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Introduction to Autism Spectrum Disorders

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder that includes a wide spectrum of presentations. ASD is primarily characterized by repetitive and restrictive patterns of behavior, communication challenges, and social deficits (Mughal et al., 2022). In addition to the symptoms of ASD, individuals diagnosed with ASD often face comorbid conditions such as sleep difficulties, anxiety, attention-deficit/hyperactivity disorder (ADHD), and gastrointestinal issues.

According to the Behavior Analyst Certification Board® (BACB®)'s most recent report, 71% of board certified behavior analysts (BCBA®s) work with individuals with ASD, representing a vast majority of the field (BACB®, 2022). As such, behavior analysts should have a strong understanding of ASD.

This course will provide a thorough understanding of ASD. Topics will include the background of the diagnosis, levels of severity, diagnostic testing, causes and risk factors, comorbid conditions, treatments, and prevalence.

Section 1: Background and History of ASD

Autism is a spectrum disorder that covers a broad range of signs and symptoms related to social and communication deficits, as well as restrictive and repetitive behaviors. The particular signs, symptoms, and levels of severity can vary significantly from one individual to another.

Autism was first included in the Diagnostic and Statistical Manual version 3 (DSM-III) in 1980. However, the term autism was initially coined by Eugen Bleuler, a German psychiatrist, nearly 70 years prior in 1911 (Evans, 2013). At the time, Bleuler described a symptom of schizophrenia, a concept he was also the first to identify. Per Evans, "according to Bleuler, autistic thinking was characterized by infantile wishes to avoid unsatisfying realities and replace them with fantasies and

hallucinations" (Evans, 2013). Autism was believed to define an individual's inner life and therefore was not objectively observable to those around them. Throughout the next few decades, psychologists and other mental health practitioners used the term autism to have this meaning as coined by Bleuler.

This conceptualization of autism shifted drastically by the 1940s and onward. In 1943, Leo Kanner, a child psychiatrist from John Hopkins, published a keystone article, in which he coined infantile autism. Kanner described eleven children who did not possess the social instinct to orient toward others, were overly focused or fixated on particular objects, and had an insistence on sameness, resisting unexpected change (Baron-Cohen, 2015).

One year after Kanner's coining of infantile autism, an Austrian pediatrician named Hans Asperger published an article describing a group of children who were similar in many ways to the group of children that Kanner described. While Kanner's article gained a high level of attention, Asperger's article received very little attention. It wasn't until 1981 when a child psychiatrist named Lorna Wing published an article that brought Hans Asperger's article to the forefront (Baron-Cohen, 2015). One key difference between Kanner and Asperger's initial findings was that Kanner emphasized autism as being a developmental disorder. Conversely, Asperger's report noted behaviors that were more closely aligned with a potential personality disorder. Additionally, Asperger found the fathers of the children he observed to have similar difficulties, highlighting the possibility of a genetic link (Rosen et al., 2021).

Kanner's findings in many ways still align with the autism diagnosis as we know it today. For example, symptomatology such as echolalia, pronoun reversal, and abnormal prosody were all observed and noted by Kanner. However, our understanding of autism has shifted drastically since Kanner as well. One of Kanner's key beliefs was that autism indicated an impaired level of self-centered

thinking, similar to Bleuler's conceptualization of autism as a schizophrenic characteristic. In fact, the term 'autism' was derived from the Greek word, autos, which means self. However, developments in psychiatric diagnoses occurred in the 1960s and 1970s, which included a better understanding of autism. This eventually led to autism being included in the DSM-III in 1980. In 1964, the first checklist for assessing a child's symptoms of autism was created, which gave professionals the first concrete manner of identifying an autism diagnosis. Research during this time also identified autism as a distinct concept, independent of schizophrenia (Rosen et al., 2021).

DSM-III Definition of Autism

Prior to the DSM-III, practitioners struggled with the psychiatric diagnosis guidelines from the earlier versions of the manual. The guidelines provided limited applicability for children. For children who were demonstrating symptoms similar to those noted by Kanner and other researchers, the only diagnosis included in the DSM-II that could explain these symptoms was childhood schizophrenia. Practitioners and researchers alike identified challenges in applying this diagnosis to those who were experiencing symptoms that more closely aligned with autism, hence the push toward including autism as an independent diagnosis in the diagnostic manual (Rosen et al., 2021).

The DSM-III included a new class of conditions, not previously included in prior versions of the manual. The class was referred to as Pervasive Developmental Disorders (PDDs). Infantile Autism was included in this class. Infantile Autism was defined as a pervasive lack of social responsiveness. An additional diagnosis of Residual Infantile Autism was also included under the DSM-III which described children who had once met the criteria for autism, but no longer did now. When autism was initially included in the third edition of the DSM, it was believed to be an extremely rare disorder, affecting only three to seven children for every 10,000.

We now know today that ASD is much more common, with around 1 in 44 children receiving an ASD diagnosis. Gender differences were noted during this time as well, with males being 3-5 times more likely to be diagnosed with ASD than females, which is still true today (Rosen et al., 2021).

According to the American Psychiatric Association (APA), the DSM-III criteria required for an Infantile Autism diagnosis included the following six items (APA, 1980):

- Onset before 30 months of age
- Pervasive lack of responsiveness to other people (autism)
- Gross deficits in language development
- If speech is present, peculiar speech patterns such as immediate and delayed echolalia, metaphorical language, and pronominal reversal.
- Bizarre responses to various aspects of the environment (i.e., resistance to change, peculiar interest in or attachments to animate or inanimate objects).
- Absence of delusions, hallucinations, loosening of associations, and incoherence as in Schizophrenia.

One key challenge presented by the DSM-III's criteria is that each of the six items were required for an autism diagnosis. If one or more of the criteria were not present, then the individual did not qualify for the Infantile Autism diagnosis. This criterion lacked flexibility, resulting in individuals not receiving a diagnosis, despite exhibiting many of these symptoms. It was unclear how to proceed for those children who met some, but not all criteria. The APA published a revised version of the DSM-III, the DSM-III-R, to address this concern, among others. The disorder's name shifted from 'infantile autism' to 'autistic disorder.' Autistic disorder

encompassed a more flexible approach to diagnosis, allowing practitioners to assign a diagnosis to those who did not meet all diagnostic criteria that infantile autism required. (Rosen et al., 2021).

