.92</td>
<td>.87</td>
<td>.91</td>
<td>.74</td>
<td>.74</td>
<td>.82</td>
</tr>
</tbody>
</table>

*Note.* M-P-R = Merrill-Palmer-Revised Test; Rec. Lang. = Receptive Language

**Validity**

Correlations were calculated for the clinical and non-clinical groups using the scores obtained on the various domains of the M-P-R Cognitive Battery, including the composite Developmental Index as well as the Gross Motor domain; results are found in Table 6. Inter-correlations for the supplemental Expressive Language domains and parent report results from the Social-Emotional and Self Help dimensions, for both the clinical and non-clinical groups, were also calculated and are reported in Table 7. For both tables, the AD group results are reported in the lower left while the non-clinical group results are found in the upper right. As can be seen in Table 6, with the exception of the Gross Motor domain, the results from the AD group show uniformly high correlations between all 28 variables, with each respective value higher than the corresponding value found with the non-clinical group. This would suggest, then, that, despite their various cognitive designations, domains comprising the M-P-R Cognitive Battery suggest a stronger inter-relationship when used with children with AD. A different finding is noted, however, with the supplemental domains shown in Table 7. The high inter-correlations for
the autism subsample have disappeared, except for the one correlation between Self-Help and Social-Emotional domains which yields a highly significant correlation of .83. In summary, the inter-correlations between the M-P-R Cognitive Battery domains and the Self-Help supplemental parent rating scale seem to suggest greater domain similarity when assessing the skill levels of the clinical group, compared to the non-clinical group. Alternatively, the Gross Motor, Expressive Language, Total Language, and Social-Emotional domains appear to assess skills that are relatively dissimilar for the clinical group.

Table 6

**Inter-domain Correlations of the M-P-R Cognitive Battery for the Autistic (lower left half of the table) and Non-Clinical (upper right half) Groups**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dev. Index</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive</td>
<td>.97**</td>
<td>1</td>
<td>.70**</td>
<td>.70**</td>
<td>.83**</td>
<td>.61**</td>
<td>.63**</td>
<td>.33**</td>
</tr>
<tr>
<td>Fine Motor</td>
<td>.95**</td>
<td>.91**</td>
<td>1</td>
<td>.55**</td>
<td>.65**</td>
<td>.61**</td>
<td>.80**</td>
<td>.23*</td>
</tr>
<tr>
<td>Recep. Lang.</td>
<td>.98**</td>
<td>.96**</td>
<td>.93**</td>
<td>1</td>
<td>.60**</td>
<td>.60**</td>
<td>.48**</td>
<td>.25*</td>
</tr>
<tr>
<td>Memory</td>
<td>.97**</td>
<td>.97**</td>
<td>.91**</td>
<td>.95**</td>
<td>1</td>
<td>.54**</td>
<td>.52**</td>
<td>.41**</td>
</tr>
<tr>
<td>Speed</td>
<td>.90**</td>
<td>.87**</td>
<td>.97**</td>
<td>.89**</td>
<td>.86**</td>
<td>1</td>
<td>.34**</td>
<td>.27**</td>
</tr>
<tr>
<td>Visual Motor</td>
<td>.97**</td>
<td>.95**</td>
<td>.98**</td>
<td>.96**</td>
<td>.94**</td>
<td>.93**</td>
<td>1</td>
<td>.24*</td>
</tr>
<tr>
<td>Gross Motor</td>
<td>.69**</td>
<td>.66**</td>
<td>.70**</td>
<td>.66**</td>
<td>.66**</td>
<td>.67**</td>
<td>.70**</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note. M-P-R = Merrill Palmer-Revised; Dev. = Developmental; Cog. = Cognitive; Recep. = Receptive; Lang = Language; * = p < 0.05; ** = p < 0.01.*
To further assess aspects related to the clinical utility of the M-P-R, it was hypothesized that the mean standard scores obtained by the clinical group would be generally lower than the non-clinical group. First, an Independent Samples t-test was conducted to compare the mean standard scores of the Developmental Index for the clinical and non-clinical groups; the respective means and standard deviations appear in Table 8, along with distribution statistics. Results indicate that, as expected, the overall M-P-R Developmental Index score for the clinical group ($M = 62.0, SD = 37.4$) was significantly lower (and with a substantially greater standard deviation) than the non-clinical group ($M = 99.6, SD = 14.4$) ($t \ (128) = -8.08, p < .001, d = .55$). Levine’s statistic was significant (99.1, $p < .001$), suggesting that the subgroup variances were not equal, although the difference between the means is substantial (almost 37 points); given the robustness of the $t$-test, this result likely remains valid despite the $SD$ differences.

While the distribution of the Developmental Index scores for the clinical group is not significantly skewed despite what appears to be a large proportion of scores below 20 (see Figure

Table 7

Inter-domain Correlations of the M-P-R Supplemental Scales for the Autistic (lower left half of the table) and Non-Clinical (upper right half) Groups

<table>
<thead>
<tr>
<th></th>
<th>Expressive Language</th>
<th>Language Total</th>
<th>Social Emotional</th>
<th>Self-Help</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressive Language</td>
<td>1</td>
<td>.97**</td>
<td>.36**</td>
<td>.44**</td>
</tr>
<tr>
<td>Language Total</td>
<td>.06</td>
<td>1</td>
<td>.41**</td>
<td>.48**</td>
</tr>
<tr>
<td>Social Emotional</td>
<td>.07</td>
<td>.15</td>
<td>1</td>
<td>.61**</td>
</tr>
<tr>
<td>Self-Help</td>
<td>-.03</td>
<td>.28</td>
<td>.83**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. M-P-R = Merrill-Palmer-Revised; ** $p < 0.01$. 
1), the kurtosis statistic suggests a flat distribution. The extreme range of performance for the clinical subgroup contributes to a rectangularly-shaped distribution. In contrast, the distribution of the Developmental Index scores for the non-clinical group closely approximates a normal distribution (see Figure 2). Therefore, despite what may be a change in the shape and variance of an autism sample’s distribution, results suggest that the M-P-R Developmental Index is sensitive in differentiating between a group of children diagnosed with AD and a non-clinical group.

Table 8

<table>
<thead>
<tr>
<th></th>
<th>Autistic Sample (n = 50)</th>
<th>Non-Clinical Sample (n = 80)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-P-R Developmental Index</td>
<td>62.0 37.4</td>
<td>99.6 14.4</td>
</tr>
<tr>
<td>Skewness Statistic</td>
<td>.209</td>
<td>.03</td>
</tr>
<tr>
<td>Kurtosis Statistic</td>
<td>1.50</td>
<td>-.58</td>
</tr>
<tr>
<td>Range of scores</td>
<td>105</td>
<td>62</td>
</tr>
<tr>
<td>Minimum and Maximum</td>
<td>(10-115)</td>
<td>(70-132)</td>
</tr>
</tbody>
</table>

*Note: M-P-R = Merrill-Palmer-Revised Test.*

Next, differences between the six M-P-R Cognitive Battery domains, the Gross Motor domain, and the supplemental domains (Expressive Language, Overall Language, Social-Emotional, and Self-Help/Adaptive Scales) for each of the groups were examined. While test
results are complete for the children’s performance on the Cognitive Battery, Gross Motor domain, and Expressive Language domain, the corresponding parent report measures on each child were not provided by the parents/guardians in 17% of the autistic sample and 13.8% of the non-clinical sample. The means, standard deviations, and number of participants for the clinical and non-clinical group domain standard scores are listed in Table 9. Figure 3 displays the standard score distributions for both groups across each domain. Figures 4 through 14 individually illustrate the standard score distributions for each of the domains for the clinical and non-clinical groups. The autism group obtained lower scores in each domain.
Figure 2. Distribution of Developmental Index Scores for the Non-Clinical Sample (n = 80).

The impact of age was examined along with the domain and group variables by dividing the sample into older and younger subgroups (using a median split). Table 10 reports the mean scores of each age subgroup for the Cognitive Battery and the Gross Motor domain, and Table 11 reports the mean scores of each age subgroup for the supplemental domains. Interestingly, the clinical groups SDs for the various domains are nearly twice those of the non-clinical group. This is unusual as lower mean scores typically shrink variability. Figures 15 and 16 illustrate the mean differences amongst the age subgroups for the clinical and non-clinical samples.
### Table 9

**Means and Standard Deviations (in parentheses) for Clinical and Non-Clinical Domain Scores**

<table>
<thead>
<tr>
<th>Domain</th>
<th>N</th>
<th>Clinical Group</th>
<th>n</th>
<th>Non-Clinical Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive</td>
<td>50</td>
<td>70.72</td>
<td>80</td>
<td>98.98</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(38.60)</td>
<td></td>
<td>(14.58)</td>
</tr>
<tr>
<td>Fine Motor</td>
<td>50</td>
<td>72.10</td>
<td>80</td>
<td>100.81</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(38.63)</td>
<td></td>
<td>(13.30)</td>
</tr>
<tr>
<td>Visual Motor</td>
<td>50</td>
<td>62.6</td>
<td>80</td>
<td>100.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(33.90)</td>
<td></td>
<td>(12.73)</td>
</tr>
<tr>
<td>Speed</td>
<td>50</td>
<td>84.42</td>
<td>80</td>
<td>99.73</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(34.00)</td>
<td></td>
<td>(15.54)</td>
</tr>
<tr>
<td>Memory</td>
<td>50</td>
<td>65.00</td>
<td>80</td>
<td>99.80</td>
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<tr>
<td></td>
<td></td>
<td>(37.35)</td>
<td></td>
<td>(13.66)</td>
</tr>
<tr>
<td>Receptive Language</td>
<td>50</td>
<td>65.48</td>
<td>80</td>
<td>97.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(40.52)</td>
<td></td>
<td>(14.91)</td>
</tr>
<tr>
<td>Gross Motor</td>
<td>50</td>
<td>74.48</td>
<td>80</td>
<td>100.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(20.07)</td>
<td></td>
<td>(13.19)</td>
</tr>
<tr>
<td>Expressive Language</td>
<td>41</td>
<td>59.76</td>
<td>76</td>
<td>102.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(25.94)</td>
<td></td>
<td>(16.36)</td>
</tr>
<tr>
<td>Overall Language</td>
<td>42</td>
<td>64.00</td>
<td>78</td>
<td>100.63</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(26.02)</td>
<td></td>
<td>(15.92)</td>
</tr>
<tr>
<td>Social-Emotional</td>
<td>41</td>
<td>74.10</td>
<td>60</td>
<td>97.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(22.80)</td>
<td></td>
<td>(12.60)</td>
</tr>
<tr>
<td>Self-Help/Adaptive</td>
<td>42</td>
<td>79.50</td>
<td>62</td>
<td>98.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(23.37)</td>
<td></td>
<td>(16.10)</td>
</tr>
</tbody>
</table>
Figure 3. Domain standard score means scores for the Autism (AD) and non-clinical groups.

