Bethel University

2020

# Understanding Gender Differences in Autism Spectrum Disorder to Better Identify Females With ASD

Betsy M. Galles
*Bethel University*

## Recommended Citation

UNDERSTANDING GENDER DIFFERENCES IN AUTISM

TO BETTER IDENTIFY FEMALES WITH ASD

A MASTER'S THESIS

SUBMITTED TO THE FACULTY OF BETHEL UNIVERSITY

BY

BETSY GALLES

FOR THE DEGREE OF

MASTER OF ARTS

DECEMBER 2020

BETHEL UNIVERSITY

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BETSY GALLES

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ADVISOR:  SUSAN LARSON, M.A., M.S. CCC-SLP

DIRECTOR: KATIE BONAWITZ, Ed. D.

**Abstract**

Males are diagnosed with Autism Spectrum Disorder (ASD) compared to females at a ratio of 4:1. When isolating for higher intellectual ability, the ratio increases to 10:1. Gender differences exist in restricted, repetitive behaviors and social interaction. Gender differences vary based on age, race, ethnicity, cognitive level, and socio-economic circumstances, assessment procedures, diagnostic tools, evaluator experience, and bias. Diagnostic test elements have been found to be biased toward males. With new knowledge based on the female presentation of ASD symptoms and behaviors, efforts must be made to update evaluation tools, properly train clinicians, and assess using instruments that accurately diagnose females who have been overlooked.

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**Chapter I:  INTRODUCTION**

Autism Spectrum Disorder (ASD) is a developmental disability that causes social,

communication, and behavioral challenges for individuals of all ages. Many factors are linked to

ASD including genetic factors, chromosomal abnormalities such as Fragile X Syndrome,

environmental factors, pregnancy, and behavioral factors. While there is no known autism cure

for many children, early intervention has improved social and communication skills, reduced

behavioral symptoms, and improved daily living skills resulting in a better quality of life.

Autism has gained a presence in our society due to the alarming rise in the number of

children diagnosed each year. In 1988, Rain Man was the first motion picture to focus on an

adult living with autism. In the fictitious drama, Raymond, "Rain Man," was a savant who lived

in an institution and was visited periodically by his brothers. Beginning in the 2000's, many

television shows have a lead character with autism including Parenthood (2010), Atypical

(2017), and the Good Doctor (2017). The first ASD character to be played by a person with

autism is Kayla Cromer in Everything's Gonna Be Okay (2020). Non-fictional movies such as the

Temple Grandin story, have also aired recently.

Although ASD might seem like a relatively recent medical diagnosis, the word autism was

first used in 1908 to refer to individuals thought to have schizophrenia, who were withdrawn

and self-absorbed. In 1943 Leo Kanner, M.D. first used the term "early infantile autism" to

describe children who were highly intelligent, displayed solitude, and rigid in their routine. In

1944 Hans Asperger described high-functioning individuals who showed social deficits and

termed it Asperger Syndrome. In 1967 the term "Refrigerator Moms" was theorized as the

cause of autism due to poor parenting. In 1980 Autism entered the Diagnostic and Statistical Manual of Mental Disorders (DSM) as a separate entity, no longer aligned with schizophrenia. In 1990, autism became a special education disability category, which allowed individuals with autism to qualify for special education. Now, over 70 years later, there is an entire spectrum of individuals with autism. All former categories of autism including autism, childhood disintegrative disorder, Asperger syndrome, and pervasive developmental disorder -not otherwise specified (PDD-NOS) fall under one umbrella titled Autism Spectrum Disorder (ASD). To be identified with a medical label of ASD, a diagnosis is required based on the Diagnostic and Statistical Manual - 5th edition (DSM-5). In the school setting, students are labeled with ASD if they meet criteria established by the federal and state mandates whether or not they have a medical diagnosis. Although studies of ASD have come a long way in the last 70 years, many questions remain surrounding the ratio gap between male and female diagnosis.

I recently interviewed a woman by the name of Susan, who shared her personal story with me about her children: 10-year-old twin boys and a 13-year-old daughter. One of her twin boys, John, was diagnosed with Asperger's when he was 5 years old (his twin brother, James, was typically developing). John had early developmental delays and his doctor recommended he receive ASD testing. Once diagnosed, John's early interventions included social skills, speech therapy, music therapy, and Applied Behavior Analysis (ABA). These interventions were successful for John. Today he is a happy boy with lots of friends and seems to have a well-adjusted life. Susan's daughter, Jane, on the other hand, was diagnosed with ASD at the age of 8. Jane did not have any developmental delays and she demonstrated typical development in her early years. Due to mental and emotional problems, she eventually visited

a psychologist, who recommended that she have an ASD evaluation. Jane was diagnosed with ASD at the age of eight. Interventions for Jane were not as successful as they were for her brother John according to her mother. Jane refused ABA Therapy because she "hated being told what to do", and eventually, her parents agreed to discontinue the therapy because it was too stressful for both Jane and her entire family. This struck me hard as I realized how one person's behavior can affect an entire family experience and their emotional health. Overall, according to Susan, the interventions for her daughter seemed "very ineffective". Jane memorized responses to questions and mimicked appropriate behavior that she learned from books and activities. She masked her ASD behaviors during assessments and could easily fly under the radar as achieving. Little attention was paid to her or her emotional stability, and she grew to have very low self-esteem. Susan explained how her daughter was lonely. Jane had no friends, played alone during recess, and could not develop reciprocal relationships at school. In addition, because Jane "looked normal", teachers often treated her as typically developing, and did not offer her the necessary support she needed to succeed. Susan explained that they lived in a small town and the educational practices were very "old- fashioned"; meaning the school culture did not recognize and support ASD or students with special needs. When Jane transitioned into middle school, she "fell through the cracks" because she struggled with executive functioning and did not have the support necessary to help her succeed in school. It was at that time that Susan pulled Jane from the public-school system and began home-schooling. According to Susan, there was no other option at that point. Susan was not prepared to take on this responsibility and it flipped her life upside-down. Today Susan receives mental health therapy for herself and to help her family. This story was a revelation for me as I had

recently completed my educational ASD license and was eager to begin my journey into special education. Susan's story propelled me into my research as to why there are so few girls diagnosed with ASD compared to boys. I wanted to learn more about why girls are diagnosed later in life as compared to boys. Were the assessments not finding enough data to support a diagnosis for girls?

Studies have indicated a higher dominance of Autism Spectrum Disorder (ASD) in men than in women, with a male-to-female ratio of 4:1 (Fombonne 2003). As intellectual ability increases (IQ >70), the ratio increases to 10:1. This suggests that most females diagnosed with ASD also have an intellectual disability (Fombonne2009). Moreover, females who are diagnosed with ASD typically receive the diagnosis at a later age than males (Begeer et al. 2013).

Even though studies have been done over the last 10 years, research on gender differences in ASD is far from complete. We need to better understand what differentiating behaviors exist between the genders, and what variables contribute to those differences so as to affect the outcome.

The guiding question leading to my thesis work, "Gender differences in Autism Spectrum Disorder – How can we better identify females with ASD". My research dives into the distinct categories of ASD behaviors and where differences exist. Many variables exist within each research study and are important to note and understand when interpreting the outcomes. We must remember that ASD is a spectrum and individuals are unique in how they behave and cope with their behaviors. Once we realize the spectrum of behavior, it enables us to better identify the individual.

I have divided my research into the following sub-categories: Social Gender Differences, Communication Gender Differences, Repetitive & Restrictive (RRBs) Gender Differences, Early Diagnosis, Camouflage, and Testing Instruments. As you will see in the following pages, many factors contribute to each study outcome, such as age, IQ, the testing environment, the various assessment/screening tools, clinician impact, size of testing sample, and the subjective observations made by parents, clinicians, and teachers.

**CHAPTER II: LITERATURE REVIEW**

**Gender differences in Autism Spectrum Disorder – How can we better identify females**

**with ASD?**

To locate the literature for this thesis, the author searched Education Journals, ERIC,

EBSCO Mega FILE, and SpringerLink for publications from 2009 to 2020. This list was narrowed

by only reviewing published empirical studies articles from peer-reviewed journals focused on

gender differences within the Autism Spectrum Disorder (ASD); in particular, gender differences

in females. The key words used in the searches were "ASD in Females", "Gender Differences in

ASD", "Under Diagnosed Girls with ASD", "Late Diagnosis for Girls with ASD". Chapter II

structure reviewed the most recent research on gender differences in ASD diagnosis to better

understand the discrepancy in diagnosis between males and females (Ratio of 4:1).

**Gender Differences in Repetitive, Restricted, and Social Behaviors (RRBs)**

Mandy et al. (2012) completed a study prior to the DSM-5, which reclassified autism to a

spectrum and reduced the criterion from three to two areas. The focus of the study was to

better understand gender differences in core ASD symptoms over time. The study was

completed over a 10-year period. Subjects were initially tested for core differences; the

differences were observed longitudinally and analyzed in-depth to further understand the

changes through continued analyses. The study prioritized having enough statistical power, and

included females of similar ages observed over time, using varied statistical methods that

included parent and teacher observations. The overall focus was to investigate high functioning

females with ASD over time and to determine the differences compared to males.

Fifty-two females and 273 males were included in the study. The participants were

primarily Caucasian, along with a mixed heritage of African-Caribbean and Asian. Families

varied in socioeconomic status. Testing and analyses included the Autism Diagnostic

Observation Schedule (ADOS), Strengths and Difficulties Questionnaire (SDQ), Developmental

Dimensional and Diagnostic Interview (3Di), British Picture Vocabulary Scale, and Wechsler

Intelligence Scale Third Edition (WISC III) and WISC IV.

The results found no significant differences in Reciprocal Social or Communication

symptoms between gender; however, according to the ADOS and the 3Di parent reports, there

were more RBBs observed in boys compared to girls. This supported the theory of 'Extreme

Male Brain", which suggested that the male brain tended to systemize or recognize patterns in

a technical pattern, whereas females perform better in social areas. No gender differences

were reported over time for visuo-spatial impairment, gross motor, auditory sensitivity, or

feeding difficulties. However, there was a trend noting that fine motor skills were better for

girls as they got older as compared to boys. In the early years, there was no significant

difference. In addition, parents reported more emotional symptoms in girls compared to boys

but no difference in hyperactivity, inattention, conduct, peer problems, or prosocial behavior.

According to the teacher report, boys had more problems with hyperactivity, inattention, and

prosocial behavior. There was a trend showing that boys had fewer peer relationships

compared to girls. This was not affected by age. Although this study was larger in size and

included multifaceted assessments including parent/teacher reports and observations, it did

not include lower functioning participants with ASD. In addition, data was not available for all

participants on the ADOS and SDQ assessments. Age effects were limited and need further

analysis over a longer period (Mandy et al., 2012).

Hiller and Weber (2014) evaluated and recorded subject's ASD characteristics based on the criteria found in the Diagnostic and Statistical Manual, Fourth Edition (DSM-IV) and the DSM-5 and compared the differences between males and females. The study focused on specific deficits within the range of criteria that resulted in the clinician's diagnosis of ASD. The data allowed for an in-depth focus on behaviors as reported by parents, teachers, and clinicians across different environments. Sixty-nine girls were paired with 69 boys diagnosed with high-functioning ASD (IQ >70). Probability ratios considering gender differences were noted in the data. Subjects were scored *Yes* for meeting the criteria, *Somewhat* for partially meeting the criteria, and *No* for not meeting the criteria (Hiller and Weber, 2014).

Behaviors for social and repetitive/ritualistic domains were reviewed using the DSM-IV. In the social domain, no significant differences were found for non-verbal or sharing-of-interest criteria. However, considering behaviors rated *Somewhat,* or *Partially met*, females could be significantly predicted to achieve in both areas of non-verbal and sharing of interests. No significant differences by gender were found in peer relationships and social/emotional reciprocity. In the Restricted and Repetitive behavior (RRB) domain, the criteria for restricted or fixated interest was significantly predicted between genders. A subject who failed this category was 10 times likely to be female. Strict routine adherence, stereotyped movements, and preoccupation with parts of objects all failed to significantly predict gender (Hiller and Weber, 2014).

Hiller and Weber (2014) considered specific behaviors within each criterion using the DSM-5 standards, where the participants met all criteria for high-functioning ASD under the

DSM-IV-TR. The following behaviors indicated ways that girls presented differently from boys based on the DSM-5:

1. Social and Emotional Reciprocity – 17% of girls (only one boy) demonstrated greater ability to engage in reciprocal conversation, 50% of girls (only 18% of boys) had some ability to engage in reciprocal conversation and 38% of girls (only 13% boys) were more willing to share their interests.