The DSM-III-R (1987) also included a new set of 16 criteria, compared to the originally identified six criteria as listed above. Autistic disorder prior to the DSM-III-R, required at least eight of the following sixteen items to be present. Additionally, at least two items from section A, one from section B, and one from section C were required.

a. *Qualitative impairment in reciprocal social interaction (the examples within parentheses are arranged so that those first listed are more likely to apply to younger or more disabled, and the later ones, to older or less disabled) as manifested by the following:*

    1. Marked lack of awareness of the existence or feelings of others (for example, treats a person as if that person were a piece of furniture; does not notice another person's distress; apparently has no concept of the need of others for privacy);

    2. No or abnormal seeking of comfort at times of distress (for example, does not come for comfort even when ill, hurt, or tired; seeks comfort in a stereotyped way, for example, says "cheese, cheese, cheese" whenever hurt);

    3. No or impaired imitation (for example, does not wave bye-bye; does not copy parent's domestic activities; mechanical imitation of others' actions out of context);

    4. No or abnormal social play (for example, does not actively participate in simple games; refers solitary play activities; involves other children in play only as mechanical aids); and

5. Gross impairment in ability to make peer friendships (for example, no interest in making peer friendships despite interest in making friends, demonstrates lack of understanding of conventions of social interaction, for example, reads phone book to uninterested peer.

b. *Qualitative impairment in verbal and nonverbal communication and in imaginative activity, (the numbered items are arranged so that those first listed are more likely to apply to younger or more disabled, and the later ones, to older or less disabled) as manifested by the following:*

1. No mode of communication, such as: communicative babbling, facial expression, gesture, mime, or spoken language;

2. Markedly abnormal nonverbal communication, as in the use of eye-to-eye gaze, facial expression, body posture, or gestures to initiate or modulate social interaction (for example, does not anticipate being held, stiffens when held, does not look at the person or smile when making a social approach, does not greet parents or visitors, has a fixed stare in social situations);

3. Absence of imaginative activity, such as play-acting of adult roles, fantasy character or animals; lack of interest in stories about imaginary events;

4. Marked abnormalities in the production of speech, including volume, pitch, stress, rate, rhythm, and intonation (for example, monotonous tone, question-like melody, or high pitch);

5. Marked abnormalities in the form or content of speech, including stereotyped and repetitive use of speech (for example, immediate echolalia or mechanical repetition of a television commercial); use of "you" when "I" is meant (for example, using "You want cookie?" to

mean "I want a cookie"); idiosyncratic use of words or phrases (for example, "Go on green riding" to mean "I want to go on the swing"); or frequent irrelevant remarks (for example, starts talking about train schedules during a conversation about sports); and

6. Marked impairment in the ability to initiate or sustain a conversation with others, despite adequate speech (for example, indulging in lengthy monologues on one subject regardless of interjections from others);

c. *Markedly restricted repertoire of activities and interests as manifested by the following:*

1. Stereotyped body movements (for example, hand flicking or twisting, spinning, head-banging, complex whole-body movements);

2. Persistent preoccupation with parts of objects (for example, sniffing or smelling objects, repetitive feeling of texture of materials, spinning wheels of toy cars) or attachment to unusual objects (for example, insists on carrying around a piece of string);

3. Marked distress over changes in trivial aspects of environment (for example, when a vase is moved from usual position);

4. Unreasonable insistence on following routines in precise detail (for example, insisting that exactly the same route always be followed when shopping);

5. Markedly restricted range of interests and a preoccupation with one narrow interest, e.g., interested only in lining up objects, in amassing facts about meteorology, or in pretending to be a fantasy character.

d. Onset during infancy or early childhood Specify if childhood onset (after 36 months of age) (American Psychiatric Association, 1987).

DSM-IV Definition of Autism

The next diagnostic criteria for autism came in 1994 with the DSM-IV. By this point, it was identified that the DSM-III-R was too broad. With the identification that there was such a high degree of variability in symptomatology, additional diagnoses were added with distinctions made. The DSM-IV diagnostic criteria for each of the PDD included the following (American Psychiatric Association, 1994).

299.00 Autistic Disorder

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

1. Qualitative impairment in social interaction, as manifested by at least two of the following:

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

    b. failure to develop peer relationships appropriate to developmental level

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

    d. lack of social or emotional reciprocity

2. Qualitative impairments in communication as manifested by at least one of the following:

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

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

c. stereotyped and repetitive use of language or idiosyncratic language

d. lack of varied spontaneous make-believe play or social imitative play appropriate to developmental level

3. Restricted, repetitive, and stereotyped patterns of behavior, interests, and activities, as manifested by at least of one of the following:

a. encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus

b. apparently inflexible adherence to specific, nonfunctional routines or rituals

c. stereotyped and repetitive motor mannerisms (e.g. hand or finger flapping or twisting, or complex whole body movements)

d. persistent preoccupation with parts of objects

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

c. *The disturbance is not better accounted for by Rett's disorder or childhood disintegrative disorder.*

299.80 Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS)

This category should be used when there is a severe and pervasive impairment in the development of reciprocal social interaction or verbal and nonverbal communication skills, or when stereotyped behavior, interests, and activities are present, but the criteria are not met for a specific PDD, schizophrenia, schizotypal personality disorder, or avoidant personality disorder. For example, this category includes "atypical autism" –presentations that do not meet the criteria for autistic disorder because of late age of onset, atypical symptomatology, or subthreshold symptomatology, or all of these.

299.80 Asperger's Disorder (or Asperger Syndrome)

An Asperger/HFA screening tool must meet all six areas defined by the DSM-IV description of Asperger Syndrome (A-F below) to qualify for a positive rating from First Signs:

a. *Qualitative impairment in social interaction, as manifested by at least two of the following:*

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

    2. failure to develop peer relationships appropriate to developmental level

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

4. lack of social or emotional reciprocity

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

    1. encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus

    2. apparently inflexible adherence to specific, nonfunctional routines or rituals

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

    4. persistent preoccupation with parts of objects

c. *The disturbance causes clinically significant impairment in social, occupational, or other important areas of functioning.*

d. *There is no clinically significant general delay in language (e.g., single words used by age 2 years, communicative phrases used by age 3 years).*

e. *There is no clinically significant delay in cognitive development or in the development of age-appropriate self-help skills, adaptive behavior (other than in social interaction), and curiosity about the environment in childhood.*

f. *Criteria are not met for another specific PDD or schizophrenia.*

299.80 Rett's Disorder (or Rett Syndrome)

a. *All of the following:*

    1. apparently normal prenatal and perinatal development

2. apparently normal psychomotor development through the first five months after birth

3. normal head circumference at birth

b. *Onset of all of the following after the period of normal development:*

1. deceleration of head growth between ages five and 48 months

2. loss of previously acquired purposeful hand skills between ages five and 30 months with the subsequent development of stereotyped hand movements (i.e., hand-wringing or hand washing)