Figure 4. Distributions of the M-P-R Cognitive domain standard scores for the AD ($n = 50$) and Non-Clinical Groups ($n = 80$). The Autism subgroup distribution is on the left.
Figure 5. Distributions of the M-P-R Fine Motor domain standard scores for the AD ($n = 50$) and Non-Clinical Groups ($n = 80$). The Autism subgroup distribution is on the left.

Figure 6. Distributions of the M-P-R Visual-Motor domain standard scores for the AD ($n = 50$) and Non-Clinical Groups ($n = 80$). The Autism subgroup distribution is on the left.
Figure 7. Distributions of the M-P-R Speed domain standard scores for the AD (n = 50) and Non-Clinical Groups (n = 80). The Autism subgroup distribution is on the left.

Figure 8. Distributions of the M-P-R Memory domain standard scores for the AD (n = 50) and Non-Clinical Groups (n = 80). The Autism subgroup distribution is on the left.
Figure 9. Distributions of the M-P-R Receptive Language domain standard scores for the AD (n = 50) and Non-Clinical Groups (n = 80). The Autism subgroup distribution is on the left.

Figure 10. Distributions of the M-P-R Gross Motor domain standard scores for the AD (n = 50) and Non-Clinical Groups (n = 80). The Autism subgroup distribution is on the left.
Determining the Clinical Utility of M-P-R Scales

Figure 11. Distributions of the M-P-R Expressive Language domain standard scores for the AD ($n = 41$) and Non-Clinical Groups ($n = 76$). The Autism subgroup distribution is on the left.

Figure 12. Distributions of the M-P-R Total Language domain standard scores for the AD ($n = 42$) and Non-Clinical Groups ($n = 78$). The Autism subgroup distribution is on the left.
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Figure 13. Distributions of the M-P-R Social-Emotional domain standard scores for the AD ($n = 41$) and Non-Clinical Groups ($n = 60$). The Autism subgroup distribution is on the left.

Figure 14. Distributions of the M-P-R Self-Help/Adaptive Behavior domain standard scores for the AD ($n = 42$) and Non-Clinical Groups ($n = 62$). The Autism subgroup distribution is on the left.
Table 10

**Means and Standard Deviations for Clinical and Non-Clinical Domain Scores by Age**

<table>
<thead>
<tr>
<th>Domain</th>
<th>Clinical Group</th>
<th>Non-clinical Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age &lt; 61 months</td>
<td>Age ≥ 61 months</td>
</tr>
<tr>
<td></td>
<td>n = 23</td>
<td>n = 27</td>
</tr>
<tr>
<td>Developmental Index</td>
<td>60.57 (35.69)</td>
<td>63.22 (39.59)</td>
</tr>
<tr>
<td>Cognitive</td>
<td>63.26 (33.62)</td>
<td>77.07 (42.02)</td>
</tr>
<tr>
<td>Fine Motor</td>
<td>73.30 (37.16)</td>
<td>71.07 (35.05)</td>
</tr>
<tr>
<td>Visual Motor</td>
<td>62.70 (33.27)</td>
<td>62.52 (35.06)</td>
</tr>
<tr>
<td>Speed</td>
<td>84.96 (34.49)</td>
<td>83.96 (34.19)</td>
</tr>
<tr>
<td>Memory</td>
<td>61.74 (34.18)</td>
<td>67.74 (40.30)</td>
</tr>
<tr>
<td>Receptive Language</td>
<td>62.87 (39.04)</td>
<td>67.70 (42.34)</td>
</tr>
<tr>
<td>Gross Motor</td>
<td>78.30 (16.33)</td>
<td>71.22 (22.74)</td>
</tr>
</tbody>
</table>

A 2 (clinical vs. non-clinical) x 2 (younger vs. older age groups) x 7 (domains) MANOVA was calculated. Box’s Test revealed that equal variances should not be assumed ($F (84, 24439) = 2.18, p < .001$); therefore, Pillai’s Trace was used as the indicator of significance.
The main effects of group (F(7, 120) = 26.12, \( p < .001, \eta^2 = .604 \)) and age category (F(7, 120) = 4.65, \( p < .001, \eta^2 = .213 \)) were both found significant. The non-clinical older and younger groups consistently scored higher across all the domains. A significant interaction between group and age was also obtained, F(7, 120) = 2.13, \( p = .05, \eta^2 = .111 \)). Univariate ANOVA results indicated that the non-clinical group significantly differed for seven M-P-R domains: Cognitive (F(1, 126) = 36.62, \( p < .001, \eta^2 = .225 \)); Fine Motor (F(1, 126) = 41.47, \( p < .001, \eta^2 = .248 \)); Receptive Language (F(1, 126) = 42.23, \( p < .001, \eta^2 = .251 \)); Memory (F(1, 126) = 57.36, \( p < .001, \eta^2 = .
Determining the Clinical Utility of M-P-R Scales

Speed (F(1, 126) = 11.87, p = .001, $\eta^2 = .086$); Visual Motor (F(1, 126) = 79.78, $p < .001$, $\eta^2 = .388$); Gross Motor (F(1, 126) = 74.57, $p < .001$, $\eta^2 = .372$). The younger age group was found to be performing significantly lower for the Cognitive domain (F(1, 126) = 3.78, $p = .05$, $\eta^2 = .029$). Age group was not found to be significant for Fine Motor (F(1, 126) = .02, $p = .90$, $\eta^2 = .000$).

**Figure 15.** Mean score distribution of the M-P-R domains for AD age groups.

**Figure 16.** Mean scores across M-P-R supplemental domains for Non-Clinical age groups.
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The supplemental domains were next evaluated using a 2 (clinical vs. non-clinical) x 2 (younger vs. older age groups) x 4 (domains) MANOVA. Box’s Test revealed that equal variances should not be assumed (\(F(30, 6655.14) = 6.91, p < .001\)); therefore, Pillai’s Trace was used as the indicator of significance. The main effect of group (\(F(4, 78) = 27.13, p < .001, \eta^2 = .58\)) was significant; the non-clinical group consistently scored higher across all the domains. Age category (\(F(4, 78) = .95, p = .44, \eta^2 = .05\)) was not found to be significant. A significant interaction between group and age was found (\(F(4, 78) = 3.31, p = .02, \eta^2 = .15\)) and likely due to the higher Social-Emotional domain score for the younger clinical group. Univariate ANOVA results indicated that group significantly differed for the four supplemental M-P-R domains:

- Expressive Language (\(F(1, 81) = 77.17, p < .001, \eta^2 = .488\));
- Language Total (\(F(1, 81) = 49.97, p < .001, \eta^2 = .382\));
- Social-Emotional (\(F(1, 81) = 29.43, p < .001, \eta^2 = .267\));
- Self-Help (\(F(1, 81) = 12.13, p < .001, \eta^2 = .130\)).

Age group was not found to be significant with Expressive Language (\(F(1, 81) = .01, p = .94, \eta^2 = .00\)); Language Total (\(F(1, 81) = .55, p = .46, \eta^2 = .007\)); Social-Emotional (\(F(1, 81) = 1.52, p = .22, \eta^2 = .018\)); and Self-Help (\(F(1, 81) = .001, p = .98, \eta^2 = .00\)). Figures 17 and 18 illustrate the mean difference by age group for the Non-Clinical sample.
The M-P-R performance by the clinical group was then compared to performance of other clinical groups whose test results were included in the *M-P-R Manual*, including a small sample of 14 children diagnosed on the autism spectrum (i.e., A D, Asperger’s Disorder, and PDD). Table 12 identifies these clinical groups and Table 13 provides their M-P-R means and SDs across the domains. The clinical and non-clinical samples from this study have also been included in Table 13. Data available were limited to means and SDs for each of the clinical groups found in the *Manual*, therefore statistical analyses were not possible. Nevertheless, some

*Figure 17*. Mean scores across M-P-R domains for non-clinical age groups.
Figure 18. Mean scores across M-P-R domains for non-clinical age groups. Interesting comparisons are warranted; Figure 19 illustrates the patterns of the scores presented in Table 13. First, the Autism Spectrum group obtained noticeably lower scores in each domain with the exception of the Memory and the Gross Motor domain. As anticipated, the non-clinical group’s mean scores across the domains are close to average while the Cognitive Delay, Speech/Language Impaired, Motor Delay groups all obtained below mean scores within each domain (with the exception of the Speech/Language Impaired domain score for Gross Motor). Children within the Premature Infant group achieved domain scores near average. Children within the Deaf group also achieved scores close to average across all domains with the exception of Receptive Language and the Gross Motor; these scores fell nearly two and one standard deviations below the non-clinical group, respectively. Further, the means reported in the M-P-R Manual for the Speed domain appear to be a relative strength (i.e., the highest score, albeit well below the non-clinical score) for the Cognitive Delay, Motor Delay, ASD and this
study’s clinical group. This finding may suggest that the items within the Speed domain are not as sensitive to fine motor delays in young children.

