EXAMINATION OF THE FACTOR STRUCTURE AND AGREEMENT OF THREE QUESTIONNAIRES FOR IDENTIFYING YOUNG CHILDREN AT RISK FOR AUTISM SPECTRUM DISORDERS

by

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DISSERTATION ABSTRACT

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Title: Examination of the Factor Structure and Agreement of Three Questionnaires for Identifying Young Children at Risk for Autism Spectrum Disorders

The factor structure and agreement among commonly used questionnaires for identifying children at risk for developmental disability and autism spectrum disorders between the ages of 36 and 66 months were studied. The Age and Stages Questionnaires (ASQ), the Ages and Stages Questionnaire: Social Emotional (ASQ: SE), and the Social Communication Questionnaires (SCQ) were examined and compared in their ability to identify developmental disability and autism spectrum disorders (ASDs) in young children. The results showed the classification agreement of the ASQ was superior to the ASQ: SE and the SCQ. In addition, the factor structure of the ASQ appeared more theoretically grounded in comparison to the SCQ and the ASQ: SE. The results of the factor structure and agreement analysis indicate that the ASQ can be used to identify children at risk for developmental disability and ASDs. In addition, the ASQ: SE and the SCQ had strong agreement with a diagnosis of ASDs in young children, indicating that the ASQ: SE or the SCQ can also be used to identify children at risk for developmental disability and ASDs. Limitations of the current study and directions for future studies are discussed.

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CHAPTER I

INTRODUCTION

In the 1940s, the American psychiatrist Leo Kanner identified a syndrome of atypical behaviors manifested by 11 children in his laboratory. These behaviors included: (a) lack of communication skills, (b) social isolation, (c) echolalia, (d) resistance to change, and (e) overselectivity. The unique constellation of these behaviors led Kanner to coin the term "autism"; he chose this term because it described the self-contained behavior of these 11 children. Today we think of Kanner as the "father" of autism disorders because of his work to identify and name the syndrome.

According to Volkmar and Klin (2005), Kanner laid responsibility for the cause of autism disorders on the relationship between parents and their children. The assumption was that autism is an inborn and dormant disorder, and that parents exacerbate the symptoms of autism disorders in their daily interactions with their children. In the 1950s, Bruno Bettelheim hypothesized that the passive relationship between the mothers and their children was the cause of autism. Bettelheim coined the term "refrigerator mother" to describe the passive relationship between the mothers and their children.

Although the argument about the cause of autism disorders began in the 1940s, autism disorders became widely recognized by professionals only in 1980 upon the publication of the third edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM). The DSM-III corrected the common misconception that autism disorder was a special case of schizophrenia as it was described in the DSM-II; the DSM-III clearly distinguished between these disorders by stating that patients with autism are

born with the disorder, while schizophrenic patients develop the symptoms of schizophrenia later in life (Volkmar & Klin, 2005). The DSM-III was critiqued on several issues, such as including residual infantile autism as one of the PDD sub-disorders and for the multi-axial placements of disorders. The DSM-III-R was published as an attempt to modify and correct flaws in the DSM-III; however, Hyman (2011) states that later editions of the DSM inherited an inaccurate classification of disorders, and he emphasizes the importance of conceptualizing disorders as spectra. The term "spectrum" should be incorporated in the DSM-V because it is the currently accepted way to view autism disorders (Hyman, 2011; Johnson & Myer, 2007). For instance, children with autism spectrum disorders (ASDs) demonstrate a wide range of social skills, intellectual abilities, and communication fluency (Johnson & Myer, 2007); acknowledging these skills might contribute to finding a good fit intervention when developing individualized interventions that meet the needs of these children.

To summarize, Kanner directed the world's attention to the symptoms of ASDs, but it was not until the 1980s, with the publication of DSM-III, that professionals became widely familiar with the symptoms. Because children with ASDs show a wide range of skills, the new view of this disorder endorses the spectrum perspective in terms of the abilities of those with ASDs. Although the symptoms of ASDs are listed in DSM, the cause of ASDs still remains debatable (Johnson & Myers, 2007; Lee, Marvin, Watson, Piggot, Law, Law, Constantino, & Nelson, 2010).

Etiology of ASDs

DSM-IV-TR (2000) indicated that the cause of ASDs was unknown; however, there have been attempts to identify the factors that might cause ASDs and that increase

the risk of developing the symptoms. For instance, a few findings have linked advanced paternal or maternal age to the risk factors of having a child with ASDs, while other studies have emphasized environmental factors (Johnson & Myer, 2007; Matson & Spies, 2010).

Yet other studies have linked the cause of ASDs to a certain gene. Numis, Major, Montenegro, Muzykewicz, Pulsifer, and Thiele (2011) studied the prevalence of ASDs in patients with tuberous sclerosis complex (TSC). One hundred and three participants were recruited and their records were examined by a neurologist to investigate this association. Tools such as electroencephalography (EEG), magnetic resonance imaging (MRI), and TSC mutational analysis were utilized. 41 (40%) had ASDs; patients with ASDs and TSC had lower IQs and higher frequencies of seizure periods than those without ASDs (Numis et al., 2011).

Other studies have focused on brain development of ASDs and have examined possible links between ASDs and a malformation in the brain (Halsey & Hyman, 2001). For instance, Kulesz, Lukose, and Stevens (2011) found a malformation of the superior olivary complex (SOC) in patients with ASDs. The SOC nuclei in patients with ASDs were found to be fewer in number and smaller in size in comparison to those of typical people; however, the number of participants was too small to generalize such a result as only 13 participants were recruited for the study. Furthermore, Pelphrey and Carter (2007) found intriguing evidence about the abnormal development areas in ASDs located in the amygdala, superior temporal sulcus, and fusiform gyrus.

In summary, ASDs are a complex, sometimes heritable disorder with genotypic and phenotypic aspects. Although some studies have revealed results that point to the

possible biological origins of ASDs, the main causes of ASDs are still unknown (Johnson & Myer, 2007; Pelphrey & Carter, 2007). However, the prevalence of ASDs is documented in the DSM-IV and in several studies (Centers for Disease Control and Prevention [CDC], 2012; Fombonne, 2005; Matson, Fodstad, & Dempsey, 2009).

Symptoms and Prevalence of ASDs

ASDs are the primary disorders within pervasive developmental disorders (PDDs), which include autistic disorder, Rett's disorder, childhood disintegrative disorder, Asperger's syndrome, and pervasive developmental disorder not otherwise specified (PDD-NOS). In general, PDDs are characterized by (a) impairments in social communication and in communication skills, (b) repetitive behaviors, and (c) lack of interest in environmental stimuli. Children or adults diagnosed with PDDs show qualitative impairments in social and communication skills, which range from severe deficits to near-typical ability; however, their skills often deviate from their chronological and mental ages. Patients diagnosed with one of the pervasive developmental disorders might also have intellectual disabilities; hence, these patients are also diagnosed on Axis II of the DSM-IV. Some patients diagnosed with one of the pervasive development disorders might also have a concomitant medical condition, which is described on Axis III.

The symptoms of ASDs usually manifest prior to the age of three, with qualitative impairments in both social and communication skills along with stereotypic behaviors. According to the DSM-IV-TR (2000), children with ASDs sometimes do not have a period of normal development before expressing the symptoms of ASDs. Children with ASDs often show a lack of interest in socializing with people and making

friendships with peers, and are often oblivious to the people around them. Their verbal and nonverbal communication skills are limited, characterized by echolalia, abnormal pitch and intonation, and incorrect grammatical structure and word stress. In regards to the stereotypic behaviors, children with ASDs resist changes in their environment and maintain sameness in performing skills, and often show repetitive behaviors such as finger flicking or hand clapping. In short, symptoms of ASDs are reported in the DSM and a great number of studies, but the prevalence of this disorder has been a contentious topic.

Accurate reporting of the prevalence of ASDs in children assists healthcare professionals in accommodating and improving their treatments (Avchen, Wiggins, Devine, Braun, Rice, Hobson, Schendel, & Yeargin-Allsopp, 2011). Inconsistent findings on the prevalence of ASDs have been found (Avchen et al., 2011; Johnson & Myers, 2007). Some studies have shown the median prevalence is five cases per 10,000, while other studies have shown two to 20 cases per 10,000. Recently, the Centers for Disease Control and Prevention initiated a project entitled *Autism and Developmental Disabilities Monitoring Network* (ADDMN). According to the 2000 ADDMN report, the prevalence of ASDs in 8-year-old children in the United States is 1 in 150 or 6.5 per 1,000. According to CDC (2012), the prevalence of ASDs is 1:88 in the United States. In Canada, a survey revealed that the overall prevalence of PDD in the general population was 6.5 per 1,000 persons; the rate of ASDs was 2.2 per 1,000; the rate of Asperger's syndrome was 1.0 per 1,000; and the rate of PDD-NOS was 3.3 per 1,000 (Fombonne, 2003). In the United States, the prevalence of ASDs in males is 6.5 times higher than in females. High functioning children with ASDs are also more commonly male than

female, with ratios of 6:1 and 15:1, respectively (Fombonne, 2005). Some studies have pointed to the difficulty of diagnosing girls with ASDs at early ages; later, during middle school, their symptoms become clearly identifiable as those of ASDs. Preschool girls with ASDs usually have higher social skills and intellectual ability than boys, which may mask the symptoms of ASDs (Filipek, Accardo, Baranek, Cook, Dawson, Gordon, Gravel, Johnson, Kallen, Levy, Minshew, Prizant, Rapin, Rogers, Stone, Teplin, Tuchman, & Volkmar, 1999).

Studies have indicated that the prevalence of ASDs has increased since the 1990s; the rate of increase was between 0.4 and 0.5% per 1,000 in children younger than eight years old, from 4.2 to 12.1 per 1,000 among 8-year-old children, with an average prevalence of 9.0 per 1,000 across 11 US communities. The reasons for non-agreement upon the prevalence of ASDs in a population could be related to the sample size of the epidemiologic studies and the sources of information, such as the registries, administrative databases, or multi-source record reviews of health and education records. In other words, estimation of an accurate prevalence of ASDs requires the investigation of several sources of information.

In summary, ASDs are the major types of the pervasive developmental disorders and are recognized by qualitative impairments in social communication and communication skills along with stereotypic behaviors. Debate is ongoing about the prevalence of ASDs; however, studies have emphasized the importance of early intervention, which ameliorates the symptoms of ASDs and increases the chance of successful engagement in society.

Early Intervention

A few definitions have been provided to explain the principles of early intervention (EI) (Heward, 2003) for improving developmental outcomes in young children. For instance, EI has been defined as a wide array of components including educational, nutritional, childcare, and family support programs that reduce and prevent the risk of disabilities adversely impacting the lives of children (Heward, 2003). EI consists of:

> Home- and classroom-based efforts that provide (1) compensatory or preventative services for children who are assumed to be at risk for learning and behavior problems later in life, particularly during the elementary school years, and (2) remedial services for problems or deficits already encountered… simply put, early intervention must provide early identification and provision of services to reduce or eliminate the effects of disabilities or to prevent the development of other problems, so that the need for subsequent special services is reduced (Heward, 2003, p. 162).

The demonstration of EI services started in university settings and then spread across the nation during the 1960s and the 1970s (Guralnick, 2005). Initially, services were provided to children with disabilities, but a perspective shift occurred that led to designing preventive programs for children at risk for disability. According to Guralnick (2005), EI services reduce the effects of disabilities on children who are at risk. The awareness about EI services and proliferation of EI services is related to factors including: (a) societal views of EI; (b) the flexibility of young children's brains in their early years; (c) importance of early experience for children; and (d) the promising and

positive results of EI (Guralnick, 2005; Heward, 2003; McBride & Schwartz**,** 2003; Sandall et al., 2006).

Evidence-based practices (EBPs) have been adopted by EI (Guralnick, 2005); "applying scientifically based findings to facilitate systemic changes, related to the provision of services to children with disabilities, in policy, procedure, practice, and the training and use of personnel" (Public Law 108-446-DEC. 3, 2004, 118 Stat, p. 2781). No Child Left Behind also emphasized the use of EBPs with students with special needs (Odom, Klingenberg, Rogers, & Hatton, 2010). EBPs that have been used and reported as effective for children with ASDs included modeling, pivotal response training, and discrete trial teaching (Odom et al., 2010; Delano, 2007).

The effects of early intervention and EBPs on the life of children with ASD have been documented in a number of studies (Green, 1996; Koegel, Koegel, Nefdt, Fredeen, Klein, & Bruinsma, 2005). For instance, studies have shown that early intervention boosts the social, communication, behavioral, and cognitive skills of children with autism (Adrien, Deletang, Martineau, Couturier, & Barthelemy, 2001; Barbaro, & Dissanayake, 2010; Barbaro, & Dissanayake, 2010; Scheffer, Didden, Korzilious, & Sturmey, 2011). Also, several studies have demonstrated that early intervention increases the parental involvement in their children's schools and rights (Bailey, Raspa, Olmsted, Novak, Sam, Humphreys, Nelson, Robinson, & Guillen, 2011; Conyers et al., 2003). Although early intervention programs are effective, identification of some disorders is still a challenging task. The late identification of some disorders might abate the potentials of early intervention (Crane & Winsler, 2008).

In summary, integrating EBPs in the process of EI increases the positive outcomes of EI; however, the first step toward entry into the EI system is screening (Guralnick, 2005); screening is defined as a brief assessment process that identifies children in need of further assessment (Bailey, 2004). Screening provides information about the general skill level of children. If their development is at risk, they are referred for further assessment. Many screening instruments have been widely used to identify children who are at risk for ASDs (Matson & Spies, 2010), but there have been inconsistent results about the psychometric properties and utilities of these screening tools (Matson & Spies, 2010; Volkmar & Klin, 2005).

Importance of Early Screening and Identification

Early identification and intervention have impacts on several aspects of life for children at risk for disability. Because of the high cost of special education programs, research has focused on reducing the cost of special education programs through early identification and intervention (Conyers Reynolds, & Ou, 2003; Gupta, Hyman, Johnson, Bryant, Byers, Kallen, Levy, Myers, Rosenblatt, & Yeargin-Allsopp, 2007). The cost of special education programs is double that of general education programs; the cost of special education programs was 31.8 billion of the national expenditures for K-12 public education from 1995 to 1996 (Conyers et al., 2003). Another finding about the cost of special education programs showed that one-fifth of the total educational budget is designated for special education (Hanushek, Kain, & Rivkin, 2007).

The American Academy of Pediatrics (2001) suggested a surveillance approach to identifying children at risk for disability early on. The name of this approach was is the *Surveillance Screening Algorithm*. This algorithm is based on three concepts:

surveillance, screening, and evaluation. Surveillance is defined as the ongoing process of identifying children at risk for disability. Screening is defined as the use of concise standardized instruments to sort children at risk for disability from those who are not at risk. Evaluation is defined as a thorough examination that is given to children at risk for disability to identify certain disabilities or health issues. As is obvious from these definitions, the *Surveillance Screening Algorithm* is a two-level system that begins with screening and ends with evaluation (Johnson & Myers, 2007). This system is implemented at pediatric clinics, but it can misidentify some children at risk for two obvious reasons. The first reason is that this system is utilized with children only until the age of 30 months, and the second reason is related to the psychometric properties of some screening tools (Cupta et al., 2007).

ASDs are an example of disorders that manifest prior to the age of 36 months; however, the identification of children with ASDs prior to the age of 36 months is challenging because the symptoms reported in the *DSM-IV-TR* do not always manifest until the age of three. In addition, information about the pattern of development of infants and infants with ASDs is limited (Crane & Winsler, 2003). According to Gupta et al. (2007), the average age at which ASDs are diagnosed in the U.S is about 36 to 48 months. The late diagnosis is due to several factors; one of these factors is pediatricians' hesitation to inform families about their children's condition (Koegel et al., 2005).

Parent-completed developmental questionnaires have been an effective method for identifying children with special needs (Skellern, Rogers, & O'Callaghan, 2001; Squires, Bricker, & Twombly, 2004). For instance, the Ages and Stages Questionnaires (ASQ) have shown excellent psychometric properties in identifying children at risk for

disability (Hix-Small, Marks, Squires, & Nickel, 2007). In addition, the ASQ has been recommended in identifying children at risk for ASDs (Hix-Small, 2007). The ASQ has been utilized across different cultures ("Council on Children with Disability," 2006). The ASQ: Social Emotional (ASQ: SE) is another tool used to measure the competency of social emotional skills in children aged from 6 to 66 months and is recommended by the AAP and other professional organizations.

Although both the ASQ and the ASQ: SE have been recommended to screen for developmental delay and social emotional respectively, the domains and content of the ASQ and the total score of ASQ: SE could be utilized to identify children problematic skills in children at risk for ASDs. Therefore, there is a need to investigate the use of the ASQ and the ASQ: SE in identifying children with ASDs. Such an investigation requires the agreement between the ASQ and ASQ: SE to be calculated with a well-designed instrument for identifying children at risk for ASDs. An instrument such as the Social Communication Questionnaire (SCQ) has shown excellent psychometric properties in terms of sensitivity and specificity for ASD identification (Johnson, Hollis, Hennessy, Kochhar, Wolke, & Marlow, 2007; Rutter, Bailey, & Lord, 2007). In addition, the items of the SCQ are derived from a gold standard instrument for ASDs, which is the Autism Diagnostic Interview-Revised (Rutter, et al., 2007).

In summary, early identification and the issues of the psychometric properties of ASD screening instruments and their utilities are addressed. These issues led to the establishment of a rationale for exploring the utilities of ASQ and ASQ: SE with children with ASDs. The accuracy of the questionnaires' results will be explored, based on their

agreement with the Social Communication Questionnaire already used with children with ASDs.

CHAPTER II

LITERATURE REVIEW

Research in autism spectrum disorders (ASDs) has made significant advances towards designing interventions and differentiating between ASD symptoms and those of other disorders. However, with young children, differentiating between ASD symptoms and those of other disorders, particularly Asperger Syndrome, continues to pose a challenge to professionals (Ventola, Kleinman, Pandey, Wilson, Esser, Boorstein, Mathieu, Marshia, Barton, Hodgson, Green, Volkmar, Chawarska, Babitz, Robins, & Fein, 2007). The available assessment instruments make such differentiation even harder (Matson & Spies, 2010; Ventola et al., 2007).

This literature review chapter begins with an introduction to ASDs, addressing their history and conceptualization across different editions of the *Diagnostic and Statistical Manual of Mental Disorders* and their prevalence and etiology. A discussion of the importance of early intervention, in particular its benefits for children with ASDs, follows. Next comes a discussion of the importance of quality assessment instruments, specifically the importance of developmental screening in the identification of children with ASDs and issues related to the currently used screening tools for ASDs. The chapter concludes with a discussion of the psychometric properties of the Ages and Stages Questionnaires (ASQ), the Ages and Stages Questionnaires: Social-Emotional (ASQ: SE), and the Social Communication Questionnaire (SCQ), and research questions related to the use of these screening tools on a sample of children with ASDs.

The developmental, behavioral, and transactional perspectives are the philosophical framework of this research, which embraces the practice of the

surveillance-screening algorithm presented by the American Academy of Pediatrics (AAP, 2001), and focuses on comparing two level I screening instruments (i.e., ASQ and ASQ:SE) with a level II screening instrument, the SCQ. Descriptions of this philosophy, practice, and their supporting literature are provided.