2. Non-verbal Communicative Behavior – 34.5% of girls (only 9% of boys) had no impairment in non-verbal and verbal behaviors. The ability to understand and interpret non-verbal cues was not predictive of gender. Only 10% of girls (0 boys) had no impairment in this category.

3. Friendships and Public Appearance – 45% of girls (18% of boys) revealed no impairment for imaginative play, 30% of girls (18% of boys) had partial impairment for imaginative play (noted, partial could suggest the children were scripting). Friendships manifested differently between boys and girls, such as 50% of girls (31% of boys) initiated friendships but struggled to maintain them. Sixty-five percent of boys (40% of girls) had trouble both initiating and maintaining friendships, suggesting boys struggled significantly and more noticeably with friendships than girls. Only 19% of girls (1 boy) displayed the ability to regulate their behavior in a variety of scenarios. Overall, girls were more likely to regulate behaviors in public, such as controlling voice volume, avoiding inappropriate comments, or having meltdowns. However, according to parent reports, these skills presented problems for girls in some situations.

4. Twenty-seven percent of girls (6% of boys) did not meet criteria for stereotyped use of objects (lining up or sorting objects). Sixty percent of girls (29% of boys) had interests in the "seemingly random" category, such as rocks, stickers, or pens. Meeting criteria in this category significantly predicted the child to be a girl. The "screen time fixations" category strongly predicted the child to be a boy. Thirty-eight percent of boys (9% of girls) showed obsessive interest in screens, such as iPads and watching YouTube. Slight variations in obsessions around a television program or character, or obsession over a particular toy were noted. When categorizing restricted interests by age, boys under seven seemed to focus around wheeled toys but changed when they got older to screen time. Girls remained the same with random interests (Hiller and Weber 2014).

Diagnostic comparisons between the DSM-IV and the DSM-5, revealed that 31.4% of girls compared to 17.5% of boys would not have been diagnosed per the DSM-IV. The primary reason was because girls would not have met one of the three criteria in the social domain. Sixty-nine percent of girls failed to demonstrate a specific impairment in non-verbal communication. Boys met criteria across all three domains. The percentages were based on children diagnosed with Pervasive Development Disorder-Not Otherwise Specified (PDD-NOS) or Asperger's Disorder, now identified as higher-functioning ASD (Hiller and Weber 2014).

Observational behaviors of RRBs and social presentation described why ASD might be harder to diagnose in girls as compared to boys. This study explored that girls may exhibit fewer behaviors in the school environment and described how social impairments in girls appeared differently than the typical male-centric presentation of ASD (Hiller and Weber 2014).

The strength of this study was the data collected from a variety of sources (parents, clinicians, and teachers) that included a large sample of higher-functioning girls diagnosed with ASD. However, more research is needed to continue evaluating whether girls present behaviors differently than boys by exploring whether the differences are typical sex differences or if they are created by the way children are socialized (Hiller and Weber 2014).

Van Wijngaarden-Cremers et al. (2014) noted that many of the past autism studies contradicted each other when considering gender differences in the ASD core criteria areas. Researchers performed a systematic review of gender differences in core symptoms of ASD from infancy to adulthood. After screening over 500 peer reviewed articles they focused this study on information from 22 articles that specifically looked at the three core symptoms. The information was then divided into the following groups: 1. Sample size, 2. Gender distribution, 3. Age, 4. ASD diagnostic criteria used, 5. Test instrument used, 6. Scorer, and 7. Test scores.

The results showed that females exhibited fewer RRBs than males after the age of six. However, before the age of 6, no significant differences between gender in symptom severity from all three domains: communication, social behavior, and RRBs were noted. The results were viewed from three different perspectives. The first perspective stated that females truly showed fewer RRBs and stereotypical behaviors than males. Females presented behaviors with a different phenotype than males. Biological and environmental factors may have contributed to these differences, and these factors continued to be studied so that we may understand them better. One theory, for example, stated that there is an unknown mechanism in females that allows them to cope and hide their symptoms so they are not as "observable" as in males.

This suggests the diagnostic tools are biased toward male behaviors and a contributing factor as to why many females are un or mis-diagnosed.

A second perspective suggested that intellectual ability was a contributing factor to diagnosing females with ASD. In this case, females with low IQ may be over represented for ASD since stereotypical behaviors such as RRBs and communication deficits were also found in people with intellectual disabilities.

The third perspective suggested that females presented less severe social and communication deficits than males and were seen more as "shy" or "anxious". This misrepresentation could result in failure to diagnose or mis-diagnose. Females with internalizing disorders such as anxiety were referred less often than males because these symptoms were considered somewhat normal for females.

Overall, this study showed that gender differences existed in RRBs but not significantly in Social or Communication behaviors. The reasoning behind the differences in behaviors can be due to biological factors such as phenotype, IQ, and age. More research is needed to identify contributing factors and to use better diagnostic tools specifically for females. There is a new screening tool used called the Autism Spectrum Screening Questionnaire - Revised Extended Version (ASSQ-REV) which is more sensitive regarding the female features of ASD (Van Wijngaarden-Cremers et al., 2014).

According to the study by Harrop et al. (2015), past research on girls with ASD varied widely based on the number of variances during studies. It was challenging to find general truths about girls with ASD while considering the many variances, so researchers focused on

specific criteria and developed conclusions based on the results. The results delineated common themes used to address or explain the gender gap in ASD.

Harrop and her colleagues were interested in two main behaviors that provided social advantages for typically developing girls compared to boys: Joint Attention and Behavioral Request. The purpose of Harrop's study was to determine if these behaviors also benefited young girls compared to boys with ASD. Differences between the genders would help explain the reason girls are under or mis diagnosed in their early years (Harrop et al., 2015).

The study involved 29 girls with ASD matched with 29 boys with ASD. They were matched through similar ADOS-2 and Mullen Scales of Early Learning (MSEL) scores. They were also matched by age, 22 to 36 months. The children were video-taped either at home playing with a caregiver or in a classroom playing with a clinician. Two assessments were administered: 1. The Structured Play Assessment (SPA), and 2. Early Social Communication Scales (ESCS). SPA is a 20-minute play interaction where the examiner observes the complexity of the child's play with a toy. The examiner cannot provide a model, but can respond to a child's communication. Play was grouped into four categories used in previous studies: Simple, Combination, Pre-symbolic and Symbolic play. Behaviors were coded and identified by complexity. The ESCS assessment elicits verbal and non-verbal communication skills with a non-verbal developmental age between six and 30 months. This was a 20-minute interaction where the examiner faced the child at a table that displayed basic items (such as a wind-up toy, comb, book, ball, car) put out of the child's reach. Colorful posters were placed around the room. The examiner tried to engage the child by pointing to a poster and saying, "Give it to me.", to prompt the child to engage in a social game and turn-taking. They were looking for "initiation of joint attention"

(IJA), "initiation of behavioral requests" (IBR), "responding to joint attention" (RJA) and "responding to behavioral requests" (RBR) (Harrop et al., 2015).

The study results showed that boys and girls were more similar than dissimilar during play (Joint Attention and Behavioral Requesting). Slight gender differences were noted in play skills and complexity, considered insignificant. Generally, girls responded to the examiner's requests more often than boys, but again, it was insignificant. This data assumed that they are not using parental input, which could be subjective to what that parent does during child play. One main difference noted in the results was an association in boys IBR and RBR based on their developmental ability. In other words, the higher functioning boys initiated behavior requests more frequently, but no difference was noted in girls. In addition, girls with better non-verbal skills were better at responding to examiner's requests. It could be that more advanced abilities in children of this age influenced their ability to initiate and respond to requests. The findings helped formulate approaches to teach requesting during interventions for girls (Harrop et al., 2015).

This study has many strengths, as it used a large subject sample providing greater statistical power. This study is unique because it focused on specific behaviors (joint attention and behavior requests) associated with language development. Limitations include the lack of a typically developing (TD) control group. Gender differences in TD groups were well replicated, but they could be outdated and should be included as a third group. The study duration was short so longitudinal study would be useful to track data over time (Harrop et al., 2015).

Tillmann et al. (2018) completed a secondary analysis using 28 studies from 18 sites across nine European countries. The researchers wanted to continue the study on whether age

played a role in gender differences in the ASD phenotype on the Autism Diagnostic Interview -

Revised (ADI-R) and Autism Diagnostic Observation Schedule (ADOS).

Researchers selected data from previously published research that included 2,684

participants with ASD. This was one of the largest sample sizes with longitudinal data. The

results of this study were somewhat limited by the fact that not all datasets were matched by

assessment method, diagnostic procedures, or strategy. Samples used in the study were

selected for different purposes with respect to ASD symptom severity by age, which limited the

conclusions (Tillman et al., 2018)

RRB differences were found between genders in early years. Boys had more obvious

behaviors than girls. Communication and social differences remained similar in both early years

and in older ages. Both boys and girls showed fewer social communication behaviors as they

grew older (Tillman et al., 2018).

Continued research could improve measures that diagnose girls at earlier ages by

healthcare professionals and educational programs. Continued research could also help us

better understand the neurobiological and developmental differences underlying ASD.

McFayden et al. (2019) focused on gender differences for RRBs – specifically differences

in the sub domain of Restricted Interests (RI). Many researchers such as Attwood et al. (2006);

Duvekot et al. (2016); and Frazier et al. (2014) have suggested that RRBs help to explain the sex

differences in diagnosing ASD in girls and boys. Hiller and Weber (2014) also reported specific

differences in gender related to restricted interests, with girls focused on random interests and

boys focused more on screen-time and gaming.

McFayden et al. (2019) attempted a more accurate study by providing descriptive profiles for both males and females across a broad age range using the new DSM-5 criteria. McFayden et al., hoped to better define how the female phenotype presented with ASD to create effective intervention and assessment methods. They hypothesized that females would have fewer instances of RRBs and that the nature of restrictive interests (RI) would differ between the sexes.

The sample studied included 20 females and 55 males with ASD, 87% Caucasian with a mean age of 12.43 years. Note 50% of the boys were under age seven. The participants completed a three-hour assessment with measures from the Autism Diagnostic Interview - Revised (ADI-R), Autism Diagnostic Observation Schedule 2 (ADOS-2), Restrictive and Repetitive Behavior Scale - Revised (RRBS-R), and Social Response Scale 2 (SRS-2). Ten categories of RI were created from the specific interests recorded in the ADI-R and ADOS-2 assessments. The results were unexpected. No gender difference was found in the number of RIs. Thirty-one percent of females and 34% of male participants did not have any RIs. Little gender difference was noted in the levels of electronics and reading. Males showed a broad range of interests, including trains, construction vehicles, trucks, history, and past presidents. Females reported more interest in animals, people, and science. Female interests were more socially accepted interests compared to males. Thirty-four percent of females' interests were in living things, compared to 11 percent from males. Males often found interests in objects. In addition, females acted upon their interests in a more socially acceptable manner, such as writing letters to clubs or activists, whereas males collected figurine animals and repeatedly watched videos about them (McFayden et al., 2019).

The researchers' hypothesis was unfounded based on the results. This may have been due to the broad age span for participants and that participants generally lived in rural areas and were not referred by medical practitioners. Most previous studies involved participants from urban settings who were referred from medical practitioners. Other potential explanations included that female participants were older, had higher IQs, and were more socially competent (McFayden et al., 2019).

**Gender Differences in Early Years**

Harrop et al. (2015) studied a group of 40 evenly matched preschool-aged girls and boys with ASD. The aim of the study was to observe the role of gender in type and complexity of play skills, and skills for initiating Joint Attention (JA) and Behavior Requesting (BR). Researchers specifically looked at differences observed in play and social communication as it related to nonverbal and language variables.

Two types of assessments were used in the study - Structured Play Assessment (SPA) and Early Social Communication Scales (ESCS). Joint Attention, the ability to shift attention between objects/events and people as a way to share and learn, was a focus in the study that also included Behavioral Requesting (BR), the ability to use non-verbal and verbal behaviors to request aid from others to obtain things. Twenty minutes of play was provided during the SPA evaluation, where an unfamiliar examiner presented one set of toys at a time (tea set with dolls, cups, utensils, teapot, or a barn with a dump truck, garage, blocks, animals). A Developmental Play Assessment (DPA) was used to sequence the categories by complexity based on imaginative play. Each act was scored. The second type of assessment was the ESCS. In this type of play, toys remained out of the child's reach. The examiner activated one toy at a

time by pointing to a picture of the toy and saying "Give that to me" to elicit child participation.