3. loss of social engagement early in the course (although often social interaction develops later)

4. appearance of poorly coordinated gait or trunk movements

5. severely impaired expressive and receptive language development with severe psychomotor retardation

299.10 Childhood Disintegrative Disorder

a. *Apparently normal development for at least the first two years after birth as manifested by the presence of age-appropriate verbal and nonverbal communication, social relationships, play, and adaptive behavior.*

b. *Clinically significant loss of previously acquired skills (before age ten years) in at least two of the following areas:*

1. expressive or receptive language

2. social skills or adaptive behavior

3. bowel or bladder control

4. play

5. motor skills

c. *Abnormalities of functioning in at least two of the following areas:*

    1. qualitative impairment in social interaction (e.g., impairment in nonverbal behaviors, failure to develop peer relationships, lack of social or emotional reciprocity)

    2. qualitative impairments in communication (e.g., delay or lack of spoken language, inability to initiate or sustain a conversation, stereotyped and repetitive use of language, lack of varied make-believe play)

    3. restricted, repetitive, and stereotyped patterns of behavior, interests, and activities, including motor stereotypies and mannerisms

d. *The disturbance is not better accounted for by another specific pervasive developmental disorder or by schizophrenia (American Psychiatric Association, 1994).*

Between the DSM-IV in 1994 and the DSM-V in 2013, a significant body of research on the symptoms of autism had been developed. It was evident in the research that there was variability in the number and severity regarding the symptoms of autism both within and between the subgroups (i.e., autistic disorder, Asperger's disorder, PDD-NOS, Rett's disorder, and childhood disintegrative disorder). For example, autistic disorder and Asperger's disorder were two separate diagnoses in the DSM-IV. These two diagnoses had different criteria but included similar core symptom profiles. While there were differences between individuals who were diagnosed with autism and those diagnosed with Asperger's, the differences were no more significant than the differences between individuals who were all diagnosed with the same disorder. In other words, there was significant variability within and between each group. This led to a shift

toward consolidating the many pervasive developmental disorders into a single diagnosis: autism spectrum disorder (ASD). This change came with the American Psychiatric Association's DSM-V in 2013 (Rosen et al., 2021).

DSM-V definition of ASD

With increased research came an understanding of the core symptoms of autism. Individuals with autism each present differently, with significant variation. This led to the development of autism as a spectrum disorder. Rather than multiple individual disorders, the DSM-V defined one disorder, ASD.

Per the American Psychiatric Association's DSM-V definition of ASD, a child must display persistent deficits in each of the three areas of social communication and interactions (see A-1 through A-3 below), in addition to at least two out of four areas related to restricted and repetitive behaviors (See B-1 through B-4 below) (APA, 2013).

a. *Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history (examples are illustrative, not exhaustive; see text):*

    1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.

    2. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.

3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

Specify current severity:

Severity is based on social communication impairments and restricted, repetitive patterns of behavior. For either criterion, severity is described in three levels: Level 3 – requires very substantial support, Level 2 – requires substantial support, and Level 1 – requires support.

b. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history (examples are illustrative, not exhaustive; see text):

1. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypes, lining up toys or flipping objects, echolalia, idiosyncratic phrases).

2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat same food every day).

3. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).

4. Hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment (e.g. apparent indifference to pain/temperature, adverse response to specific sounds or textures,

excessive smelling or touching of objects, visual fascination with lights or movement).

Specify current severity:

Severity is based on social communication impairments and restricted, repetitive patterns of behavior. For either criterion, severity is described in three levels: Level 3 – requires very substantial support, Level 2 – requires substantial support, and Level 1 – requires support.

a. Symptoms must be present in the early developmental period (but may not become fully manifest until social demands exceed limited capacities, or may be masked by learned strategies in later life).

b. Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.

c. These disturbances are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay. Intellectual disability and autism spectrum disorder frequently co-occur; to make comorbid diagnoses of autism spectrum disorder and intellectual disability, social communication should be below that expected for general developmental level (American Psychiatric Association, 2013).

The American Psychiatric Association's definition of ASD did not come without criticism. There were concerns as to whether individuals previously diagnosed with a PDD would now qualify under the criteria for ASD. However, over 90% of individuals who previously met the criteria for a PDD met the criteria for ASD. Many of those who did not meet the new criteria for an ASD would instead meet the criteria for a social communication disorder (SCD), which was also newly added to the DSM-V. The primary similarity between ASD and SCD is the difficulty

with social communication skills. Children with ASD also display restricted interests and/or repetitive behaviors, which is not demonstrated in children with SCD. Individuals who were previously diagnosed with a PDD due to social and communication deficits but do not meet the restrictive and repetitive behavior criterion, may meet the criteria for SCD. The move from multiple diagnoses to a single spectrum diagnosis has led to improved diagnostic reliability (Evans, 2013).

Section 1 Personal Reflection

What changes or improvements in treatment may be possible with improvements in diagnostic criteria?

Section 1 Key Words

American Psychiatric Association (APA) - A scientific and progressional organization. The APA creates and publishes the Diagnostic and Statistical Manual, providing professionals diagnostic criteria for conditions of mental wellbeing.

Autism spectrum disorder (ASD) - A developmental disorder encompassing a spectrum of severity levels relating to social communication deficits and restricted or repetitive behaviors. ASD became an official diagnosis in the DSM-V of 2013.

Autistic disorder - The diagnostic term identified in the 1987 DSM-III-R. An autistic disorder diagnosis was more flexible than the previously identified diagnosis of infantile autism.

Autos - The greek word, meaning self, which the term ‘autism’ was derived from.

Diagnostic and Statistical Manual (DSM) - A handbook published by the American Psychiatric Association, which provides diagnostic criteria for mental health diagnoses.

Infantile autism - The autism diagnosis per the DSM-III, defined as a pervasive lack of social responsiveness.

Pervasive Developmental Disorders (PDDs) - A class of disorders included in the DSM-IV, which included autistic disorder, Rett's syndrome, Asperger's syndrome, PDD-NOS, and childhood disintegrative disorder.

Residual Infantile Autism - A diagnosis from the DSM-III, which described children who had once met the criteria for autism but no longer did now.

Section 2: Levels of Severity

As reviewed in section one, the current criteria for an ASD diagnosis include three levels of severity. This was added to the DSM-V's criteria when conceptualizing autism as a spectrum disorder, rather than separate individual diagnoses. The primary reason for distinguishing between different levels of severity was to ensure each child receives the level of care they need, rather than a one-size-fits-all approach to treatment. Based on the 5th edition of the DSM, people with significant differences may qualify for an ASD, so long as they meet the core autism symptom criteria. Being a spectrum disorder, this results in individuals diagnosed with ASD with significant variations of symptom presentation. Each child with ASD therefore will not require the same level of support (Mehling & Tassé, 2016).