Also, there appears to be a fair amount of overlap across the clinical groups. This study’s clinical group showed the most overlap with Speech/Language Impaired, Deaf, and Motor Delay groups in the Receptive Language domain. The overlapping scores with other clinical subgroups suggest that the M-P-R, although sensitive to significant developmental delay, does not seem to differentiate between other early disabling conditions; therefore, it should not be used to establish an ASD diagnosis. Even comparing two ASD subgroups, there was noticeable absence of overlap in several domains. Therefore, there seems to be little basis to assert that there is an “ASD pattern” yielded by the M-P-R.

Table 12

<table>
<thead>
<tr>
<th>Clinical Groups as Defined in the M-P-R Manual</th>
<th>Definition</th>
<th>Median Age (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Delay ($n = 32$)</td>
<td>Mild, Moderate or Severe Mental Retardation</td>
<td>56</td>
</tr>
<tr>
<td>Premature Infants ($n = 39$)</td>
<td>Children born 37 weeks or less gestational age as reported by parents</td>
<td>11</td>
</tr>
<tr>
<td>Severe Speech/Language Delay ($n = 43$)</td>
<td>Children with documented delays in either speech or language development</td>
<td>47</td>
</tr>
<tr>
<td>Deafness or Severe Hard-of-Hearing Conditions ($n = 18$)</td>
<td>Children documented as deaf or severe hearing difficulties</td>
<td>49</td>
</tr>
<tr>
<td>Severe Motor Delay ($n = 15$)</td>
<td>Children with documented motor delays or deviations (Cerebral Palsy, etc)</td>
<td>50</td>
</tr>
<tr>
<td>Autistic Spectrum ($n = 14$)</td>
<td>Children with documented diagnosis of autism or autism spectrum disorder.</td>
<td>53</td>
</tr>
</tbody>
</table>

*Note.* M-P-R = Merrill-Palmer-Revised.
Figure 19. Merrill Palmer-Revised standard score means across domains for various clinical groups described in the M-P-R test Manual, along with the current study’s AD and non-clinical groups. CogDelay = cognitive delay; Lang = language; Impair = impairment; ASD = Asperger’s Disorder; Non-Clin = non clinical.

Table 13

Means and Standard Deviations (in parentheses) of the M-P-R Standard Scores for Clinical Groups Reported in the M-P-R Manual, in Addition to This Study’s Clinical and Non-Clinical Groups

<table>
<thead>
<tr>
<th>Clinical Groups</th>
<th>M-P-R</th>
<th>Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cog.</td>
<td>Fine Motor</td>
</tr>
<tr>
<td>Cognitive Delay (n = 25)</td>
<td>49.6</td>
<td>47.0</td>
</tr>
<tr>
<td></td>
<td>(26.4)</td>
<td>(26.5)</td>
</tr>
<tr>
<td>Premature Infants (n = 36)</td>
<td>94.2</td>
<td>90.8</td>
</tr>
<tr>
<td></td>
<td>(22.3)</td>
<td>(19.6)</td>
</tr>
<tr>
<td>Speech/ Lang. Impaired (n = 42)</td>
<td>85.8</td>
<td>87.2</td>
</tr>
<tr>
<td></td>
<td>(22.7)</td>
<td>(21.5)</td>
</tr>
</tbody>
</table>
### Determining the Clinical Utility of M-P-R Scales

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaf ($n = 16$)</td>
<td>92.5 (21.9)</td>
<td>72.8 (19.5)</td>
<td>95.4 (20.1)</td>
<td>93.4 (18.9)</td>
<td>95.5 (21.6)</td>
<td>83.9 (25.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Delay ($n = 13$)</td>
<td>76.5 (35.8)</td>
<td>73.4 (25.4)</td>
<td>73.9 (31.0)</td>
<td>80.6 (38.8)</td>
<td>74.3 (33.3)</td>
<td>70.9 (31.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autism Spectrum ($n = 14$)</td>
<td>58.7 (30.7)</td>
<td>54.2 (15.6)</td>
<td>68.3 (22.9)</td>
<td>69.4 (23.2)</td>
<td>57.1 (23.2)</td>
<td>75.5 (15.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Group ($n = 50$)</td>
<td>70.7 (38.6)</td>
<td>65.5 (40.5)</td>
<td>65.0 (37.4)</td>
<td>84.4 (34.0)</td>
<td>62.6 (33.9)</td>
<td>74.58 (20.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Clinical Group ($n = 80$)</td>
<td>98.9 (14.6)</td>
<td>98.0 (14.9)</td>
<td>99.8 (13.7)</td>
<td>99.7 (15.5)</td>
<td>100.4 (12.7)</td>
<td>100.0 (13.2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* M-P-R = Merrill-Palmer-Revised; Cog. = Cognitive; Recep. = Receptive; * = not reported.
Chapter 4

Discussion

This study assessed important aspects related to the clinical utility of the M-P-R in the assessment of children diagnosed with AD. The Developmental Index scores for the AD sample gathered for this study ranged from 10 to 115, indicating that this clinical group consists of children with a broad range of functioning levels, which is common with this population. Other studies have reported below mean standard scores with large standard deviations. For example, Coolican, Bryson, and Zwaigenbaum, 2008 reported an AD sample with a SB-5 mean Full Scale IQ and SD of 67.75 and 21.02, respectively. Tsatsanis et al. (2003) reported an AD sample with a Leiter-R mean Full Scale IQ of 68.8 and SD of 22.3. Therefore, while large standard deviations for samples of autistic children are typical, the standard deviation obtained in the present study is almost 50% larger than the two studies just cited. In part, the greater variability found in this study’s autism group, is likely attributable to the large number of participants (52%) who obtained a Developmental Index score below 70. In addition, it is well known that children with AD struggle with imitation tasks, using gestures, and utilizing functional language. Several M-P-R tasks may have been too difficult as eleven participants obtained a Developmental Index score of < 20. A similar experience was reported by Akshoomoff (2006) when several ASD participants obtained T – scores < 20 on the Mullen Scales of Early Learning (Mullen, 1995). However, in his particular study the children were much younger (mean age = 29.9 months SD = 7.6). The children who obtained very low scores in the present study ranged in age from 40 – 70
months. One reason could be that the combination of severe autism symptoms, poor attention, and item difficulty contributed to the extremely low scores. Another reason, and as mentioned previously, research has found that intellectual disability is likely to be comorbid with AD (Edelson, 2006; Fombonne, 2005; Hartley & Sikora, 2010). The high variability, and those with severe cognitive impairment in the present study, raises questions whether these participants may have been improperly diagnosed or if other co-morbidities were included (i.e., Fragile X).

In an attempt to reduce the high variability, and possible floor effects, 11 participants who received a Developmental Index score ≤20 were removed and the resultant subsample’s M-P-R scores along with the original sample’s scores are shown in Table 14. This subsample’s data have been added to Figure 19, and can be viewed in Figure 20.

Table 14

Means and Standard Deviations (in parentheses) of the M-P-R Standard Scores for the AD Group obtaining a Developmental Standard Score ≥ 20, in Addition to This Study’s Clinical and Non-Clinical Group

<table>
<thead>
<tr>
<th>Groups</th>
<th>M-P-R</th>
<th>Domain</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cog.</td>
<td>Fine Motor</td>
<td>Recep. Lang</td>
<td>Memory</td>
<td>Speed</td>
<td>Visual Motor</td>
<td>Gross Motor</td>
<td></td>
</tr>
<tr>
<td>Revised Clinical Group</td>
<td>85.56</td>
<td>87.97</td>
<td>81.13</td>
<td>79.62</td>
<td>99.26</td>
<td>76.67</td>
<td>81.26</td>
<td></td>
</tr>
<tr>
<td>Clinical Group</td>
<td>70.7</td>
<td>72.1</td>
<td>65.5</td>
<td>65.0</td>
<td>84.4</td>
<td>62.6</td>
<td>74.58</td>
<td></td>
</tr>
<tr>
<td>(n = 50)</td>
<td>(38.6)</td>
<td>(35.7)</td>
<td>(40.5)</td>
<td>(37.4)</td>
<td>(34.0)</td>
<td>(33.9)</td>
<td>(20.0)</td>
<td></td>
</tr>
<tr>
<td>Non-Clinical Group</td>
<td>98.9</td>
<td>100.8</td>
<td>98.0</td>
<td>99.8</td>
<td>99.7</td>
<td>100.4</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>(n = 80)</td>
<td>(14.6)</td>
<td>(13.3)</td>
<td>(14.9)</td>
<td>(13.7)</td>
<td>(15.5)</td>
<td>(12.7)</td>
<td>(13.2)</td>
<td></td>
</tr>
</tbody>
</table>

Note. M-P-R = Merrill-Palmer-Revised; Cog. = Cognitive; Recep. Lang = Receptive Language.
Figure 20. Merrill Palmer-Revised standard score means across domains for various clinical groups described in the M-P-R test Manual, along with the current study’s revised AD group. CogDelay = cognitive delay; Lang = language; Impair = impairment; ASD = Asperger’s Disorder; AD = Autistic Disorder; Non-Clin = non clinical.