Autism Spectrum Disorders

History of Autism Disorders

The history of autism disorders is underscored by Leo Kanner's seminal work in the 1940s, which directed the world's attention to a discrete syndrome as expressed by 11 children in his laboratory. Thus, Leo Kanner is considered the "father" of autism disorders (Filipek, Accardo, Baranek, Cook, Dawson, Gordon, Gravel, Johnson, Kallen, Levy, Minshew, Prizant, Rapin, Rogers, Stone, Teplin, Tuchman, & Volkmar, 1999; Johnson & Myers, 2007; Volkmar & Klin, 2005). Kanner reported that these children lacked social and language skills and resisted environmental changes in their daily routines (Johnson & Myers, 2007; Matson & Neal, 2009). To describe these 11 cases, Kanner coined the term "autism." His explanation of these children's behaviors was that some children are born with an inability to interact with people and the environment. This explanation contradicts Gesell's hypothesis that all children are born with the ability to socialize and show interest in their environments (Volkmar & Klin, 2005). In 1908, well before Kanner's work, Theodor Heller reported children showing behaviors similar to the symptoms reported by Kanner. Heller labeled these children, whose ages ranged from three to 10, with progressive dementia. These children showed the following behaviors: (a) withdrawn helplessness, (b) challenging behaviors, (c) immature behaviors, (d) tics,

(e) stereotypic behaviors, and (f) an inability to communicate (Matson & Neal, 2009; Wolff, 2004).

Kanner borrowed the term "autism" from the published work of psychoanalysts, but he applied the term to the socially-isolated behaviors manifested by particular children (Volkmar & Klin, 2005). The assumption was that autism is a type of childhood schizophrenia, but in 1943, Kanner drew a border between the symptoms of childhood schizophrenia and those of autism disorders. According to Kanner, the main distinction is that children with autism disorders are born with the symptoms of the disorder, while children with schizophrenia are born with typical behaviors, with the symptoms of schizophrenia manifesting later in life (Volkmar & Klin, 2005; Wolff, 2004).

Social isolation, dysfunction in communication, resistance to change, echolalia, and over-selectivity were the symptoms of autism reported by Kanner (Hall, 2009; Volkmar & Klin, 2005). These symptoms were incorporated into the *Diagnostic and Statistical Manual of Mental Disorders* (DSM), but Kanner's explanation of the main cause of autism disorders was rejected by a large number of studies (Hallahan & Kauffman, 2006; Hall, 2009; Heward, 2003). Both Kanner in the 1940s and Bruno Bettelheim in the 1950s agreed that the relationship between parents and their children was the cause of the autism disorders. In the 1950s, Bettelheim introduced the term "refrigerator mother" to portray the passive relationship between the mother and her child; however, studies have since demonstrated that parents' relationships with their children could not cause autism disorders (Hall, 2009; Heward, 2003; Volkmar & Klin, 2005; Wolff, 2004).

In 1943, Kanner measured the intellectual abilities of children with autism disorders, and the results indicated that children with autism disorders were functionally retarded; however, this notion has not been supported by recent findings on the intellectual abilities of children with autism, which indicate that the intellectual disabilities of these children can range from mild to profound disability (American Psychiatric Association, 2000). Therefore, Johnson and Myers (2007) suggested replacing the term autism disorders with autism spectrum disorders (ASDs) in order to include the wide range of abilities and skills demonstrated by children with ASDs.

In summary, even though his assumptions and hypotheses of both the cause of ASDs and the intellectual abilities of those who have ASDs are not supported by recent literature, Kanner contributed to the identification and diagnosis of ASDs. Both Kanner's contributions and the recent findings on ASDs have affected how professionals view ASDs. The change in the name and symptoms of ASDs is documented in the DSM. Over time, different editions of the DSM have shown dramatic changes in the classification and symptoms of ASDs.

ASDs in the Diagnostic and Statistical Manual of Mental Disorders (DSM)

Diagnosticians, psychologists, pediatricians, and others have examined the symptoms of ASDs listed in the DSM and have suggested changes. These changes in the conceptualization of the symptoms of ASDs are clearly documented in subsequent editions of the DSM. The term "autism disorder" was first introduced as a subtype of schizophrenia in the DSM-II, then later on as a subtype of pervasive developmental disorders in the DSM-III; since that time, the symptoms, prevalence, and etiology of

ASDs have undergone editing and examination. In this study, the history of ASDs was traced from the publication of the DSM-III.

DSM-III

Although Kanner introduced the term autism in 1943, it was not until the publication of the DSM-III in the 1980s that professionals became widely familiar with autism disorders. The DSM-III introduced the term autism as one of the sub-disorders of pervasive developmental disorders. In the 1980s, pervasive developmental disorders encompassed a number of disorders: (a) autism disorders, (b) childhood onset pervasive developmental disorders, (c) residual infantile autism disorders, and (d) pervasive developmental disorders. The DSM-III corrected the common misconception that an autism disorder was analogous to schizophrenia; it clearly distinguished between these disorders by stating that patients with autism are born with the disorder, while schizophrenic patients develop schizophrenia later in life (Volkmar & Klin, 2005, Wolff, 2004).

The DSM-III introduced the concept of multiaxial placements (American Psychiatric Association, 2000; Hyman, 2011). Under multiaxial placements, a disease or disorder was classified as either: (a) Axis I, mental retardation; or (b) Axis II, multiaxial system (American Psychiatric Association, 2000). While this contributed to the reliability of diagnoses of mental disorders, it contradicted the general medicine perspective, which held that disorders present along a continuum. The DSM-III treated all disorders as either present or absent.

Although the DSM-III clarified several issues regarding autism disorders (Filipek et al., 1999; American Psychiatric Association, 2000; Hyman, 2011), it was criticized for

several other issues. For instance, critics did not support including the childhood onset pervasive developmental disorder (PDD), which was one of the PDD sub-disorders used to refer to children who developed the symptoms of autism by the age of 30 months (Volkmar & Klin, 2005). In addition, the DSM-III was criticized for identifying residual infantile autism as one of the PDD sub-disorders. Moreover, these critics did not support including residual infantile autism in the DSM-III (Volkmar & Klin, 2005).

DSM-III-R

The DSM-III-R contained major changes in the classification of ASDs. These changes led clinicians to re-diagnose their patients in order to remain up-to-date (Volkmar & Klin, 2005). This diagnosis had a broader view than that of the DSM-III, with three major symptoms: (a) qualitative impairment in social interaction, (b) qualitative impairment in communication, and (c) repetitive behaviors. In other words, the 16 symptoms adopted in the DSM-III were regrouped under three major symptoms in the DSM-III-R. Diagnosticians used to identify a child with autism if he or she manifested eight out of the 16 symptoms reported in the DSM-III-R. The words "qualitative impairment" have been incorporated in the DSM to indicate that the child with ASDs is not necessarily lacking skills (American Psychiatric Association, 2000; Johnson & Myer, 2007; Volkmar & Klin, 2005).

The DSM-III-R dropped the onset of disorders, and no consideration of the patient's age was given during the diagnostic process. Therefore, in the DSM-III-R, the historical record was not as important as it had been in the DSM-III. Childhood onset pervasive developmental disorders and residual infantile autism were also removed from the DSM-III-R. Those children who did not meet the criteria of autism were diagnosed

with PDD-not otherwise specified (PDD-NOS). The critics of the DSM-III-R mentioned that the rate of false negative identification was around 40% because of the broad view of diagnosis and the examples of cases provided. These case examples made the diagnostic process difficult by limiting professional judgment about cases that might not fit the provided example. Because the onset of disorders was not considered, children were over-diagnosed with autism disorders (Volkmar & Klin, 2005). The DSM-IV and the DSM-IV-TR modified several issues and corrected several of the DSM-III-R's flaws.

DSM-IV and DSM-IV-TR

The multiaxial placements of disorders were refined and introduced in this edition. The new multiaxial placements were: (a) the axis I clinical disorders, (b) the axis II personality disorders and mental retardation, (c) the axis III general medical conditions, (d) the axis IV psychosocial and environmental problems, and (e) the axis V global assessment of functioning (American Psychiatric Association, 2000). In addition, ASDs remained a sub-disorder of PDD. The disorders comprised under the classification of PDD are summarized in Table 2.1.

The DSM-IV-TR inherited a potentially inaccurate classification of disorders from the DSM-III; the categorical view of disorders (i.e., disorder either present or absent) continued to be acceptable in the DSM-IV-TR (Hyman, 2011; Volkmar & Klin, 2005). The DSM-IV-TR complicated the diagnostic process by adding a number of new sub-disorders to main disorders, including schizophrenia or depression. According to Hyman and Fenton (2003), adding subtypes of disorders and revising the definitions of these disorders might not contribute to the accuracy of diagnoses. In the DSM-V (Hyman, 2011), based on advancements in neural and genetic research, disorders will be

classified as existing along spectra; in other words, disorders might manifest at varying intensities.

In summary, the list of ASD symptoms has been revised, edited, and documented in the DSM. These changes on the view of ASD symptoms led to the development of assessment tools that possess sound psychometric properties. Furthermore, these assessment instruments have contributed to an increase in the reported prevalence of ASDs (Johnson & Myers, 2007).

Table 2.1. Disorders Classified under PDD

Disorder	Onset	Ratio male: female	Familial pattern	Causes	Major Symptoms
Autism	Prior to 3 years old	4:5	Spread in siblings and affect siblings' behaviors	Multifactorial	Qualitative impairment in social interaction**,** qualitative impairment in communication**,** and restricted interests, stereotyped and repetitive behaviors
Rett	Prior to four years old	Only affects females	Unknown	Mutation in chromosomes	Normal development, regression on all acquired skills, and shrinkage in the head's circumference
Childhood disintegrative	Prior to 10 years old	Extremely rare but common among males	Unknown	Unknown	Normal development in the first two years, regression in acquired skills, qualitative impairment in social interaction, qualitative impairment in communication, restricted interests, and repetitive and stereotyped behaviors
Asperger	Prior to three years old	5:1	Risk of Asperger or autism in siblings	Multifactorial	Qualitative impairment in social interaction, restricted interests, stereotyped and repetitive behaviors, and no intellectual disabilities
PDD-NOS	Late onset	No record	No record	Multifactorial	Children receive this diagnosis if they meet one of the aforementioned disorders

Prevalence of ASDs in the Population

The prevalence of autism spectrum disorders (ASDs) has increased during the last few decades and is attributed to a variety of factors: (a) reliable screening tools, (b) pediatricians' attention to early identification, (c) media focus on the issue, and (d) the introduction of a new view of autism as a spectrum disorder (Hall, 2009; Johnson & Myers, 2007). All of these factors have resulted in an increased public awareness of the symptoms of ASDs. Because of their growing familiarity with the symptoms of ASDs, families are better able to advocate for their children with autism to receive appropriate educational services (Johnson & Myers, 2007).

Some pediatricians held the belief that ASDs were an invalid classification. Therefore, the American Academy of Pediatrics adopted the goal of familiarizing pediatricians with recent findings and increasing their awareness of early identification in three documents: (a) "Autism A.L.A.R.M," (b) "Is Your One-Year-Old Communicating with You?" and (c) "Understanding Autism Spectrum Disorders." "Autism A.L.A.R.M" underscores the prevalence of ASDs screening, the importance of parents' concerns about their children, and refers parents to specialists for further diagnoses. "Is Your One-Year-Old Communicating With You?" covers the importance of early identification of social communication impairment and encourages parents to share their concerns about their children's development. "Understanding Autism Spectrum Disorders" is designed to increase parents' understanding of ASDs (Johnson & Myer, 2007).

In the 60 years following pediatrician Kanner's coining of the term "autism," the prevalence of ASDs in the United States was 6:1000 persons (Filipek et al, 1999; Johnson & Myer, 2007). In 2000, the Centers for Disease Control and Prevention initiated a

project entitled *Autism and Developmental Disabilities Monitoring Network* (ADDMN). According to the 2000 ADDMN report, the prevalence of ASDs in 8-year-old children in the United States was 1 in 150 or 6.5 per 1,000. This rate of prevalence was confirmed by the National Autism Center (National Autism Center, 2009). In Canada, a survey of autism revealed that the overall prevalence of PDD in the general population was 6.5 per 1,000 persons; the rate of ASDs was 2.2 per 1,000, the rate of Asperger disorder was 1.0 per 1,000, and the rate of Pervasive Developmental Disorder Not-Otherwise Specified 3.3 per 1,000 (Fombonne, 2003). In the United States, the prevalence of ASDs in males was 6.5 times higher than in females. High functioning ASDs were also more common in males than in females, with ratios of 6:1 to 15:1, respectively (Fombonne, 2005). In addition, 21 to 25% of preterm children showed positive screening results for ASDs (Johnson, Hollis, Hennessy, Kochhar, Wolke, & Marlow, 2011). Other findings showed that the rate of ASDs in the U.S. is 1:96, in Australia 1:160, and in the United Kingdom 1:100 (Barbaro & Dissanayake, 2010). In short, the increase in the rate of ASDs could be attributed to the familiarity of professionals with the symptoms of ASDs, as one factor among many (Koegel, Koegel, Nefdt, Fredeen, Klein, & Bruinsma, 2005; Shevell, Majnemer, & Oskoui, 2005).

ASDs have become a common disorder in pediatric clinics; the prevalence rate of this disorder exceeds other disorders or illnesses such as Down syndrome, diabetes, spina bifida, and cancer (Attwood, 2008). The prevalence rate indicates that between 60,000 and 115,000 children under the age of 15 have been diagnosed with ASDs in the U.S. (Filipek et al, 1999). ASDs are more common in males than in females, with a ratio of 3:1 and 4:1, respectively. The ratios change to 2:1 or 4:1, respectively, if the children have

low IQs (American Psychological Association, 2000). Some girls are misidentified as autistic because of their poor social skills. Although the symptoms of ASD manifest before a child is three years old, the diagnosis is not often given to children at the age of 2 or 3 years. The late diagnosis is due to several factors; one of these factors is pediatricians' hesitation to inform families about their children's condition.

The prevalence of ASDs varies across countries (Barbaro & Dissanyake, 2010). For instance, the rate of ASDs has been reported differently in the United Kingdom than in the U.S. A survey about the early diagnosis of autism in the United Kingdom showed that the average age of children who received a diagnosis was six years (Howlin & Moore, 1997). British parents of autistic children reported that professionals rarely listened to their concerns regarding their children's development. Ten percent of children with ASDs in England received a diagnosis of autism during their first visit to pediatric clinics, while ninety percent of children with ASDs received a diagnosis at an average age of 40 months. Ten percent of the parents were told by their children's pediatricians not to worry, although the parents expressed concerns about their children's development (Howlin & Moore, 1997).

In summary, the prevalence of ASDs has increased in the last 60 years. Several factors have contributed to the increased prevalence of ASDs; examples of these factors are media and parental awareness of the symptoms of ASDs. Although ASDs have become a common disorder, its cause is still unknown (Attwood, 2004; Halsey & Hyman, 2001).

Etiology of ASDs

ASDs are a complex, heritable disorder with genotypic and phenotypic aspects (Hertz-Picciotto, Croen, Hansen, Jones, Water, Pessah, 2006; Lee, Marvin, Watson, Piggot, Law, Law, Constantino, & Nelson, 2010). Although studies have revealed results regarding genetic factors that might contribute to the causes of ASDs, the causes of ASDs are multi-factorial.

According to Johnson and Myers (2007), some findings have demonstrated that advanced paternal or maternal age is a feasible cause of ASDs in terms of de novo spontaneous mutations or changes in genetic imprinting. Although studies emphasize the genetic causes of ASDs, such studies do not neglect environmental factors (Matson & Spies, 2010). Research into the genetic causes of ASDs indicates that changes in gene expression occur without changes in the DNA sequence (Johnson & Myers, 2007; Matson & Spies, 2010).

Two approaches have been utilized in testing the genetic bases for ASDs. The first approach focuses on testing a hypothesis about the pathogenesis of ASDs (e.g., testing neurotransmitter functions). The second approach examines the genes of family members who have a child with autism; the unaffected children are not included in the genetic testing. Some studies examining genetic causes have revealed promising findings that abnormality could exist in every chromosome of children with autism. In addition, children with autism might maternally inherit the chromosome but dysmorphic features do not appear in the child (Johnson & Myer, 1999).

Some ASDs could be idiopathic, which means that the cause of autism remains undefined (Lee et al., 2010). ASDs also could be secondary to an identified medical

diagnosis or syndrome (Johnson & Myer, 2007). However, only 10 to 20% of people with autism have been diagnosed with a comorbid syndrome, and recent findings show that fewer than 10% of people with ASDs have a comorbid condition (Johnson & Myer, 2007). However, a survey in a Finnish sample revealed that the prevalence of comorbid disorders was 74 to 84% among 50 participants with high functioning ASDs (Mattila, Hurting, Haapsamo, Jussila, Gauffin, Kielinen, Linna, Ebeling, Bloigu, Joskitt, Pauls, & Moilanen, 2010). The generalization of this particular finding is challenging because of the small sample size and its contradiction with recent findings reported in the Journal of American Academy of Pediatrics and DSM (Filipek et al, 1999; Johnson & Myer, 2007; Rosenthal & Rosnow, 2008; Shadish, Cook, & Campbell, 2002).

Studies from the 1990s showed intellectual disabilities are associated with 90% of the children with ASDs (e.g., CDC, 2007; Johnson & Myer, 2007; Yeargin-Allsopp, Rice, Karapurkar, Doernberg, Boyle, & Murphy, 2003). According to CDC (2007), the 90% rate of coexisting intellectual disabilities in autistic children is not accurate; newer, more accurate methods of testing intellectual abilities have disproved this high rate (Bryson & Smith, 1998; Johnson & Myer, 2007). Bryson (1996) found that 25% of 14- to 20-year-old people with intellectual disabilities had ASDs.

Some studies have shown that certain disorders are associated with autism. For instance, 30 to 40% of children with fragile X syndrome demonstrate some symptoms of autism (Johnson & Myer, 2007; Volkmar & Klin, 2005). The main characteristics of fragile X syndrome are: (a) macrocephaly, (b) large pinnae, (c) low muscle tone, (d) joint hyperextensibility, and (e) large testicles. In addition, neurocutaneous disorders are associated with ASDs. Neurocutaneous disorders include phakomatosis and tuberous

sclerosis, affecting the nervous system, resulting in eye and skin tumors and lesions. Some children identified with tuberous sclerosis show characteristics of children with autism. Phenylketonuria used to be associated with ASDs, but due to early identification and intervention, the association is rare. Fetal alcohol syndrome, caused by exposure to alcohol during pregnancy, might cause ASDs. Angelman syndrome is a disorder that is identified by imprinting errors, uniparental disomy, and the ubiquitin protein ligase gene on chromosome 15q, and is associated with ASDs. Another disorder associated with ASDs is Smith-Lemi Optiz syndrome. Smith-Lemi Opitz syndrome is a rare disorder caused by a metabolic error in cholesterol biosynthesis.