Variability in treatment and outcomes based on the severity level has been an area of focused interest for researchers in the early 2000s. One study examined longitudinal trajectories of ASDs based on presentation severity (Gotham, Pickles, & Lord, 2012). This study found that the majority of individuals diagnosed maintained their level of severity across time from early childhood into early adolescence. More than 80% of the children studied demonstrated stability in their severity scores. Less than 20% of these individuals demonstrated a change in core ASD symptom severity (Gotham, Pickles, & Lord, 2012). This study supports the idea that severity levels may be consistent across one's lifetime. Continued

research in this area will be beneficial to convey vital information regarding the course of symptomatology and prognosis.

Autism severity levels have been informally conceptualized in various ways over the years, most notably in terms of “high functioning” and “low functioning.” An individual’s intelligence quotient (IQ), language acquisition, behavioral challenges, and other informal measures of functioning have been used to differentiate individuals who were thought to be high functioning from those who were considered low functioning. However, research has demonstrated that it is not quite that linear or clear-cut. As a spectrum disorder, one individual may have a high IQ, yet struggle significantly with adaptive behaviors and social communication. They, therefore, don’t fall perfectly into either category. Using IQ as a proxy for autism severity does not properly characterize the many potential variations across ability and functioning (Mehling & Tassé, 2016).

An individual’s severity of impairment has been found to be inconsistent across domains. For example, a child’s core ASD symptomatology may place them in one severity category, while their adaptive functioning is precisely the opposite. This adds to the challenges in conceptualizing severity or functioning levels. With these challenges, came the push to add more formal guidance on the classification of severity levels. As such, the DSM-V’s definition of ASD includes severity levels that are established by the diagnostician at the time of the diagnosis (Mehling & Tassé, 2016).

The DSM-V in 2013 provided three severity ratings to assist clinicians and researchers in better conceptualizing the differences in severity among individuals diagnosed with ASD. Instead of a general functioning level, the three severity categories refer to the level of support the individual needs, based on the presentation of their symptoms and comorbid challenges. This is beneficial as it provides more than a blanket label that may not benefit the child. It instead

focuses directly on what the individual's level of functioning across domains means in terms of the support that they will need (American Psychiatric Association, 2013).

The levels of severity relate to the supports required as a result of the individual's core ASD symptoms, as well as comorbid challenges. Supports can be defined as various resources and strategies that are provided to assist in promoting each individual's interests and welfare. Supports may result in an increased level of personal independence and productivity, a higher degree of participation in the general society, and/or an improved quality of life (Mehling & Tassé, 2016).

Another distinction in the current severity level conceptualization is that each domain is individually rated, rather than the child having one overarching level of functioning. For example, a child may have a level 2 "requiring substantial support" in the social communication domain but have a level 3 "requiring very substantial support" in their restricted, repetitive patterns of behavior (American Psychiatric Association, 2013). This helps therapists, caregivers, parents, and other professionals direct support in the areas that the individual needs, allowing them to be as independent as possible in areas requiring less support.

Level 1: Requiring Support

The severity level requiring the least amount of support is level 1. For both the social communication domain and the restricted, repetitive behaviors domain, an individual severity level is provided. As such, the criteria for receiving a level 1 severity level is different for each domain.

To receive a level 1 severity rating under the social communication domain, the following must be true for the individual, per the DSM-V.

> *Without supports in place, deficits in social communication cause noticeable impairments. Difficulty initiating social interactions, and clear examples of*

atypical or unsuccessful response to social overtures of others. May appear to have decreased interest in social interactions. For example, a person who is able to speak in full sentences and engages in communication but whose to- and-fro conversation with others fails, and whose attempts to make friends are odd and typically unsuccessful (American Psychiatric Association, 2013).

To receive a level 1 severity rating under the restricted and repetitive behaviors domain, the following must be true for the individual, per the DSM-V.

Inflexibility of behavior causes significant interference with functioning in one or more contexts. Difficulty switching between activities. Problems of organization and planning hamper independence (American Psychiatric Association, 2013).

Level 2: Requiring substantial support

Level 2 requires a higher degree of needed support than that of level 1. In order to receive a level 2 severity level under the social communication domain, the following must be true for the individual, per the DSM-V.

Marked deficits in verbal and nonverbal social communication skills; social impairments apparent even with supports in place; limited initiation of social interactions; and reduced or abnormal responses to social overtures from others. For example, a person who speaks simple sentences, whose interaction is limited to narrow special interests, and has markedly odd nonverbal communication (American Psychiatric Association, 2013).

To receive a level 2 severity rating under the restricted and repetitive behaviors domain, the following must be true for the individual.

Inflexibility of behavior, difficulty coping with change, or other restricted/ repetitive behaviors appear frequently enough to be obvious to the casual observer and interfere with functioning in a variety of contexts. Distress

and/or difficulty changing focus or action (American Psychiatric Association, 2013).

Level 3: Requiring very substantial support

The third level is reserved for those individuals who exhibit core ASD symptoms and comorbid challenges that are the most severe. With this severity level, comes a very substantial need for support. Individuals with this severity level often require intensive treatment.

To receive a level 3 severity rating under the social communication domain, the following must be true for the individual.

> *Severe deficits in verbal and nonverbal social communication skills cause severe impairments in functioning, very limited initiation of social interactions, and minimal response to social overtures from others. For example, a person with few words of intelligible speech who rarely initiates interaction and, when he or she does, makes unusual approaches to meet needs only and responds to only very direct social approaches (American Psychiatric Association, 2013).*

To receive a level 3 severity rating under the restricted and repetitive behaviors domain, the following must be true for the individual.

> *Inflexibility of behavior, extreme difficulty coping with change, or other restricted/repetitive behaviors markedly interfere with functioning in all spheres. Great distress/difficulty changing focus or action (American Psychiatric Association, 2013).*

Severity levels as conceptualized in the DSM-V provide potential benefits for the diagnosed individual. While treatment should be individualized, severity levels help professionals and caregivers identify the areas in which the child will require

the most support. This information can also help caregivers identify what types of interventions or treatments to pursue.

Section 2 Personal Reflection

How might the severity levels under each domain affect the level of and types of treatment or environmental modifications needed?

Section 2 Key Words

ASD Level 1 - The severity rating attributed to an individual's functioning under both social communication and restricted and repetitive behavior domains. Level 1 refers to those whose ASD symptoms result in the individual requiring support.