The examiners explored three variables: interest, non-verbal development, and language.

Statistical analysis was then conducted using Statistical Package for Social Sciences (SPSS 20).

The results showed that girls displayed more unique acts than boys but the difference

was not significant. There were no significant differences in complexity of play. Girls also

showed more joint attention, but not significantly. There were stronger associations that linked

the frequency of requesting skills with both language and non-verbal development in boys as

compared to girls. Boys with stronger cognitive development also showed stronger initial BR.

Responsive BR skills were stronger in girls (Harrop et al., 2015).

This study was one of the first to examine child play and social communication in

children diagnosed with autism at an early age. The sample size was large (40 girls) and the

assessments were observed by experts, as opposed to relying specifically on parent reports.

However, the results were limited due to the lack of a typically developing control group.

Another limitation was that girls and boys were not matched by intellectual ability so the

results could be due to developmental delays rather than autism (Harrop et al., 2015).

Andersson & Miniscalco (2013) studied preschoolers aged 1-3 years as part of the

Autism Detection and Intervention in Early Life (AUDIE). The study included 20 girls and 20 boys

who were referred from Child Health Care. The participants were tested via various

instruments, including the Autistic Diagnostic Observation Schedule (ADOS), ADOS-R, history

reports from parents, Griffiths' Developmental Scales, Wechsler, Vineland Adaptive Behavior

Scales (VABS), MacArthur Communicative Development Inventory, and Reynell Developmental

Language Scales III (RDLS). The Diagnostic and Statistical Manual - Fourth Edition (DSM-IV) was used for diagnosis.

Results found no significant difference in RRBs at this age. According to the Griffiths, VABS, RDLS, and ADOS-R no significant gender differences were noted for the variables tested. There was slight evidence that girls had better communication skills according to VABS. These results were consistent with gender differences in typically developing children, where girls were suggested to be more socially expressive and responsive than boys. One third of the participants did not meet ASD criteria according to the ADOS/ADOS-R; however, when the ADOS was combined with the other instruments, a diagnosis was possible. It is stated in the ADOS manual that it is never to be used as a stand-alone test.

This suggests that the ADOS instrument is not sufficient to diagnose a child with mild ASD. It is important to note that to assess ASD symptoms properly for pre-school age children, single standardized assessments are not enough. It is vital at this young age to include observation and a variety of other assessments.

The concluding discussion talked about how this study differed from others by stating there were no gender differences between girls and boys at this young age. Though this study was small and could not represent the general population of the autism spectrum, it suggested the need for continued research to develop assessments sensitive to diagnosis for girls with ASD and continued support for exploration of gender differences.

**Gender differences in Social/Reciprocal Communication**

In one of the earliest studies to explore gender differences in ASD diagnosis ratios, Dworzynski et al. (2012) questioned the role genetics played in reduced diagnosis in females

compared to males. The team hypothesized that genetics could inhibit diagnosis in girls because their social communication was less obvious to the observer and diagnostic instruments were biased toward boy behaviors.

There were 29 girl and 160 boy subjects in the study, aged 10 -12 years, all diagnosed with ASD. The study sought to answer three questions: 1. Do girls have to show more ASD behaviors compared to boys to be diagnosed with ASD? 2. Do intellectual levels impact diagnosis more for girls than boys? 3. Do ASD girls show behaviors not seen in ASD boys? The research team compared differences between diagnosed and undiagnosed girls and boys with high autism traits.

The instruments used in the Dwarzynski et al. study consisted of the Development and Well-Being Assessment (DAWBA), the Childhood Autism Spectrum Test (CAST), DSM-IV, MacArthur Communicative Development Inventories (MCDI: UKSF), and Parent Report of Children's Ability (PARCA). Results showed that girls with low intellectual abilities and higher behavior problems met the ASD criteria more often, but many girls with additional ASD behaviors were missed. The data also showed that girls showed better adaptation of ASD traits compared to boys. Girls may have shown higher levels of ASD traits, but without additional intellectual or behavioral problems, they were missed in the ASD diagnosis by not meeting all the criteria. This proves subtle forms of ASD exist and are harder for clinicians to recognize through assessment, especially when average to high IQ and fewer behavioral problems are noted. This could contribute to the gap in ratio of diagnosis but may not entirely be the reason. Additional research is necessary (Dworzynski et al., 2010).

Cridland et al. (2014) took a unique approach and interviewed three dyads of mother/daughter, plus two additional mothers. The daughters were all diagnosed with ASD between the ages of 12-17 years. Annual income of the three ranged from $20,000 - $200,000. The purpose of this study was to gain perspective on the experiences of adolescent girls with ASD and their mothers.

Interviews were conducted in the home of the mother/daughter for their comfort. Researchers used open-ended questions with suggested topics such as "What was it like living with ASD in school, home, and community?" The data was divided into themes and then analyzed. The themes and data collected were noted as follows:

- ASD diagnosis in females is challenging: Many behaviors are different from males; females also copy normal behavior to fit in when they are younger.

- Negative results from late diagnosis: There was no support or intervention given in early years to help create a better quality of life; and girls were often negatively judged. Without early diagnosis, teachers treated girls as "misbehaving". When diagnosed later in life there was not a lot of support offered compared to early intervention.

- Girls with ASD found it easier to hang around boys with ASD compared to "gossipy" TD girls because they were more laid back.

- Experience in High School (HS) was more positive than Elementary School (ES): More diverse classes were offered; people were more diverse as well. HS felt easier because class composition was different in every class, whereas the same 20 students were together all day in ES. Lastly, the HS routine was easier to control as long as one was organized or kept a planner.

- Experience in HS was more negative than ES:  It was too big, too fast paced, and harder to make friends. If the mainstream teacher did not understand ASD behavior they made it very difficult for girls to maintain good grades. If the school had special ASD classrooms, attitudes were changed and grades improved. It was hard for moms to adjust to communicating with multiple teachers instead of one.

- Complexity of Female Relationships: TD girls become cliquey in Middle and HS, and most relationships from ES faded as girls got older. Girls felt it was more difficult because they felt the need to be popular and were let down when they were excluded; whereas boys were just considered nerds and that was "okay". Many girls with ASD tended to be loners because they could not maintain friendships. Most girls with ASD struggled with grooming and did not understand how to dress up or be fashionable.

- Puberty: Most girls with ASD were not shy about their menstrual cycle and were very factual. Moms had to teach them discretion. Girls with ASD also struggled with hygiene and needed to be taught to use soap and shampoo in the shower. They also struggled with remembering to use deodorant and to brush their teeth.

- Sexual Relationships:  Three out of 5 girls did not have any interest in sexual activity. The girls felt boys' sexual urges were stronger than girls. Again, the girls were very factual about sex and struggled with understanding the emotions involved. Mothers were concerned about sexual abuse once daughters started dating (Cridland et al., 2014). Moms reported being very involved in their daughter's lives compared to TD moms.

Moms also reported that they never received hugs from their daughters. They felt they had less personal growth opportunities compared to their friends. Moms reported that their careers and

social experiences were reduced significantly, and they reported the importance of taking time for themselves and talking to others to feel less isolated (Cridland et al., 2014).

Although this was a small sampling, it gave good perspective as to what adolescent girls with ASD struggle with in their daily lives as well as how their mothers struggle. Some limitations to the study include the omission of other family members and their perspectives. There was also no voice heard from the perspective of boys.

Dean et al. (2014) focused on relationships and acceptance in elementary aged subjects. The researchers compared group preferences by subjects with and without ASD. They also studied rejection and how rejection manifested between the two groups. This study included 50 boys and girls who had high functioning ASD and matched them with 50 typically developing (TD) boys and girls in mainstream classrooms. The participants were matched by age, gender, and IQ. There were 25 participants in all four groups. All participants, from the general education setting, provided a more authentic example of the dynamics found within an inclusive classroom as it related to social relationships.

The students completed a Friendship Survey, where they provided identifying information and names of all class mates they "liked to hang out with," "did not like to hang out with," and "hung out together." The data was examined according to variables that included social acceptance, social preference, social connections, and social salience. Secondary variables included reciprocal friendships and rejection.

The results were as follows:

- All four groups preferred same gender friends.

- Both TD and ASD girls nominated more friends (both boys and girls) compared to both groups of boys.

- TD children nominated more friends compared to children with ASD.

- The pattern of friends nominated by both girls and boys with ASD was more similar than the pattern of TD children.

- Both groups of girls had higher acceptance scores than boys.

- TD boys and girls had a higher proportion of female friend nominations than boys and girls with ASD.

- Girls with ASD received fewer nominations than TD girls.

- Boys with ASD received the same amount of nomination as TD boys.

- Children with ASD had fewer connections than TD children.

- Social connections were lower in salience for children with ASD compared to TD children, however gender did not play a role in social salience.

- The odds of having a mutual friend is significantly lower for children with ASD compared to TD children.

- Both groups of boys were rejected more than both groups of girls.

- Children with ASD were rejected more than TD children.

- The odds of "Don't want to hang out with" were higher for children with ASD and children with ASD typically hang out with same sex friends

(Dean et al., 2014).

Significant gender differences were noted between TD and ASD relationships. However, the results showed that the social challenges experienced by children with ASD were equally

present for both boys and girls. Girls typically had more social connections but were not chosen to "socialize with". Girls with ASD were neither rejected nor accepted, but rather ignored, which led to isolation, social and emotional problems, anxiety, and depression. Adults could not observe instances of being ignored and therefore seldom intervened. Boys, on the other hand, were openly rejected and adults often intervened to accommodate the situation. Although both genders struggled for acceptance, girl groups had more complex and intricate acceptance standards. As a final thought, building social awareness about gender and becoming aware of the unique characteristics of girls on the spectrum can help address friendships (Dean et al., 2014).

According to the study by Harrop et al. (2015), past research on girls with ASD varied widely based on the number of variances during studies. It was challenging to find general truths about girls with ASD while considering the many variances, so researchers focused on specific criteria and developed conclusions based on the results. The results delineated common themes used to address or explain the gender gap in ASD.

Harrop and her colleagues were interested in two main behaviors that provided social advantages for typically developing girls compared to boys:  Joint Attention and Behavioral Request. The purpose of Harrop's study was to determine if these behaviors also benefited young girls compared to boys with ASD. Differences between the genders would help explain the reason girls are under or mis diagnosed in their early years (Harrop et al., 2015).

The study involved 29 girls with ASD matched with 29 boys with ASD. They were matched through similar ADOS-2 and Mullen Scales of Early Learning (MSEL) scores. They were also matched by age, 22 to 36 months. The children were video-taped either at home playing

with a caregiver or in a classroom playing with a clinician. Two assessments were administered:

1. The Structured Play Assessment (SPA), and 2. Early Social Communication Scales (ESCS). SPA

is a 20-minute play interaction where the examiner observes the complexity of the child's play

with a toy. The examiner cannot provide a model, but can respond to a child's communication.

Play was grouped into four categories used in previous studies: Simple, Combination, Pre-

symbolic and Symbolic play. Behaviors were coded and identified by complexity. The ESCS

assessment elicits verbal and non-verbal communication skills with a non-verbal developmental

age between six and 30 months. This was a 20-minute interaction where the examiner faced

the child at a table that displayed basic items (such as a wind-up toy, comb, book, ball, car) put

out of the child's reach. Colorful posters were placed around the room. The examiner tried to

engage the child by pointing to a poster and saying, "Give it to me.", to prompt the child to

engage in a social game and turn-taking. They were looking for "initiation of joint attention"

(IJA), "initiation of behavioral requests" (IBR), "responding to joint attention" (RJA) and

"responding to behavioral requests" (RBR) (Harrop et al., 2015).

The study results showed that boys and girls were more similar than dissimilar during

play (Joint Attention and Behavioral Requesting). Slight gender differences were noted in play

skills and complexity, considered insignificant. Generally, girls responded to the examiner's

requests more often than boys, but again, it was insignificant. This data assumed that they are

not using parental input, which could be subjective to what that parent does during child play.

One main difference noted in the results was an association in boys IBR and RBR based on their

developmental ability. In other words, the higher functioning boys initiated behavior requests

more frequently, but no difference was noted in girls. In addition, girls with better non-verbal

skills were better at responding to examiner's requests. It could be that more advanced abilities in children of this age influenced their ability to initiate and respond to requests. The findings helped formulate approaches to teach requesting during interventions for girls (Harrop et al., 2015).