As expected, the results of the updated AD group show increased domain standard scores, but of interest, the large standard deviations remain. The main reason to eliminate participants with very low scores was to examine whether an AD profile of M-P-R scores might emerge. Figure 20 shows the revised subsample compared to the original clinical sample and a several other clinical groups. Clearly, the AD revised sample’s scores are no longer overlapping with the Cognitive Delay and ASD groups. However, the revised group scores overlap with other clinical groups, such as those with speech/language delays, children who are deaf, and those who
were born prematurely. Unfortunately, the revised domain scores still do not suggest a unique M-P-R profile exists for children with AD. In particular, it is curious why children with AD disorder do not seem to have M-P-R receptive language scores suggestive of significant language impairment, a central diagnostic characteristic of autism. As seen in the original AD group, the Speed domain remained the domain yielding the highest score, which was well within the average range. Therefore, excluding the lowest scoring children with AD did not help create a more diagnostically useful AD profile, reinforcing the finding that the M-P-R should not be used by itself to make the diagnosis of AD disorder.

In examining psychometric properties of the M-P-R, the internal consistency of its Cognitive Battery (Cognitive, Fine Motor, Receptive Language, Memory, Speed, and Visual Motor) was found to be strong. The alpha values for the autistic sample exceeded the values reported in the Manual for the standardization sample (Roid & Sampers, 2004). The high internal consistency indicates that the items within each domain are homogeneous and useful in skill assessment. While data are yet needed to establish test-retest reliability for an autistic sample, this study provides preliminary support for sound reliability using one reliability index (internal consistency). Other than the standardization data found in the M-P-R Manual, comparable research regarding internal consistency was not found.

In terms of the validity, a surprising result was observed when the M-P-R Cognitive Battery domains for the AD group were correlated. As shown in Table 6, all of the domain correlations were greater than .85 (.86-.98), suggesting that a much stronger inter-relationship between domains exists for children with AD compared to the non-clinical sample. Only one correlation was found to be greater than .85 for the non-clinical group, namely, the relationship
of the Cognitive domain with the Developmental Index \( r = .96 \), which is expected as the Cognitive domain contributes to the Developmental Index score. Apart from the Cognitive domain correlation with the Developmental Index, the greatest correlation using the non-clinical sample was observed between Cognitive and Memory domains \( r = .83 \) and the lowest between Speed and Visual Motor \( r = .34 \). For the most part, when looking at the non-clinical group, the low to moderate inter-domain correlations appear to support the M-P-R’s construct validity. Yet, when used with an AD population, the instrument’s construct validity appears compromised. The AD group was found to have a \( .98 \) correlation between Fine Motor and Visual-Motor compared to the \( .80 \) correlation with the non-clinical group, strongly suggesting each scale is measuring the same thing, and therefore there is little psychometric justification for including two highly overlapping domains. The exception to this considerable overlap is seen for the Gross Motor whose correlations were also found to be higher for the AD group when compared to the non-clinical group \( r = .66 \) - \( .70 \) vs. \( .24 \) - \( .41 \), but not as suggestive of the redundancy connoted in the other domain correlations. Similar findings were found in a study by Dickerson-Mays & Calhoun (2003) in which correlations of subtests of the SB-IV and Indexes of the WISC-III were higher for the autism group in comparison to the standardization sample. Interestingly, when inter-domain correlations were made between the supplemental scales the high values disappeared with the exception of the Self-Help and Social-Emotional domains (.83). This suggests that the supplemental language scales, when used with an AD population, appear to question the validity of parent report. Referring back to Table 7 it is apparent that the correlations are much lower when comparing the correlations of the Non-Clinical group. From a clinical standpoint it would appear best to not use the supplemental parent scales when working with an AD population.
When the mean standard scores obtained by the AD and non-clinical groups were compared, as anticipated, the domain scores of the AD group were found to be consistently lower (approximately 2.0 to 2.5 standard deviations lower), with the exception of Speed (which was about one standard deviation below). These results are similar to a study by Coolican, Bryson, and Zwaigenbaum (2008) in which 32 children with a mean age of 7 years, 5 months ($SD = 2.71$) diagnosed with AD completed the SB-5 and obtained mean Index scores falling approximately two standard deviations below average. Additionally, Tsatsanis et. al., (2003) administered the Leiter-R to 22 children with a mean age of 9.13 years ($SD = 3.47$) diagnosed with AD who obtained a mean Full Scale IQ score of 68.8. The AD group in this study obtained scores well below the mean when compared to a non-clinical group but similar to other studies assessing children with AD. This suggests that the M-P-R is sensitive in indentifying children with developmental delay.

The AD sample performed as expected (lower) in all of the domains when compared to a non-clinical sample, with the exception of Speed. There are differing views regarding the speed of processing abilities within an autistic population. Scheuffgen, Happe, Anderson, & Frith (2000) administered an inspection time computer task and found lower processing speed (equivalent to the non-clinical sample) in children with an ASD despite their low average IQ. Additionally, Akshoomoff, (2006) found that participants with ASD performed relatively better on the Fine Motor scale of the Mullen Scales of Early Learning (Mullen, 1995). Alternatively, Calhoun & Dickerson-Mayes (2005) and Oliveras-Rentas, Kenworthy, Roberson, Martin, & Wallace (2012) found processing speed (as assessed by the WISC-III and WISC-IV) to be a relative weakness compared to a non-clinical sample. The participants of the current study
obtained higher than expected processing speed scores, but not as high as the participants in the Scheuffgen et al. (2000) study, who obtained average scores; the reader will remember that the AD group of this study obtained scores falling one standard deviation below average. While perhaps at a different degree of magnitude, nonetheless, the processing speed results of this study seem to align more as a strength rather than a weakness.

Comparisons were made across several clinical groups identified in the M-P-R Manual. Several groups obtained somewhat similar M-P-R domain patterns. The greatest group similarities seemed to be between the AD clinical group and the Motor Delay group. The Speed Domain mean score appears to be a relative strength for both groups, which may suggest that the Speed Domain may be less impacted by delays as the other domains. The M-P-R Speed domain is calculated based upon quick performance on the Visual-Motor domain tasks. Examples of these tasks include speed in stacking rings, placing six round or square pegs in the appropriate holes, assembling two, three, and four piece puzzles, and placing form board shapes (e.g., circle and square) in their correct locations. If the tasks are completed faster than a specified time, a bonus point is awarded. One would expect children with motor delays to demonstrate difficulty completing fine motor tasks efficiently. Yet results indicate that the Motor Delay group obtained the highest score in the Speed Domain. The AD clinical group also performed the highest within this domain. Because the Speed domain appears to generate performance anomalies for the AD and Motor Delay groups, it would appear that the Speed domain may be a poor measure of processing speed abilities, at least with these particular groups, or that the tasks within this domain measure something quite different than is normally associated with performance efficiency of sensory-motor skills.
Despite its sensitivity to identify delays, there is less evidence that the M-P-R provides good diagnostic specificity between clinical subgroups. There did not seem to be an autistic M-P-R profile that was distinctive from other clinical groups, although there are some markers that deserve more attention in future studies using larger samples. The Cognitive, Fine Motor, Receptive Language, and Memory domains seem especially low for children with AD and ASD, as is shown in Figure 12. Clinicians may be more inclined to consider an ASD or intellectual disability diagnosis rather than the other clinical groups identified based upon relatively lower scores in these domains. However, given the M-P-R performance overlap among several clinical groups, it is not appropriate to use M-P-R results in making a differential diagnosis of these other conditions.

**Implications**

The need to accurately assess a child suspected of AD is vital to ensure appropriate treatment plans are employed. This study evaluated aspects of the psychometric properties of the M-P-R in the evaluation of children with AD. One measure of reliability (internal consistency) was found to be good. This particular population is recognized as being difficult to assess and the M-P-R was found to have weaknesses in regards to its validity with this sample of AD participants. The inter-domain correlations of the Cognitive Battery indicated that the items are highly correlated and do not appear to assess the individualized skill areas as found with the non-clinical standardization sample. This suggests that although the M-P-R is capable of identifying global delays, obtaining information regarding specific skills measured is less clear when working with an AD population. However, when working with children who are unable to basal on other measures of cognition (i.e., SB-5, WISC-IV, etc) the M-P-R should be considered useful in the identification of developmental delays.
The M-P-R is not recommended to be used as an AD diagnostic tool; however, if the identification of a child suspected of an ASD is in question, and using the values in Table 13 along with a “rule-of-thumb” that if all M-P-R scores are below 75 (with Speed domain removed from the comparisons) yet higher than 55, it is reasonable to consider an ASD diagnosis. Unfortunately, since individual scores from the children in the various diagnostic subgroups are not available, the utility of this diagnostic guideline cannot be determined, but could be a focus of future research. And given the large SDs found in the AD group, most any diagnostic guideline related to M-P-R domains would not likely prove useful when working with an individual child. Overall, the M-P-R does not appear to be a valid tool for the diagnostic assessment of children with an AD diagnosis. The domains comprising the Cognitive Battery are highly inter-related and the domain scores tend to be similar to those diagnosed with disabilities other than AD. Additionally, the parent report measures showed very low correlations and suggest that the supplemental measures do not aid in the diagnostic process. Therefore, while it seems sensitive to identifying dysfunction, it is not specific enough to indicate if the dysfunction may be AD.