ASD Level 2 - The severity rating attributed to an individual's functioning under both social communication and restricted and repetitive behavior domain. Level 1 refers to those whose ASD symptoms result in the individual requiring substantial support.

ASD Level 3 - The severity rating attributed to an individual's functioning under both social communication and restricted and repetitive behavior domain. Level 1 refers to those whose ASD symptoms result in the individual requiring very substantial support.

Functioning levels - The previously held conceptualization of autistic levels of severity. High and low-functioning labels related to the levels of core autism symptoms and/or an individual's IQ.

Supports - Various resources and strategies that are provided to assist in promoting each individual's interests and welfare. Supports may result in an increased level of personal independence and productivity, a higher degree of participation in the general society, and/or improved quality of life

Section 3: Diagnostic testing

There are no medical diagnostic tests, such as blood tests, that can detect an ASD diagnosis at the present time. Instead, ASD is diagnosed based on the presentation of symptoms by a qualified diagnostician, through observations as well as direct and indirect measurements. There are a few common instruments diagnosticians use in evaluating an individual for an ASD. Due to the various components of an ASD diagnosis (i.e., social communication deficits, restricted and repetitive behavior deficits, severity levels, with or without accompanying impairments.) diagnosticians often conduct a number of assessment tools before finalizing a clinical judgment. The following tools may be used alone or in combination by those trained and qualified in diagnosing an ASD (Mehling & Tassé, 2016).

Modified Checklist for Autism in Toddlers, Revised (MCHAT-R)

The MCHAT-R is not a test used to diagnose an ASD. However, it is a useful screening assessment. It is considered a universal ASD screening assessment. This screening tool is universally available and can be completed by caregivers or others who are concerned about potential signs of an ASD in toddlers between 16 and 30 months of age. The MCHAT-R includes 20 questions relating to early signs of an ASD (Choueiri & Zimmerman, 2017). The MCHAT-R contains questions such as “does your child play pretend or make-believe?” and “If you point at something across the room, does your child look at it?” (MCHAT-R, 2022). The results of this initial screening can inform caregivers and professionals whether further evaluation is necessary. A score of three or more indicates the need for further evaluation. A score of 0-2 indicates no need for further evaluation (Choueiri & Zimmerman, 2017).

Autism Diagnostic Observation Schedule (ADOS-II)

The Autism Diagnostic Observation Schedule, 2nd edition (ADOS-2) is one common diagnostic assessment tool used. The ADOS-2 is useful in both diagnosing an ASD, as well as identifying ASD severity levels in the social communication and restricted and repetitive behaviors domains. This assessment is administered in a play-based format. It is semi-structured, with the diagnostician directly assessing the core deficits in social communication and restricted and repetitive behaviors and interests. The ADOS-2 is commonly accepted across disciplines as a method of measuring ASD severity and has significant research backing to demonstrate its validity (Mehling & Tassé, 2016).

Child Autism Rating Scale (CARS-2)

The Child Autism Rating Scale, 2nd edition (CARS-2) is another common tool used in ASD evaluations. The CARS-2 is a rating scale that is assessed by gathering information from the clinician's observations during formal assessment sessions and general observations. The purpose of the CARS-2 is to identify behaviors that are characteristics of the core symptoms of ASD to assist in the clinical determination of an ASD diagnosis, as well as to assist in identifying severity levels. The CARS-2 has been found through empirical research to cover the full autism spectrum (Mehling & Tassé, 2016).

Social Responsiveness Scale (SRS-2)

The Social Responsiveness Scale, 2nd edition (SRS-2) is another rating scale used to evaluate for symptoms of an ASD. This rating scale is used with children ages 2 ½ and older. It measures social skills, repetitive or stereotypic behaviors, and communication abilities. The SRS-2 is primarily useful in identifying an ASD diagnosis in individuals who are at risk, though it can be used for the determination of ASD severity as well (Mehling & Tassé, 2016).

One unique component of the SRS-2 is that subscale scores can be used to develop treatment plan goals. With this comes an ability to monitor intervention progress as related to the symptoms of an ASD from the initial assessment across the individual's treatment timeline (Mehling & Tassé, 2016).

Vineland-2

The Vineland Adaptive Behavior Scale, 2nd edition measures adaptive behavior. It is norm-referenced, comparing each individual's adaptive functioning to the average functioning level of neurotypical counterparts. The Vineland II can be used with individuals from birth through ninety. The four domains assessed in the Vineland II include communication, daily living skills, socialization, and motor skills (Mehling & Tassé, 2016).

One strength of the Vineland II is that it measures the functional impairment in each individual's performance through daily activities. This information can help clinicians, caregivers, and others understand how much support an individual needs, based on the severity of their functioning deficits in each domain. This assessment is frequently used among others in a comprehensive ASD evaluation. However, the Vineland-2 is not solely specific to an ASD (Mehling & Tassé, 2016).

Repetitive Behavior Scale-Revised (RBS-R)

The primary intention of the Repetitive Behavior Scale-Revised (RBS-R) is to measure restricted and repetitive interests and patterns of behavior. This tool measures particular behaviors in terms of whether or not the individual exhibits said behaviors, as well as the severity of the restrictive and repetitive behaviors. The RBS-R is typically used in conjunction with other more thorough assessment tools such as the ADOS-2 (Mehling & Tassé, 2016).

Section 3 Personal Reflection

What diagnostic evaluation tools are you familiar with? What benefits, if any, do these assessment tools have on the development of supports, treatment goals, and teaching procedures used, from a behavior analyst's perspective?

Section 3 Key Words

Autism Diagnostic Observation Schedule (ADOS-II) - A play-based, semi-structured assessment tool used to evaluate the core symptoms of an ASD.

ASD screening - Tools used to identify children who may be at risk for an ASD. Screening is a common component of a child's pediatric well visits. The results of screenings identify those who require further assessment.

Child Autism Rating Scale (CARS-2) - A rating scale that is used to evaluate the symptoms of an ASD by gathering information from the clinician's observations during formal assessment sessions and general observations.

Diagnostic assessments - Formal and informal tools used to assess the symptoms and severity of an ASD.

Modified Checklist for Autism in Toddlers, Revised (MCHAT-R) - A screening tool to identify those children who are demonstrating early signs of an ASD and may require additional testing.

Repetitive Behavior Scale-Revised (RBS-R) - An assessment tool used to evaluate the restricted and repetitive behaviors, commonly associated with an ASD, as well as the severity of each behavior.