Although there are some findings about genetic causes of ASDs, these findings have remained unsatisfactory because of small sample sizes (Lee, 2010; Johnson & Myers, 2007). For instance, some findings have shown associations between ASDs and the following genes: (a) CDH10 and CDH9 at 5p14.1, (b) SEMA5A on chromosome 5p15, (c) A2BPI1, NRXN1B, and NLGN4 (Lee, 2010). These discoveries of genetic causes cannot be generalized because of the small sample size and heterogeneity of ASD nature.

In summary, ASDs are complex conditions related to multiple factors. Professionals from different disciplines have debated the causes. In addition, some professionals argue for the comorbidity of other medical conditions and disorders with ASDs. Because of the complexity of the disease and its perhaps multiple causes, there is a need for valid and reliable instruments for screening for ASDs (Coonrod & Stone, 2005; Heward, 2003; Richdale & Schreck, 2008).

Intervention for ASDs

The American Academy of Pediatrics has established an algorithm system, consisting of surveillance and screening algorithms to identify children with ASDs and other developmental disabilities (Johnson & Myer, 2007). This system includes two levels of screening. Level 1 takes place during a well-child visit in a pediatric clinic in which a pediatrician utilizes a developmental screening tool to detect children at risk for ASDs. Level 2 takes place when a pediatrician refers a child for further assessment and evaluation. In the Level 2 screening, ASD screening instruments are used to distinguish children at risk for ASDs from those who are at risk for other developmental disorders. Some findings have indicated that agreement between Level 1 and 2 is not high (e.g., Filipek et al., 1999).

Information gathered by assessment instruments is used to plan interventions, treatments, and education programs. Section 1414 of the Individuals with Disabilities Education Improvement Act (IDEIA) states that children with special needs must be provided with individualized education programs (IEPs). Successful IEPs are centered on the lifespan of individuals with special needs (Leblanc, Riley, & Goldsmith, 2008; Yell, 2006). Different definitions were provided to elucidate the meaning of lifespan: the needs of individuals in different contexts or environments are one of the aspects of lifespan; growth and change in individuals' characteristics are another. According to Leblanc et al. (2008), lifespan was described as the skills or needs that an individual requires at a certain moment. These aspects of lifespan should be considered when it comes to designing plans for children with ASDs. For instance, puberty is a critical time during which people with ASDs might show certain behaviors because of growth or changes in

their bodies. A survey of the pattern of behaviors that women with ASDs engage in due to late menarche showed that the average age of puberty for women with ASDs is 17 years (Knickmeyer, Wheelwright, Hoekstra, & Cohen, 2006). Furthermore, women with ASDs might have premenstrual dysphoric disorder, which causes stress due to agitation that can accompany the menstrual cycle (Lee, 2004). This life change in young women with ASDs should be addressed in their IEPs.

Some studies have investigated variables related to success in the lives of children with ASDs, specifically the impact of early identification and intervention on the quality of life of children with ASDs (Conyers, Reynolds, & Ou, 2003). A relationship between intellectual abilities and general improvement in the lives of children with ASDs has been examined (Harris & Handleman, 2000; Harris, Handleman, Gordon, Kristoff, & Fuentes, 1991). For instance, children with ASDs scoring in the high-functioning IQ range have shown better life outcomes than those children with low IQs.

Some children with ASDs identified before the age of two and exposed to early intervention show verbal language and academic skills almost equal to typical children (Green, 1996; Scheffer, Didden, Korzilius, 2011). A few studies have shown that children who received services could live independently, work, and seek higher education (e.g., Earls, Andrews, & Hay, 2009; Howlin, Goode, Hutton, Rutter, 2004). In contrast, other children with ASDs who receive services still live with their families, are not able to work, and do not pursue higher education. Therefore, outcome studies have been examining several predictors that could improve the lives of children with ASDs. Predictors such as adaptive skills, language abilities, intellectual abilities, and verbal IQ have been documented as predictors of the child's future outcomes (Baghdadli, Picot,

Michelon, Bodet, Pernon, Burstezjn, Hochmann, Lazartigues, Pry, & Aussilloux, 2006; Earls et al., 2009; Howlin et al., 2004).

Interventions are often needed to ameliorate the behaviors of children with ASDs. According to Hall (1997) and Cohen, Dickens, and Smith (2006), applied behavior analytic strategies have resulted in positive long-term outcomes for children and adults with ASDs. Most of these behavioral strategies have targeted social interaction, communication interaction, and repetitive behaviors commonly associated with the autism spectrum (Hall, 1997).

Some studies have shown that children with ASDs often do not benefit from being around their peers unless there are direct interventions to encourage children's interactions (Nikopoulos & Keenan, 2003; Maione & Mirenda, 2006). A study by Cohen, Dickens, and Smith (2006) showed that children with autism who received applied behavior analytic strategies for 35 to 40 hours per week demonstrated an average functioning IQ, mastered new skills, and increased in language initiation. However, Lovaas (2003) noted that modeling and imitation were more efficient in terms of time and effort than other behavioral analytic strategies.

Because of the debate about which interventions are effective for children with ASDs, the concept of evidence-based practices has flourished (Detrish, 2008). An example of evidence-based practice is video modeling. Some studies have demonstrated that video modeling is an effective strategy to teach children with autism various skills, such as play skills and social skills (Reagon, Higbee, & Endicott, 2006). One example is Maione and Mirenda's study (2006) conducted to assess the effectiveness of video modeling and video feedback on teaching verbal social interactions in peer play activities

for children with autism. The study results demonstrated the effectiveness of video modeling on increasing verbal and social interactions of the participants.

Several studies have demonstrated the effectiveness of video modeling, and it has been recommended as one of the evidence-based practices for ASDs (Brunson, Green, & Goldstein, 2008; National Autism Center, 2009). In addition, in a review of 19 video modeling intervention studies, Delano (2007) supported the use of video modeling, with the results corresponding to Bellini and Akullian's (2007) study. The effectiveness of video modeling in the maintenance and generalization of the acquired behaviors by children with autism was demonstrated.

In summary, using early intervention and evidence-based practices is important for bringing positive change into the lives of children with autism. In 2009 the National Autism Center examined several behavioral interventions that have been used to improve various skills for children with autism, and made recommendations based on its reviews. In addition, Matson and Sipes (2010) conducted a literature review on methods of early identification for children with autism and emphasized the importance of early interventions and their outcomes on the lives of children with autism.

Longitudinal Studies on the Lives of Children with ASDs

Some studies have shown the importance of early intervention on the lives of children with ASDs. Although the DSM states that symptoms of ASDs manifest prior to the age of three, studies have shown that children are generally diagnosed at the age of five (Wiggins, Bakeman, Adamson, & Robins, 2007). Two information sources about the trajectory of development of children with ASDs include autobiographical accounts and

clinical studies (Howlin, 2005). Clinical studies have been critiqued because of the ambiguity of their data.

Kanner's studies were among the longitudinal studies about the trajectory development of ASDs (Howlin, 2005). In 1973, he followed up on 96 children and assessed them when they were in their 20s and 30s and found that the majority of them ended up in shelters, psychiatric hospitals, family households, and institutions for learning disabilities. Other longitudinal studies have revealed some findings about the association between intellectual abilities and life outcomes of children with ASDs. For instance, Venter, Lord, and Schopler (1992) conducted a study on children with ASDs whose IQs were above 60. They found that by the age of 18, one third of the 22 participants were employed full time. In addition, the majority of these participants lived in their places of employment or special training programs.

Another study (Howlin et al., 2004) showed that children with IQs above 70 had greater outcomes than children with lower IQs; these outcomes are represented by: (a) paid work, (b) developing friendships, (c) developing meaningful relationships with the other gender, and (d) becoming self-independent. Although some studies associated IQ with life outcomes, there were some findings that individuals with ASDs who had higher IQs might still be dependent on their families and have noticeable social difficulties (Rumsey, Rapoport, & Sceery, 1985).

The scope of longitudinal studies is not restricted to the relationship between the intellectual functions or abilities and the life outcomes of children with autism; these studies have also focused on the effectiveness of early intervention programs on the life of children with ASDs. For instance, Baghdadli et al. (2007) examined the effects of

early intervention on preschoolers' achievement. They examined the development of 222 preschoolers with PDD, autism, and Asperger's disorders over a period of three years. The findings showed stability in the acquisition of communication, socialization, and object related cognition. Also, developmental regression in daily life skills and person-related cognition was observed.

Other longitudinal studies have focused on the developmental trajectory of those with ASDs. Szatmari, Bryson, Boyle, Streiner, and Duku (2009) showed that children without structural language impairment functioned better than the group with impairments. A study by Billstedt, Gillberg, and Gillberg (2011) revealed among a cohort of 108 participants with ASDs that the majority of them were dependent on their families for help in education and on accommodation in occupations.

Although these studies indicated that children with ASDs might live independently and function fully in their societies, some unclear data were also presented. More to the point, the studies did not always name the research designs they utilized. In addition, the psychometric properties of the assessment instruments were unclear in terms of validity and reliability. Thus, recalculating the reliability every time a test is administered to a target sample has recently been emphasized (Thompson, Diamond, McWilliam, Snyder, & Snyder, 2005). A variety of assessment instruments have been utilized to measure the characteristics of people with ASDs and the outcomes of their lives; more research on effective instrumentation is clearly needed.

Diagnostic Instruments for Autism Spectrum Disorders (ASDs)

Assessment

Assessment is an ongoing process of gathering information about a client regarding a certain area or skill (Mclean, 2004; Overton, 2009; Yell, 2006). Tests and assessments vary in terms of their definitions and applications. According to some definitions, a test focuses on measuring the mastery levels of performing skills while an assessment focuses on the monitoring process (Overton, 2009). Sections 1412 and 1414 of the Individuals with Disabilities Education Improvement Act 2004 (IDEIA) requires that a student must be assessed to verify whether: a) the student has an IDEIA disability, b) special education services are required, and c) needs exist that must be addressed in the student's individualized education program IEP (Yell, 2006).

IDEIA 2004 emphasizes that the purpose of assessment is to help in decision-making. These decisions include: (a) pre-referral, (b) entitlement, (c) programming, and (d) accountability or outcome decisions. For instance, classroom teachers make pre-referral decisions by assessing the student's ability, using informal tests, observations, and interviews, with the main goal to ameliorate the students' deficiencies before referring them to special education programs. Entitlement decisions identify whether or not the students are eligible to receive special education services. Therefore, some screening tools are employed to determine if students need further assessment for possible special education eligibility. Programmatic assessments are then used to write the IEP plans. Accountability or outcome decisions are part of the evaluation process of the school system.

Each decision stage involves different types of assessments. More to the point, assessment tools are used to measure a student's eligibility for services or evaluate the student's current achievement level. Section 1412 of IDEIA 2004 requires the use of a variety of assessment instruments to make a decision about a student; instruments such as screening tools, norm-referenced tests, curriculum-based assessments, and progress monitoring can be used to reach a decision. Screening tools for children with ASDs will primarily be reviewed with brief definitions and examples of norm-referenced tests and curriculum-based assessment.

Norm-Referenced Tests

The purpose of norm-referenced tests is to measure how well a child can perform a certain task (Bailey, 2004). Norm-referenced tests are also used for diagnostic purposes (Hall, 2009) and produce raw scores, which are then converted to specific types of standardized scores (Mclean, 2004), based on a normative group. Norm-referenced tests are generally administered to children for eligibility or diagnostic purposes and are conducted by trained examiners. The Autism Diagnostic Observation Schedule-Generic (ADOS-G) and Autism Diagnostic Interview revised (ADI-R) are two norm-referenced tests used to diagnose ASDs (Matson & Spies, 2010). The ADOS-G has four modules assessing: (a) preverbal skills, (b) flexible phrase speech, (c) fluency between childhood and adolescence, and (d) fluency between adolescence and adulthood; each module takes 30 to 45 minutes of implementation (Schwalm & Matson, 2008). The ADI-R is a semi-structured interview measuring the main symptoms of ASDs and requires special training in order to be administered appropriately. The administration of an ADI-R takes from 90 minutes to two hours (Schwalm & Matson, 2008).

Curriculum-based Assessment

Curriculum-based assessment is defined as the use of curriculum content to assess the student's progress (Overton, 2009). Curriculum-based measurement can be used as both a formative and summative assessment process to monitor the progress of students in their achievement of a certain level of mastery of academic skills (Overton, 2009). Thus, teachers can use this assessment to prevent students from falling behind their peers and to make decisions about the student's progress toward particular goals. The Social Communication, Emotional Regulation, and Transactional Support (SCERTS) (Prizant, Wetherby, Rubin, Laurent, & Rydell, 2006), is a curriculum-based assessment for ASDs. In addition to monitoring, curriculum-based assessment can be used for diagnostics. The progress of students can also be measured by behavioral methodologies including the interval recording system, time sampling recording, event-recording system, duration recording system, and the latency recording system (Alberto & Troutman, 2006).

Screening Tools

Screening is defined as a brief assessment process that identifies children who need further assessment (Bailey, 2004). Screening processes can help identify children who might be at risk for academic achievement difficulties; furthermore, screening tools can identify children at risk for developmental disabilities. There are several types, including developmental screening, readiness screening, instructional screening, and selective screening (Brassard & Boehm, 2007). Screening can be administered to a group of children or administered individually (Overton, 2009). For developmental screening, children should be screened more than once and on a regular basis (Bailey, 2004).

Furthermore, families' participation and involvement are crucial during the screening process (Bailey, 2004). Screening can be carried out by teachers or parents.

Screening is quick, should be inexpensive, and provides a snapshot of development (Squires, Bricker, & Twombly, 2004). In contrast, the diagnostic process is more comprehensive and thorough. Diagnostic instruments may provide information about: (a) the nature of the problem; (b) the existence or non-existence of the problem; (c) the cause of the problem; and (d) environmental barriers and facilitators (Rupp, Templin, & Henson, 2010; Volkmar, & Klin, 2005).

Screening identifies children who are in need of early intervention and is an initial step in the assessment process. Screening results are less costly in comparison to norm-referenced tests and are necessary for early identification. According to IDEA 2004 (PL 101-476), each state must administer developmental screening to find children with disabilities. Child Find screening should be carried out at regular intervals in order to improve accuracy (Brassard & Boehm 2007). While states often have different approaches for Child Find, the following areas are usually included: (a) physical development, (b) cognitive development, (c) communication development, (d) social and emotional development, and (e) adaptive and self-help development (Brassard & Boehm, 2007; Sheveil, Majnemer, & Oskoui, 2005). In regard to screening for ASDs, recommendations focus on the following behaviors or domains: (a) eye contact, (b) social engagement, (c) slow motor development and seizures, (d) challenging behaviors, (e) stereotypic and repetitive behaviors, and (f) social communication (Greenspan, Brazelton, Cordero, Solomon, Bauman, Robinson, Shanker, & Breinbauer, 2008; Matson & Spies, 2010). Even if the psychometric properties of developmental screeners are sound, there

are errors inherent in screening because of its brief and cost-effective nature (Brassard & Boehm, 2007).

Developmental screening tools should possess certain properties. The purpose of the screening must be clearly stated (e.g., readiness or developmental screening). According to Barbaro and Dissanayake (2010), reliability of screening tools must be reported (e.g., 0.80 for referrals and 0.90 for making decisions). The predictive validity of the screening instrument with other diagnostic tools should be stated and value of 0.60 are recommended; concurrent validity should be at least 0.70. The sensitivity (i.e., ability of the assessment instrument to identify children with the disorder) should be 0.80 or above and specificity (i.e., ability of the assessment instrument to identify children without the disorder) 0.80 or above (Brassard & Boehm, 2008). A clear description of the normative sample should be provided, and the measures of central tendency delineated. The items of the instruments need to be culturally appropriate, and the user's manual should address what training the administer needs to perform.

In summary, assessment is accomplished through different tools, such as norm-referenced tests, curriculum-based assessment, and screening. The main goal of assessment is to collect information about certain behaviors or conditions, and to assist in decision-making. Screening for Child Find, including for identification of ASDs, is extremely important for early identification and intervention.

Studies on ASD Screening Instruments

Training Professionals on Using Screening Instruments

Parental screening measures facilitate the early detection of ASDs because these instruments solicit information about children's development from their parents (Wiggins et al., 2007). Also, developmental questionnaires completed by parents help in identifying children at risk for disabilities and increase the rate of referral, which is low when relying on clinical judgment alone (Hix-Small, Marks, Squires, & Nickel, 2007). For instance, the early detection of children with ASDs was examined through the following interventions: (a) training professionals on detecting the early signs of ASDs, (b) using a referral protocol to refer children with ASDs to specialists, and (c) forming a multidisciplinary team (Oosterling,Wensing, Swinkels, Gaag, Visser, Woudenberg, Minderaa, Steenhuis, & Buitelaar, 2010). In all, 2793 children ranging in age from birth to 11 years and with various disabilities, including autism, participated in the study. 60 % of these children displayed externalizing behaviors, 13% displayed internalizing behaviors, and 27% showed evidence of disorders other than autism. Professionals such as pediatricians were assigned to either an experimental or a control group to compare the mean differences in detecting children with ASDs before the age of 36 months. The control group was only introduced to detecting the early signs of ASDs using the Early Screening of Autistic Traits Questionnaire with 14 items, while the intervention group received all three interventions related to ASDs. The results revealed that there was a significant difference in the age of diagnosis between groups; the difference in age was 21 months in favor of the experimental group. Furthermore, 28.7% of children were diagnosed with a follow up condition before age 36 months in the experimental group,

and only 3% of children in the control group. Children with higher functioning ASDs were misidentified in the study (Oosterling et al., 2010).

Some studies have shown that autism can be diagnosed at the age of 18 months, and that between 20 months and 36 months it is possible to differentiate autism from other disorders (Allison, Cohen, Wheelwright, 2008; Eldin, Habib, Noufal, Farrag, Bazaid, Al-Sharbati, Badr, Moussa, Essali, & Gaddour, 2008). However, high functioning children are sometimes misidentified because of their mild symptoms but are later diagnosed during elementary school because of their academic and social difficulties. The American Academy of Pediatrics (2001) requires routine surveillance of children in which pediatricians listen to specific parental concerns regarding their children's development. Frequent parental concerns are speech and language development, social development, and the potential of younger siblings to have autism. Several studies have been published about the possibility of diagnosing ASDs prior to the age of three. For instance, Koegel et al. (2005) described First S.T.E.P, which is a model for identifying children with autism, developed at the University of California, Santa Barbara. Funded by Santa Barbara School District, the program directors tried to increase pediatricians' awareness of the early signs of children with ASDs by informing the pediatricians about atypical child development, early signs of children with ASDs, and typical development of children. The project aims to encourage pediatricians to refer children for screening without reaching a formal decision about the child's development. First S.T.E.P also aims to increase family awareness through media outlets. Families receive educational and training support to deal with their children. From 2003 to 2005, the percentage of children referred by pediatricians increased from 36% to 57%, and the

average age in months was 32.3 in 2003 in comparison to 29.6 months in 2004. The Modified Checklist for Autism in Toddlers (MCHAT), the Autism Diagnostic Observation Schedule (ADOS), and the Vineland Adaptive Behavior Scales were utilized as tools, and families also received help to locate a case management worker and in being introduced to Pivotal Response Treatment.