**Limitations and Future Directions**

There are several limitations to this study. Autism severity was not assessed. The ADOS algorithm scores obtained from the hospital recruited children were archival data but the raw scores for each ADOS domain were not available. As such, Modules 1-3 were not comparable. Gotham, Pickles & Lord (2009) have developed a system to standardize ADOS scores for the purpose of assessing severity. This information would have been useful to use in order to compare ADOS scores with the results of the M-P-R, as the ADOS is considered the “gold
standard” in autism diagnosis. It would be interesting to see which domains correlate the most closely with the various ADOS scores.

The present study was unable to perform a discriminate function analysis using the AD clinical group and the previously identified clinical groups found in the M-P-R Manual due to a limitation in available data from the other clinical groups, as well as rather small sample sizes. As a result, observations were made based upon superficial comparisons of group means and standard deviations. Future collaborative studies across institutions may provide access to larger and diagnostically diverse data sets.

Also, a longitudinal investigation using the M-P-R would have value. The mean age of participants in this study was 5.0 years, and it would be useful to identify the utility of the M-P-R in identifying delays of children suspected of ASD at a younger age as the M-P-R has been developed for the use in children as young as one month. A longitudinal study of infants identified with delays may be useful to observe the developmental progression and determine if there are patterns seen early on that later would help diagnostically differentiate among autism, intellectual disability, speech and language delay and other subgroups demonstrating developmental abnormalities.
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Determining the Clinical Utility of M-P-R Scales


Appendix A

M-P-R Sample Test Items
### Determining the Clinical Utility of M-P-R Scales

#### 14. Body Parts

<table>
<thead>
<tr>
<th>Item</th>
<th>Key</th>
<th>Circle the Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP 1.1</td>
<td>Point to your nose (Apunte a tu nariz)</td>
<td>0 1</td>
</tr>
<tr>
<td>BP 1.2</td>
<td>Point to your mouth (Apunte a tu boca)</td>
<td>0 1</td>
</tr>
<tr>
<td>BP 1.3</td>
<td>Point to your eyes (Apunte a tus ojos)</td>
<td>0 1</td>
</tr>
<tr>
<td>BP 1.4</td>
<td>Point to your hair (Apunte a tu pelo)</td>
<td>0 1</td>
</tr>
<tr>
<td>BP 1.5</td>
<td>Point to your hands (Apunte a tus manos)</td>
<td>0 1</td>
</tr>
</tbody>
</table>

#### 15. Pop Out

Use switch-activated camera. Hold the toy camera up for the child to see. Just before pressing the button, say Watch! The toy is going to pop! (¡Mira! Este juguete va a saltar!) making big movements. Demonstrate the toy opening two times, then say Your turn! (¡Ahora tú!) offering the camera (opened) to the child. Examiner can hold it, or the child can hold it.

<table>
<thead>
<tr>
<th>Item</th>
<th>Key</th>
<th>Circle the Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO 1.1</td>
<td>Demonstrate toy opening, 2 times (T)</td>
<td>—</td>
</tr>
<tr>
<td>PO 1.2</td>
<td>Closes the open toy</td>
<td>0 1</td>
</tr>
<tr>
<td>PO 1.3</td>
<td>Activates toy by pressing the button</td>
<td>0 1</td>
</tr>
</tbody>
</table>

#### 16. Simple Puzzle

Use shapes formboard. Place the formboard in front of child. Remove all pieces, placing them below their corresponding spaces. The first piece, the circle, is the teaching piece. The examiner can hand child the circle, encourage the child, and/or point to its correct space. If the child places a piece over the wrong opening, the examiner can provide encouragement. Say Try another way! (¡Intente de nuevo!) Teaching is only allowed on the first piece. Time Limit: 180 seconds.

<table>
<thead>
<tr>
<th>Item</th>
<th>Key</th>
<th>Circle the Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 1.1</td>
<td>Help child place the circle (T)</td>
<td>—</td>
</tr>
<tr>
<td>SP 1.2</td>
<td>Number of shapes correctly placed, even if only briefly. Count each shape only once, and count the circle if placed correctly</td>
<td>0 1 (0-2) (3-4)</td>
</tr>
<tr>
<td>SP 1.3</td>
<td>All 4 pieces correctly placed at one time</td>
<td>0 1</td>
</tr>
<tr>
<td>SP 1.4</td>
<td>Record time to correctly complete formboard puzzle</td>
<td>1 (1-35)</td>
</tr>
</tbody>
</table>

#### 17. Square Peg Board (B)

Use Square Peg Board (B). Place peg board with pegs beside it. Say Another peg board. (Otro tablero.) Do not demonstrate. Say Your turn! (Ahora tú!) while pointing to the peg board. After 180 seconds (3 minutes) or completion, reset the toy and say Do it fast! (Hazlo rápido.) If needed, prompt with Your turn! (¡Ahora tú!) Administer two times.

<table>
<thead>
<tr>
<th>Item</th>
<th>Key</th>
<th>Circle the Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB 1.1</td>
<td>Circle the number of pegs in board at one time</td>
<td>0 1 (0-6)</td>
</tr>
<tr>
<td>PB 1.2</td>
<td>Record time to place 6 square pegs in board Bonus if within 70 seconds</td>
<td>1 (1-70)</td>
</tr>
<tr>
<td>PB 1.3</td>
<td>Record time for second attempt to place 6 square pegs in board Bonus if within 60 seconds</td>
<td>1 (1-60)</td>
</tr>
</tbody>
</table>

### Supplemental Scales

<table>
<thead>
<tr>
<th>Domain</th>
<th>C</th>
<th>FM</th>
<th>RL</th>
<th>M</th>
<th>S</th>
<th>VM</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-Cognitive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M-Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V-Motor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Developmental Index

- **Add 0s 1s** from this page
- **Total cumulative from previous page**
- **Total cumulative (STOP when 0s=12)**

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Determining the Clinical Utility of M-P-R Scales

RECORD FORM Cognitive Battery

33. Word Pictures
Use Merrill-Palmer Easel Book (37064EB), p. 42-44. The child must point to pictures on easel, as directed by examiner. Child need NOT say words, just point to correct pictures, for points.

<table>
<thead>
<tr>
<th>Item</th>
<th>Key</th>
<th>Circle the Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP 3.1</td>
<td>Cat (T)</td>
<td>—</td>
</tr>
<tr>
<td>WP 3.2</td>
<td>Baby</td>
<td>0 1</td>
</tr>
<tr>
<td>WP 3.3</td>
<td>Ear</td>
<td>0 1</td>
</tr>
<tr>
<td>WP 3.4</td>
<td>Hat</td>
<td>0 1</td>
</tr>
<tr>
<td>WP 3.5</td>
<td>King</td>
<td>0 1</td>
</tr>
<tr>
<td>WP 3.6</td>
<td>Blow: Wind, Trumpet, Fan (T)</td>
<td>—</td>
</tr>
<tr>
<td>WP 3.7</td>
<td>Run: Horse</td>
<td>0 1</td>
</tr>
<tr>
<td>WP 3.8</td>
<td>Run: Fox</td>
<td>0 1</td>
</tr>
<tr>
<td>WP 3.9</td>
<td>Run: Boy</td>
<td>0 1</td>
</tr>
<tr>
<td>WP 3.10</td>
<td>Ride: Police Car</td>
<td>0 1</td>
</tr>
<tr>
<td>WP 3.11</td>
<td>Ride: Helicopter</td>
<td>0 1</td>
</tr>
<tr>
<td>WP 3.12</td>
<td>Ride: Horse</td>
<td>0 1</td>
</tr>
</tbody>
</table>

34. See It?
Use Merrill-Palmer Easel Book (37064EB), p. 45-48. The child must find hidden pictures on easel that match the objects shown on the examiner’s right.

<table>
<thead>
<tr>
<th>Item</th>
<th>Key</th>
<th>Circle the Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>VP 3.1</td>
<td>Dinosaur and Bush (T)</td>
<td>—</td>
</tr>
<tr>
<td>VP 3.2</td>
<td>Dog</td>
<td>0 1</td>
</tr>
<tr>
<td>VP 3.3</td>
<td>Wagon</td>
<td>0 1</td>
</tr>
<tr>
<td>VP 3.4</td>
<td>Plant</td>
<td>0 1</td>
</tr>
<tr>
<td>VP 3.5</td>
<td>Faucet</td>
<td>0 1</td>
</tr>
<tr>
<td>VP 3.6</td>
<td>Brush</td>
<td>0 1</td>
</tr>
<tr>
<td>VP 3.7</td>
<td>Big Lemon</td>
<td>0 1</td>
</tr>
<tr>
<td>VP 3.8</td>
<td>Two lemons</td>
<td>0 1</td>
</tr>
<tr>
<td>VP 3.9</td>
<td>Shirt</td>
<td>0 1</td>
</tr>
</tbody>
</table>

35. Shapes Puzzle
Use Merrill-Palmer Easel Book (37064EB), p. 49 and two formboards. Place the formboards in front of child. Remove all pieces, placing them in the order shown in easel. Scoring is based on the number of pieces and time to complete both formboards.