This study has many strengths, as it used a large subject sample providing greater statistical power. This study is unique because it focused on specific behaviors (joint attention and behavior requests) associated with language development. Limitations include the lack of a typically developing (TD) control group. Gender differences in TD groups were well replicated, but they could be outdated and should be included as a third group. The study duration was short so longitudinal study would be useful to track data over time (Harrop et al., 2015).

Coffman et al. (2015) examined the gender differences in social functioning when looking at brain recordings during facial perception. The researchers wanted to explore the differences in how gender processes facial perception. They considered two hypotheses: 1. Females would show weaker neural responses to the stimuli because they typically showed more severe ASD symptoms, or 2. Because typically developing (TD) females have stronger social brain functions than males, perhaps females with ASD would do the same. They also predicted that the neural responses would directly associate with ASD symptoms and adaptive functioning.

The research team selected 12 males with ASD and evenly matched them with 12 females to compare gender results. Participants were matched by age and IQ, using the Autism Diagnostic Interview - Revised (ADI-R) and the Autism Diagnostic Observation Schedule (ADOS). These were based on the Diagnostic and Statistical Manual - Fourth Edition (DSM-IV) and

measured autism severity in the study. The Vineland Scales of Adaptive Behavior - Survey

Interview, 2nd Edition was used to measure adaptive function of the participants. Researchers

used the Benton Facial Recognition Test, which used 92 stimuli images of neutral faces,

inverted faces, and houses. The participants were video-taped while viewing the stimuli, and

pressed a button when a particular stimulus was repeated. Event related potentials (ERP) were

recorded and analyzed (Coffman et al., 2015).

The results showed that females failed to differentiate between neutral faces and

inverted ones compared to males. Males demonstrated a stronger ability to discriminate

between faces, houses, and inverted faces, suggesting a weaker social perception in females

relative to males. Reduced modulation was associated with greater levels of social impairment

in females with ASD. These behaviors exist in spite of the more restrictive and repetitive

behaviors (RRBs) found in males. This study suggested that social information processing

impairment is found to be much higher in females compared to males as it is observed in ERP

amplitude. More neurological research is necessary to explore variables between individuals

with ASD compared to TD individuals as well as variables relating to written and spoken

communication (Coffman et al., 2015).

Lehnhardt et al. (2016) explored gender related cognitive differences in individuals

diagnosed with ASD later in life. The participants included 38 females and 69 males matched by

age and cognitive abilities at the time of ASD diagnosis. The study hypothesized that females

would show different adaptations in communication strategies over and above general

intelligence compared to males.

The participants self-reported through the Beck Depression Inventory (BDI) to rule out depression influences. The subjects were given questionnaires, such as the Autism Quotient (AQ), to gather information on autistic traits; Empathy Quotient (EQ) to identify emotions and thoughts; Systemizing Quotient (SQ) to analyze ability to create rule-based systems; and the Reading-the-Mind-in-the-Eyes Test (Eyes-ToM) to examine the ability to correctly assign emotions to facial expressions. Statistical analysis was performed on intelligence, executive function, and psychosocial - which surveyed lifetime health care, intimate relationships, living status, and education/vocational status (Lehnhardt et al., 2016).

The results of this study revealed some gender differences based on strategies used in social communication. Males had better verbal abilities and females showed higher processing speed and executive functioning. These two cognitive skills are important characteristics for high functioning females to camouflage their behavior. Females are able to establish both acceptable social reciprocal and mimicry skills. Therefore, cognitive compensation could be considered why females receive late ASD diagnosis (Lehnhardt et al., 2016).

Limitations to the Lehnhardt et al. (2016) study included the lack of a typically developing control group of girls and boys. Some differences found could be gender related as opposed to related to the subjects' ASD diagnosis. Comorbidities other than depression, such as Attention Deficit/Hyperactivity Disorder (ADHD) may have influenced the results. Lastly, typical daily behaviors could not be observed in this research.

Past research indicated the majority of females were diagnosed later in life because girls could mask their ASD characteristics through camouflage. Examples of camouflage included eye contact during conversation, pre-rehearsed jokes or phrases, mimicking behaviors, speaking

softly, keeping a safe distance in groups, refraining from personal remarks, and modeling

behaviors of neurotypical peers to gain acceptance. Lai et al. (2017) studied the nature of

"camouflage" in ASD. Investigators wanted to answer several questions about camouflage, such

as: 1. How many adults with ASD camouflage their behavior? 2. What are the differences

between males and females who camouflage? 3. Is camouflaging associated with severe anxiety

and depression? 4. Is more camouflaging associated with better verbal ability, better signal

detection from background events, and more conservative responses?

Lai et al. (2017) studied 30 adult males and 30 adult females. The participants were

matched by ages ranging from 18-49. No intellectual disability was noted from the participants.

The definition of camouflage used in this study was "the discrepancy between the person's

"external" behavioral presentation in social-interpersonal contexts and the person's "internal"

status (i.e. dispositional traits and/or social cognitive capability." (page 693). Qualitative and

quantitative data was collected and analyzed. The results showed that age correlated with

camouflage measurement. Females with autism showed more camouflaging behavior than

males and there were significant variances between the two genders. Individual differences in

camouflage between males and females was not affected by age or IQ. Surprisingly, there was

also no significant association between camouflage and Verbal IQ (VIQ) or Performance IQ

(PIQ). The results showed that camouflaging was not dependent on ability to reason or

processing speed. It was dependent on personality, motivation, and contextual factors (Lai et

al., 2017).

Socio-cultural factors and gender socialization across gender could explain why more

females camouflage compared to males. Expectations for females to "act like a lady" may

contribute to the imitation of normal social behavior. More research and longitudinal studies will continue to clarify why and how females use camouflage. It is important to note that camouflage occurred in both male and female phenotypes. It was not gender specific but rather depended on the individual person and how they choose to cope (Lai et al., 2017).

The study also found that camouflage was associated with depression in males, but not females. No association was found between camouflaging and anxiety for either gender. The information postulates that camouflaging existed as an adaptive behavior pattern. Additional studies are necessary to determine if camouflaging is associated with anxiety in younger people. The fact that men with depression camouflage more than women might suggest that the task of camouflaging is exhausting for them; women might be used to camouflaging in high - pressure social environments in which they exist. Additional cross-sectional data and longitudinal studies will need to confirm this hypothesis (Lai et al., 2017).

No correlation existed between verbal ability and camouflage in either males or females. Findings also showed an association between executive function and camouflage for females. Further investigation should examine this relationship for men (Lai et al., 2017).

The last findings in this study considered exploratory and hypothetical brain testing using a Neurosynth Image Decoder. There were notable neuro-scientific findings related to executive function, emotion, and memory. Future research is needed to correlate camouflage and brain activity, specifically for females (Lai et al., 2017).

Dean et al. (2017) studied a group of 96 1st through 5th grade children on the playground to determine what social behaviors are needed to help girls camouflage behaviors during play. The study included 24 girls and 24 boys with ASD, and 24 girls and 24 boys with

typical development (TD). A timed behavior coding system was used on the playground that included 10-minute intervals recorded in three areas: 1. Game (playing a game with peers), 2. Joint engagement (actively socializing with peers), and 3. Solitary - Child is alone and no engagement.

The children were matched by gender, grade, age, cognitive ability, and symptomatology of ASD behaviors measured by the ADOS. The results were as follows:

- Game - more boys (both ASD and TD) participated in Game than girls. TD boys engaged more than boys with ASD.

- Joint Exchange (JE) - more girls (Both TD and ASD) participated in JE compared to boys (both TD and ASD)

- Solitary - boys and girls with ASD were more solitary than TD boys and girls, and boys with ASD were more solitary compared to girls with ASD.

The social profiles of each group were described as follows:

- TD boys were engaged almost all of their time in Game and Joint Engagement.

- TD girls were less involved in Game but if they were, it was more likely to be solitary games rather than group games. TD girls were fluid in social reciprocation and JE as they moved easily between activities while maintaining interaction.

- Boys with ASD played significantly less time in Game and spent some time in JE. Most of the time was spent in Solitary - more than any other group. When engaged in Game, boys with ASD showed many RRBs during play.

- Girls with ASD spent most of the time talking in JE, usually at the perimeter of the TD girl groups. Many weaved in and out of JE, never maintaining conversation with the group. They were also not included in TD girl games - not getting a "turn".

Dean et al. (2017) concluded that overall girls' behaviors were more difficult to observe as girls tended to camouflage themselves by standing close to groups but not actively participating in them. They worked in and out of groups between JE and Solitary because they were not able to maintain social communication and social cues. Typically developing girls excluded the girls because they were not able to keep up the pace of communication, which violated the social norms that TD girls expected. Boys' behaviors were easily noted by the observers as they were often in Solitary. Boys also displayed more RRBs such as hand flapping.

Although the study evenly matched the girls and boys, a relatively small group was analyzed and they only completed one observation at the beginning of the school year. It would be interesting to complete multiple observations throughout the year to determine if more girls with ASD were rejected over time by the TD girls and if they turned to Solidarity or to other groups.

Mademtzi et al. (2018) investigated the parent perspective on the challenges that faced their daughters with ASD. The study recruited 40 females with ASD and matched them with their 40 parents. The method used involved in-depth structured questionnaires with guided questions that allowed flexibility in their open discussions. The data collected was grouped into two categories: Challenges and Services/Resources. One of the most common challenges was that girls reported difficulty initiating and sustaining conversations. They found it difficult to identify boundaries when communicating with others and often scripted responses to try to fit

in. They also struggled with understanding others emotions as well as their own. The younger girls found it easier to converse with peers, however, as they got older, young teens found it difficult not only to initiate conversations but also to sustain friendships. After 5th grade many girls dealt with bullying and cyberbullying as they were not able to maintain the social pace of typically developing girls. Another challenge for the teen girls was understanding romantic relationships. Girls reported their struggle with puberty, menstruation, and birth control. Girls were sexually and emotionally exploited and were unaware due to lack of ability to understand not only the emotions of others, but also their own. This can lead to a lack of self-esteem, which often manifests into depression, anxiety, and substance abuse.

Many of the problems brought up in the discussions aligned with the core symptoms of ASD as we know it - resistance to change, rigidity with transition, and obsession. The data showed that early intervention could have helped the girl's experience for a better quality of life as they got older (Mademtzi et al., 2018).

Data was also collected for Services and Resources. Key ideas included life skills, bike riding, social media education, peer mentors, volunteer work, college prep, and more programs for parents to connect and collaborate about their experiences. Parents identified barriers to diagnostic assessments that omitted characteristics unique to females. They felt the questionnaires were biased and confessed lying on them to improve the chance for diagnosis. Parents weighed financial concerns when considering programs to help their children, and threatened schools with lawsuits for not assisting them with necessary interventions (Mademtzi et al., 2018).

This study lacked identifying girls within an age range. Additionally, no control groups of males or neurotypical girls were identified for comparison. Demographic data was omitted. Despite these weaknesses, this study identified the need to differentiate diagnostic assessments based on gender to improve identifying females with ASD at an early age to implement interventions that will provide them with coping skills.

Moran et al. (2019) studied the role of gender differences in social inclusion of children with autism (ASD) as well as intellectual disability (ID). The sample included 420 participants between the ages of 4 - 21. Most participants were males in the study (79.3%) and most participants were at a moderate level IQ. In addition, most of the participants had extensive support levels and attended special education schools.

The Spanish version of the ASD-KidsLife Scales was used. This instrument assessed quality of life (QOL) outcomes of children with ASD and ID. The questionnaire divided 96 items into 8 domains:  material well-being, physical well-being, emotional well-being, interpersonal relationships, social inclusion, rights, personal development, and self-determination. The questionnaire was completed by observers who knew the child well, and observed their behaviors over a long period of time, and in multiple environments. Once the data was analyzed, researchers felt the differences in the QOL scores could have been related to ASD, ID, or amount of support the child used. When controlled, all gender differences disappeared except for Social Inclusion (Moran et al., 2019).

Moran et al. (2019) introduced a new instrument that focused on the quality of life though analysis of specific items. It revealed that there is a need to make gender adaptations for supports, interventions and services dealing with social inclusion. Males scored higher in

social inclusion compared to girls, but we have to keep in mind that boys tend to be more involved in group games and sports that do not require a lot of communication; whereas females tend to be more involved in friendship conversations, leading to higher communication demands and difficulties, and resulting in frustration, exhaustion, and internal conflict. Males scored higher in QOL for social inclusion, but the analyses showed that the gender differences were not related to their intellectual abilities, but rather to their age, gender, and support needs. The lack of support was a barrier to participation. For example, as boys tended to exhibit more behaviors, they might get more support from observers. Females, on the other hand, tend to exhibit fewer obvious behaviors, and therefore did not get the necessary support to help them. This could lead to negative feelings. The social inclusion scores also depended on the context, opportunities, family strategies, professional practices, and cultural settings.