Filipek et al. (1999) designed a practice parameter to diagnose very young children with autism, suggesting a dual process: (a) conducting developmental surveillance routinely and (b) using diagnostic assessments to refer children. The idea of diagnosis as a process that encompasses two levels was stressed: (a) screening should be conducted during a well-child visit to a pediatric clinic and (b) diagnosis requires sophisticated assessment tools and specialists' decisions. The algorithm of the practice parameter is portrayed as a care provider who routinely observed the child development for ASDs. If the child passes routine surveillance, another screening is scheduled. If the child fails the routine surveillance, the child is referred for an audiological assessment and a lead screen for pica. If the child passes these tests, the parents receive general education training. If the child fails these tests, screening for ASD will be conducted. If the child fails the screening, he or she is referred to level II, which is diagnosis and evaluation of ASDs, where the child receives a diagnosis of ASD using a second level screening such as ADOS or ADI-R.

Psychometric Properties of ASDs Screening Instruments

Matson and Sipes (2010) listed widely used screening tools for ASDs such as the Pervasive Developmental Disorders Screening Test (PDDST), Modified Checklist for Autism in Toddlers (MCHAT), Childhood Autism Rating Scale (CARS), Checklist for

Autism in Toddler (CHAT), and Social Communication Questionnaire (SCQ). The psychometric properties of these screening tools are summarized in Table 2.2.

ADOS and ADI-R are widely used to look at various aspects of autism spectrum disorders, but their psychometric proprieties have not been examined (Matson & Spies, 2010). The Checklist for Autistic Children Development, MCHAT, Quantitative Checklist for Autism in Toddlers, and Checklist for Autistic Children Development-23 have been studied in terms of their psychometric proprieties and show high sensitivity and specificity (Matson & Spies, 2010). The Baby and Infant Screen for Children with Autism Traits is a new assessment tool that targets three major symptoms of ASDs (Matson & Sipes, 2010), and can be used with ASDs and PDD-NOS.

The psychometric properties of several screening tools were examined and compared (Eaves, Wingert, & Ho, 2006; Matson & Spies, 2010). For instance, the ability of MCHAT and the Social Communication Questionnaire (SCQ) were examined in identifying young children with ASDs in a clinical setting (Eaves et al., 2006). These screening tools are easily administered when identifying children at risk for disabilities. The MCHAT is used for children ages 18 months to two years, while SCQ is utilized for children above four years of age. The sample size used to compare the SCQ and MCHAT was 178 children; 84 received MCHAT and 94 took SCQ. The MCHAT had high sensitivity, ranging from 77% to 92%, but the MCHAT showed low specificity, ranging from 43% to 27%. MCHAT scores had negative correlations with IQ and adaptive scores, and a significant positive correlation with the Childhood Autism Rating Scale (CARS), (r = 0.38 and 37, $p < 0.001$), but not with DSM-IV (r = 0.19 and 0.14). The SCQ showed a high sensitivity of 74% and a low specificity of 54% and had a significant and modest

correlation with CARS ($r = 0.42$, $p < .001$ with DSM-IV $r = 0.33$, $p < 0.01$), and with other cognitive assessments. The researchers stated that the sensitivity of these questionnaires was high for participants who spoke English as second language.

CARS is also one of the widely used tools for identifying children at risk for ASDs (Magyar & Pandolfi, 2007) and requires non-intensive training. CARS has a cutoff score of 30; this total score indicates the presence of ASDs. A score of 30 to 36 suggests mild symptoms of ASDs while a score of 37 or more suggests moderate to severe ASDs. The reliability of CARS ranged from 0.73 to 0.90 according to different published studies (e.g-reference). CARS was compared with ADI-R and correlated 91.8% in positive cases and a 44.4% disagreement in negative cases. Two studies examined the factor structures of CARS, and the studies disagreed on the factors as well as the number of factors. For instance, Dilalla and Rogers (1994) used Principal Components Analysis (PCA) with an oblique direct oblimin rotation to explore the CARS factor structure. Three factors were found to account for 64% of the total variance: social impairment, negative emotionality, and distorted sensory response. Most variance loaded on the social impairment at about 52%.

Another study by Stella, Mundy, and Tuchman (1999) re-examined the CARS factor structure and found factors different from the ones reported by Dilalla and Rogers (1994). These factors were social communication, emotional reactivity, social orienting, cognitive and behavioral consistency, and odd sensory exploration, which accounted for 64% of the total variance. On the other hand, Magyar and Pandolfi (2007) also examined the CARS factor structure and found factors different from the ones reported by Dilalla and Rogers (1994) as well as Stella, Mundy, and Tuchman (1999). They used PCA and

Principal Axis Factor Analysis (PAF). PCA extracted four factors that accounted for 57.16% of the total variance. PAF extracted four factors that accounted for 41.67% of the total variance. The oblique rotation and varimix were used in both analyses. They were social communication, social interaction, stereotypes and sensory abnormalities, and emotional regulation.

Although screening tools differ in their psychometric properties, they can be used to identify children with ASDs at earlier ages if they are combined with other methods (Oosterling et al., 2009). There are two recommended stages of screening in identifying ASDs: the Level 1 and Level 2 (AAP, 2000; AAP, 2006). In Level 1, screening tools are used to identify children who are at risk for ASDs. This screening usually takes place during a visit to a pediatric clinic or other early childhood setting. If the child is identified as potentially having an ASD, the child is referred to Level 2 screening, where the child is screened specifically for ASDs.

The Checklist for Autism in Toddlers (CHAT) and the Early Screening of Autistic Traits Questionnaire (ESAT) are Level 1 screens (AAP) and are widely used. The CHAT relies on the assumption that children with ASDs lack joint attention; lack of joint attention is a precursor of ASDs and supported by theory-of-mind functioning. The CHAT measures both pretend play and joint attention and can be scored using parental reports or health practitioner observations. The screening tools differ in: (a) the symptoms measured, (b) the age intervals targeted, and (c) the way that the tools are administered (i.e., parental report, questionnaires, and observations). The CHAT has items related to pretend play and joint attentions tests could indicate ASDs at 18 months

of age. The ESAT shows that lack of direct smiling, interest in people, and responses to cues are indicators of ASDs at 14 months of age.

Oosterling, Swinkels, Gaag et al. (2009) conducted a study to examine the psychometric properties of the following tools: (a) ESAT, (b) the Communication and Symbolic Behavior Scales Developmental Profile (CSBS DP) infant-toddler checklist, and (c) Social Communication Questionnaires (SCQ). The ESAT is administered through two steps. The first step consists of four questions that screen the child as positive or negative for the disorder. The second step consists of 14 questions for children at risk for ASDs. These 14 questions are yes or no answers and the higher the score, the more likely the children are to have ASDs.

Two hundred and thirty-eight children at risk for ASDs participated in the study (Oosterling et al., 2009). The ESAT's four items or pediatricians' concerns classified them at risk for ASDs. The children's ages ranged from eight months to 44 months. There was no statistical difference between their IQs. The CSBS DP measures social skills, speech, and symbolic skills and has 40 yes or no items. The CSBS DP has 24 items that are answered using a three-point scale: not yet, sometimes, and often. The remaining question looks at the quantity of words or phrases the child understands. The higher the test score is, the lower the chance that the child has an ASD. Some of the questions in the CSBS DP and the SCQ overlap with the CHAT; these questions were used as CHAT key questions.

Receiver-Operator Characteristic (ROC) analyses were used to measure the sensitivity and specificity of the tools, and a Phi coefficient was utilized to measure the correlation between each item and measure the outcomes. Sensitivity, specificity,

positive predictive value, and negative predictive value were also calculated. The results showed the clinical significance of various diagnostic indices and were evaluated by the following criteria: < 0.70 was poor, 0.70 to 0.79 was fair, 0.80 to 0.89 was good, and 0.90 to 1.00 was excellent. Looking at the four indices using these criteria shows that these screening tools do not show an acceptable level of diagnostic accuracy; however, looking at each index of each screening tool showed an acceptable level. For instance, the cutoff score of the ESAT at 14 months is 3 and showed a sensitivity of about 0.88 while the CHAT key items showed a positive predictive value of around 0.97. However, the ROC showed poor-to-fair specificity, and the sensitivity of the screening tools was between 0.58 and 0.74. Phi coefficients between items and diagnostic index were significant and showed a weak 0.35. The strongest Phi values were in joint attention, following attention, eye gaze, direct smile, offering comfort, and waving bye-bye.

Some studies examined the validity of screening tools against gold standard assessments. For instance, Sikora et al. (2008) examined the psychometric properties of the Gilliam Autism Rating Scale (GARS) and the CBCL using the ADOS before employing the aforementioned screening tools to identify children with autism, with ASDs, and without ASDs. The Mullen Scales of Early Learning were used to measure the cognitive levels of the participants, and there were statistically significant differences between the participants' scores on this test, with the autism group having lower scores on this test. According to Sikora et al. (2008), the cutoff GARS score of 90 or above indicated symptoms of autism. Sikora et al. (2008) indicated that the CBCL showed better sensitivity and specificity than the GARS in identifying children with autism; however, the sensitivity and specificity of the CBCL was low when it was used to

identify high functioning children with autism. Sikora et al. (2008) suggested the use of the CBCL as a tool to identify children with autism in settings that lack a thorough clinical examination. Table 2.2 displays a list of widely used ASD screening instruments.

Table 2.2. Widely Used ASD Screening Instruments

Screening measure	Author(s)	Measure format	Start age	Sensitivity	Specificity	Internal consistency
Checklist for Autism in Toddlers	Baird, Charman, Baron-Cohen, Cox, Swettenham, & Wheelwright (2000)	Interview	18 months	0.18-0.38 0.65-0.85	0.98-1.0	NR
Modified Checklist for Autism in Toddlers	Robins, Fein, Barton, Green (2001)	Questionnaire	24 months	0.95-0.97	0.95-0.99	0.83-0.85
Pervasive Developmental Disorders Screening Test-Stage -1	Siegel, & Hayer (1999)	Questionnaire	72 months	0.85	0.71	NR
Autism Behavior Checklist	Krug, Arick, & Almond (1980)	Checklist	18 months	0.38-0.58	0.76-0.97	0.38-0.87
Social Communication Questionnaire	Rutter, Bailey, & Lord (2003)	Questionnaire	48 months	0.85-0.96	0.67-0.80	0.90
Childhood Autism Rating Scale	Schopler, Reichler, Renner (1988)	Checklist	NS	0.92-0.98	NR	0.73-0.94

Table 2.2. (continued).

Screening measure	Author(s)	Measure format	Start age	Sensitivity	Specificity	Internal consistency
Pervasive Developmental Disorders Screening Test-Stage -2	Siegel (1996)	Checklist	36 months	0.69-0.98	0.25-0.63	0.88-0.96
Screening for Autism in Year-Olds	Stone & Ousley (1997)	Observation	24 months	0.92	0.85	NR

Note. (NR) means that the measure reliability was not reported in the literature while (NS) means that the age was not specified.

Manifesting characteristics of ASDs in young children might be confused with the symptoms of other disorders, such as language developmental delay, global developmental delay, and PDD-NOS (Ventola et al., 2007). The findings on differentiating the symptoms of young children with autism from other disorders have not had enough evidence in comparison to the findings on the differential diagnosis of ASDs in older children (Ventola et al., 2007; Wetherby, Woods, Allen, Cleary, Dickinson, & Lord, 2004). For instance, studies have shown the differences in behaviors of children with ASDs compared to other disorders in cognitive, social, and language skills (Adrien, Deletang, Martineau, Couturier, & Barthelemy, 2001; Ventola et al., 2007). However, the issue of differentiating the behavioral differences between children with ASDs and those with other disorders has not been thoroughly examined; young children with autism might show symptoms that overlap with other disorders (Wetherby, Woods, Allen, Cleary, Dickinson, & Lord, 2004). For example, repetitive behaviors have been noted in

children with language delay (Rogers, 2003). In addition, communication impairment could be difficult to use to differentiate children with autism from other disorders. According to Ventola et al. (2007), children with developmental delay and language delay show the same communication symptoms displayed by children with autism. However, the distinction between ASDs and other disabilities becomes clearer as the children grow up. For instance, some studies have shown that young children with autism show delays in pretend play and this delay distinguishes them from children with other disabilities (Wainwright & Fein, 1996).

Ventola et al. (2007) examined the behavioral differences among 195 children with autism and children with other developmental delays, ages ranging from 16 to 32 months. In their study, they investigated the differences among children who failed the M-CHAT and those who were diagnosed with "possible autism" at the age of two. Assessments such as ADOS, CARS, and parent reports were used. For participants who failed the M-CHAT, follow up phone interviews were scheduled. These children were assessed with different assessment tools such as ADOS, clinical judgment, CARS, and ADI-R. The agreement between ADOS, CARS, and clinical judgment was high. Developmental delay was diagnosed if a child met the criteria of ASDs and scored lower than two standard deviations from the mean in three areas of development. Language delay was diagnosed if a child met the criteria of ASDs and scored lower than two standard deviations from the mean in expressive and receptive languages. The findings were that the children with ASDs had lower standard deviations than children with developmental delay and language delay in socialization, communication, daily living, and motor functioning. In addition, the children with ASDs had lower cognitive skills

than other groups as measured by the Bayley. Moreover, the performance of the autism and non-autism groups was significantly different on ADOS and CARS. Furthermore, the children with ASDs failed all significant items more frequently than the non-autism group. When controlling for language, the M-CHAT items "pointing to interests", "pointing to request", "following a point", and "response to name" remained significant for all ASDs.

Another line of research is to utilize a comprehensive assessment instrument to identify children with ASDs earlier. For instance, Matson, Fodstad, and Dempsey (2009) conducted a study using the Baby and Infant Scale for Children with Autism Traits (BISCUIT) to identify children with autism at the ages of 17 to 37 months. The BISCUIT has three parts: (a) Part-1 measures symptoms of autism, (b) Part-2 measures the symptoms of comorbid psychopathology, and (c) Part-3 measures problem behaviors. According to the researchers, the BISCUIT has three latent factors: (a) repetitive behavior, (b) socialization and nonverbal communication, and (c) communication. The BISCUIT uses a three-point Likert scale. The internal consistency of the BISCUIT sections is 0.92, 0.93, and 0.83 respectively. The test is based on interview and observation. Nine hundred and fifty-seven children participated in the study through Louisiana's Early Steps Program. Doctoral level psychologists evaluated children as having ASD, PDD-NOS, or atypical development using DSM-IV-TR criteria. Matson et al. (2009) reported that the BISCUIT Part 1 differentiated between ASD and other disorders. In addition, the BISCUIT could distinguish between the autism and PDD-NOS groups. The internal reliability of BISCUIT on 279 children receiving services for disabilities was for part -1 = 0.97, part-2 = 0.96, and for part -3 = 0.91.

In summary, the differential diagnosis of children with ASDs is still challenging (Matson & Spies, 2010; Ventola et al., 2007; Wetherby, Woods, Allen, Cleary, Dickinson, & Lord, 2004). The Division for Early Childhood recommends the use of comprehensive assessment instruments in making decisions (Neisworth, Bagnato, 2005). Ages and Stages Questionnaires (ASQ) have been recommended by professionals to be used to identify children at risk for ASDs (American Academy of Pediatrics, 2001). The ASQ has been validated across a variety of cultures and communities, has shown highly acceptable psychometric properties, and is described below.

Ages and Stages Questionnaires

Ages and Stages (ASQ) Questionnaires is a first-level screening tool developed for children from two to 65 months of age at the University of Oregon (Squires & Bricker, 2009). It is a series of parent-completed questionnaires, with 30 items divided into five domains: (a) communication, (b) gross motor, (c) fine motor, (d) problem-solving, and (e) personal-social. ASQ meets the requirement of Level 1 screening stated by the American Academy of Pediatrics in terms of the comprehensiveness of ASQ results and can be used for two purposes: (a) producing general findings of children's skills, and (b) monitoring children's progress. The ASQ can be used to screen children from at risk backgrounds including poverty, children whose parents have intellectual disabilities, or have a history of abuse or neglect in their homes.

The ASQ is written in parent-friendly language, at a fourth-to-sixth grade reading level. It does not require intensive training to administer. The ASQ shows high sensitivity and specificity, 0.83 and 0.91 at 2 SD, respectively, and 1.00 and 0.73 at 1 SD, respectively (Squires, Twombly, Bricker, & Potter, 2009). To examine the validity of

ASQ, the classifications of children were compared with their scores on standardized tests such as the Bayley Scales of Infant Development Examination and the Stanford-Binet Intelligence Scale. The overall agreement between the results of ASQ and other tools ranged from 83% to 88%. The test-retest result of ASQ was a 92% agreement among administrations of the test (Squires et al., 2009).

Research on ASQ

The agreement between the ASQ and Pediatric Developmental Impression (PDI) (i.e., pediatrician impression of typical or atypical development) was studied (Hix-Small, Marks, Squires, & Nickel, 2007). The findings showed that the agreement between PDI and ASQ was 81.8%. The ASQ results indicated that 78.4% (*n*=548) were typically developed, while the PDI indicated that 89.4% (*n*=625) were typically developed. The ASQ results indicated that 6.0% (*n*=47) had questionable development, while the PDI showed slightly different results, 6.7% (*n*=47) had questionable development. Also, the ASQ results indicated that 15.6% (*n*=109) had developmental delays, while the PDI revealed that 3.9% (*n*=27) had developmental delays (Hix-Small et al., 2007). The overall agreement between the PDI and ASQ was high acceptable and consistent with the literature (Rosenthal & Rosnow, 2008; Shadish et al., 2002). Given that pediatricians missed identifying 60% to 70% of children at risk in well visits, such an agreement between the ASQ in and PDI supports the use of ASQ in pediatrician's offices to identify children at risk.

The ASQ was used as part of the North Carolina ABCD project to: (a) measure the number of parents who completed screening during a well-child visit to pediatric clinics, (b) report the type of risk children might have, and (c) report the number of

referrals after screening. Earls, Andrews, and Hay (2009) indicated that parents completed the ASQ in a two-year period, and 96 out of 529 children were at risk for disabilities and referred for further assessment since the inception of ABCD project.

The ASQ has also been used to measure the effect of some variables on the development of children. For instance, the ASQ was utilized in a large international sample to identify children at risk for neurosensory disabilities because their mothers had eclampsia or high blood pressure in pregnancy (Yu, Hey, Doyle et al. 2007). Both a full and a short version of the ASQ were administered to the sample group. Of the sample group, 406 participants were identified with neurosensory disabilities, and 1640 participants passed the ASQ items. The full version of the ASQ had a sensitivity of 87.4% and specificity of 82.3%. The short version of the ASQ had a sensitivity of 69.2% and a specificity of 95.7%. The agreement between clinical diagnosis and ASQ was not provided; however, such findings should be interpreted with caution.