<table>
<thead>
<tr>
<th>Item</th>
<th>Key</th>
<th>Circle the Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS 3.1</td>
<td>Shapes Formboard: All 10 shapes placed correctly (T)</td>
<td>0 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time Limit: 180 seconds (3 minutes)</td>
</tr>
<tr>
<td></td>
<td>Bonus if within 50 seconds</td>
<td>1</td>
</tr>
</tbody>
</table>

After testing, add 1s from above

DEVELOPMENTAL INDEX

Add 0s 1s

Telephone: (330) 860-9700 • Fax: (330) 860-9775 • email: psychtests@stoeltinco.com • website: stoeltinco.com/tests
Appendix B

DSM-IV-TR Diagnostic Checklist
**DSM-IV-TR Diagnostic Criteria for Autism**: (where appropriate rate each question: 1)

- behavior present and seen regularly in different situations and environments; 2) behavior sometimes seen or seen only in a specific situation or environment; or 3) behavior not seen or not yet developed)

Qualitative impairment in social interaction, as manifested by two of the following:

- Y N

  Marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction.

  - in general, will look you/others in the eye, e.g., when he/she wants something
  - will nod his/her head for “yes,” shake his/her head for “no,” wave “bye-bye” at appropriate times, point to indicate his/her wants, use other gestures
  - does he/she look at you when you start talking to him/her or doing things with him/her
  - will he/she turn his/her head to look at you when you call his/her name
  - will he/she look where you point when you point to show him/her a toy or a picture in a book
  - does he/she point to a toy or object to show you he/she is interested in it
  - does he/she smile, frown, raise his/her eyebrows... show a variety of facial expressions (can you tell how he/she’s feeling or what he/she’s thinking by his/her facial expressions)
  - does he/she gesture with his/her hands when he/she’s talking

- Y N

  Failure to develop peer relationships appropriate to developmental level

  - is he/she interested in other children
  - does he/she talk to or try to join other children in their play (e.g., at the park, school or daycare, how does he/she join another child or a group; for example, start playing next to them)
  - how does he/she respond if other children talk to or try to play with him/her
  - how many friends does he/she have (children he/she plays with regularly)
  - does he/she invite friends over to play and is he/she invited to play at other children’s houses (ask about play “dates” set up by parent)
— what do they do when they play together, e.g., parallel play only, chase, video games, make believe play
— are his/her relationships based primarily on his/her special interests
— does he/she have trouble participating in groups, following cooperative rules of games

Y N

**A lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest)**

— does he/she try to involve you in his/her play, in his/her favorite activities or does he/she prefer to play by himself/herself
— how does he/she try to engage you
— does he/she bring a toy or book to show you what he/she is doing
— how does he/she respond to praise
— does he/she offer to share things (toys or food) with you; and will he/she offer to share things with other children
— at different times, does he/she frown and pout, act embarrassed, look surprised or look happy and excited (show a range of emotions)
— how does he/she share his/her feelings with you, e.g., his/her excitement after drawing a picture that he/she really likes, and how does he/she respond to praise
— does he/she like to be held or cuddled, does he/she give hugs and kisses (does he/she imitate you or does he/she spontaneously give a hug)

Y N

**Lack of social or emotional reciprocity**

— will he/she play ball by rolling or throwing it back and forth
— does he/she play other games that require turn taking
— is he/she interested in what game you want to play or what you want to do
— does he/she recognize how you are feeling, e.g., when you’re happy, angry sad or ill, will he/she try to comfort you
— does he/she notice when others are upset or hurt
— does he/she realize certain things he/she does bother others
Qualitative impairments in communication as manifested by at least one of the following:

Y  N

Delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)

— how many words and gestures does he/she use
— does he/she use words or gestures to indicate his/her wants (e.g., does he/she point to indicate wants)
— how does he/she usually let you know what he/she wants or when he/she needs something

Y  N

In individuals with adequate speech, marked impairment in the ability to initiate or sustain conversation with others

— can you have a conversation with him/her. For example, if you make a comment but don’t ask a question, will he/she say something in response
— will he/she start a conversation with you just to talk or chat, not to ask for something
— can he/she take turns in a conversation or is it usually one-sided, e.g., does he/she always want to talk about his/her favorite subject
— does he/she notice when you’ve lost interest in talking or does he/she talk on and on
— does he/she interpret what you say literally or concretely, e.g., “what’s up” (what are you doing) or “you must have springs in your shoes” (to jump that high) or “hop to it” (hurry)

Y  N

stereotyped and repetitive use of language or idiosyncratic language

— what word or name does he/she use to refer to himself/herself
— does he/she sometimes mix up pronouns, e.g., you for I, he or she for I
— does he/she say what you say right after (immediate echolalia)
— does he/she repeat the same phrase over and over
— does he/she use pat or set phrases, e.g., things you may have said or that he/she heard someone else say, such as from a TV show or movie (delayed echolalia)
— talk to himself during play, or make nonsense noises or words to himself/herself during play (words that he/she made up)
— does he/she seem to talk too loudly or too softly
Determining the Clinical Utility of M-P-R Scales

— does he/she use the same tone of voice each time or have a sing-song pattern to his/her voice?

Y N

**lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level**

— will he/she play games such as pat-a-cake or peek-a-boo; make hand gestures to familiar songs such as “itsy-bitsy-spider”; fill in a word in a familiar song like “wheels on the bus”
— does he/she like to “pretend” or “make-believe” when playing. For example, will he/she pretend to talk on a toy phone or pretend to feed or take care of a doll or stuffed animal? Will he/she dress-up and “make believe” he/she is someone else
— does he/she pretend a toy is something else, e.g., a toy banana is a phone or a block is a sandwich

**Restrictive repetitive and stereotyped patterns of behavior, interests, and activities as manifested by at least one of the following:**

Y N

**Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus**

— what are his/her favorite toys and activities
— does he/she always play with toys in the same way, e.g., by lining up toy cars or sorting toys by color
— does he/she have a special (all encompassing) interest in one toy, activity or subject (e.g., trains or flags) or an interest in unusual objects or topics (e.g., sprinkler systems, astrophysics)
— how does he/she react if you try to change a favorite activity or topic of conversation
— does he/she have an unusually good memory for the details of special interests, family activities or vacations

Y N

**Apparently inflexible adherence to specific, nonfunctional routines or rituals**

— does he/she have rigid rituals or routines. For example, are there things he/she has to do in a particular way or in an exact order every time at mealtime, bedtime or during play
— how does he/she react if his/her routine is interrupted or he/she can’t complete it (e.g., a toy is broken or missing, he/she has to sleep at a motel when on vacation, you drive a different way home)
— how does he/she react to changes in his/her schedule (e.g., school assembly canceled) or changes in his/her environment, (e.g., how the furniture is arranged at home or classroom, where he/she sits at the dinner table)

— does he/she repeat certain activities over and over, for example: with objects (dropping or rolling; always carrying a specific object); cleaning (washing) hands; use of toilet paper; checking) appliances off, doors closed); counting (toys, money); or ordering (toys, clothes, towels in bathroom). Do these activities interfere with day-to-day function

Y N

**Stereotyped and repetitive motor mannerisms (e.g., hand and finger flapping or twisting, or complex whole-body movements)**

— does he/she have any mannerisms or odd ways of moving his/her hands or his/her body that look the same each time, e.g., flapping hands when excited, walking on his/her toes, flicking his/her fingers, spinning or rocking his/her body, running in a circle

Y N

**Persistent preoccupation with parts of objects**

— does he/she mostly play with objects that light up or make sounds, objects that move or spin, e.g., wheels, fans, running water

— does he/she pay attention only to part of the toy, e.g., spinning the wheels of the car rather than driving it around on a “make-believe” road,

— does he/she use toys or objects in unusual ways, e.g., repeatedly opens and closes doors of toy cars, touches most toys to his/her lips/mouths toys, holds toys very close to his/her eyes or looks out of the “side” of his/her eyes at toys

— does he/she have an attachment to unusual objects, e.g., string
Appendix C

Consent Form
Oregon Health & Science University

Consen Form

eIRB#: 4031

Protocol Approval Date: 3/18/2009

OREGON HEALTH & SCIENCE UNIVERSITY

Consen Form

TITLE: Possible Role of Cholesterol Metabolism in the Etiology of Autism, and Correlates with Neurocognitive/Neurobehavioral Phenotype

PRINCIPAL INVESTIGATOR: Michael Harris, Ph.D. (503) 494-8942

CO-INVESTIGATORS:
Trevor A. Hall, Psy.D. (503) 494-0333
Robert Steiner, M.D. (503) 494-2783
Cheryl Maslen, Ph.D. (503) 494-2011
Michael Kruer, M.D. (503) 494-8211

STUDY STAFF:
Meaghan Peters (503) 494-0333
Diomaris Jurecska (503) 494-0333
Karen Grant (503) 418-1832

SPONSOR: Northwest Health Foundation

PURPOSE: You and your child are being asked to participate in this study because your child has been diagnosed with an autism spectrum disorder. About 80 participants will participate over the next two years. The purpose of this research study is to gather information about children with autism spectrum disorder (ASD). We aim to understand the neuropsychological profiles that exist for people with ASD.
and use this data to improve the treatment, care, and quality of life for individuals with ASD and their families.

We also think that genes important in making cholesterol may impact autism. If a gene or genes that effect autism can be found, the diagnosis and treatment of autism may be improved. Genes are the units of DNA—the chemical structure carrying your genetic information—that determine many human characteristics such as the color of your eyes, your height, and whether you are male or female. As part of this study, we will ask your child to provide blood samples for genetic testing. If your child has had blood drawn in another autism-related study here at OHSU he/she will not have another draw for this study. The blood samples will be analyzed in the laboratory to determine whether there are differences in the cholesterol-making genes of people with autism. If you agree, your child’s blood samples will be stored indefinitely and used for future research studies that may include genetic research.