Social Responsiveness Scale (SRS-2) - An ASD assessment tool that measures social skills, repetitive or stereotypic behaviors, and communication abilities.

Vineland II - A norm-referenced tool used to evaluate adaptive functioning abilities from birth to ninety years of age.

Section 4: Causes and Risk Factors

There has, historically, been a great deal unknown concerning the causes and risk factors for an ASD. There has been much speculation regarding whether vaccines or other environmental factors may be the cause. It is not uncommon for parents of newly diagnosed children to consider whether anything they did during pregnancy or in the early years of their child's life may have contributed to the diagnosis. While there is still much unknown, research in this area has led us to have a higher degree of understanding of the etiology of an ASD.

Genetics

The earlier assumption following the classification of autism was that it was solely caused by environmental factors. However, advancements in research into genetics have led us to understand that an ASD is a highly heritable disorder (Chaste & Leboyer, 2022).

Early twin studies such as that conducted by Folstein & Rutter in 1977 were the first to identify this likely genetic link. Many have speculated as to whether an increased rate of an ASD diagnosis between siblings can be better explained as a result of a shared environment. However, the 1977 study, among others, found that monozygotic (identical) twins had a higher incidence of autism than dizygotic (fraternal) twins. This demonstrates a strong genetic influence and suggests genetic components may have a stronger influence than environmental factors (Chaste & Leboyer, 2022).

Comprehensive gene-expression analyses on the brains of individuals with an ASD diagnosis found numerous differences between the transcriptome organization in

autistic brains, as compared to the brains of neurotypical individuals. Transcriptome refers to the collection of all gene readouts in a particular cell. The authors found 444 genes that were expressed differently in the brains of individuals diagnosed with an ASD, compared to the control group. They also discovered two discrete modules of coexpressed genes that were found to be associated with ASD. One of those modules is related to synaptic function and neuronal projection. This module was underexpressed in individuals with an ASD. Alternatively, another module was found to be overexpressed (Chaste & Leboyer, 2022).

By the late 1990s, it was clear in the research that autism did indeed have strong genetic components. However, researchers were still unsure which genes specifically were involved. This continues to be a primary focus of autism research. Current research suggests autism may originate based on a number of genetic alterations that directly affect brain development and plasticity (Chaste & Leboyer, 2022).

Independent heritability levels based on each domain of autistic symptomatology have yet to be established, according to a 2022 study. Some research indicates that different symptoms of autism may have individual genetic influences, rather than a single gene influencing the development of all autistic symptoms. More research is needed in this area (Chaste & Leboyer, 2022).

Genetic research continues to be a primary focus in understanding the etiology of autism. Many researchers believe that a combination of heritability and environmental factors is most likely to be at play in the development of autism. It is possible that environmental factors such as parental age or medication use may modify the phenotypes, resulting in the development of autism. Again, while research supports this likelihood, it cannot yet be stated for certain (Chaste & Leboyer, 2022).

Advances in research have led us to a greater level of understanding of ASD's etiology. While we see clear links to genetic factors, questions still remain. Research is continuing to look into the role of common variants and the interactions between genotype and phenotype (Chaste & Leboyer, 2022).

Disproven: Vaccinations

Over the years, there have been many myths regarding the causes of autism. One of the most well-known myths that have since been proven to be unsubstantiated is that vaccines cause autism. It is believed that this idea may have contributed to parents choosing to forgo potentially life-saving vaccinations for their children, out of fear that the vaccines may cause their child to develop autism. Still today, some families are uncertain about vaccinations for their children, out of fear that they may cause the development of autism. A thorough review of the research shows that these claims have been disproven a number of times (DeStefano & Shimabukuro, 2019).

The most common vaccine that has been assumed to have an impact on the development of autism is the measles, mumps, and rubella (MMR) vaccination. This vaccine was released in 1971 to protect children from contracting measles, mumps, and rubella (DeStefano & Shimabukuro, 2019). Research on the efficacy of the MMR vaccine, when taken on the recommended schedule, shows a 93% effectiveness against measles, 78% effectiveness against mumps, and 97% effectiveness against rubella (Center for Disease Control and Prevention, 2021).

Andrew Wakefield, a British gastroenterologist, was the most influential in the development of this vaccine hypothesis. In 1998, Wakefield published a paper in the Lancet journal. This paper claimed that the MMR vaccination causes intestinal inflammation and allows proteins to enter the bloodstream. These proteins, Wakefield claimed, are harmful to the brain. The consequence of this, per Wakefield, was the development of autism (DeStefano & Shimabukuro, 2019).

Wakefield described twelve children he claimed to study whom each had developmental delays. Eight of these children also had an autism diagnosis. All twelve of these children were diagnosed with autism shortly after receiving the MMR vaccine. The children also each experienced intestinal discomfort within one month of receiving the MMR vaccination, which Wakefield argued, added evidence of intestinal inflammation caused by the vaccination. Wakefield did not present causal links between intestinal inflammation and the vaccine. Furthermore, the research was found to be fraudulent, with data strongly misrepresented (DeStefano & Shimabukuro, 2019).

In addition to Wakefield's research being based on scientific misconduct, around 90% of children in England at the time, where Wakefield studied, received the MMR vaccine. It is therefore reasonable to assume that some individuals who did receive the vaccine would also be diagnosed with autism. Wakefield's study was conducted on twelve children who each received the vaccine, with no control group to compare the findings to, demonstrating a flawed experimental design (DeStefano & Shimabukuro, 2019).

The MMR vaccination is also administered during a time when autistic symptoms are commonly identified, during toddlerhood. The first MMR dosage is typically provided between 12 and 18 months of age, according to the Center for Disease Control and Prevention's (CDC) recommended vaccine schedule (Center for Disease Control and Prevention, 2021). This is the time when neurodivergent tendencies begin to emerge that likely were not evident during infancy. Therefore, it would be expected that many children who were recently diagnosed also recently received an MMR vaccination. This is a simple correlation and continued research has failed to support any causal link (DeStefano & Shimabukuro, 2019).

Wakefield's work has been retracted and is not considered to be a part of scientific records. Additionally, research since Wakefield's research has failed to

support the notion that an ASD is caused by the MMR vaccine or any other vaccinations. As previously alluded to, correlations do exist between the time when children commonly receive their MMR vaccine and when the symptoms of an ASD are observed. However, a 2017 meta-analysis found no evidence of a higher risk of an ASD in those who were vaccinated, compared to those who were not vaccinated (Modabbernia et al., 2017).