Validity of ASQ has been examined across different cultures and communities. For instance, Janson and Squires (2004) examined the mean differences in domains between the Norwegian and American samples. The raw score difference between samples was around seven points, and the effect size of the group's differences was about 0.05 Cohen's D, which the researchers referred to as a negligible difference between Norwegian and US samples. Although Janson and Squires (2004) did not document differences between groups, they reported some missing data, more on the unmarried and uneducated mothers than other participants. The conclusion was that this non-responding number of mothers might reduce the variability in scores. Thus, this study might require further investigation to support its findings (Janson & Squires, 2004). Another study

investigated the response rate of Norwegians with the ASQ (Janson, 2003). The sample included 2,392 mothers of children whose ages ranged from 4 months to 60 months. They found that mothers of children older than 8 months responded less frequently than mothers of children younger than 8 months. Furthermore, mothers who were unmarried or uneducated tended to respond less frequently than other mothers in the study (Janson, 2003).

Other studies have used the ASQ on Canadian, Australian, Chinese, and Danish samples. For instance, using a Danish version of the ASQ showed a significant (0.48) correlation between the ASQ and the Wechsler Preschool and Primary Scales Intelligence. In addition, there was a significant correlation between the ASQ overall score and ASQ domains, ranging from 0.38 to 0.70 (Klamer, Lando, Pinborg, & Greisen, 2005). Some findings showed that ASQ had highly acceptable psychometric properties on samples of children from Canada and Australia. The ASQ was utilized to identify children at risk for developmental delay from 43 Canadian children and 68 Canadian communities. Community children and referral children were recruited to measure the impact of the heart surgery on their development. The results of the ASQ were compared with the results of a follow up 3 years later by neurologists. The results revealed that the ASQ had sensitivity of 75% with at risk groups and 100% with the community groups; in addition, the ASQ had specificity of 90% with at risk groups and 95% with the community groups (Elbers, Macnab, Mcleod, & Gagnon, 2008). Other studies have examined the utility of the ASQ in samples of Australian children at risk for developmental delay. For instance, the psychometric properties of the ASQ were examined with premature infants from an Australian population. The findings

demonstrated that the psychometric properties of ASQ in comparison to gold standard assessments (e.g., Bayley Mental Developmental Intelligence Scale, Griffith Mental Developmental Scale, and McCarthy General Cognitive Intelligence Scale) had sensitivity of 90%, specificity of 77%, a positive predictive value of 40%, and a negative predictive value of 98%. These results supported the use of the ASQ to identify children at risk for developmental delay (Skellern, Rogers, & O'Callaghan, 2001).

A study by Heo, Squires, and Yovanoff (2008) examined the use of the Korean translation of ASQ. They studied the internal consistency of ASQ, its concurrent validity, and established a cutoff score. They also compared the Korean sample with the US normative sample on domain performance and reported that two out of 50 comparisons were significant. The ASQ was compared to other measures for concurrent validity. Cronbach's alpha coefficient was consistent with other findings, exceeding 0.70. The Korean version of ASQ showed strong sensitivity and specificity across age intervals, 80% and 76% at 30 months, respectively.

The concurrent and convergent validity of the ASQ have been examined against several gold standard assessments and outcomes. For instance, the concurrent validity of the ASQ with the Language Developmental Survey (LDS) was examined (Zubrick, Taylor, Rice, Slegers, 2007). The Item Response Theory scores of ASQ and LDS moderately correlated, 0.66. The children with late language emergence (LLE) also had a lower mean score on the ASQ communication domain than those children in the normal sample (e.g., = 62.5 and = 52.5). The cross-tabulation analyses of individual items in the ASQ and LDS indicated a correlation of 0.78. These results demonstrated the utility of the ASQ communication scale in identifying children with LLE and support the use of an

individual ASQ domain to measure a certain behavior or skill (Zubrick, Taylor, Rice, Slegers, 2007).

Studies have examined the concurrent validity of the ASQ with other assessment instruments. The concurrent validity between the ASQ and the Bayley Scales of Infant Development II (BSID-II) was examined with 53 children aged 24 months (Gollenberg, Lynch, Jackson McGuinness, & Msall, 2009). The ASQ communication and personal social domains were moderately correlated with the BSID cognitive scales at 0.52 and 0.45 respectively, and ASQ gross motor domain was moderately correlated with BSID at 0.45. However, the ASQ fine motor and problem solving domains were not correlated with BSID. The researchers calculated the sensitivity and specificity of the ASQ, and they reported a sensitivity of 100% and a specificity of 87% for children aged 24 months. The conclusion was that use of developmental screening, such as the ASQ, might reduce the need for norm-referenced tests (Gollenberg, Lynch, Jackson McGuinness, & Msall, 2009). Another study measured the concurrent validity of the Harris Infant Neuromotor Test (HINT) with the ASQ. The HINT is a developmental screener that measures motor and cognitive disorders in infants. The test-retest reliability of HINT was about 0.98. The HINT was concurrently validated with BSID and showed correlation coefficients ranging from -0.73 to -0.89. The participants were 67 Canadian and U.S. children between 2.5 and 12.5 months of age. To compare the populations, the researchers matched the samples according to age, ethnicity, and socioeconomic status. The correlation coefficient representing concurrent validity ranged from -0.82 to -.084 and was significant at the alpha level of 0.05. Although there was a high and significant correlation between the two screeners, the findings might have been strengthened if they had explained the high

negative correlation between screeners (McCoy, Bowmen, Blockley, Sanders, Megens, & Harris 2009).

The content and concurrent validity of the ASQ with a Dutch sample of 2508 children was investigated by Kerstjens, Bos, Vergert, Meer, Butcher, & Reijneveld (2009). The examination of the content validity of ASQ produced agreement between the expert panel and the ASQ. In addition, the ASQ showed an overall Cronbach's alpha of 0.79 and 0.61 to 0.73 for all domains. Construct validity was measured using the following indicators: (a) early prematurity; (b) gender; (c) mother's educational level; (d) household situation; and (e) family income. Children born preterm often failed in total and domain ASQ score. Children in low-income families scored low in communication, problem-solving, personal-social, and total score, and children of mothers with a low education level scored low in fine motor skills. Twenty-five out of 28 children were placed in special education and received medical care due to developmental delays by the age of five. The sensitivity of ASQ was 89%; specificity was 80%; negative predictive value was 99.7% and positive predictive value was 91%. In general, the results of the Dutch version of the ASQ were consistent with the standard of the literature in terms of sensitivity, specificity, and both positive and negative predictive values (Brassard & Boehm, 2007).

Ages & Stages Questionnaires: Social Emotional (ASQ: SE)

The ASQ: SE is a parental questionnaire focusing on the social and emotional competence of children ages 3 months to 5.5 years. The ASQ: SE is a companion tool for the ASQ, is scored on a 3-point scale, and examines the following developmental areas: (a) autonomy and coping, and (b) communication (c) compliance, (d) adaptive

functioning (Bricker, Davis, & Squires, 2004; Jee, Conn, Szilagyi, Blumkin, Baldwin, & Szilagyi, 2010; Salomonsson & Sleed, 2010). The ASQ: SE consists of 21 to 35 items depending upon the age interval; the test-retest agreement of its items is 94% (Bricker, Davis, & Squires, 2004). Its concurrent validity was calculated against several assessment instruments; for instance, concurrent validity with the CBCL and Social-Emotional Early Childhood Scale (SEECS) ranged from 0.81 to 0.95 with an overall agreement of 0.89 (Bricker, Davis, & Squires, 2004). The sensitivity of the ASQ: SE ranges from 75% to 88%, while its specificity ranges from 82% to 92%.

Jee et al (2010) studied the systematic use of screening tools to identify children in foster care who have social-emotional disorders, using the ASQ and ASQ: SE. Participants were between the ages of 6 months and 5.5 years. Children new to foster care showed a higher mean in social-emotional disorder than those who had entered foster care earlier. Jee et al. (2010) reported that a low correlation between ASQ and ASQ: SE in identifying children with social-emotional disorders, finding the ASQ: SE more sensitive than the ASQ. In addition, the researchers reported that social-emotional disorders are three times more likely to develop in preschool age children in foster care.

Salomonsson and Sleed (2010) examined the use of the ASQ: SE with a clinical sample of mothers receiving psychoanalytic treatment for depression and distress. The researchers argued that mothers with distress reported inaccurate information about their children's social and emotional behaviors. In other words, mothers with distress or depression exaggerated their concerns about their children's social and emotional behaviors on questionnaires. Therefore, the researchers utilized a variety of measures to validate the mothers' responses on the ASQ: SE. The researchers stated that parents'

reports should be followed by observation of behaviors, even though this statement is not supported by other researchers (e.g., Rothbart & Hwang, 2002). Salomonsson and Sleed (2010) used observer ratings of the interaction between the mother and her child and the relationship quality between the mother and her child. The average age of the children was 5.6 months. In addition, researchers used measures to assess the mother's distress and depression such as the Edinburgh Postnatal Scale, the Symptoms Checklist-90, and the Swedish Parental Stress Questionnaires. The researchers reported there was zero correlation between the observer-rating scale, expert rating of the relationship quality between the mothers and her children, and the scores of ASQ: SE. However, there were significant correlations between the ASQ: SE and other measures in the study.

Although Salomonsson and Sleed (2010) conducted an important study, their data analyses were questionable. The researchers used PCA to measure the intercorrelation between the ASQ: SE and other distress measures. PCA is a method for item reduction, and it does not show the intercorrelation among the scores of the assessment. Furthermore, PCA does not distinguish between unique and common variance (Brown, 2006; Field, 2009; Preacher, MacCullum, 2003). In addition, Salomonsson and Sleed (2010) used backward stepwise multiple regression to predict the score of the ASQ: SE by other measures; this analysis is critiqued because it deletes each predictor that causes a reduction in a multiple correlation coefficient (Pedhazur, 1997). Therefore, the results were not consistent with the acceptable practice in the field. The study showed that parents' reports are highly accurate in identifying children with developmental disorders (Kerstjens et al. 2009).

Social Communication Questionnaire (SCQ)

The Social Communication Questionnaire (SCQ) is a parent-report screening measure for children age 4 and above, including 40 items with a yes and no scoring option (Rutter, Bailey, & Lord, 2007). Parents often complete the SCQ in less than 10 minutes. The SCQ is designed to be a companion screening tool for the Autism Diagnostic Interview-Revised (ADI-R), which consists of 93 items about a child's developmental history (Rutter, Bailey, & Lord, 2007). The bivariate correlations between the total scores of the ADI-R and the SCQ range from moderate to high, 0.57 to 0.71 (Rutter, Bailey, & Lord, 2007).

The SCQ was validated on a sample of children with ASDs and without ASDs. Chandler, Charman, Baird, et al. (2007) showed that the SCQ scores were highly correlated with the symptoms of ASDs measured by the ADI-R. Furthermore, a receiver-operating characteristic (ROC) showed that the area under curve (AUC) was 0.88; sensitivity was 88% and specificity was 72% for a cutoff score of 15 and greater. Witwer and Lecavalier (2007) showed that the SCQ had more robust psychometric properties than the Developmental Behavior Checklist-Autism Screening Algorithm. In the Witwer and Lecavalier study (2007), sensitivity and specificity of the SCQ were 92% and 62%, respectively, while the sensitivity and specificity of the Developmental Behavior Checklist-Autism Screening Algorithm were 94% and 46%, respectively. The SCQ has four factor structures: social interaction, communication, abnormal language, and stereotyped behavior (Rutter, Bailey, & Lord, 2007). These factor structures were produced by PCA with varimax rotation, which may not be the most desirable procedure

because of the inaccurate results produced (Costello & Osborne, 2005; Preacher & MacCallum, 2003).

Studies on SCQ

The SCQ has been utilized to identify ASDs in children born preterm (Johnson, Hollis, Hennessy, Kochhar, Wolke, & Marlow, 2007). One hundred seventy-three parents of preterm children born at 25 weeks gestational age participated in the study. The results revealed that when the children were age 11 years, the SCQ had a sensitivity of 82% and a specificity of 88% for identifying ASDs when compared with the Kaufman-Assessment Battery for Children, the Strengths and Difficulties Questionnaire, and the Development and Well Being Assessment. According to Johnson et al. (2011), increasing the cutoff score of the SCQ to 22 reduced the sensitivity and improved the specificity of the test, with sensitivity and specificity at 64% and 96% respectively. In addition, increasing the cutoff score caused an increase in the positive predictive value of the SCQ. Johnson et al. (2011) noted that the high positive screening of ASDs in their sample reflected a high rate of ASDs among preterm-born children. Another study by Johnson et al. (2009) conducted on investigating ASDs in extremely preterm children born at less than 26 weeks gestation. The SCQ, the Kaufman-Assessment Battery for Children, the Strengths and Difficulties Questionnaire, and the Development and Well Being Assessment were used to identify children at risk for ASDs (n = 183). The results of the study showed that extremely preterm children scored higher on the SCQ than other normal gestation participants. ASDs were diagnosed in 16 preterm children.

In addition to investigating the use of the ASQ with premature children, several research studies were conducted to investigate the use of the SCQ with preschoolers. For

instance, Wiggins, Bakeman, Adamson et al. (2007) employed the SCQ to measure its sensitivity and specificity in children from 17 to 45 months. The results of the study showed that the ideal cutoff score was 11, and the sensitivity and specificity of this cutoff score were 89%. The researchers noted that parents tended to report the absence of typical behaviors rather than report atypical behaviors. In addition, some SCQ items were not appropriate for children in this age range because these items focus on friendship and interest in unfamiliar children. However, the results of this study showed the possibility of using the SCQ with young children.

Another study examined the utility of the SCQ with toddlers at risk for ASDs (Oosterling,Wensing, Swinkels, Gaag, Visser, Woudenberg, Minderaa, Steenhuis, & Buitelaar, 2010). Two hundred eight children participated in the study; their ages ranged from 20 to 40 months. The discriminative validity of SCQ was fair for children aged 36 to 40 months. The SCQ discriminated between the children with autism and children without ASDs better at the age of 36 and 40 months than from 20 to 35 months. The results of the study showed that IQ was a significant predictor of the participants' scores on the SCQ. In addition, the results of the study showed that both the SCQ and the ADI-R strongly and significantly correlated with each other. However, the researchers noted that the results of the SCQ for younger children were not as satisfactory as for the older children. The sensitivity and specificity of the SCQ for young children were 70%. According to Oosterling et al. (2010), reducing the cutoff scores might produce unacceptable sensitivity and specificity levels.

Lee et al. (2007) recruited 268 children from preschool special education programs to investigate the convergent validity of the SCQ against the following indices:

(a) parents' reports, (b) ADI-R, (c) ADOS-G, and (d) education department reports about the participants' conditions. They found that when using the ADOS as an index or predictor with the SCQ, the SCQ produced a sensitivity of 80% and specificity of 85%. Furthermore, using the ADI-R as an index or predictor against the results of the SCQ produced a sensitivity of 62% and a specificity of 75%. Thus, Lee et al. (2007) suggested the use of the SCQ with three-year-old children.

In summary, the effectiveness of the SCQ with preschoolers has had variable results. Researchers such as Oasterling et al. (2010) did not find the results of the SCQ satisfactory with young children, while other researchers such as Wiggins et al. (2007) reported promising results when using the SCQ with young children. Future research is needed to focus on the use of the SCQ with younger children.

Study Purpose

Because early identification is critical for improving outcomes, further studies are needed on screening instruments, including the ASQ, ASQ: SE, and SCQ. Also, further studies are needed to examine the psychometric properties of the ASQ and ASQ: SE when these screening tools are used with a sample of children having ASDs. The purpose of this dissertation is to investigate the following research questions:

1. What are the factor structures that represent the ASQ, the ASQ: SE, and the SCQ?
2. What is the agreement among these commonly used questionnaires in identifying children at risk for developmental disability and ASDs?
    a) What is the agreement between the ASQ and the ASQ: SE with the SCQ?
    b) What are the sensitivity and specificity of the ASQ, the ASQ: SE and the SCQ when compared with the disability status reported by parents?

CHAPTER III

METHOD OF STUDY

This chapter describes the methodology and statistical analyses that will be used to answer the research questions proposed for this study. First, the purpose of the study and the research questions are defined. Second, the characteristics of participants and how they were recruited are described. Third, the psychometric properties of the instruments utilized are explained. Finally, the statistical analysis that will be used for each research question will be discussed.

Purpose of the Study

The purpose of the study is to measure the factor structure and the agreement of the ASQ, ASQ: SE, and the SCQ. The research questions include:

1. What are the factor structures that represent the ASQ, the ASQ: SE, and the SCQ?
2. What is the agreement among these commonly used questionnaires in identifying children at risk for developmental disability and ASDs?
    a) What is the agreement between the ASQ and the ASQ: SE with the SCQ?
    b) What are the sensitivity and specificity of the ASQ, the ASQ: SE and the SCQ when compared with the disability status reported by parents?

Participants

Participants in this study were children between the ages of 36 to 66 months recruited from across the United States. Participants were typically developing children or children with ASDs. Parents of the children were asked to complete the ASQ, the ASQ: SE and the SCQ. In addition, parents completed a demographic checklist about

their socio-economic status, school attainment, ethnicity, their child's age, their child's disability status, and their child's gender.

Recruitment Procedures

Official letters were dispatched to directors of autism programs and preschools across the United States. The letters described the study and provided information about how the directors could help with this study. The letters addressed the incentive (a gift card) provided to parents to complete the questionnaire online or mail the screening instruments to the University of Oregon. In addition, the study was announced on free public websites such as www.valerieslist.com and www.autism-society.org. The website used for the online data collection was: http://pages.uoregon.edu/asqstudy/. The participants received a gift based on the following conditions: (a) completing the ASQ, ASQ: SE, and the SCQ, and (b) having a child either with ASDs or typically developing.

Measures

Ages and Stages Questionnaires (ASQ)

The ASQ is a first-level screening tool developed at the University of Oregon (Squires et al., 2009). It is a parent report instrument consisting of 21 intervals each with 30 items grouped under five domains: (a) communication, (b) gross motor, (c) fine motor, (d) problem solving, and (e) personal social. According to Squires et al., the ASQ could be used for two purposes: (a) producing general findings regarding children's skills and (b) monitoring the children's progress. The ASQ is administered to children whose ages range from 2 months to 5.5 years.

The ASQ has been judged to have excellent psychometric properties (American Academy of Pediatrics, 2001). For instance, the ASQ shows great sensitivity and

specificity consistent with the literature, 0.83 and 0.91 at 2 SD, respectively, and 1.00 and 0.73 at 1 SD, respectively (Janson & Squires, 2004). In addition, studies have shown that ASQ is a cost-effective tool to detect children at risk for disabilities (Earls, Andrews, & Hay, 2009; Gollenberg et al., 2009).

The ASQ is written in user-friendly language, requiring a fourth-to-sixth-grade literacy level (Squires et al., 2009) and can be completed by parents in 10 to 15 minutes. In addition, the ASQ does not require intensive training in order for users to administer it. The concurrent validity of ASQ was evaluated with several other standardized tests, such as the Bayley Scales of Infant Development Examination, the Stanford-Binet Intelligence Scale, and the Wechsler Preschool and Primary Scales of Intelligence-Revised (Klamer et al., 2005; Squires et al.,2009). The overall agreement between the results of ASQ and other standard criteria on the classification of children's abilities ranged from 83% to 88%. In addition, the test-retest reliability of ASQ was 92% (Squires et al., 2009).