**PROCEDURES:**

Your participation will last up to 3 months. During this time, some tests will be completed during in-person visits at the CDRC clinic. Questionnaires will be filled out by the parent or primary caregiver and may be filled out away from the clinic. The number of in-clinic visits will be determined by the parent/caregiver and investigator as needed to complete the testing in a 3-month time period. You will receive a report on the testing.

If you agree to participate in this study, the initial study visits will be conducted to complete the eligibility requirements using two diagnostic measures, ADI-R and the ADOS-G. If your child has been evaluated through the CDRC Autism Program he/she will not need to repeat the ADOS-G or ADI-R.

1. The ADI-R is a parent interview that will ask for a thorough description of the child’s cognitive, social, communicative, and behavioral development. The ADI-R takes 1 to 3 hours to complete and will be done with the parent/caregiver in person at the clinic.
2. The ADOS-G is an assessment observing the child’s social and communicative abilities using age-appropriate toys. The ADOS-G takes \( \frac{1}{2} \) hour to an hour to complete and must be completed...
with your child at the clinic.

The next study visit will be scheduled for you and your child to begin study testing. Multiple site visits may be required and you and the research study staff will determine the schedule. There are a set number of assessments that you will have to complete, some of which will be completed with your child while others are interviews or questionnaires you will complete. All assessments with your child will be completed at the clinic site. Some questionnaires will be completed during an interview while you will complete others at home. Staff will be available to answer any questions you may have.

The assessments will include measures that will focus on your child’s development in the areas of:

1. Cognition
2. Adaptive skills
3. Speech and language
4. Motor skills
5. Behavior
6. Psycho-social development

Your first study site-visit with the investigator will be scheduled with the staff. The remaining parent questionnaires will be provided to you at each site visit until all have been completed. The assessment study visit will take 2 to 4 hours.

You will be asked to complete all testing within a 3 month time period.

Your second study site-visit will be an appointment for a blood draw (if feasible you will be offered a blood draw during the first study visit). The blood draw will occur at the Oregon Clinical and Translation Research Institute (OCTRI).

In the OCTRI a nurse or research assistant will draw about one tablespoon of blood from a vein in your child’s arm. This should take less than five minutes. We will use your child’s blood to measure cholesterol and related compounds and to analyze genes that are involved in making cholesterol. You
will be allowed to stay with your child during the blood draw and your child will get a small toy for helping with the study.

In addition to the above procedures, if you child has been evaluated through the OHSU Autism Program, historical test results will be recorded from your child’s OHSU medical record and used in this study.

In the future, samples of your child’s blood may be given to researchers as part of the search for a genetic cause of autism. You will be given a choice as to whether you want your child to participate in this part of the study.

If you have any questions regarding this study now or in the future, contact Michael Harris, PhD (503) 494-8942

**RISKS AND DISCOMFORTS:**

The main risk is fatigue of the children being tested due to the amount of time needed to complete the testing sessions. Because attention and concentration will be needed from your child, breaks will be allowed between tests. Additional visits may be scheduled if needed to complete all of the tests within 3 months. Children may stop testing at any time.

If the results of these studies of your child’s genetic makeup were to be released through a breach of confidentiality, this could affect your child’s ability to get insurance or to get or keep a job.

Your child may feel some pain when the blood is drawn. There is a small chance the needle will cause bleeding, a bruise, or an infection. Your child may cry or become angry. Your child may be fearful of blood draws in the future.

**SUBJECT ACCESS TO RESEARCH INFORMATION:**
Determining the Clinical Utility of M-P-R Scales

The results of your child’s genetic testing in these studies will not be made available to you because the research is still in an early phase and the reliability of the results is unknown. However, a written report detailing your child’s neuropsychological profile will be provided at no cost.

**BENEFITS:**
Your child will not personally benefit from being in this study. However, by serving as a subject, your child may help us learn how to benefit patients in the future.

**ALTERNATIVES:**
You may choose not to participate in this study at all, or you may choose to participate in the cholesterol measurement and genetic testing portions, but not to have DNA stored for future genetic testing.

**CONFIDENTIALITY:**
We will not use your name or your identity for publication or publicity purposes. All the information gathered will be coded with a unique identifier. Only study personnel will have access to identifying information.

Research records may be reviewed and copied by the sponsor (the Northwest Health Foundation), the OHSU Institutional Review Board, the Office for Human Research Protections (OHRP), the Oregon Clinical and Translational Research Instituted (OCTRI), and the National Center for Research Resources (NCRR).

Please note that under Oregon Law, suspected child abuse must be reported to appropriate authorities.

**COSTS:**
There will be no cost to you for participating in this research.

**LIABILITY:**
If you believe you have been injured or harmed while participating in this research and require immediate treatment, contact Michael Harris, PhD (503) 494-8942.

You have not waived your legal rights by signing this form. If you are harmed by the study procedures, you will be treated. Oregon Health & Science University does not offer to pay for the cost of the treatment. Any claim you make against Oregon Health & Science University may be limited by the Oregon Tort Claims Act (ORS 30.260 through 30.300). If you have questions on this subject, please call the OHSU Research Integrity Office at (503) 494-7887.

The Northwest Health Foundation does not offer compensation for injury. It is not the policy of the U.S. Department of Health and Human Services to compensate or provide medical treatment for human subjects in the event the research results in physical injury.

Oregon Health & Science University is subject to the Oregon Genetic Privacy law (ORS 192.531 through ORS 192.549) and its requirements concerning confidentiality and the legal remedies provided by that law for breach of its requirements. You have not waived your legal rights by signing this form. For clarification on this subject, or if you have questions, please call the OHSU Research Integrity Office at (503) 494-7887.

**PARTICIPATION:**

If you have any questions regarding your rights as a research participant, you may contact the OHSU Research Integrity Office at (503) 494-7887.

You do not have to join this or any research study. If you do join, and later change your mind, you may withdraw at any time. If you refuse to join or withdraw early from the study, there will be no penalty or loss of any benefits to which you are otherwise entitled.
Your child’s health care provider may be one of the investigators of this research study, and as an investigator is interested in both your child’s clinical welfare and in the conduct of this study. Before entering this study or at any time during the research, you may ask for a second opinion about your care from another doctor who is in no way involved in this project.

If in the future you decide you no longer want to participate in this research, we will destroy all your child’s blood/genetic samples as well as information from your child’s medical record. However, if your child’s genetic samples or information are already being used in an on-going research project and if their withdrawal jeopardizes the success of the entire project, we may ask to continue to use them until the project is completed.

Your child may be removed from the study if the investigator stops the study, or if the sponsor stops the study. We will give you a copy of this form.

**SIGNATURES:** Your signature below indicates that you have read this entire form and agree to have your child participate in the study detailed above.

(Please initial where appropriate)

_______ I give my consent for my child’s blood/DNA samples to be used for this study only.

_______ I give my consent for my child’s blood/DNA samples to be used for this study and stored for possible use in future studies of autism or related disorders, **but I wish to be contacted for permission** prior to any future use.

_______ I give my consent for my child’s blood/tissue samples to be used for this and future studies of autism or related developmental disorders, and **do not need to be contacted for permission** in the future.
Appendix D

Demographics
Demographics

Please circle the response that best represents you and your family.

1. What is the sex of your child?  a. male  b. female

2. Highest level of education completed:
   a. High school
   b. Vocational or Technical College
   c. Bachelor’s Degree
   d. Graduate Degree
   e. Some College

3. What do you consider to be your ethnicity?
   a. White/Non-Hispanic
   b. Hispanic
   c. Asian/Pacific Islander
   d. African American
   e. American Indian
   f. Other
Appendix E

Curriculum Vita
Meaghan E. Peters
Curriculum Vitae
740 Warm Springs Ave.
Boise, ID 83712
(208) 343-7797
mpeters@childrenshomesociety.com

EDUCATION

2007-2013
Doctoral Candidate, Clinical Psychology
George Fox University, Newberg, OR
Committee Members: Wayne Adams, Ph.D. ABPP., Trevor Hall, PsyD., Kathleen Gathercoal, Ph.D.

2007
Master of Arts, Clinical Psychology
George Fox University, Newberg, OR

2000
Bachelor of Arts, Psychology, Cum Laude
Trinity International University, Deerfield, IL

HONORS AND AWARDS

April 2008
Richter Research Award Grant
Determining the Clinical Utility of the Merrill Palmer Revised Scales of Development on an Autistic population.
Role: Principal Investigator
Funding Period: April 2007-Dec 2009, $1,896

August 2004
Richter Research Travel Award
Present research at professional conference.
Funding period: August 2004, $1,500

April 2003
Richter Research Award Grant
Establish a baseline for guessing on recognition tasks of the Wide Range Assessment of Memory and Learning- 2nd Edition.
Role: Principal Investigator
May 1999

**Elected Psi-Chi Honor Society President**
Trinity International University

**CLINICAL EXPERIENCE**

**Psychometrician**
**Warm Springs Counseling Center**
Boise, ID
Supervisor: Brett Thomas, Ph.D.
Conducting comprehensive psychological evaluations for children and adolescents seeking a medical diagnosis

**Psychometrician**
**Northwest Neurobehavioral Health**
Meridian, ID
Supervisor: Trevor Hall, Psy.D.
Conducted neuropsychological assessments for children and adolescents seeking a medical diagnosis.

**APA Accredited Pre-Doctoral Internship**
**Warm Springs Counseling Center**
Boise, Idaho
Supervisor: Carolyn Golden, Psy.D.
Conducted neurobehavioral assessments for children and adolescents seeking a medical diagnosis. Provided individual, family, and group therapy.