**Gender differences in Communication**

The Kauschke & Kamp-Becker, (2016) study sought to determine if narrative storytelling skills were affected by gender. The researchers felt that past studies focused on gender comparisons in children with lower cognition, so they focused their study on subjects with IQ > 70.

The participants in the study included 11 high functioning girls with ASD, 11 typical developing (TD) girls, and 11 high functioning boys with ASD. They were 8 - 19 years old. The ASD subjects were diagnosed through Autism Diagnostic Observation (ADOS), Autism Diagnostic Interview - Revised (ADI-R) and Wechsler Intelligence Scale (WISC) IQ test. The TD group was tested to make sure they did not qualify as Asperger's. Each were paired with subjects closest in IQ and age and they were all native speakers of German. The participants

were given a wordless picture book and asked to tell the story. They were videotaped and the audio was then transcribed using the Codes for Human Analysis of Transcripts (CHAT). Competence was measured by story length, Coherence (reference to characters and events), Cohesion (connecting relationships), and Evaluative Function (use of modifiers, intensifiers, and expressions in speech). Other categories included Emotion, Cognition, Physiology, Evaluation, Modality, and Causes of Internal States of Language (ISL). Data was collected and analyzed (Kauschke & Kamp-Becker, 2016).

The main differences in the study were found in Internal State Language (ISL). Girls with ASD verbalized internal states of characters more than boys with ASD but less than TD girls. They also produced fewer emotion words compared to the TD group. There were no significant gender differences in the ASD groups relative to narrative word production, organization, and linguistic devices. These results differed from past research highlighting significant differences in gender; as boys produced shorter stories, used less sophisticated language, and had more difficulty in recall. The lack of significant differences may have been due to the fact that participants were tightly matched and controlled and were at a higher cognitive level. For total ISL, girls with ASD produced more words for internal states, especially when referring to physical sensory and modality. They also explained the causes and consequences of internal states of characters more often than boys with ASD (Kauschke & Kamp-Becker, 2016).

Sutherland et al. (2017) explored the real-life characteristics of school-age girls and boys with autism to describe the parents' perspectives as compared to clinicians. Researchers hypothesized that they would find differences in social and communication skills between boys and girls with ASD.

Researchers surveyed 171 parents of girls and 163 parents of boys with ASD. The children diagnosed with ASD ranged from 5 - 18 years. The parents were given multiple choice questionnaires that rated communication and social skills, special interests, repetitive behaviors, and sensory needs (Sutherland et al., 2017).

The demographic results showed most of the girls and boys were diagnosed by a pediatrician. Eight percent of the girls were diagnosed by a psychiatrist, versus 1.8% of boys. This percentage difference could be because the girls were not referred by their doctor and the parents sought another opinion. Ten percent of boys and girls attended special schools. Over 80% of both boys and girls were in the mainstream classroom setting with an aide. Thirty-six percent of girls were without support compared to 25% of boys. Seven percent of girls were homeschooled compared to 2.5% of boys. In the area of communication, 70% of boys communicated well if the topic was of interest compared to 50% of girls. Sixty-eight percent of boys preferred to talk about their own interests compared to 50% of girls. Significant differences in interest were found between genders, where boys preferred technology, math/science, dinosaurs, sci fi, and transportation; girls preferred singing, dancing, music, animals, reading books, arts and crafts, and collectibles. Both genders scored similarly for social interaction, for number of friends (1 or 2), difficulty with social clues and group gatherings; both groups worried excessively about social situations. Sixty-seven percent of boys and 72% of girls indicated RRB behaviors:  motor (flapping, flicking, rocking), sameness (routines), sensory (sniffing, licking, touching), verbal (scripting, repetitive questioning), self-injurious (picking skin), movement (running, pacing), and obsessive (cleaning, color coding, organizing) (Sutherland et al., 2017).

Some differences were also reported by parents who stated that most boys and girls displayed similar behaviors across home and school environments. Parents reported that some children were more confident and talkative at home. Thirteen percent of parents reported their daughters melted down at home after "holding it together" all day at school to "fit in" (Sutherland et al., 2017).

The Sutherland (2017) study was one of the largest to focus specifically on communication characteristics, social strengths and weaknesses, and interests. However, a limitation of this study was that no specific questions about camouflaging or masking were included. More research should be done in that area. Another limitation was researchers did not compare the behaviors to typically developing (TD) children. A final limitation was the use of a non-standardized survey that did not include diagnostic criteria.

Conlon et al. (2019) explored the narrative production between genders to determine if there were differences in how boys and girls retold a story narrative. The researchers used the Expression, Reception and Recall Narrative Instrument (ERRNI). Research has shown differences between eight-year-old children with ASD and typically developing (TD) children, however, researchers wanted to examine the differences between gender in this study. They predicted both genders would perform similarly.

Thirteen girls and boys were selected for the study from a Canadian longitudinal study and were matched by age (8 years old), intellectual ability based on the Wechsler Intelligence Scale - Fourth Edition (WISC-IV), and core language scores based on the Clinical Evaluation of Language Fundamentals (CELF). The participants were scored on content, comprehension of important details, and grammar complexity. First, they were given a book with pictures only

and told a story based on the pictures. Then they completed other assessment activities.

Finally, they returned to the book and were asked to retell the story and answer questions

(Conlon et al., 2019).

Following the data analysis, Conlon et al. (2019) found that girls told more complete and

richer stories compared to the boys. They explained character intentions more frequently and

used more character references to help the listener understand the story. Structural language,

nonverbal abilities, story length, and syntactic complexity were similar between the genders.

There were no differences in narrative structure and speech. The biggest reveal in this study

was how the girls showed more intentionality for the characters, an important aspect of social

communication for those with ASD. Standardized tests should be updated to include a more

sensitive communication assessment when considering ASD. Sophisticated tools are needed to

measure social communication skills with peers to prepare for employment later in life.

This study was only a small glimpse using a small sample of eight-year-olds who were

tightly matched. However, because it was tightly matched, a clear picture of differences

between gender was illustrated (Conlon et al., 2019).

Rodgers et al. (2019) studied high-functioning females with ASD (HFASD) to further

understand the previously documented gender discrepancies. The ratio between males and

females with HFA can range from 5:1 to 16:1. This could be due to use of the Autism Diagnostic

Observation Scales (ADOS) and Autism Diagnostic Interview - Revised (ADI-R), considered the

gold-standard diagnostic measures which rely on symptom behaviors rather than rating scales

for behavior. Rodgers et al. (2019) used the Social Responsiveness Scale Second Edition (SRS-2)

and subscale scores to learn more about the gender differences in HFASD. Researchers studied

the association between intelligence and language correlated with ASD symptom severity between the genders, and how the SRS-2 treatment subscale scores and ASD characteristics in the Diagnostic Statistical Manual 5th Edition (DSM-5) correlated to age and parent education.

Rogers et al. (2019) looked at 34 females and 34 males with ASD. Their ages ranged from 6 - 12 years. All were diagnosed with ASD by results of the ADI-R, Wechsler Intelligence Scale 4th Edition (WISC-IV) and Comprehensive Assessment of Spoken Language (CASL). Ninety-two percent of subjects were Caucasian and their parents had an average of 15 years of education.

The SRS-2 was completed by the child's parent or guardian and the data was collected and analyzed. The results showed that males and females did not differ in age, IQ, ethnicity, parent education, ADI-R scores, language level, or comorbid diagnoses. The core ASD symptoms were similar. Although their symptoms were similar, the subjects' responses to intervention varied and required further research. Correlations were found for four of the five cognitive/language measures. Higher verbal and language skills were associated with lower social cognition and motivation, suggesting that language skills played an important role in understanding social cues in females (Rodgers et al., 2019).

This study was one of the largest using children with HFASD. Although this was a large study, it used predominantly Caucasian subjects from well-educated families, which excluded the broader population of children with ASD.

Milner et al. (2019) studied a small group of females with ASD along with some parent reports to further understand the discrepancies in female diagnosis as it relates to a male-

biased field. This qualitative study hoped to gain a better understanding of the challenges women and girls face during the various stages in life with an ASD diagnosis.

The participants were selected from a previous longitudinal study, focusing on social relationships. They participated in discussions and questionnaires to help identify core themes resulting from largely male biased research. Participants included 18 females with Autism Spectrum Disorder (ASD), and four mothers of autistic girls. Ages ranged 11 to 55 years. They participated in both group and individual discussions. All discussions were audio recorded and transcribed. Discussions were grouped into 3 topics: 1. Diagnostic pathway, 2. Impact of autism, and 3. Resilience and coping of behaviors. Discussions were flexible to follow participants' answers. Discussions lasted on average 55 minutes and data was divided into 5 themes and 17 subthemes (Milner et al., 2019).

In analyzing the themes and sub-categories, researchers gained a better insight into first-hand experiences of these females. There was a broad variety of opinions coming from a wide variety of ASD diagnosis as well as a wide range in age of diagnosis. This allowed the study to have a unique quality and variety. There was a lot of overlapping in data collection and for the most part cohesive in responses. The women reported learning strategies to mask and camouflage symptoms to fit into their environments. By gaining skills to camouflage, females are often overlooked when diagnosing for ASD. Women also reported on how camouflage can be considered protective, but on the other hand harmful, as it can lead to exhaustion and poor mental health. Some women reported masking and camouflage was not effective or even possible to do, which raises questions about what drives individuals to use these strategies. Data also showed that females struggled with initiating conversations and relationships. A big

misconception found that people often felt individuals with ASD do not seek relationships, but this study revealed that these females were socially motivated and wanted relationships but reported feelings of loneliness. Although males were not included in this discussion, past research has shown males are not as socially motivated, indicating there is a difference in the female phenotype. One participant found it easier to communicate with male peers than other female peers as they are less complex and easier to understand (Milner et al., 2019).

A general lack of understanding the female phenotype and symptomatology may lead to late diagnosis in females. Mothers reported lack of awareness from clinicians toward female ASD symptoms despite early concerns from parents. This would support the idea that diagnostic tools are biased toward male presentations of autism. And finally, this study helps us to better understand that without the necessary support and intervention these women may lead to a less desired quality of life and mental health. The later the diagnosis, the less support that is offered or available.

**Testing Methods in ASD**

Sturrock et al. (2020) explored gender differences based on observation reports from clinicians, parents, teachers, or the child and the various environments from which they reported. This group hypothesized that 1. Clinical observation would elicit gender differences more than parent/teacher/child reports, 2. Parent child reports for males would reveal fewer behaviors than clinical reports, 3. Teachers would report fewer social difficulties in males, and more social difficulties in females as compared with  parent reports, 4. They also compared functional measures to direct assessment (DA) and predicted that  ASD groups would likely perform worse in real life situations compared to isolated 1:1 assessment.

This study used 13 females and 13 males with ASD, aged 9 - 11 years. A control group of typical developing (TD) females and males were matched with the group. All children spoke English as their first language, had a performance IQ (PIQ) over 70 and had no hearing or visual impairment. The children were assessed in their home or at school. Subjects were videotaped while performing tasks based on Autism Diagnostic Observation - Second Edition (ADOS-2) for three observations, 60 minutes each. Pragmatic Rating Scales (PRS) were used by clinicians to rate communication behaviors in a checklist formatted questionnaire. Parents filled out the Children's Communication Checklist - 2nd Edition (CCC-2), a questionnaire that scores language, semantics, non-verbal communication, social relations, and interests. The Communication Checklist-Self Report (CC-SR), a similar questionnaire, was completed by the children. Strengths and Difficulties Questionnaire - Parent Edition (SDQ - P) and Teacher Edition (SDQ - T) were also completed for this study. Direct Assessments were administered along with these questionnaires for comparison. The assessments included Pragmatics: Local Coherence Inference task, Pragmatics: Figurative language Task, British Picture Vocabulary Scale (BPVS-3), and the Clinical Evaluation of Language Fundamentals Fourth Edition (CELF-4) Word Associations sub test (Sturrock et al., 2020).