Ages and Stages Questionnaires: Social Emotional (ASQ: SE)

The ASQ: SE is a parent-report questionnaire focusing on the social and emotional competence of children whose ages range from 3 months to 66 months. The ASQ: SE has eight intervals and includes 19 to 33 items scored on a three-point scale. These questionnaires measure the following developmental areas: (a) attachment, (b) autonomy and self-development, and (c) peer relationships (Jee et al., 2010; Salomonsson & Sleed, 2010). Response options range from 0 to 10 to indicate answers of: never or rarely, sometimes, and most of the time, respectively. Additionally, 5 points are assigned to items checked by parents as a concern (Squires, Bricker, & Twombly, 2004). The concern box helps the service providers or teachers knowledgeable about the needs of a

child (Gilkerson & Kopel, 2005). Both important and problem behaviors are included, with only problem behaviors assigned points.

The ASQ: SE is written for users with a fifth- to sixth-grade reading level (Squires et al., 2004). Studies have examined the reliability and validity of the ASQ: SE (Heo, 1999; Squires et al., 2004). For example, one study found that Cronbach's alpha was 0.71 for the 24-month group and 0.73 for the 36-month group; in addition, the overall agreement between the CBCL and the ASQ: SE was 95% (Heo, 1999). According to Squires et al. (2004), the internal consistency of the ASQ: SE ranged from 0.67 to 0.91, and the sensitivity and specificity were: 0.78 and 0.95 respectively.

Social Communication Questionnaire (SCQ)

The SCQ is a parent-report screening measure for children age 4 and above consisting of 40 items to which respondents reply yes or no. Parents often complete the SCQ in approximately 10 minutes. The SCQ is designed to be a companion screening tool for the Autism Diagnostic Interview-Revised (ADI-R), which consists of 93 items about a child's developmental history. The bivariate correlations between the total scores of the ADI-R and the SCQ range from moderate to high, 0.57 to 0.71 (Rutter, Bailey, & Lord, 2007).

The SCQ was validated on a sample of children with ASDs and without ASDs. For instance, Chandler et al. (2007) showed that the SCQ scores were highly correlated with the scores of the ADI-R. The sensitivity and specificity of the SCQ are 88% and 72%, respectively. The SCQ has shown psychometric properties superior to those of the Developmental Behavior Checklist-Autism Screening Algorithm (Witwer & Lecavalier, 2007).

Data Analysis

Confirmatory Factor Analysis (CFA)

A Confirmatory-Factor Analysis with categorical data was employed to examine the factor structure of each screening instrument. The Mplus software was used to carry out this analysis (Muthen & Muthen, 2010). The factor structures of screening instruments reported in the users' manuals were utilized to examine the hypothesized construct of the ASQ, the ASQ: SE, and the SCQ. Goodness of fit indices were used to determine whether or not the CFA model was interpretable. The indices and criteria to evaluate the CFA model were: Chi-square ($p > .05$), root mean square error of approximation (RMSEA < .08), comparative fit index (CFI ≥ .95), and Tucker-Lewis index (TLI ≥ .95). Also, the loading of the items on their latent factors was considered in evaluating the CFA model; the loading of items is treated as a bivariate correlation (Brown, 2006). Standardized Loading is small if it is less than .30.

According to Squires et al. (2009), the ASQ measures the following domains: (a) communication (CM), (b) gross motor (GM), (c) fine motor (FM), (d) problem solving (CG), and (e) personal social (PS), which will be treated as latent variables. These latent variables were modeled for each age interval with CFA. In regard to the ASQ: SE, it was modeled with one factor because there was a factor structure reported about the ASQ: SE.

Finally, the factors of SCQ reported in the user's guide were: (a) social interaction, (b) communication, (c) abnormal language, and (d) stereotyped behavior. These factors were utilized to conduct the CFA.

Agreement between Questionnaires

Pearson product moment correlation coefficients were calculated as an index of the agreement between the ASQ, and the ASQ: SE, with the SCQ (Furr & Bacharach, 2008). The total scores of the participants were used to conduct the correlation analysis. It was expected that the correlation between the ASQ and the SCQ would assume a negative value because of the scoring system of the questionnaires.

Classification Agreement

The following matrix was developed to measure the sensitivity and specificity of each individual tool. This matrix was utilized to calculate the negative predictive value and positive predictive value of each tool. The variable disability status and the cutoff scores were used to develop this matrix. The results of this matrix were the answer to part "b" of question 2. Table 3.1 displays the matrix of calculating the classification agreement.

Table 3.1. Matrix of Calculating Classification Agreement

	Disability status		
Screening result	At risk for (DD/ASDs)	Not at risk for (DD/ASDs)	Total
At risk	A	B	A+B
Not at risk	C	D	C+D
Total	A+C	B+D	N(A+B+C+D)

Note. Sensitivity (Se) = A/(A+C), specificity (Sp) = D/(B+D), positive predictive value (PPV) = A/(A+B), negative predictive value (NPV) = D/(C+D). DD = developmental disability, ASD = autism spectrum disorders.

CHAPTER IV

RESULTS

Chapter IV reports the results of the statistical analyses used to answer the following research questions:

1. What are the factor structures that represent the ASQ, the ASQ: SE, and the SCQ?
2. What is the agreement among these commonly used questionnaires in identifying children at risk for developmental disability and ASDs?
    a) What is the agreement between the ASQ and the ASQ: SE with the SCQ?
    b) What are the sensitivity and specificity of the ASQ, the ASQ: SE and the SCQ when compared with the disability status reported by parents?

Descriptive statistics summarizing the sample size and participants' demographics are given. The statistical analyses were done using both the SPSS software version 17 and Mplus software version 6. The SPSS software version 17 was utilized to conduct the following statistical analyses: (a) descriptive statistics of the sample size, contingency tables, and bivariate correlation; the Mplus software version 6 was utilized to test the confirmatory factor analysis of the ASQ, the ASQ: SE, and the SCQ.

Demographic Information of Participants

Twenty-five directors of autism treatment programs were contacted via email and regular mail requesting their participation in the study; of these, 19 agreed to disseminate information to the families of children with ASDs in their programs. The study was also publicized on free public websites: (a) autism awareness page on Facebook, http://www.facebook.com/group.php?gid=2207942310; (b) Autism Speaks, http://www.facebook.com/groups/2204582850/; (c) Autism Is?

http://www.facebook.com/groups/autismis/; and (d) Valerieslist, http://www.valerieslist.com, and (e) the ASQ website: http://pages.uoregon.edu/asqstudy/. In addition, the study was electronically publicized on a number of autism chapters sponsored by the U.S. Autism Society: (a) Eugene, OR; (b) Portland, OR; and (c) Lincoln, NE. Finally, two Oregon magazines—NK Magazine and Metro Parent Metro—published announcements about the study.

Data were collected online. The sample included 285 participants from all over the United States; participation from west coast states was high at 52.9%. Children of participants were between 35.98 and 62.85 months old; with a mean age of 47.68 and an age standard deviation of 7.19. The sample included 64 children with autism spectrum disorders, and 221 typically developing children.

Sixty-four participants had children with ASDs and other developmental disabilities. Of 64 children, 45 were diagnosed with ASDs and have for one year or more been receiving a variety of special education services through Early Childhood Cares, and through autism programs using interventions based on the principles of applied behavior analysis. The other 19 children showed the symptoms of autism disorder (e.g., social emotional delay, echolalia, communication impairment, intellectual disability). These 19 children were also enrolled in autism programs and were therefore considered on the spectrum of autism disorder. Appendix A describes participants' types of disabilities and their ages in months, corrected for matching the ASQ month intervals. Table 4.1 displays descriptive statistics of demographic characteristics of participants.

Table 4.1. Demographic Characteristics of Participants

Variables	*N*
Gender	
Male	158 (55.4%)
Female	127 (44.6%)
Disability status	
Autism	64 (22.5%)
Typical Children	221 (77.5%)
Ethnicity	
Asian	14 (4.9%)
White	208 (73%)
Native American	1 (.4%)
Black	8 (2.8%)
Hispanic	16 (5.6%)
Pacific Islander	1 (.4%)
Mixed	22 (7.7%)
Birth Condition	
Mature	236 (82.8%)
Premature	45 (15.8%)
Do not know	4 (1.4%)
Mother Education	
Less than High School	11 (3.9%)
High School	69 (24.2%)
Associate Degree	43 (15.1%)
Four year college or above	157 (55.1%)
Do not know	5 (1.8%)
Socioeconomic Status	
0-12,000	26 (9.1%)
12,001-24,000	29 (10.2%)
24,001-40,000	49 (17.2%)
40,000 and above	169 (59.3%)
Do not know	12 (4.2%)

Factor Structure of the ASQ, the ASQ: SE, and the SCQ

Each age interval of the ASQ and the ASQ: SE was modeled independently, for the ASQ: (a) 36 months, (b) 42 months, (c) 48 months, (d) 54 months, and (e) 60 months; for the ASQ:SE: (a) 36 months, (b) 42 months, and (c) 60 months. The rationale for modeling each age interval of the ASQ and ASQ: SE was that their items are phrased differently and varied across age intervals, while the items of the SCQ were phrased identically.

The response scales of the questionnaires (i.e., ASQ, ASQ: SE, and SCQ) were either ordinal or binomial scales; therefore, the responses on the binomial scale were modeled using the tetrachoric correlation matrix, while the responses on the ordinal scale were modeled using the polychoric correlation matrix. The weighted least square mean variance (WLSMV), a robust estimating method utilized with small and moderate sample sizes (Byrne, 2011; Brown, 2009), was the fitting estimating method utilized with all CFA models. The findings showed that the WLSMV corrects the mean and variance of estimating parameters and produces accurate estimates of goodness of fit indices, standard errors, and model parameters (Byrne, 2011; Flora & Curran, 2004; Muthén, 1984; Muthén, 1993).

Because of examining the CFA model of each ASQ and ASQ: SE age interval, there was a need to increase the sample size of each age interval. Thus, dissertation data were combined with current ASQ and the ASQ: SE on-line data. Tables 4.2 and 4.3 showed the number of total cases.

A t-test for independent samples and a number of chi-square tests were conducted to test whether the participants in the combined dataset represented the same population.

Mother's age, mother's education, socioeconomic status of families, genders of children, ethnicity, prematurely born children, diagnoses of ASDs, and receiving special education services were variables used to determine if participants in this combined dataset were pooled from the same population. There were not significant differences between the participants in the mother's age, $t(712) = -.671$, $p > .05$; gender, $\chi^2 (1) = .805$, $p > .05$; ethnicity, $\chi^2 (8) = 11.27$, $p > .05$; mother's education, $\chi^2 (4) = 6.19$, $p > .05$; and the socioeconomic status of families, $\chi^2 (4) = 9.84$, $p > .05$. However, there were statistically significant differences between the participants in disability condition, $\chi^2 (1) = 44.72$, $p < .05$ and in receiving special education services, $\chi^2 (1) = 45.47$, $p < .05$. The significant differences among participants in disability conditions and receiving special education services can be explained by the number of typically developing children versus the number of children diagnosed with ASDs: Table 4.4 shows the frequency of children diagnosed with ASDs and typically developing children.

In short, the combined dataset was used to test the factor structure of the ASQ and the ASQ: SE intervals. Non-statistical differences among participants in the combined dataset in a number of variables supported the hypothesis that these participants were from the same population, except for disability status and special education services received by the children diagnosed with ASDs.

Table 4.2. ASQ Sample Size

Age interval	Dissertation data	Child development data	Combined data
36 months	35	119	154
42 months	83	147	230
48 months	72	99	171
54 months	62	89	151
60 months	32	81	113

Table 4.3. ASQ: SE Sample Size

Age interval	Dissertation data	Child development data	Combined data
36 months	74	193	267
48 months	149	214	363
60 months	62	128	190

Table 4.4. Frequency of Children's disability conditions after data aggregation

Dataset	Typical developing	At risk (for DD/ASDs)	Total
Dissertation data	221	64	285
Child development data	272	54	326
Combined data	493	118	611

Note. DD = developmental disability, ASDs = Autism spectrum disorders.

CFA Model of ASQ 36-Month Interval

The 36-month interval was modeled with five latent variables, which were: (a) communication, (b) gross motor, (c) fine motor, (d) problem solving, and (e) personal social. Six items were associated with each latent variable except for gross motor, which had five items. The results of the Model goodness of fit indices were, χ^2 (348) = 415.503, $p < .05$; the RMSEA = .04, CI (.03 to .052); CFI = .97, and TLI = .97. Therefore, the five-factor model showed a satisfactory fit to the data (Chou & Bentler, 1999; Hu & Bentler, 2005).

The Pearson correlations coefficients between the latent variables were moderate-to-large and were statistically significant, $p < .0001$. The Pearson correlation coefficients ranged from .58 to .89. Latent variables were evaluated with regard to the size of their bivariate correlation values. Correlation values exceeding .80 suggest evidence of convergent validity, while correlation values negative or less than .80 suggest evidence of discrimination validity (Bollen, 1989; Brown, 2006). This criterion was used with all CFA models in the study.

The latent variables communication, problem solving, and personal social showed evidence of convergent validity; however, the other latent variables had moderate bivariate correlation values, which indicated evidence of discrimination validity. Table 4.5 shows the bivariate correlation values among the five latent variables.

Table 4.5. Bivariate Correlation between the latent variables of ASQ 36-Month Interval

Variables	Communication	Gross motor	Fine motor	Problem solving
Communication	1.00***			
Gross motor	.62***	1.00***		

Table 4.5. (continued).

Variables	Communication	Gross motor	Fine motor	Problem solving
Fine motor	.77***	.57***	1.00***	
Problem solving	.89***	.67***	.74***	1.00***
Personal social	.87***	.53***	.69***	.77***

Note. $p < .0001$.

The latent variable communication was strongly represented by five items (i.e., communication item one to communication item five), which had large standardized loadings ranging from .79 to .95, and R^2 values were between .63 and .90. The standardized residual values of these five items were small, ranging from .10 to .37, indicating that these items captured a large amount of the variance. However, item six of the latent variable communication had a small standardized loading .43 and R^2 of .19, which made this item not a good measure of the communication skills.

In the latent variable gross motor, five items were a measure of the gross motor skills except item three of gross motor. Item three had the smallest standardized loading of R^2, .24 and .06 respectively. The latent variable gross motor was well represented by five items rather than six. Likewise, both the latent variable fine motor and the latent variable personal social were well represented by five instead of six items. Finally, the latent variable problem solving was represented by six items, which showed strong relatedness to the hypothesized skill of problem solving. The findings of this latent variable suggest that this latent variable was theoretically grounded because it was measured by the six items hypothesized by the authors (i.e., Squires, Twombly, Bricker,

& Potter, 2009). The results of the standardized results of the ASQ 36-month interval are displayed in appendix B.

CFA Model of ASQ 42-Month Interval

The 42-month interval was modeled with five latent variables: (a) communication, (b) gross motor, (c) fine motor, (d) problem solving, and (e) personal social. Six items were associated with each latent variable except personal social with five items. The results of the Model goodness of fit indices were, χ^2 (367) = 484.94, $p <$ .05; The RMSEA = .04, CI (.03 to .05); CFI = .98 and TLI = .97. Therefore, the implied model showed acceptable level of fitting, so its parameters were interpretable (Chou & Bentler, 1999; Hu & Bentler, 2005).

The Pearson correlations between the latent variables were moderate-to-large and statistically significant, $p < .0001$. The evaluation criterion of latent variables was exactly the same as the one of the ASQ 36-month interval. The latent variable communication showed evidence of convergent validity with the following latent variables: fine motor, problem solving, and personal social. Also, the latent variable fine motor had a large bivariate correlation coefficient with problem solving and personal social, and the latent variable problem solving correlated strongly with personal social. The bivariate correlations of these latent variables were evidence of their convergent validity. Table 4.6 displays the correlation values among the five latent variables.

Table 4.6. Bivariate Correlation between the latent variables of ASQ 42-Month Interval

Variables	Communication	Gross motor	Fine motor	Problem solving
Communication	1.00***			
Gross motor	.73***	1.00***		

Table 4.6. (continued).

Variables	Communication	Gross motor	Fine motor	Problem solving
Fine motor	.80***	.77***	1.00***	
Problem solving	.93***	.68***	.81***	1.00***
Personal social	.95***	.77***	.82***	.95***

Note. $p < .0001$.

The CFA model of the ASQ 42-month interval had five latent variables and six items for each except the latent variable personal social with five items. Item one of the latent variable personal social was removed from the analysis because it made the model matrix non-positive definite. The inspection showed that item one of the latent variable personal-social had a negative variance, so the model can be estimated (West, Finch, Curran, 1999). The results of the analyses showed that the CFA model of the ASQ 42-month interval was better than the results of the CFA model of the ASQ 36-month age interval. The standardized loadings of the items and their R^2 values indicated that the model was theoretically grounded because the items were largely loading on their latent variables. The results of the analysis of the CFA of the ASQ 42-month interval are represented in Appendix C.

CFA Model of ASQ 48-Month Interval

The 48 months interval was modeled with four latent variables, which were: (a) communication and problem solving, (b) gross motor, (c) fine motor, and (d) personal social. The model produced improper solutions when modeled with five latent variables. The correlation between the latent variable communication and problem solving exceeded the value 1.00; therefore, the model was non-positive definite. The items of the latent variable problem-solving were grouped with the items of the latent variable

communication as a recommended solution to such as a correlation (Brown, 2006). The results of the model goodness of fit indices were, χ^2 (399) = 480.34, $p < .05$; The RMSEA = .04, 95% CI (.02 to .05); CFI = .97 and TLI = .96. Therefore, the implied model showed acceptable level of fitting, so its parameters were interpretable (Chou & Bentler, 1999; Hu & Bentler, 2005).

The correlations between the four latent variables were statistically significant, $p < .0001$. There was evidence of convergent validity between the communication problem solving latent variable and the personal social. Other latent variables correlated moderately with each other, as evidence of discrimination validity. Table 4.7 shows the bivariate correlation values among the four latent variables.

Table 4.7. Bivariate Correlation between the latent variables of the ASQ 48-Month Interval

Variables	Communication	Gross motor	Fine motor
Communication	1.00***		
Gross motor	.61***	1.00***	
Fine motor	.70***	.57***	1.00***
Personal social	.81***	.52***	.76***

Note. $p < .0001$.

The ASQ 48-month interval was represented by four latent variables; the goodness of fit indices showed that the model was satisfactory fit the data, which also meant that its parameters were interpretable. Appendix D shows the standardized results of the CFA model of the 48-month interval.

CFA Model of ASQ 54-Month Interval

The 54-month interval was modeled with five latent variables, which were: (a) communication, (b) gross motor, (c) fine motor, (d) problem solving, and (e) personal social. The results of the Model goodness of fit indices were, χ^2 (367) = 539.21, $p < .05$. The RMSEA was .06, 95% CI (.05 to .07), CFI was .97 and TLI was .96. Therefore, the implied model showed an acceptable level of fit, so its parameters were interpretable.

The Pearson correlations between the latent variables were moderate-to-large and statistically significant, $p < .0001$. The latent variable communication showed evidence of convergent validity with fine motor and personal social. The correlation values of the other latent variables did not exceed .80, so there was evidence of discrimination validity among them. Table 4.8 shows the bivariate correlation values among the five latent variables.