Risk Factors

While research has in many ways linked ASD to genetic etiologies, certain environmental considerations have been identified as risk factors. In this discussion of causes and risk factors, it is important to differentiate between those two terms. A risk factor indicates an association with a given outcome. It does not, however, automatically indicate that it causes the disorder. Certain factors have been found to increase the risk of a child having ASD, though they are not known to cause the disorder. The following factors discussed in this section are considered risk factors for the development of an ASD (Wu et al., 2017).

Parental age

While parental age is not considered to be a cause of autism, it may affect the risk. In a 2017 meta-analysis, Wu et al. found a reduced risk of ASD diagnosis in the children of parents in the youngest age categories. They similarly found an increased risk of an ASD in the children of the highest parental age category. This illustrates a strong possibility that the age of the mother and/or father may increase the likelihood of a child having an ASD. More specifically, for mothers, each 10-year increment in age was found to increase the risk of ASD in their children by 18%. Interestingly, the age of fathers resulted in a slightly higher risk. For fathers, each 10-year increment in age was shown to increase the risk of ASD in their children by 21% (Wu et al., 2017).

Parental age is a common risk factor in the development of other mental and developmental disorders such as ADHD (Chudal et al., 2017), schizophrenia (Byrne et al., 2013), obsessive compulsive disorder (Min, Li, & Yan, 2021), and many others. Additional research is, however, needed to better understand why children of older parents have a higher risk of having a child with ASD (Wu et al., 2017).

Maternal medication use during pregnancy

Certain medications have been found to increase the risk of an ASD diagnosis when taken by mothers during pregnancy. One medication commonly used to treat epilepsy and bipolar disorder, valproate, may increase the risk of ASD and other neurodevelopmental challenges. This risk is increased with higher dosages (Modabbernia et al., 2017).

Antibiotics have also been thought to be contributing risk factors for an ASD diagnosis when taken by the mother during pregnancy, labor, and/or delivery, as well as when taken by the child during infancy. However, numerous studies have failed to identify a clear association between antibiotics and ASD. One meta-analysis found a slightly increased risk of ASD in two studies, while the remaining studies showed either no risk or a reduced risk of autism (Lukasik et al., 2019).

Selective serotonin reuptake inhibitors (SSRIs) used to treat depression, anxiety, and other mental health symptoms have also been studied to evaluate the risk of an ASD when these drugs are used during pregnancy. As with antibiotics, research has been largely inconclusive. A meta-analysis conducted by Kobayashi et al. (2016), found that children who were exposed to SSRIs did have significantly higher risks of an ASD. However, maternal psychiatric conditions were a major confounding factor. (Kobayashi et al., 2016).

Maternal weight

Many studies have identified links between maternal BMI and ASD, showing obesity to be positively correlated with an increased risk of ASD. A 2018 study found that, when compared to mothers within a normal weight range, mothers who were obese or underweight had a significantly higher likelihood of having children with ASD. This study found similar results when assessing the risk factors for ADHD (Anderson et al., 2018).

Pregnancy-related complications

While medical advances have come a long way in making pregnancy and childbirth much safer, there are still many things that can go wrong during pregnancy, labor, and delivery. Such complications have been studied to identify what effect they may have on the risk of an ASD diagnosis.

One pregnancy complication that may increase the risk for ASD is exposure to intrauterine infections. Infections even as mundane as influenza can impact a child's risk. Intrauterine infections may further increase the risk for those individuals who are already genetically susceptible to ASD. In these cases, research has shown that a mother's immune response is responsible for the increased likelihood of ASD, rather than the direct effect of the infection. Research suggests that gestational infections trigger an immune response in the mother, which can affect the fetus' brain development (Smith et al., 2007).

A meta-analysis evaluated the current research on prenatal risk factors (Wang et al., 2017). The authors reported an increased risk of an ASD in children who were delivered via cesarean and babies born under 36 weeks of gestation. Those babies who were born via induced labor, those who were in breech presentation, and those who experienced fetal stress, were all found to have an increased risk of ASD as well. Preeclampsia (maternal hypertension during pregnancy) was also positively associated with ASD risk. Additionally, mothers who have delivered four

or more babies were also found to have an increased relative risk (Wang et al., 2017).

The meta-analysis found the following relative risks among the studies on prenatal and postnatal risk factors (Wang et al., 2017).

Complication	Relative risk (RR)
Gestational hypertension	1.33
Gestational diabetes	1.49
Antepartum hemorrhage	1.49
Cesarean delivery	1.30
Breech presentation	1.47
Preeclampsia	1.50
Fetal distress	1.40
Threatened abortion	2.28
Low birth weight	1.26
Postpartum hemorrhage	2.10
Brain anomaly	5.38

Umbilical cords wrapped around the baby's neck and premature membrane rupture were found to not increase the risk for an ASD diagnosis. Exposure to cigarette smoking was not found to increase the risk for ASD (Wang et al., 2017).

Nutritional factors

Research has looked into potential links in nutritional elements as risk factors for ASD. The research on this has been limited, as the current studies have primarily assessed the nutritional levels in children after they have received a diagnosis,

rather than assessing the nutritional levels of mothers during pregnancy. For example, in a 2013 meta-analysis, it was demonstrated that children with ASD had significantly lower protein and calcium intake, resulting in potential nutritional deficits (Sharp et al., 2013). Another meta-analysis showed that children with ASD had significantly lower levels of zinc than their neurotypical counterparts (Babaknejad et al., 2016). Vitamin D levels were also found to be significantly lower in children with ASD (Wang et al., 2016). It is important to note that this research does not show causal relationships. There are many other potential factors that can result in nutritional deficiencies. Individuals diagnosed with ASD, for example, tend to have more limited diets. Sensory challenges and rigid tendencies often result in children with ASD having few preferred food items. It is, therefore, reasonable to deduce that the limited diet may be a factor in the lack of calcium, vitamin D, zinc, and others. There is, therefore, no evidence to support maternal nutritional deficiencies leading to an increased likelihood of an ASD diagnosis (Sharp et al., 2013).

Epigenetic effects

Most recently, researchers have found evidence to suggest that certain environmental factors likely interact with genetic factors on various levels. This interaction increases the risk of gene mutation, which may in turn increase the risk of ASD and other disorders. For example, maternal obesity has been considered to be a risk factor for ASD. Maternal obesity can modify the expression of a number of important genes that affect the neurodevelopment of a fetus. This type of biochemical modification of DNA can affect the expression of genes without changing the actual DNA sequence. This is known as epigenetics. It is likely that various environmental risk factors can affect a fetus' neurodevelopment in this manner. Valproate, as previously mentioned, is considered to be a strong risk factor for ASD, and professionals therefore strongly recommended against taking it during pregnancy. It is believed that this medication interferes with the

metabolism of folic acid, resulting in DNA modification. The exact effect environmental factors have on gene mutation and modification has not yet been clearly established, though research continues to develop in this area with promising results (Modabbernia et al., 2017).