The results were as follows: The Pragmatic Rating Scale scores showed significant gender differences. The self-report, parent, and teacher reported similar levels of impairment compared to typically developing (TD) groups. Overall, clinicians, parents, and teachers tended to score males with ASD as having more severe symptoms compared to females with ASD. However, teachers and parents both reported more severe symptoms for females in the areas of emotions and internalizing behavior. Parents identified more difficulties for females than

males when compared to clinician scores. In self-reports, females with ASD, females (TD), and males (TD) all rated themselves with more difficulties than rated by the clinicians. Males with ASD reported significantly fewer difficulties. In the ASD group, parents generally rated higher difficulty levels than the children self-reported compared to the TD group whose parents rated them lower compared to the self-report. Parents of ASD children consistently scored greater levels of difficulty for their children compared to teacher reports. The discrepancy was found to be significantly higher for girls, compared to boys. Clinicians rated females with ASD as having significantly more functional language difficulties than those identified during direct assessment in the areas of vocabulary and recalling sentences. Parents rated female children with ASD as more challenged compared with the direct assessment of semantics and syntax results (Sturrock et al., 2020).

Sturrock et al. (2020) found evidence of gender differences in the female phenotype compared to males with ASD. These differences included better skills in conversational reciprocity, language and pragmatics, and non-verbal communication. Females performed better than males with ASD but worse than TD females. This study also showed that children with ASD could identify difficulty with language and social behaviors; meaning they were aware at an early age that they were different from the TD group. Parents of ASD children also reported more problems compared with TD parents. This awareness could lead to feelings of loneliness and depression. Questionnaires showed differences in parent reports compared to clinicians and teachers, especially when rating their female child with ASD. This may have been due to the high demands from girls to be accepted by their peers. Sturrock et al. (2020) concluded that it was important to note that while direct assessment is an important part of

ASD diagnosis, pragmatic and language observation were key to understanding the limitations experienced by many females early in life. If diagnosed when young, interventions could be implemented to help girls form and maintain successful friendships that improve overall well-being.

Ratto et al. (2018) studied gender differences in child performance on the Autism Diagnostic Observation Second Edition (ADOS-2), and Autism Diagnostic Interview - Revised (ADI-R) assessments, known as the gold-standard diagnostic measure for ASD. They found that data collected by clinicians using these two methods reported less impairment in females, suggesting that the assessments alone were not successful in diagnosing autism for girls. Many studies have suggested that girls can manifest their social behavior better than boys, and their repetitive and restricted behaviors (RRBs) are played out in more "normal" content areas (animals, celebrities, books). Because of the female phenotype, it is important that diagnostic assessments not show bias toward males.

The group studied 228 children with ASD - 114 females and 114 males, matched by IQ>70, age who had an ASD diagnosis based on the Diagnostic and Statistical Manual (DSM-IV or DSM-5) (Ratto et al., 2018).

The participants were assessed using the ADOS or ADOS-2, a play-based assessment focused on social communication skills and autistic behavior. The data and results were grouped into three categories: 1. No impairment, 2. Mild impairment, and 3. Significant impairment. The scores were summarized into two domains:  Social Affect (SA) and RRB. The participants were also assessed using the ADI-R, which gathered historical data on development and behavior between ages four and five. Scores were grouped into four domains: Reciprocal

Social interaction, Communication, RRBs and Abnormal Development. Parents completed the

Social Response Scale (SRS and SRS-2) and the Vineland Adaptive Behavior Scale (Ratto et al.,

2018).

Following the statistical analysis of all data collected, the results showed that 90% of

males and females met the ASD criteria on the ADOS/ADOS-2 assessment and 75% of males

and females met ASD criteria on the ADI-R. Parent reports showed stronger impairment for

their daughter's ASD traits compared to their son's traits. Females were rated lower in daily

living skills (such as hygiene). This suggested that once females were diagnosed, their

manifestation of autistic traits was stronger, and they were more severely affected in real-

world settings compared to males. The reason behind such strong parent reporting might be

the higher social expectations for females in the real world. The Vineland and SRS assessments

(parent reports) were sex-normed continuous scale measures compared to the ADOS and ADI-

R, symptom count measures and based on male samples. Both the SRS and the Vineland were

sensitive toward female diagnosis as they allowed greater variability in scores and showed

more subtle differences in the severity of autistic traits. (Ratto et al., 2018).

The gold standard autism diagnostic tools (ADOS and ADI-R) used alone missed

identifying females with ASD. The ADI-R as a stand-alone evaluation was not as reliable as

combining assessments, such as the ADOS and clinician observations of behavior. Females with

higher IQ were at the greatest risk for not meeting the ADI-R autism criteria. To meet criterion,

the ADI-R required early developmental abnormalities, however, females with a higher IQ

typically do not show these impairments and would not have been identified during diagnostic

testing. Early developmental delays were removed from the DSM-5 requirements and should also be removed from the ADI-R to remain a useful evaluation tool (Ratto et al., 2018).

The Ratto et al. (2018) study was limited by their choice of testing instruments. ASD diagnosis by the ADOS and ADI-R are best at capturing autistic traits most commonly found in males, therefore, the sample of females in this study held similar characteristics as the males.

Kopp & Gillberg, 2011 researched whether revising the Autism Spectrum Screening Questionnaire (ASSQ) would better identify female autistic traits to bridge the gap in ASD diagnosis between genders. Past studies showed that girls with higher IQ went undiagnosed until later in life (Kopp et al., 2010). Other studies showed males had more autistic systemizing traits, where females have more empathizing traits. Based on these findings, the researchers hypothesized that females would need screening which was more sensitive toward their symptom presentation. The ASSQ-REV would help to identify more females with an Autism Spectrum Disorder (ASD).

One hundred eighty children were divided into three groups: 60 ASD/ADHD girls, 7-16 years old, and IQ > 80, 62 boys ASD/ADHD 6-16 years old, and 58 matched typically developing (TD) girls 7-16 years old. The ASSQ-REV added 18 carefully constructed questions to the original questionnaire focused on the symptom presentation more commonly found for the female phenotype. The study tested the validity of the ASSQ-REV, examined its ability to differentiate between ASD and non-ASD cases, analyzed the sensitivity toward female presentation of items on the questionnaire, and determined the best ASD predictors versus non-ASD for both genders (Kopp & Gillberg, 2011).

The results found only slight differences on ASSQ and ASSQ-REV scores for girls with ASD compared to boys.

- The ASD boys and girls both scored higher on the diagnostic measure than the Attention Deficit/Hyperactivity Disorder (ADHD) girls and boys.

- The TD female group differed significantly from both the ASD and ADHD groups in both versions of the ASSQ.

- On the ASSQ-REV, girls with ASD and ADHD differed more than boys. Boys scored higher in "lacks best friend", and girls scored higher in "has a different voice/speech, "difficulties in completing daily activities because of compulsory repetitions, avoids demands", and "interacts mostly with younger children". (p. 9,10)

- The ASSQ was a better predictor for boys with ASD compared to the ASSQ-REV.

- The ASSQ-REV had the highest validity for ASD diagnosis in girls compared to the TD girl group.

- The study supported the use of some items on the ASSQ-REV to be used in conjunction with other screening instruments for ASD diagnosis in females.

- The ASSQ-REV performed well in determining ASD versus non-ASD cases.

- Item levels between girls with ASD vs. ADHD showed differences in girls, but not boys. However, there were no overall gender differences in mean test scores.

- Boys with ASD scored higher on questions compared to girls with ASD, but girls rated a "definite" response more often than boys

(Kopp & Gillberg, 2011).

The findings showed that it is important to consider gender differences for each symptom that should be screened individually, and not as a total score. The small sample size was a limitation of the study, and the data was based on parent reports only, no observations. Parent-report could be biased as parents could have different expectations based on gender.

Begeer et al. (2013) performed a study examining the differences in gender for the timing of ASD diagnosis. Researchers hypothesized that girls would be diagnosed later than boys due to masking, camouflage, IQ levels, and testing.

This study equally represented all 12 provinces of the Netherlands. Data was provided by 1843 males and 432 females with ASD. The participants' ages ranged from 0 - 85 years. Surveys were completed by parents, next of kin, or self-report. The Dutch National Autism Association developed the survey and included topics such as diagnostic process, treatment, residential situation, schooling, and employment. Analyses used "age of diagnosis" as the dependent variable. Current age, sex, and first parental concern was entered as three separate variables in two age groups: 18 years and below and 19 and above (Begeer et al., 2013).

The results showed that the average time between first signs and ASD diagnosis was longer for females compared to males. Within the child diagnosis, those with higher IQs were diagnosed later than those with lower IQs. Females had a 1.8-year delay in the diagnosis of Asperger Syndrome (higher IQ). No differences were found in those with lower IQs in the adult group. Females with a lower IQ were diagnosed 4.3 years later. No differences in gender were found in those with a higher IQ. Three hundred were diagnosed before age 12 - 18 and 730 were diagnosed older than 18 years (Begeer et. al., 2013).

This study confirmed that girls with higher IQs are diagnosed later than boys, but not if their IQ is lower. ASD Diagnosis frequently occurs years after observable symptoms are noted and generally two years after the parent expresses concerns. Because there are significant differences in age of diagnosis for females with a higher IQ, it is critical to continue to develop sensitive diagnostic instruments that will show the deviations in female presentation of social and verbal abilities (Begeer et al., 2013).

One study limitation was that parents and self-report must rely on memory; for some adults, it was more difficult to recall specific data. In addition, there was not an equal representation of both genders, females were underrepresented in the child group 1:10 and 1:5 in the adult group. Additionally, no information on ethnicity or socioeconomic status was included, which could have influenced the timing of diagnosis. Despite these limitations, this study highlighted gender differences in diagnosing females, especially with a higher IQ. Scholars need to create more sensitive instruments such as the Autism Spectrum Screening Questionnaire-Revised Extend Version (ASSQ-REV), a more suitable tool for detecting female behaviors earlier to allow for earlier interventions that could improve their quality of life (Begeer et al., 2013).

 Duvekot et al. 2017 studied gender differences related to behavior. They hypothesized that higher emotional and behavioral struggles in addition to lower cognitive functioning would increase the probability that girls would be diagnosed with ASD.

A group of 64 girls and 167 boys, ages 2-12 were assessed with the Developmental, Dimensional and Diagnostic Interview (3Di), the Autistic Diagnostic Observation Schedule (ADOS), and an IQ assessment. Other diagnostic assessments included Repetitive Behavior Scale

Revised (RBS-R), Short Sensory Profile (SSP), Social Responsive Scale (SRS) (reported by parents and teachers), and the Child Behavior Checklist (CBC).

The results showed higher scores for boys on the SRS for 65 behaviors; indicating stronger autistic behavior compared to the girls. There were no significant gender differences in data from the RBS-R, however, girls showed fewer RRBs. Only a few behaviors were measured in this assessment which could indicate that girls' behaviors were more acceptable and harder to observe. This was also found to be true with sensory findings. Boys scored higher on the CBLC for externalizing behaviors and girls scored higher on internalizing behaviors. These findings showed some differences between genders at an early age, and although girls may not be diagnosed early; girls may be at risk for developing behaviors later in life. In particular, this study showed that girls were able to mask behaviors during standard observational testing, such as the ADOS. It is important to note not to deviate from the standard ASD evaluation protocol, but perhaps suggest longer observations from more highly trained evaluators when assessing girls (Duvekot et al., 2017).

Kauschke & Kamp-Becker, 2016 performed a study to compare gender differences between boys and girls in relation narratives. Past research shows research on boys and girls with low cognitive abilities, showing little difference between gender. This study wants to research gender differences between boys and girls with higher IQ >70. The study included 11 girls with high functioning ASD (IQ >70), 11 traditionally developing (TD) girls, and 11 boys with high functioning ASD. ASD was diagnosed through the Autism Diagnostic Observation (ADOS) and the Autism Diagnostic Interview - Revised (ADI-R) as well as the Wechsler Intelligence Scale (WICS) for IQ.

The participants told a story using wordless books while being videotaped. The audio was then transcribed according to the Codes for Human Analysis of Transcript (CHAT). They were then rated on story length (number and types of words), coherence (number of references to characters, time, and detailed events), cohesion (relationship to explicit and implicit events and connectors), and evaluative devices (word modifiers, interjections, repetitions, and expressions of speech). The results showed that all three groups were very similar in narrative competence. The main differences were found in Internal State Language (ISL). Girls with ASD verbalized more internal intentions, thoughts and emotions of the characters compared to boys with ASD, however, both ASD groups fell below the TD group when producing emotions (Kauschke & Kamp-Becker, 2016).

This study confirmed that there are no major gender differences related to narrative competence for the production of words, organization and linguistic devices. ISL was used more by females than males but that was the only difference confirmed by this group. Other researchers have found various differences in gender when studying other characteristics of narrative, which warrants more attention to this segment of research (Kauschke & Kamp-Becker, 2016).