Table 4.8. Bivariate Correlation between the latent variables of the ASQ 54-Month Interval

Variables	Communication	Gross motor	Fine motor	Problem solving
Communication	1.00***			
Gross motor	.64***	1.00***		
Fine motor	.86***	.72***	1.00***	
Problem solving	.78***	.58***	.78***	1.00***
Personal social	.81***	.63***	.78***	.73***

Note. $p < .0001$.

The CFA model of the ASQ 54-month interval had five latent variables and six items for each. The results of the analyses showed that the CFA model of the ASQ 54-month interval was better than the results of the CFA model of the ASQ 36, 42, and 48-

month age intervals. The standardized loadings of the items and their R^2 values indicated that the model was theoretically grounded because the items were largely loading on their latent variables. The results of the analysis of the CFA of the ASQ 54 month interval are represented in Appendix E.

CFA Model of ASQ 60-Month Interval

The 60-month interval was modeled with five latent variables, which were: (a) communication, (b) gross motor, (c) fine motor, (d) problem solving, and (e) personal social. The results of the Model goodness of fit indices were, χ^2 (395) = 481.67, $p < .05$. The RMSEA was .04, 95% CI (.03 to .06), CFI was .97 and TLI was .96. Therefore, the implied model showed acceptable level of fitting, so its parameters were interpretable.

The Pearson correlations between the latent variables were moderate-to-large and statistically significant, $p < .0001$. There was evidence of convergent validity among the following latent variables: (a) communication and fine motor, problem solving, and personal social; (b) gross motor and personal social; and (c) fine motor and personal social. The results are displayed in Table 4.9.

Table 4.9. Bivariate Correlation between the latent variables of the ASQ 60-Month Interval

Variables	Communication	Gross motor	Fine motor	Problem solving
Communication	1.00***			
Gross motor	.78***	1.00***		
Fine motor	.82***	.72***	1.00***	
Problem solving	.82***	.65***	.79***	1.00***
Personal social	.88***	.92***	.92***	.76***

Note. $p < .0001$.

The results of the CFA model of the ASQ 60-month interval were approximately equivalent to the results of the ASQ 54-month interval. However, the items of the ASQ 60-month age interval showed larger loadings than those of the 54. The overall range of standardized loading values ranged from .55 to .99. Each latent variable was modeled with its six items, which indicated that the ASQ 60-month interval was a theoretically grounded model. The results are presented in appendix F.

CFA Model of ASQ: SE 36-Month Interval

The ASQ: SE was modeled with one latent variable; the goodness of fit indices did not show a good fit. Therefore, the parameters were not reported. The goodness of fit indices was: χ^2 (434) = 839.41, $p < .05$. The RMSEA was .06, 90% CI (.05 to .07), CFI was .88 and TLI was .88.

CFA Model of ASQ: SE 48-Month Interval

The ASQ: SE was modeled with one latent variable; the goodness of fit indices did not show good fit. The goodness of fit indices were: χ^2 (495) = 983.75, $p < .05$. The RMSEA was .05, 90% CI (.05 to .06), CFI was .92 and TLI was.

CFA Model of ASQ: SE 60-Month Interval

The ASQ: SE was modeled with one latent variable; the goodness of fit indices did not show good fit. The goodness of fit indices were: χ^2 (495) = 1156.77, $p < .05$. The RMSEA was .08, 90% CI (.08 to .09), CFI was .82 and TLI was .82.

CFA Model of SCQ

The analysis was conducted with 285 participants. Three out of four latent variables were modeled; one of the latent variables was not included because there were 15 participants on the latent variable, this latent made the matrix non-positive definite.

The latent variables were: (a) communication, (b) social interaction, and (c) repetitive behavior. The latent variable abnormal language was not modeled because its items were only taken by 44 participants. The goodness of fit indices were: χ^2 (491) = 726.54, $p <$ .05. The RMSEA was .04, 90% CI (.03 to .05); CFI was .95 and TLI was .94. The implied model showed acceptable goodness of fit indices consistent with the literature criteria except for TLI.

The Pearson correlations between the latent variables were moderate-to-large and statistically significant, $p < .0001$. There was evidence of convergent validity among the following latent variable communication and social interaction. Table 4.10 shows the correlation among the latent variables of the SCQ.

Table 4.10. Bivariate Correlation between the latent variables of the SCQ

Variables	Communication	Social interaction
Communication	1.00***	
Social interaction	.88***	1.00***
Repetitive behavior	.64***	.66***

Note. $p < .0001$.

In the communication factor, the range of loadings was from .15 to .93; SCQ item five had the smallest R^2 .15, which was also not statistically significant. Other items of this latent variable were loading largely on it, and such loading showed that the items were a good measure of the hypothesized construct, communication. In regard to the stereotyped behavior latent variable, it had only one non-statistically significant item, which was SCQ item 17 with the smallest R^2 .17. The other items were statistically significant and loading largely on it. The last latent variable of the SCQ was the social

interaction variable, which had a greater number of items than the other factors. All items of the social interaction were statistically significant and largely loaded on the factor except SCQ 23 with R^2 of .18. Appendix G shows the standardized CFA results of the SCQ.

Agreement among Questionnaires

The Agreement of the ASQ, the ASQ: SE, and the SCQ was measured by Pearson correlation coefficient and the classification agreement, which measured the sensitivity, specificity, positive predictive value and negative predictive value of each questionnaire. The total scores of participants in the ASQ and the SCQ as well as the ASQ: SE and the SCQ were used to measure the magnitude of agreement by Pearson product moment correlation coefficient. Before conducting Pearson product moment correlation analysis, descriptive statistics were calculated to determine if the data met the statistical assumptions of Pearson Product Moment Correlation Coefficient. Table 4.17 includes the means, standard deviations, and minimum and maximum scores of each questionnaire. The classification agreement was measured through the 2 x 2 contingency table and the formula reported in table 3.1. The results of the agreement analyses are reported below, beginning with the Pearson Product Moment Correlation Coefficient and ending with the classification agreement.

Pearson Product Moment Correlation Coefficient

Pearson Product Moment Correlation Coefficients were calculated to measure the agreement magnitude between the total scores of each ASQ domain, the total score of the ASQ: SE with the total score of the SCQ. The SCQ was the autism standard questionnaire used in the study to identify children with ASDs. The Pearson Product

Moment Correlation Coefficient was calculated as an index of the agreement (Furr & Bacharach, 2008). The total score of each questionnaire was inspected for the assumptions of normality and linearity before conducting the Pearson Product Moment Correlation Coefficient (Field, 2009; Howell, 2007). The assumption of normality was inspected by the histograms and box plots, while the scatter plot was used to visually examine the assumption of linearity (Pedhazur, 1997). The assumption of linearity was tenable for all questionnaires as evident by: (a) the positive trend between the total scores of ASQ: SE and the SCQ, and (b) the negative trend between the total scores of the ASQ domains and the total score of the SCQ.

The next section includes the results of the Pearson Product Moment Correlation Coefficient calculated for the total scores of the ASQ, of the ASQ: SE with the SCQ; a descriptive statistics precedes the results of the validity coefficients. Table 4.11 included descriptive statistics of the total scores of the ASQ domains, the total scores of the ASQ: SE and the SCQ.

Table 4.11. Descriptive Statistics of the Scores on the ASQ, ASQ: SE, and SCQ

Variables	*n*	*M*	*SD*	Min - Max
ASQ				
Communication	285	45.72	16.78	0.00 - 60.00
Gross motor	285	48.44	13.66	10.00 - 60.00
Fine motor	285	40.32	17.91	0.00 - 60.00
Problem solving	285	49.12	13.70	15.00 - 60.00
Personal social	285	46.40	15.62	0.00 - 60.00
ASQ:SE total score	285	73.14	66.10	0.00 - 325.00
SCQ total score	285	8.62	7.00	0.00 - 32.00

Note. Min/Max means the minimum and maximum scores

The correlation coefficients were statistically significant between the total score in the domains of the ASQ and the total score in the SCQ; the correlation coefficients ranged from -.57 to -.66, indicating strong agreement between the domains of the ASQ and the SCQ (Furr & Bacharach, 2008; Shultz & Whitney, 2005). The largest correlation coefficients were between the communication domain and the total score of the SCQ. In regard to the agreement between the ASQ: SE and the SCQ, the correlation coefficients indicated evidence of strong agreement as evaluated by the correlation coefficient and its magnitude. The correlation coefficients between the ASQ, the ASQ: SE, and the SCQ were statistically significant and had a positive linear direction and large magnitude. Table 4.12 shows the correlation coefficients among the scores of the ASQ, of the ASQ: SE, with the SCQ.

Table 4.12. The results of Pearson Product Moment Correlation Coefficient among the ASQ, the ASQ: SE, with the SCQ

	SCQ		
Variables	*r*	*95%CI*	R^2
ASQ			
Communication	-0.66***	[-0.74, -0.57]	.44
Gross motor	-0.57***	[-0.67, -0.47]	.33
Fine motor	-0.57***	[-0.67, -0.48]	.33
Problem solving	-0.57***	[-0.67, -0.47]	.33
Personal social	-0.64***	[-0.73, -0.55]	.41
ASQ:SE total score	0.84***	[0.77, 0.90]	.71

Note. ***$p < .0001$.

Classification Agreement

A 2 x 2 contingency table was used with each questionnaire to calculate the classification agreement among the questionnaires in terms of identifying children at risk for developmental disability and ASDs. The statistical analysis was conducted on 285 participants. The classification agreement was defined as follows: (a) sensitivity, (b) specificity, (c) positive predictive value, and (d) negative predictive value. The parents' reports of children's disability status and the cutoff scores of the questionnaires were utilized to form the contingency tables, which were then used to calculate the classification agreement among the questionnaires. The results of the statistical analyses are presented in table 4.13, table 4.14, table 4.15, and table 4.16.

Table 4.13. Classifications of Children as at Risk for Developmental Disability and ASDs Using One or More Domains of the ASQ and the Parents' Reports of Disability Status

All age intervals		Disability status		
		At risk (for DD/ASDs)	Not at risk (for DD/ASDs)	
ASQ classification	At risk	54	41	95
	Not at risk	10	180	190
	Total	64	221	285

Sensitivity	Specificity	PPV	NPV
84%	81%	57%	95%

Note. DD = developmental disability; ASDs = autism spectrum disorders; PPV = positive predictive value; NPV = negative predictive value.

Table 4.14. Classifications of Children as at Risk for Developmental Disability and ASDs Using Two or More Domains of the ASQ and the Parents' Reports of Disability Status

All age intervals		Disability status		
		At risk (for DD/ASDs)	Not at risk (for DD/ASDs)	
ASQ classification	At risk	41	14	55
	Not at risk	23	207	230
	Total	64	221	285

Sensitivity	Specificity	PPV	NPV
64%	94%	75%	90%

Note. DD = developmental disability; ASDs = autism spectrum disorders; PPV = positive predictive value; NPV = negative predictive value.

Table 4.15. Classifications of Children as at Risk for Developmental Disability and ASDs Using the Cutoff Scores of the ASQ: SE and the Parents' Reports of Disability Status

All age interval		Disability status		
		At risk (for DD/ ASDs)	Not at risk (for DD/ASDs)	
ASQ:SE classification	At risk	53	61	114
	Not at risk	11	160	171
	Total	64	221	285

Sensitivity	Specificity	PPV	NPV
83%	72%	47%	94%

Note. DD = developmental disability; ASDs = autism spectrum disorders; PPV = positive predictive value; NPV = negative predictive value.

Table 4.16. Classifications of Children as at Risk for Developmental Disability and ASDs Using the Cutoff Score of the SCQ and the Parents' Reports of Disability Status

All age interval		Disability status		
		At risk (for DD/ASDs)	Not at risk (for DD/ASDs)	
ASQ classification	At risk	45	28	73
	Not at risk	19	193	212
	Total	64	221	285

Sensitivity	Specificity	PPV	NPV
70%	87%	62%	91%

Note. DD = Developmental disability; ASDs = autism spectrum disorders; PPV = positive predictive value; NPV = negative predictive value.

Summary

The study focused on three research questions related to the factor structure of each questionnaire and the agreement between the ASQ, the ASQ: SE and the SCQ. The results were promising in terms of the agreement classification of the ASQ if one or more domains were used to identify children at risk for developmental disability and ASDs. The results showed that the ASQ: SE showed promising sensitivity of the ASQ for identifying children at risk for developmental disability and ASDs; also, the sensitivity of the ASQ: SE was higher than the sensitivity of the SCQ.

The ASQ: SE and the SCQ displayed strong agreement in identifying children at risk for developmental disability and ASDs as measured by the bivariate correlation coefficients. Also, the same strong agreement was present between the domains of the ASQ and the total score of the SCQ.

Finally, the ASQ displayed a factor structure, which was theoretically grounded based on the assumption of its developers. However, the ASQ: SE did not show an interpretable factor structure with one latent variable. In regard to the factor structure of the SCQ, it was not strongly supported by the goodness of fit indices, but its parameters were interpretable.

CHAPTER V

DISCUSSION

The study began with a description of and recent findings related to ASDs. The description covered the symptoms of ASDs distinguishing it from other developmental disorders. Also, recent findings were reviewed regarding the prevalence of ASDs, which are inconsistent across studies conducted in the US and broadly. But the finding of ASD prevalence reported in the 2000 ADDMN report – 6.5:1000 – indicates a slight increase in ASDs in comparison with Kanner's finding of 6:1000. The prevalence of ASDs is still a contentious and volatile issue, but a great number of longitudinal and experimental studies have demonstrated that early identification and intervention have significantly positive effects on various life aspects of children with ASDs. Therefore, this study compared the factor structures of level-I screening instruments, ASQ and ASQ: SE, with the factor structure of a level-II screening instrument, the SCQ. In addition, the agreement between the ASQ, and the ASQ: SE with the SCQ was investigated. Two major research questions were the foci of the dissertation. The first research question centered on the factor structure of three commonly used questionnaires, while the second research question measured the agreement between the ASQ, and the ASQ: SE, with the SCQ.

Factor Structures of the Three Questionnaires

The factor structure of the ASQ was theoretically grounded on five latent variables; each was measured by six items. However, the factor structure of the ASQ age interval of 48-months was not consistent with the other age intervals in terms of the number of latent variables hypothesized for the ASQ. The results showed that the ASQ

age interval 48-months was represented by four latent variables as listed in Table 4.14; these four latent variables showed acceptable level of fit as measured by the indices of goodness of fit. A few items were detected in each ASQ age interval having small loadings; the small loadings might suggest a need for rephrasing the items.

In the ASQ 36-month interval, both the communication item six and the gross motor item three had small loadings and large residual variances. Communication item six is, *"When you ask, "What is your name?" does your child say both her first and last names?"* (Squires et al., 2009) and gross motor item three is,

> Does your child walk up stairs, using only one foot on each chair? (The left foot on one step, and the right one is on the next one) she should hold onto the railing or wall. (You can look for this at a store, playground, or at home.) (Squires et al., 2009).

Therefore, these items might require rephrasing and further analyses because their relatedness to the communication latent variable was not as good as that of other items of the same latent variable (Brown, 2006; Kline, 2011). Future evaluation of the small loading items is needed; the small loadings might be explained by a number of factors such as the wording issue of the item or their lack of relatedness to the constructs.

The CFA models of the ASQ 42, 54, and 60-month intervals were theoretically grounded. Both goodness of fit indices and the item loadings supported the hypothesized structure of the ASQ with five latent variables. The item loadings were largely loaded in their latent variables as evidenced in appendixes B, C, and D. However, the item ps1 was deleted from the ASQ 42-month interval because it had a negative variance – Heywood case – hindering the model from converging. The personal-social item one is, "*When he*

is looking at a mirror and you ask, "Who is in the mirror? Does your child say either me or his own name" (Squires et al., 2009). Personal-social item one appears not to be related to the personal social latent variable by having a negative correlation with other items in the personal social domain (Brown, 2006).

The CFA results of the ASQ 48-month interval showed that the items of fine motor and personal social were strongly related to their hypothesized constructs as the value of their item loadings, R^2, and the residual variance indicate. For instance, the item loadings of the latent variable fine motor ranged from .58 to .82, R^2 ranged from .34 to .54, and the residual variances of these items ranged from .33 to .66. However, item one of the latent variable gross motor had a small loading value; gross motor item one is: "*Does your child catch a ball with both hands? You should stand about 5 feet away and give your child two or three tries before you mark the answer*" (Squires et al., 2009). The small item loading indicates that gross motor item one might not be related to the latent variable gross motor; the item seems to measure two skills related to gross motor and ability to attention. Rephrasing of this item might be warranted.

In regard to CFA model of the ASQ: SE, the results showed that the items of the ASQ: SE could not be modeled with one factor. The factor structure of the ASQ: SE required further analyses, first by exploratory factor analysis and then by CFA. Finally, the SCQ showed a factor structure represented by three factors.

As with the ASQ, there were a few items of the SCQ that might require rephrasing and further analyses. These items, SCQ nine and SCQ 23, could be culturally biased or unrelated to their latent variables. SCQ item nine is, "*Has she/he ever got her/his pronouns mixed up (saying you or she/he for I*" (Rutter et al., 2003). SCQ item 23

is, "*When she/he was 4 to 5, did she/he ever use gestures, other than pointing or pulling your hand, to let you know what she/he wanted*" (Rutter et al., 2003). In addition to cultural bias or unrelatedness of these items to their latent variables, the repetitiveness of the subject pronouns in the items might confuse the test-takers. These items require rephrasing to reduce any change of confusion.

In summary, the ASQ showed a well-established factor structure across the age interval except for the 48-month interval, which was represented by four latent variables. Also, the items loadings of the 54 and 60-month intervals demonstrated their strong relatedness to the latent variables. There was a single items deleted in the ASQ 42-month interval because the item had a negative variance, which in turn affected the goodness of fit of the model. Other items in the ASQ 36 and 48-months had small loadings, which could be explained by a number of factors such as unrelatedness of the items of the latent variables. In regard to the ASQ: SE, its factor structure was not theoretically grounded, and further analysis is required for the factor structure of the ASQ: SE. This finding may be related to design of the ASQ: SE in that it is designed to screen for overall social emotional competence and is not divided into domains or subareas that might cluster in a factor structure analysis. For example, items such as a child's ability to fall asleep are not clustering with questionnaire items such as naming friends, taking turns, and making eye contact. Therefore the factor structure measures one or two main factors. Finally, the SCQ did not show a strong good fit and had some items showing small loadings.

Agreement between the Questionnaires

The descriptive statistics of the total scores of the ASQ, ASQ: SE, and the SCQ showed positive skewness; the box plots displayed some outliers, which were the scores of children with ASDs in the questionnaires. For instance, three children with ASDs scored –3 z standard deviations below the mean in the problem-solving domain of the ASQ 42-month age interval. In the ASQ 48-month age interval, one child with ASDs scored –3 z standard deviations below the mean on the gross motor domain. There were a few other cases (three to four) scoring -3 z standard deviations below the mean scattered over each age interval of the ASQ and ASQ: SE. Although the assumption of normality seemed untenable, some research findings indicated that the Pearson product moment correlation coefficient is a robust test against violation of the assumption of normality (Havlicek & Peterson, 1977; Kraemer, 1980). In addition, Field (2007) emphasized the importance of the linearity assumption over the assumption of normality when the Pearson product moment correlation coefficient is calculated. Although the data were tenable for calculating the correlation between the participants' scores, the cases of the three standard deviations below the mean supported that the sensitivity of ASQ and the ASQ: SE for cases with profound developmental delay. Some cases scored lower in some ASQ domains than the others.