**Multidisciplinary Autism Clinic Practicum**
**Oregon Health and Science University, Portland, OR**
Supervisor: Darryn Sikora, Ph.D.
Conducted cognitive and autism related assessments for children referred to the autism clinic seeking a medical diagnosis. Provided feedback and recommendations to families.

**School-based Assessment Practicum**
**North Marion School District, Aurora, OR**
Supervisor: Susan Patchin, Psy.D.
Conducted cognitive and academic assessments for students grade K-12 for the purpose of special education eligibility.

**Vocational Rehabilitation/ Educational Assessment Practica**
**Forest Grove, OR**
Supervisor: Susan Patchin, Psy.D.
Conducted vocational assessments for an adult vocational rehabilitation training
Determining the Clinical Utility of M-P-R Scales

Program and psycho-educational assessments for a local university for the purpose of detecting learning disabilities.

Residential/Day Treatment Practica

August 2003-May 2004
Edgefield Children’s Center, Troutdale, OR
Supervisors: Kelli Peligreni, Psy.D., and Freda Manning, Psy.D.
Conducted intake and academic assessments. Provided individual play therapy and group therapy for residential and day treatment students grade K-8 with a range of mental health problems (bipolar disorder, oppositional defiant disorder, ADHD, conduct disorder, schizophrenia, anxiety disorders, mood disorders). Participated in IEP evaluations and classroom consultation.
Received training and supervision in the use of play therapy and behavior management strategies.

Supplemental Residential/School Practica

May 2003-August 2003
Yellowstone Boys and Girls Ranch, Billings, MT
Supervisors: Phil House, Psy.D., and Loretta Sand, M.A.
Provided individual, family, and group therapy for boys ages 10-15 living in a residential home with a range of mental health problems (mood disorders, anxiety disorders, bipolar disorder, conduct disorder, oppositional defiant disorder, mental retardation, PTSD). Also facilitated experiential hiking trips and horse therapy.
Conducted intake assessments, cognitive assessments, and IEP evaluations.
Received training and supervision in the use of play therapy, horse therapy, and behavior management strategies.

School-based Practica

August 2002-May 2003
Archer Glen Elementary, Sherwood, OR
Supervisor: Hannah Stere, Psy.D.
Conducted academic assessment and classroom observations. Participated in student assistance team meetings and weekly teacher consultation.
Provided individual and group therapy for students grade K-5 with a range of mental health problems (anxiety disorders, mood disorders, ADHD, autism spectrum disorder, and behavior disorders). Groups focused on anger management, social skill building, and grief support.
Received supervision in the use of play therapy and behavior management.

Psychology Trainee

August 2002-May 2003
George Fox University Health and Counseling Center, Newberg, OR
Supervisors: Carol Dell’ Oliver, Ph.D., and Brad Garner, M.A.
Provided individual psychotherapy to university students, one male and one female.
Conducted personality assessments, developed treatment plans, and participated in case presentations to supervision group.
SUPERVISION EXPERIENCE

September 2010-August 2011
Psychosocial Rehabilitation Specialist Supervisor
Warms Springs Counseling Center, Boise, ID
Conducted group supervision for PSR specialists. Provided training surrounding relevant diagnostic material, consulted on individual cases, and oversaw treatment planning.

January 2008-May 2008
Student Therapist Overseer
George Fox University, Newberg, OR
Supervisor: Mary Peterson, Ph.D
Provided supervision and feedback for a first year graduate student. Offered assistance with intake interview strategies, treatment planning, and behavior strategies with an undergraduate population.

September 2007-May 2008
Student Therapist Supervisor
George Fox University, Newberg, OR
Supervisor: Mary Peterson, Ph.D.
Provided supervision and feedback for a second year graduate student. Offered behavior strategies, assistance with treatment planning, and clarification of diagnosis with student working with adult clients at a community mental health setting.

RELEVANT WORK EXPERIENCE

October 2004-June 2005
Child Development Specialist, .5 FTE paid position
Archer Glen Elementary, Sherwood, OR
Oregon Child Development Specialist Certification
Supervisor: Pete Miller, Principal
Provided individual and group therapy to students K-5 with a variety of mental health disorders (anxiety disorder, mood disorder, autism spectrum disorder, ADHD, adjustment disorder). Implemented Steps to Respect, an anti-bullying campaign, and mentored a fifth grade leadership team. Conducted academic assessments for IEP evaluations and created 504 plans.

May 2002-May 2004
Camp Manager, Summer full-time paid position
Universal Cheerleading Association, Memphis, TN
Supervised the production of Jr/Sr high school cheerleading camps throughout Oregon, Washington, Idaho, and California. Acted as a liaison between the company and the host university to ensure successful camps with an average of 250 campers and 20 staff. Was on call 24 hours a day attending to behavior issues, physical injuries, and supporting a positive atmosphere for participants.
Determining the Clinical Utility of M-P-R Scales

S.M.A.R.T. Program Coordinator, .5 FTE paid position
October 2000-May 2002
Oregon Children’s Foundation, Portland, OR
Recruited, trained, and supervised 40 adult volunteers to act as reading coaches to children grades K-3. Established positive communication efforts between school officials and the Oregon Children’s Foundation.

RESEARCH EXPERIENCE

Research Vertical Team Member
September 2007-Present; August 2002-May 2004
George Fox University, Graduate Department of Clinical Psychology, Newberg, OR
Participated in bimonthly meetings which discussed ongoing research projects focusing on assessment of children. Literature reviews were presented and consultation with respect to methodology, statistical analysis, and idea clarification.
Supervisor: Wayne Adams, Ph.D., ABPP

Study Coordinator
July 2008-June 2010
Title: Possible role of cholesterol metabolism in the etiology of autism, and correlates with neurocognitive/neurobehavioral phenotype
Principal Investigator: Michael Harris, Ph.D.
Project Mentor: Robert Steiner, MD.
Responsible for recruiting and scheduling project participants, administering the Merrill-Palmer-R to children aged 2-6, the Vineland Behavior Adaptive Scale-II, Child Behavior Checklist, and the PDDBI. Also manage coding and data entry.

Research Assistant
June 2008-February 2009
Pediatric Pain Management Center, Oregon Health and Science University, Department of Anesthesiology and Peri-Operative Medicine, Portland, OR.
Advisors: Tonya Palermo, Ph.D., and Anna Wilson, Ph.D.
Currently assisting with study coordination of a study examining the effects of a Web-based Cognitive Behavioral treatment program for adolescents ages 11-17 years with chronic pain. Assisting with participant recruitment, data management, and contacting project participants.

Research Assistant
June 2008-November 2008
Title: The relationship between cholesterol metabolism and autism.
Principal Investigator: Darryn Sikora, Ph.D.
Assisted with recruitment and scheduling project participants.

Research Assistant
June 2005-August 2005
Title: Administering the Wide Range Assessment of Memory and Learning-2 with an ADHD population.
Determined the Clinical Utility of M-P-R Scales 88

Principal Investigator: Robert Weniger, Psy.D
Administered the WRAML-2 to participants in conjunction with CBCL.

Research Leader
April 2003 - November 2004

Title: Establishing a baseline for guessing using the WRAML-2 recognition subtests.
Advisor: Wayne Adams, Ph.D., ABPP
First authored project designed to establish a baseline for guessing on the recognition memory subtests of the Wide Range Assessment of Memory and Learning-2nd Edition. Intent was to determine the likelihood of guessing on recognition tasks if those tasks had not been previously presented for the purpose of detecting malingering. Presented poster of findings at the 2004 APA convention in Honolulu, HI, and at the 2004 NAN Convention in Seattle, WA.

TEACHING EXPERIENCE

March 2003

Guest Lecturer
Undergraduate Department of Psychology, George Fox University
Newberg, OR
PSY 130 Introduction to Psychology. Presented a lecture on emotion and motivation.

April 2003

Guest Lecturer
Undergraduate Department of Psychology, George Fox University
Newberg, OR
PSY 381 Counseling
Presented a lecture on Coping

August 1999 - December 1999

Teaching Assistant
Undergraduate Department of Psychology,
Trinity International University, Deerfield, IL
Taught a freshman level course on the college adjustment process. Facilitated discussion surrounding adjustment and offered supportive techniques.
Advisor: Timothy Robinson, Ph.D.
SERVICE

Peer Mentor
August 2003-July 2004; August 2007-Present Assistance first and second year graduate student with the adjustment process and provided ongoing support by means of answering questions, giving advice, assisting with learning test administration, and suggesting involvement in extracurricular activities to maintain balance.

APAGS Representative
May 2003-August 2004 Served as liaison between APA and student body, responsible for membership renewal, and provided support to graduate students.

Division 54 Student Recruiter
May 2003-August 2004 Increased student awareness of society and recruited student members of Pediatric Psychology

PROFESSIONAL MEMBERSHIPS

2007-Present; 2001-2004 American Psychological Association (APA), Student Member

2007-2010; 2002-2004 Society for Pediatric Psychology, APA Division 54, Student Member

Peer-reviewed Publication

POSTER PRESENTATIONS


PROFESSIONAL REFERENCES

Current Supervisor:
Brett Thomas, Ph.D.
Warm Springs Counseling Center
740 Warm Springs Ave.
Boise, Idaho 83712
(208) 343-7797

Internship Training Director:
Carolyn Golden, PsyD
2076 S. Eagle Rd.
Meridian, ID 83642
(208)-955-7333

Primary Graduate Advisor:
Wayne Adams, Ph.D., ABPP
414 N. Meridian St. #V 104
Newberg, OR 97132
(503) 554-2372