Solomon et al. (2011) took a group of boys and girls with ASD and a control group of typically developing (TD) boys and girls to analyze their social communication, language, and restrictive and repetitive behaviors (RRBs) gender differences. They also wanted to compare females with ASD to TD girls in social and language abilities. And lastly, they wanted to see if girls with ASD showed higher levels of internalizing symptoms compared to all groups. Seventy-six children (ages 8-18) participated in the study:  20 boys and 20 girls with ASD, 19 TD girls and

17 TD boys. Each group consisted of approximately half children (ages 8-11) and half

adolescents (ages 12-18). The ASD groups were matched on IQ (high functioning) but they were

not matched to the TD groups.

The researchers used the Wechsler Abbreviated Scale of Intelligence (WASI) to assess

intelligence. The IQ scales ranged from 76 - 145 in the ASD groups and 98 - 139 in the TD

groups. The Autism Diagnostic Observation Schedule Generic (ADOS-G) was used to confirm

ASD diagnosis. The Social Communication Questionnaire (SCQ) was administered to all groups

to measure communication and social skills. Autism symptoms were measured by the Social

Responsiveness Scale (SRS) and the children's Communication Checklist - 2nd Edition (CCC-2),

and the Repetitive Behavior Scale - Revised (RBS-R). The Behavior Assessment System for

Children-2nd Edition (BASC2), and the Children's Depression Inventory (CDI) assessed

internalizing psychopathology. The BASC2 used terms around anxiety, depression and

somatization items on the questionnaire. The CDI is a self-report scoring child mood,

interpersonal problems, feelings of effectiveness, physical symptoms and self-esteem (Soloman

et al., 2011).

The results found ASD symptom profiles to be similar between the two ASD groups. Girls

with ASD did not resemble TD girls in terms of language and social abilities. Internalizing

psychopathology became more evident in adolescent girls as compared to matching boys with

ASD and TD girls. Significantly higher RRBs were found in males compared to females with ASD.

Differences in RRBs could be due to variations in neuropeptides such as oxytocin and

vasopressin, but measurement remains biased toward males as they refer to male preferred

objects such as trains, dinosaurs and toy cars. Girls RRBs present differently compared to boys

and could be recognized given a more gender specific list of items. Lastly, girls with ASD were at a higher risk for internalizing behaviors compared to boys with ASD and TD girls. Prior research shows that as TD girls grow older their social groups intensified and conversations became more intimate. These social processes and changes in TD adolescence created an even more difficult environment for girls with ASD and led them to a more isolated existence as they got older. Some of these differences could be scored higher from parents of girls as compared to boys because girls generally are expected to talk more to their parents. More research is needed to examine internalizing behaviors. Some studies have been effective using cognitive-behavioral strategies on high functioning girls with ASD and anxiety. Perhaps cognitive-behavioral strategies could also be effective on depressive symptoms but more research is needed. Interventions are critical for this type of symptom in adolescent girls to help prevent depression, hospitalization, and even suicide. We continue the need to better understand if girls with ASD are less impaired and/or under detected compared to boys with ASD (Soloman et al., 2011).

Hull et al. (2019) examined the use of a new self-reporting autism measurement of camouflaging called the Camouflaging Autistic Traits Questionnaire (CAT-Q) to see if there were significant gender differences in this particular aspect of ASD behavior.

The participants included 182 females and 108 males with Autism Spectrum Disorder (ASD), and 252 typically developing (TD) females 193 TD males. Those with ASD self-reported when and how they were diagnosed. Participants were recruited from social media through the Cambridge Autism Research database and word of mouth. The participants self-reported using the new CAT-Q questionnaire, which uses 25 questions surrounding 3 factors: Compensation,

Masking, and Assimilation. Total scores can range from 25 to 175, with higher numbers

representing higher levels of camouflage. The CAT-Q has been validated in autistic and TD

samples (Hull et al., 2019).

Results showed that females consistently scored higher than males in camouflaging. This

supports the research hypothesis, which stated that females with ASD use more masking

strategies than males and experience more pressure to adapt their behavior to fit in with

others. There was no gender difference found under the Compensation subscale, suggesting

both males and females use similar compensatory strategies to fit in. TD individuals showed no

significant differences in camouflage, however, there was evidence of TD males showing slightly

more camouflaging. Most participants were either European or North American in early to

middle adulthood, experiencing similar levels of Westernized culture and gender-based

stereotypes and expectations. The importance of this study is to better understand that even

when autistic symptoms were controlled, females camouflaged more than males due to the

higher expectations of female interactions in daily life. Further research is needed to explain

why TD individuals did not show gender difference in camouflaging results. Variables based on

age also need further exploration to determine gender difference at an earlier age (Hull et al.,

2019).

Assouline et al. (2009) did a qualitative study to reveal the unique similarities and

differences between two gifted girls: Hannah was a gifted female with no ASD diagnosis, who

had social impairments that disappeared when she was put in an environment with individuals

with similar interests. Carrie was a gifted female with an ASD diagnosis, who had severe social

impairments in all environments. The intent of the study was to identify where the differences

existed during testing that determined the fine line between being gifted and having an ASD

diagnosis or not - both looked very similar when observed in daily life.

The two girls were assessed using the following instruments:

- Social Skills Rating System (SSRS) - Parent and Teacher questionnaires to screen

  social and behavioral difficulties in children and adolescents.

- Behavioral Assessment System for Children - 2nd Edition (BASC-2) Parent,

  teacher and self-questionnaires to assess behavior and self-perception.

- Autism Diagnostic Observation System (ADOS) to evaluate behaviors in the three

  main domains of communication, reciprocal social interaction and restrictive and

  repetitive behaviors (RRBs).

- Autism Diagnostic Interview - Revised (ADI-R) - Parent questionnaire assessing

  behaviors of their child in their 4th year of life.

- Vineland Adaptive Behavior Scales - 2nd Edition - Parent interview measuring

  adaptive behavior as well as communication, daily living skills and socialization.

- Neuropsychological Assessment - 2nd Edition (NEPSY -II) - a set of tests

  measuring attention, executive functioning, language, memory, sensorimotor,

  social perception, and visuospatial processing (Assouline et al., 2009).

Both girls showed high levels of functioning in intellectual, academic, and

neuropsychological domains, however, there were areas where Carrie scored significantly

below Hannah for auditory attention (distraction and impulsivity), inhibition in naming (quickly

naming an object and then its opposite), memory for faces (difficulty in differentiating,

encoding, and recognizing faces), and social perception (determining emotions based on facial

expression). Both girls scored high on academic skills in Woodcock-Johnson Level 3 (WJ III) in reading, math, written language and oral language. There was a slightly lower score for Carrie in story recall. Both girls scored high in cognitive flexibility, processing speed, language comprehension, receptive and expressive language, and verbal memory. Carrie struggled with voice tone during assessment (spoke in a louder voice) and had difficulty in making conversations with the examiner compared to Hannah, who had no difficulty in these areas at all. Carrie also felt unorganized play made her feel uncomfortable, where Hannah was able to use her imagination at free will. Neither girl showed unusual sensory interests, hand or finger movements, however, Carrie mentioned she would "read all day if her mother would let her" (p. 100), which showed a form of rigid interest. Both girls used communication with a purpose, however, Carrie differed from Hannah because she did not want to discuss her interests. She also mentioned that she corrected and argued about facts with others.

Other differences between the girls were determined through ADOS results where Carrie never pointed to things or waved good-bye and Hannah did. Carrie did not use imitative play and Hannah did. Carrie was reported to have difficulty with reciprocal communication and Hannah did not. As preschoolers, both children had difficulty using facial expressions to communicate ideas but only Carrie had difficulty showing eye contact. Although Hannah used imaginative play, neither girl showed interest in playing or sharing with peers. On the Vineland Hannah scored in the high range for communication, living skills, and socialization skills, whereas Carrie scored average or below expectations for interpersonal skills. Carrie had many more psychosocial symptoms compared to Hannah including difficulty in hyperactivity, attention, social skills, daily living activities, and functional communication. Hannah's mom

reported mild difficulty with withdrawal and attitude toward school because there were few peers with her intellect which made it difficult to relate in the school environment. Hannah and Carrie both had high scores in self-control, but Carrie's scores fell below Hannah for cooperation, assertion, and empathy, suggesting some social difficulties for her.

This study provided a glimpse of two girls who behaviorally appeared the same, but when tested using various instruments, showed differences in many sub-categories that differentiated between ASD and non-ASD symptoms. However, one cannot generalize the results to the main population of girls with ASD. The lesson learned was that using many instruments paints a full picture of individuals considered for ASD diagnosis (Assouline et al., 2009).

**CHAPTER III: DISCUSSION AND CONCLUSION**

Studies have indicated a high dominance of Autism Spectrum Disorder (ASD) in men compared to women, with a male-to-female ratio of 4:1 (Fombonne, 2009). As intellectual ability increased (IQ >70), the ratio increased to 10:1. This suggests that most females diagnosed with ASD also have an intellectual disability (Fombonne,2009). Moreover, females diagnosed with ASD typically receive the diagnosis at a later age than males (Begeer et al., 2013).

Studying ASD gender differences is unique in that there is not a string of continuous research studies leading to a conclusion. There were a multitude of studies that agreed and disagreed with others, based on the variables that existed with each group of participants. The size of the study (or statistical power), participant age, ASD diagnosis method, clinician subjectivity, environment in which the assessments were made, race, culture, length of study, socio-economic status, and home environment highlight a clearer picture of what gender differences existed beginning at what age. We recognized that female behaviors present differently than males, and learned about ways to screen using more sensitive assessments and instruments.

Researchers selected focused targets in their studies to help isolate one variable at a time. One must understand that this did not represent the ASD spectrum as a whole, but only a piece of it. It is important to keep that in mind and continue to create studies and interviews to gain knowledge about the female phenotype and bridge the gender gap in ASD diagnosis.

Western cultures have generally been more accepting of ASD as an individual diagnosis. Here in the United States it is documented in the DSM-V, and federal special education criteria

to allow individuals with ASD access free education in our public schools. Most of the studies in

my research took place in the United States, Canada, Spain, England, and Germany. Many

countries do not share the same understanding of special needs etiology, and continue to

isolate or institutionalize individuals with special needs. This likely means that girls with ASD in

many countries will never receive the interventions needed to improve their quality of life. I

currently have a student from Slovakia whose parents moved their family to Minnesota for the

sole purpose of giving their son, who has been diagnosed with ASD, an education. Once he

meets grade level expectations with his peers and/or graduates, the family plans to return to

Slovakia. In his homeland, he would not be eligible to attend school.

Within the United States, special education can look different from state to state, town to

town, and district to district. For example, in the interview described in Chapter 1, the small

town in which Susan and her daughter live does not practice an inclusive culture, so Susan has

chosen to homeschool her daughter. Even so, whether homeschooling and/or taking on what is

often an expensive fight with public schools to obtain adequate support for the needs of their

children with autism, can contribute to stress, anxiety and depression in parents who already

have increased parenting challenges.  States with larger cities can offer specialized options for

students with special needs. The Twin Cities has a strong culture of support for special

education as described by the Minnesota Department of Education, where inclusion is the goal

for every individual with special needs.

Completing significant research targeting girls will take time. Research was limited due to

the many variables within the studies between genders. Throughout Chapter 2, I discussed

these limitations that directly affected the outcomes. The age variable, for example, was

considered a limitation as it represented only a small percentage of the ASD spectrum. Another limitation was the low statistical power, where limiting group data results did not represent ASD as a whole. IQ played a particularly significant role in gathering statistical data on gender difference and should be considered in all future outcomes. Other limitations were variables with race, culture, and socio-economic factors. Many studies that I used in my thesis consisted of Caucasian groups within Western cultures. Limiting diversity in these areas did not provide an accurate study outcome and should be considered in further research. Lack of diversity undermines the value of study results and should be remedied in further research. Another limitation was the subjectivity of the assessing clinician, parent, or teacher. The assessment environment limited the outcomes. The instruments used for ASD diagnosis limited some studies; some used single instruments, some self-diagnoses, and others were assessed in multiple environments with multiple instruments. Lastly, a critical limitation in these studies was the lack of female subjects and neurotypical females for comparison. Without this data, an accurate picture of how females present with ASD is incomplete.