In short, the bivariate correlation analysis has shown high agreement between the ASQ the ASQ: SE and the SCQ. The agreement indicates the possibility of utilizing either of these screening instruments to identify children at risk for autism. The high agreement is an evidence of the similarity shared between the questionnaires, so it is economical to use one of them in the process of finding children at risk for ASDs.

Classification Agreement

Screening is an initial step of the diagnostic process for finding children at risk for disability. The SCQ was used as a level II ASD screening instrument. Its classification agreement has not been consistent across studies; sensitivity ranged from .85 to .96 (Table 2.2), while its specificity ranged from .67 to .80. Other studies showed that the SCQ has sensitivity and specificity of .70, which is consistent finding with the findings of this study (Oosterling et al., 2010).

In regard to the ASQ, the results of the classification agreement of the ASQ showed that the number of positive cases captured by one or more domains of the ASQ was greater than the positive cases identified by two or more domains of the ASQ; therefore, using one or more domains of the ASQ to identify children at risk for developmental disability and ASDs resulted in higher sensitivity than that of using two or more domains of the ASQ for identifying children at risk for ASDs. The specificity of one or more domains of the ASQ also was greater than the two or more domains of the ASQ. The values of sensitivity and specificity of using one or more ASQ domains as a criterion of identifying children at risk for developmental disability and ASDs were consistent with the recommended values reported in the literature of .80 and above (Coonrod & Stone, 2005; Lalkhen & McCluskey, 2008).

The sensitivity of the one or more domains of the ASQ was greater than the sensitivity of ASQ: SE and the sensitivity of the SCQ; however, the SCQ showed greater specificity than the specificity of one or more domains of the ASQ and the specificity of the ASQ: SE. In addition, the positive predictive value of SCQ was greater than the positive predictive values of the ASQ: SE. The results of the positive predictive values

indicated the likelihood that a participant with ASDs would test positive on the SCQ was higher than the likelihood of testing positive for a participant with ASDs on the ASQ: SE.

In summary, the psychometric properties of using one or more domains of the ASQ for identifying children at risk for developmental disability and ASDs showed superiority over the results of the ASQ: SE and the SCQ. Discrepancies among the agreement classification of the ASQ: SE and the SCQ were obvious: the sensitivity of ASQ: SE was greater than the sensitivity of the SCQ, while the latter had greater specificity than the former in terms of identifying children who did not have ASDs. Although there were discrepancies between the ASQ: SE and the SCQ in terms of the agreement classification results, the questionnaires showed high agreement when their total scores were correlated.

Implications of the Results

The study indicates that the ASQ shows a promising result in terms of identifying children at risk for developmental disability and ASDs. The finding suggests the use of ASQ as a level-I screening instrument to identify children at risk for developmental disability and ASDs; identification does not mean diagnosis, but it means finding children who are at risk for developmental disability and ASDs and in need of further assessment (Johnson & Myer, 2007). For instance, the ASQ might be utilized in pediatric clinics to screen for the risk of developing the symptoms of ASDs. Also, the result of CFA demonstrates that the domains of the ASQ are theoretically grounded; practitioners can refer children for further assessment if one or more domains are failed by a test taker. The referral should be based on the domain that is failed. For instance, if a child fails the

communication domain, further assessment should be conducted on the communication skills of this child.

The ASQ: SE had a strong bivariate correlation coefficient with the SCQ, which suggests the ASQ: SE might be utilized as an alternative to the SCQ. The agreement between the ASQ: SE and the SCQ is 84%, which indicates high similarities between the questionnaires (Furr & Bacharach, 2008). In other words, the information provided by the ASQ: SE is somewhat similar to that provided by the SCQ. Therefore, the ASQ: SE can be used to identify children who are at risk for ASDs and eligible for further ASD assessment and diagnosis.

Limitations of Study

The sample size of the study was one limitation in terms of confirming the value of the ASQ over other questionnaires. Also, the heterogeneity of the participants with ASDs might have affected the rate of false negatives in the ASQ: SE; the participants manifested a range of ASD symptoms. Some of these participants had a comorbid disability such as ADHD and ASDs. In addition, the 64 participants with ASDs were receiving special educational services during the study period. Therefore, their skills varied in the domains of the ASQ and the items of the ASQ: SE and SCQ.. A larger sample size and a more representative random sample might have better supported the results of the CFA model and the agreement between the questionnaires.

Future Studies

The moderate and large bivariate correlation coefficients among the latent variables of the ASQ and the SCQ suggest the likelihood that the factor structures of these questionnaires might be represented by fewer than five factors for the ASQ and

three factors for the SCQ. Future studies might focus on comparing the factor structure of these questionnaires in terms of the number of the latent variables. For instance, the goodness of fit indices of the ASQ when its factor structure is modeled with one or more latent variables can be investigated. The comparisons should be drawn between the models in terms of the indices of goodness of fit (Stevens & Zvoch, 2007).

The factor structure of the ASQ: SE requires further analysis by using exploratory factor analysis and the confirmatory factor analysis. These analyses might contribute to establishing a theoretical structure for the ASQ: SE. The factor structure has a practical benefit in terms of identifying the domains of the questionnaire, which can be used to measure a particular skill or to refer a child lacking a specific skill.

Future studies should conduct invariance testing among the typical group and ASDs group, so the possibility of measuring of item difficulty across groups could be available in the context of CFA models. Another line of future research should examine the agreement among the questionnaires using multi-trait multi-method procedures to control for the measurement error and the method factor represented by the response scale of the questionnaires (Bollen, 1989; Brown, 2006; Byrne, 2011). Such an analysis will provide information about the convergent and discriminant validity among across the latent variables of the questionnaires.

Conclusion

The factor structure of the ASQ was theoretically grounded as evident in the age intervals 54 and 60-months. These age intervals showed that the ASQ was represented by five latent variables hypothesized by its authors, and these latent variables were associated with six items. However, the ASQ age interval 42-months was not

theoretically grounded because it was not consistent with the hypothesized domain structure of the ASQ; the ASQ age interval 42-months was represented by four latent variables. The communication latent variable included 12 items and six items were associated with the rest of latent variables, gross motor, fine motor, and personal social. The problem solving latent variable was combined with the communication latent variable, so the communication latent variable had 12 items.

The ASQ: SE did not show a factor structure; the indices of the goodness of fit indicated lack of fit between the observed matrix and implied matrix of the ASQ: SE. Therefore, its items were not interpretable. The SCQ showed a factor structure, which its goodness of fit indices met on 2 out of 4 criteria listed in the chapter III method. Its indices of goodness of fit were not supportive of the model as the indices of ASQ.

The ASQ demonstrated acceptable classification agreement when one or more of its domains were used to identify children at risk for developmental disability and ASDs. Its classification agreement was consistent with the recommended values of the sensitivity and specificity in the literature, .80 or above. Overall classification agreement of the ASQ, using one or more domains, was superior to the classification agreement of the ASQ: SE and the SCQ. Moreover, children's total scores in the domains of the ASQ significantly correlated with the total scores in the SCQ; the correlation between these questionnaires was evidence of agreement. The negative value was due to the reverse scoring of the questionnaires. The ASQ: SE also showed a high agreement with the SCQ.

In summary, the results of the study supported the use of the ASQ, the ASQ: SE and the SCQ to identify children at risk for developmental disability and ASDs. The ASQ appeared more theoretically grounded than the ASQ: SE and the SCQ. Using valid and

reliable screening instruments increases the positive outcomes of early identification (Guralnick, 2005). Screening provides information about the general skill level of children. A number of screening instruments have been widely used to identify children at risk for developmental disability and ASDs (Matson & Spies, 2010), but inconsistent results about the psychometric properties and utilities of these screening tools have been reported (e.g., Matson & Spies, 2010; Volkmare & Klin, 2005). However, the ASQ and the ASQ: SE showed promising findings in identifying children at risk for developmental disability and ASDs. Therefore, these screening instruments can be used to improve the early identification of children at risk for developmental disability and ASDs.

APPENDIX A

NUMBER OF PARTICIPANTS, THEIR DISABILITY STATUS, AND THEIR AGES IN MONTHS CORRECTED FOR THE ASQ MONTH INTERVALS

	ASQ Month Intervals				
Disability Status	36	42	48	54	60
Typically developing children	31	66	61	49	25
Autism disorder	4	15	8	11	7
Communication impairment	0	1	1	1	0
Social emotional delay	0	0	0	1	0
Intellectual disability	0	1	1	0	0
Developmental delay	0	0	1	1	0
Total	35	83	72	62	32

APPENDIX B

STANDARDIZED CFA RESULTS OF THE ASQ 36-MONTH INTERVAL

Items	β	*S.E.*	R^2	Residual Variance
Communication factor				
Cm1	.95***	.07	.90	.10
Cm2	.91***	.05	.82	.18
Cm3	.83***	.05	.70	.30
Cm4	.88***	.04	.78	.22
Cm5	.79***	.05	.63	.37
Cm6	.43***	.08	.19	.81
Gross motor Factor				
Gm1	.99***	.07	.97	.03
Gm2	.66***	.09	.43	.57
Gm3	.24	.12	.06	.94
Gm4	.86***	.07	.75	.25
Gm5	.62***	.13	.38	.62
Gm6	.69***	.08	.48	.52
Fine motor factor				
Fm1	.89***	.03	.78	.21
Fm2	.79***	.05	.62	.38
Fm3	.68***	.07	.46	.54
Fm4	.95***	.03	.90	.10
Fm5	.71***	.07	.50	.50
Fm6	.48***	.09	.23	.77

Problem solving factor				
Cg1	.75***	.07	.56	.44
Cg2	.69***	.10	.47	.53
Cg3	.70***	.08	.50	.50
Cg4	.87***	.04	.76	.24
Cg5	.73***	.06	.53	.47
Cg6	.85***	.04	.72	.28
Personal social factor				
Ps1	.79***	.07	.62	.38
Ps2	.44**	.15	.19	.81
Ps3	.99***	.04	.98	.02
Ps4	.60***	.07	.36	.64
Ps5	.82***	.06	.68	.32
Ps6	.75***	.05	.56	.44

Note. ***$p < .0001$, **$p < .001$, *$p < .05$. CM = Communication; GM = Gross Motor; FM = Fine Motor; CG = Problem Solving; PS = Personal Social.

APPENDIX C

STANDARDIZED CFA RESULTS OF ASQ 42-MONTH INTERVAL

Items	β	*S.E.*	R^2	Residual Variance
Communication factor				
Cm1	.85***	.04	.72	.28
Cm2	.95***	.03	.90	.10
Cm3	.86***	.05	.75	.25
Cm4	.71***	.04	.50	.50
Cm5	.80***	.03	.63	.37
Cm6	.85***	.03	.71	.29
Gross motor factor				
Gm1	.52***	.08	.27	.73
Gm2	.92***	.05	.85	.15
Gm3	.66***	.08	.44	.56
Gm4	.78***	.06	.62	.38
Gm5	.65***	.07	.42	.58
Gm6	.74***	.11	.54	.46
Fine motor factor				
Fm1	.80***	.04	.65	.35
Fm2	.85***	.03	.72	.28
Fm3	.80***	.04	.65	.35
Fm4	.59***	.06	.34	.66
Fm5	.71***	.05	.50	.50
Fm6	.83***	.05	.69	.31

Problem solving factor				
Cg1	.74***	.06	.54	.46
Cg2	.93***	.03	.86	.14
Cg3	.80***	.05	.64	.36
Cg4	.88***	.03	.77	.23
Cg5	.86***	.04	.74	.26
Gg6	.80***	.04	.64	.36
Personal social factor				
Ps2	.66***	.06	.44	.56
Ps3	.87***	.05	.76	.24
Ps4	.69***	.05	.47	.53
Ps5	.61***	.05	.37	.63
Ps6	.78***	.04	.60	.40

Note. ***$p < .0001$. CM = Communication; GM = Gross Motor; FM = Fine Motor; CG = Problem Solving; PS = Personal Social.

APPENDIX D

STANDARDIZED CFA RESULTS OF ASQ 48-MONTH INTERVAL

Items	β	*S.E.*	R^2	Residual Variance
Communication problem solving				
Cm1	.78***	.06	.61	.39
Cm2	.97***	.04	.94	.06
Cm3	.89***	.03	.79	.21
Cm4	.72***	.06	.51	.49
Cm5	.63***	.06	.40	.60
Cm6	.75***	.05	.56	.44
Cm7	.43***	.12	.19	.81
Cm8	.78***	.06	.61	.39
Cm9	.68***	.06	.47	.53
Cm10	.56***	.10	.31	.69
Cm11	.62***	.08	.38	.62
Cm12	.67***	.08	.45	.55
Gross motor				
Gm1	.48***	.09	.23	0.77
Gm2	.62***	.15	.38	0.62
Gm3	.72***	.07	.52	0.48
Gm4	.81***	.05	.66	0.34
Gm5	.90***	.05	.80	0.20
Gm6	.82***	.05	.67	0.33

Fine motor				
Fm1	.71***	.07	.50	.50
Fm2	.80***	.05	.65	.35
Fm3	.82***	.05	.67	.33
Fm4	.58***	.07	.34	.66
Fm5	.74***	.06	.55	.45
Fm6	.73***	.05	.54	.46
Personal social				
Ps1	.65***	.06	.43	.57
Ps2	.71***	.07	.50	.50
Ps3	.86***	.05	.74	.26
Ps4	.87***	.05	.75	.25
Ps5	.82***	.04	.67	.33
Ps6	.72***	.06	.52	.48

Note. ***$p < .0001$. CM = Communication and Problem Solving; GM = Gross Motor; FM = Fine Motor; PS = Personal Social.

APPENDIX E

STANDARDIZED CFA RESULTS OF ASQ 54-MONTH INTERVAL

Items	β	*S.E.*	R^2	Residual Variance
Communication factor				
Cm1	.84***	.05	.70	.30
Cm2	.95***	.02	.91	.09
Cm3	.96***	.02	.91	.09
Cm4	.75***	.06	.57	.43
Cm5	.99***	.02	.99	.01
Cm6	.89***	.03	.80	.20
Gross motor factor				
Gm1	.87***	.06	.75	.25
Gm2	.70***	.09	.50	.50
Gm3	.82***	.06	.67	.23
Gm4	.76***	.08	.57	.43
Gm5	.81***	.07	.66	.33
Gm6	.71***	.09	.50	.50
Fine motor factor				
Fm1	.92***	.04	.84	.16
Fm2	.69***	.08	.47	.53
Fm3	.76***	.05	.58	.42
Fm4	.77***	.04	.60	.30
Fm5	.78***	.05	.60	.30
Fm6	.74***	.07	.54	.46

Problem solving factor				
Cg1	1.00***	.06	1.00	.00
Cg2	.77***	.08	.60	.40
Cg3	.85***	.05	.73	.26
Cg5	.72***	.05	.52	.48
Cg6	.67***	.08	.45	.55
Personal social factor				
Ps1	.72***	.07	.52	.48
Ps2	.86***	.06	.74	.26
Ps3	.81***	.05	.65*	.35
Ps4	.71***	.07	.50*	.50
Ps5	.99***	.05	.99*	.02
Ps6	.66***	.07	.44*	.56

Note. ***$p < .0001$. CM = Communication; GM = Gross Motor; FM = Fine Motor; CG = Problem Solving; PS = Personal Social.

APPENDIX F

STANDARDIZED CFA RESULTS OF ASQ 60-MONTH INTERVAL

Items	β	*S.E.*	R^2	Residual Variance
Communication factor				
Cm1	.85***	.05	.72	.28
Cm2	.93***	.08	.87	.13
Cm3	.89***	.04	.79	.21
Cm4	.77***	.06	.59	.41
Cm5	.96***	.05	.91	.09
Cm6	.59***	.07	.35	.65
Gross motor factor				
Gm1	.83***	.08	.68	.32
Gm2	.63***	.09	.40	.60
Gm3	.88***	.06	.77	.23
Gm4	.93***	.05	.87	.13
Gm5	.85***	.05	.73	.23
Gm6	.64***	.07	.41	.59
Fine motor factor				
Fm1	.70***	.09	.49	.51
Fm2	.87***	.04	.76	.24
Fm3	.89***	.05	.79	.21
Fm4	.87***	.05	.75	.25
Fm5	.92***	.03	.85	.15
Fm6	.91***	.04	.83	.17

Problem solving factor				
Cg1	.99***	.10	.97	.03
Cg2	.75***	.08	.56	.44
Cg3	.55***	.09	.30	.70
Cg4	.98***	.06	.96	.04
Cg5	.90***	.05	.82	.18
Cg6	.83***	.05	.69	.31
Personal social factor				
Ps1	.76***	.07	.57	.43
Ps2	.62***	.10	.39	.61
Ps3	.88***	.09	.78	.32
Ps4	.70***	.07	.48	.52
Ps5	.60***	.10	.36	.64
Ps6	.72***	.07	.52	.58

Note. ***$p < .0001$. CM = Communication; GM = Gross Motor; FM = Fine Motor; CG = Problem Solving; PS = Personal Social.

APPENDIX G

STANDARDIZED CFA RESULTS OF SCQ

Items	β	*S.E.*	R^2	Residual Variance
Communication factor				
Scq9	.35***	.10	0.12	0.88
Scq15	.74***	.07	0.55	0.45
Scq20	.91***	.05	0.82	0.18
Scq24	.92***	.03	0.86	0.12
Scq25	.91***	.03	0.83	0.17
Stereotyped behavior factor				
Scq8	.62***	.07	.39	.61
Scq10	.60***	.07	.35	.65
Scq11	.94***	.05	.89	.11
Scq12	.82***	.06	.67	.33
Scq13	.50***	.08	.25	.75
Scq14	.68***	.07	.46	.54
Scq16	.79***	.07	.63	.37
Scq18	.51***	.09	.26	.74
Social interaction factor				
Scq17	.50***	.08	.49	.51
Scq19	.70***	.06	.32	.68
Scq21	.56***	.08	.32	.68
Scq22	.63***	.07	.40	.60

Scq23	.36***	.08	.13	.45
Scq26	.74***	.06	.55	.45
Scq27	.68***	.07	.46	.54
Scq28	.79***	.05	.62	.38
Scq29	.80***	.05	.64	.36
Scq30	.86***	.05	.74	.26
Scq31	.81***	.05	.66	.34
Scq32	.60***	.08	.36	.69
Scq33	.77***	.06	.60	.30
Scq34	.74***	.06	.55	.45
Scq35	.83***	.05	.69	.31
Scq36	.79***	.05	.62	.38
Scq37	.81***	.05	.66	.34
Scq38	.82***	.04	.67	.33
Scq39	.89***	.04	.79	.21
Scq40	.86***	.04	.74	.26

Note. ***$p < .0001$. SCQ = Social Communication Questionnaire.

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