Most research studies took place within the last ten years. Researchers have observed gender differences in social behaviors, communication skills, RRBs, and camouflage. However, there is so much more to learn, in part as a result of how studies so far have explored various factors of cognitive and behavioral gender differences, which can lead to more nuance in our understanding of how these factors can be measured and interact.  I was hoping to see revised and improved assessments targeting female phenotypes in ASD. The ASSQ-Revised is a more sensitive screening questionnaire which targets female behaviors that are more difficult to observe, such as questions like "avoids demands", "careless with physical appearance",

"interacts with younger individuals, and "is very determined". In addition, a trained eye will notice that girls may present RRBs in a slightly different manner than boys and are often overlooked. I look forward to seeing more female sensitive instruments in the future.

My research focused around the cognitive and behavioral differences between the genders in ASD. I began my research by looking at gender differences within the three domains of ASD criteria: Social/Emotional, Communication, and Repetitive and Restrictive behaviors. I narrowed my search looking into genetic differences in the female phenotype and presentation of ASD as well as the types of assessments that we were using in ASD diagnosis. The research showed that females have more intense social expectations compared to males (Hull et al., 2019). Females develop strategies to help them fit into their social environments such as masking or camouflaging their behaviors. The rate of maturity in typically developing (TD) girls is fast-paced, and girls with ASD struggle to keep up with that pace to fit in. Social expectations in adolescent females is far greater than that of males. Masking behaviors take a lot of energy and often results in exhaustion, anxiety, and depression (Hull et al., 2019; Cridland et al., 2014; Lehnhardt et al., 2016; Lai et al., 2017). Females can be successful in masking behavior during assessment, which can attribute to the under diagnosing of female ASD.

The final portion of my research examined the instruments used to assess and diagnose ASD. Kopp & Gillberg, (2011) reviewed the new ASSQ-REV questionnaire and Hull et al., 2019 examined the new CAT-Q questionnaire. As new data emerges about camouflaging by girls, it is important that observations and assessments designed for girls be more sensitive to gender specific behavior, based on a better understanding of the nuances and complexities of female behavior, so that female diagnosis can be more accurate.

Areas of research that I did not include in this literature review included genetic and medical gender differences. As I learned more about the developmental delays at birth, I wondered if there were gene mutations that occurred during pregnancy. Were there drugs that caused genetic mutations? Did ASD occur more often in male embryos and why? I did not research whether comorbidity might contribute to gender differences. There was a direct correlation that cognitively impaired females were more likely to be diagnosed with ASD, but I would like to learn more about other comorbidities or hereditary implications that contribute to differences.

The guiding questions leading into my thesis work were, Gender Differences in Autism Spectrum Disorder – How can we better identify females with ASD. Yes, gender differences exist in individuals with ASD, and result in under or mis-diagnosed females with ASD, along with the misunderstanding their needs.

A key take-away from my research is as we achieve a more accurate diagnosis of ASD in both males and females, the better chances for early interventions to help individuals with ASD to adapt and learn social/communication skills that will eventually lead them to a better quality of life. After all, that is what we ALL strive for in life!

REFERENCES

Andersson, G. W., Gillberg, C., & Miniscalco, C. (2013). Pre-School Children with Suspected

Autism Spectrum Disorders: Do Girls and Boys Have the Same Profiles? *Research in*

*Developmental Disabilities: A Multidisciplinary Journal*, *34*(1), 413–422.

Assouline, S. G., Nicpon, M. F., & Doobay, A. (2009). Profoundly gifted girls and autism

spectrum disorder: A psychometric case study comparison. *Gifted Child*

*Quarterly*, *53*(2), 89–105.

Begeer, S., Mandell, D., Wijnker-Holmes, B., Venderbosch, S., Rem, D., Stekelenburg, F., & Koot,

H. M. (2013). Sex Differences in the Timing of Identification among Children and Adults

with Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders*, *43*(5),

1151–1156.

Coffman, M. C., Anderson, L. C., Naples, A. J., & McPartland, J. C. (2015). Sex Differences in

Social Perception in Children with ASD. *Journal of Autism and Developmental Disorders*,

*45*(2), 589–599.

Conlon, O., Volden, J., Smith, I. M., Duku, E., Zwaigenbaum, L., Waddell, C., Szatmari, P.,

Mirenda, P., Vaillancourt, T., Bennett, T., Georgiades, S., Elsabbagh, M., & Ungar, W. J.

(2019). Gender differences in pragmatic communication in school-aged children with

autism spectrum disorder (ASD). *Journal of Autism and Developmental Disorders*, *49*(5),

1937–1948.

Cridland, E. K., Jones, S. C., Caputi, P., & Magee, C. A. (2014). Being a girl in a boys' world: Investigating the experiences of girls with autism spectrum Disorders during adolescence. *Journal of Autism and Developmental Disorders*, *44*(6), 1261–1274.

Dean, M., Kasari, C., Shih, W., Frankel, F., Whitney, R., Landa, R., Lord, C., Orlich, F., King, B., & Harwood, R. (2014). The peer relationships of girls with ASD at school: Comparison to boys and girls with and without ASD. *Journal of Child Psychology and Psychiatry*, *55*(11), 1218–1225.

Dean, M., Harwood, R., & Kasari, C. (2017). The Art of Camouflage: Gender Differences in the Social Behaviors of Girls and Boys with Autism Spectrum Disorder. *Autism: The International Journal of Research and Practice*, *21*(6), 678–689.

Duvekot, J., van der Ende, J., Verhulst, F. C., Slappendel, G., van Daalen, E., Maras, A., & Greaves-Lord, K. (2017). Factors influencing the probability of a diagnosis of autism spectrum disorder in girls versus boys. *Autism: The International Journal of Research and Practice*, *21*(6), 646–658.

Dworzynski, K., Ronald, A., Bolton, P., & Happe, F. (2012). How different are girls and boys above and below the diagnostic threshold for autism spectrum disorders? *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*(8), 788–797.

Fombonne E. Epidemiology of pervasive developmental disorders. Pediatr Res. 2009 Jun;65(6):591-8. doi: 10.1203/PDR.0b013e31819e7203. PMID: 19218885.

Harrop, C., Gulsrud, A., & Kasari, C. (2015). Does gender moderate core deficits in ASD? An

investigation into restricted and repetitive behaviors in girls and boys with ASD. *Journal

of Autism and Developmental Disorders*, *45*(11), 3644–3655.

Harrop, C., Shire, S., Gulsrud, A., Chang, Y.-C., Ishijima, E., Lawton, K., & Kasari, C. (2015).

Does gender influence core deficits in ASD? An investigation into social-communication

and play of girls and boys with ASD. *Journal of Autism and Developmental Disorders*,

*45*(3), 766–777.

Hiller, R. M., Young, R. L., & Weber, N. (2014). Sex differences in autism spectrum disorder

based on DSM-5 criteria: Evidence from clinician and teacher reporting. *Journal of

Abnormal Child Psychology, 42*(8),

1381-93.doi:http://dx.doi.org.ezproxy.bethel.edu/10.1007/s10802-014-9881-x

Hull, L., Lai, M.-C., Baron-Cohen, S., Allison, C., Smith, P., Petrides, K. V., & Mandy, W. (2020).

Gender differences in self-reported camouflaging in autistic and non-autistic

adults. *Autism: The International Journal of Research and Practice*, *24*(2), 352–363.

Kauschke, C., van der Beek, B., & Kamp-Becker, I. (2016). Narratives of girls and boys with

autism spectrum disorders: Gender differences in narrative competence and internal

state Language. *Journal of Autism and Developmental Disorders*, *46*(3), 840–852.

Kopp, S., & Gillberg, C. (2011). The autism spectrum screening questionnaire (ASSQ)-revised

extended version (ASSQ-REV): An instrument for better capturing the autism

phenotype in girls? A preliminary study Involving 191 clinical cases and community

controls. *Research in Developmental Disabilities: A Multidisciplinary Journal*, *32*(6),

2875–2888.

Lai, M., Lombardo, M. V., Ruigrok, A. N. V., Chakrabarti, B., Auyeung, B., Szatmari, P., . . .

Baron-Cohen, S. (2017). Quantifying and exploring camouflaging in men and women

with autism. *Autism, 21*(6), 690-702.

doi:http://dx.doi.org.ezproxy.bethel.edu/10.1177/1362361316671012

Lehnhardt, F.-G., Falter, C. M., Gawronski, A., Pfeiffer, K., Tempest, R., Franklin, J., & Vogeley,

K. (2016). Sex-related cognitive profile in autism spectrum disorders diagnosed

late in life: Implications for the female autistic phenotype. *Journal of Autism and

Developmental Disorders*, *46*(1), 139–154.

McFayden, T. C., Albright, J., Muskett, A. E., & Scarpa, A. (2019). Brief report: sex differences in

ASD diagnosis--a brief report on restricted interests and repetitive behaviors. *Journal

of Autism and Developmental Disorders*, *49*(4), 1693–1699.

Mademtzi, M., Singh, P., Shic, F., & Koenig, K. (2018). Challenges of females with autism: A

parental perspective. *Journal of Autism and Developmental Disorders*, *48*(4), 1301–1310.

Mandy, W., Chilvers, R., Chowdhury, U., Salter, G., Seigal, A., & Skuse, D. (2012). Sex

Differences in Autism Spectrum Disorder: Evidence from a large sample of children and

adolescents. *Journal of Autism and Developmental Disorders*, *42*(7), 1304–1313.

Milner, V., McIntosh, H., Colvert, E., & Happé, F. (2019). A qualitative exploration of the female

experience of autism spectrum disorder (ASD). *Journal of Autism and Developmental Disorders*, *49*(6), 2389–2402.

Morán, M. L., Gómez, L. E., Alcedo, M. Á., & Pedrosa, I. (2019). Gender Differences in Social Inclusion of youth with autism and intellectual disability. *Journal of Autism and Developmental Disorders*, *49*(7), 2980–2989.

Ratto, A. B., Kenworthy, L., Yerys, B. E., Bascom, J., Więckowski, A. T., White, S. W., Wallace, G. L., Pugliese, C., Schultz, R. T., Ollendick, T. H., Scarpa, A., Seese, S., Register-Brown, K., Martin, A., & Anthony, L. G. (2018). What about the Girls? Sex-Based Differences in Autistic Traits and Adaptive Skills. *Journal of Autism and Developmental Disorders*, *48*(5), 1698–1711.

Rodgers, J. D., Lodi-Smith, J., Donnelly, J. P., Lopata, C., McDonald, C. A., Thomeer, M. L., Lipinski, A. M., Nasca, B. C., & Booth, A. J. (2019). Brief Report: Examination of Sex-Based Differences in ASD Symptom Severity among High-Functioning Children with ASD Using the SRS-2. *Journal of Autism and Developmental Disorders*, *49*(2), 781–787.

Solomon, M., Miller, M., Taylor, S. L., Hinshaw, S. P., & Carter, C. S. (2012). Autism symptoms and internalizing psychopathology in girls and boys with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 42*(1), 48-59. doi:http://dx.doi.org.ezproxy.bethel.edu/10.1007/s10803-011-1215-z

Sturrock, A., Marsden, A., Adams, C., & Freed, J. (2020). Observational and Reported Measures

of Language and Pragmatics in Young People with Autism: A Comparison of Respondent

Data and Gender Profiles. *Journal of Autism and Developmental Disorders*, *50*(3),

812–830.

Sutherland, R., Hodge, A., Bruck, S., Costley, D., & Klieve, H. (2017). Parent-reported

differences between school-aged girls and boys on the autism spectrum. *Autism: The*

*International Journal of Research and Practice*, *21*(6), 785–794.

Tillmann, J., Ashwood, K., Absoud, M., Bölte, S., Bonnet-Brilhault, F., Buitelaar, J. K., Calderoni,

S., Calvo, R., Canal-Bedia, R., Canitano, R., De Bildt, A., Gomot, M., Hoekstra, P. J., Kaale,

A., McConachie, H., Murphy, D. G., Narzisi, A., Oosterling, I., Pejovic-Milovancevic, M., &

Persico, A. M. (2018). Evaluating sex and age differences in ADI-R and ADOS scores in a

large European multi-site sample of individuals with autism spectrum disorder. *Journal*

*of Autism & Developmental Disorders*, *48*(7), 2490–2505. https://doi-

org.ezproxy.bethel.edu/10.1007/s10803-018-3510-4

Van Wijngaarden-Cremers, P. J. M., van Eeten, E., Groen, W. B., Van Deurzen, P. A., Oosterling,

I. J., & Van der Gaag, R. J. (2014). Gender and Age Differences in the Core Triad of

Impairments in Autism Spectrum Disorders: A Systematic Review and Meta-Analysis.

*Journal of Autism and Developmental Disorders*, *44*(3), 627–635.