Section 4 Personal Reflection

How does the etiology of ASD align with your understanding of what causes ASD?

Section 4 Key Words

Epigenetics - Biochemical modifications of DNA which affect gene expression.

Etiology - The cause or causes of a particular condition.

Heritability - The proportion of variability that can be attributed to inherited genetic factors, rather than environmental factors.

Relative risk (RR) - A measure of the risk of a certain event happening in one group compared to the risk of that event occurring in another group.

Preeclampsia - Maternal hypertension during pregnancy. This is one pregnancy-related complication that is known as a risk factor for ASD.

Risk factors - Various factors that indicate an association with a given outcome (i.e., a particular diagnosis).

Selective serotonin reuptake inhibitors (SSRIs) - A medication class used to treat depression, anxiety, and other mental health conditions. SSRI use during pregnancy is found to increase the risk of autism, however, maternal psychiatric health conditions are a major confounding factor.

Transcriptome - The collection of all gene readouts in a particular cell.

Valproate - A medication used to treat epilepsy and bipolar disorder, known to increase the risk of ASD when taken during pregnancy.

Section 5: Comorbid Conditions

Comorbidity refers to the presence of additional diseases or disorders which coexist with another, primary disorder or disease. Comorbid conditions may include medical conditions, mental health disorders, or both, in addition to ASD. Comorbidities are common in children with ASD. Early diagnosis and intervention including applied behavior analysis (ABA), speech, and other therapies have been found to improve possible outcomes for children diagnosed with an ASD diagnosis. Early intervention is equally as important for the treatment of comorbid symptoms and conditions as it is for the core symptoms of ASD. Comorbidities can worsen the core symptoms of ASD, especially when not detected or treated early on (Al-Beltagi, 2021).

Comorbid conditions are believed to affect around 70% of children with ASD. Some of the most common comorbid conditions include sleep disturbances, gastrointestinal discomfort and disorder, epilepsy, ADHD, anxiety, and depression. One of the challenges to identifying and treating comorbid conditions is the significant overlap in many symptoms of ASD. For example, research has estimated that 60% of children with ASD also qualified for an ADHD diagnosis. Core symptoms of ASD such as rigidity and repetitive behaviors may overlap with hyperactivity and inattention as exhibited in those with ADHD. With this overlap, it is not uncommon for one of the diagnoses to go unidentified or for a child to be misdiagnosed. One study found that the age of an ASD diagnosis was roughly four years older for individuals with a comorbid diagnosis of ASD and ADHD. This is believed to be due to the overlapping symptoms making it challenging for diagnosticians to precisely provide a diagnosis (Leader et al., 2022).

Many of the medical and psychological conditions that are common comorbidities can heighten the symptoms of ASD. It is important for comorbid conditions to be identified and treated as early as possible. Treating comorbid conditions may lead to significant improvements in health outcomes, ASD symptom reduction, and quality of life (Al-Beltagi, 2021). Furthermore,

the identification and treatment of comorbidities can help guide behavioral professionals. While ABA and other behavioral treatments are highly beneficial for treating the core symptoms of an ASD diagnosis, comorbidities should always be ruled out first.

Genetic Disorders

Fragile X syndrome, Down syndrome, neurofibromatosis type 1, and tuberous sclerosis complex, are all known genetic disorders which have been associated with an increased ASD risk. Fragile X syndrome, for example, is present in 2-3% of all children with ASD and 25%-33% of those with Fragile X have ASD. Upwards of 40% of those with Down's syndrome also have ASD. With a high occurrence of comorbid genetic disorders, it is commonly recommended for those diagnosed with ASD to have a consultation with a geneticist. There are therapeutic interventions available for many of these genetic disorders, making early identification and intervention beneficial (Al-Beltagi, 2021).

Intellectual Disability (ID)

65-75% of individuals who previously had a diagnosis of ASD also have an intellectual disability (ID). This percentage decreases to 30%-55% when considering all individuals with an ASD, as diagnosed per the DSM-V criteria. A diagnosis of ID results in challenges in intellectual and adaptive functioning. Deficits in intellectual functioning include challenges such as learning, problem-

solving, critical thinking, and judgment. Deficits in adaptive functioning relate to activities of daily living (Chaste & Leboyer, 2022).

There are a few potential reasons for this overlap between ASD and ID common genetic bases. These genes that are identified to relate to both ASD and ID cause a continuum of developmental challenges, which may present themselves in various ways depending on numerous factors. Another hypothesis is that in individuals with ID, the general cognitive disability illuminates the social reciprocity challenges, making the features of ASD more easily observed. Neither has been definitively proven (Chaste & Leboyer, 2022).

Epilepsy and Other Neurological Disorders

Epilepsy is commonly associated with ASD, with 10-30% of children with ASD having epilepsy as well. Children with ASD are also more likely than their neurotypical peers to have many other neurological disorders such as macrocephaly, hydrocephalus, cerebral palsy, migraines, and congenital abnormalities within the nervous system. It is believed that the close comorbidities between ASD and other neurodevelopmental disorders may support the notion of shared etiology (Al-Beltagi, 2021).

There is some evidence suggesting that those with a comorbid epilepsy diagnosis have certain pronounced symptoms of ASD. Social interactions and eye contact are two symptom areas that have been found to be heightened in individuals with both ASD and epilepsy. Higher rates of self-injurious, compulsive, and rigid behaviors have also been associated with ASD and epilepsy comorbidities. Furthermore, comorbid epilepsy with ASD has been associated with an increased risk of poor outcomes, including general reports of a lower quality of life and increased use of psychotropic medication (Al-Beltagi, 2021).

Immune, Autoimmune, and Allergic Disorders

Roughly one-quarter of children with an ASD diagnosis experience persistent neuroinflammation and immune abnormalities. Those who experience gastrointestinal disorders are more likely to experience these immunodeficiencies. Laboratory testing can be conducted to rule out immune deficiencies and dysfunctions (Al-Beltagi, 2021).

Children with an ASD are also significantly more likely to be affected by allergies and asthma. As we see with many of the other comorbidities, the discomfort and pain that comes with these conditions can heighten the behavioral symptoms that are related to ASD. For some children, treating the underlying allergies or inflammation may improve behavioral outcomes. In addition to environmental allergies, food allergies are common. This may further exacerbate eating challenges that are common with children with ASD (Al-Beltagi, 2021).

Sleep Disturbances

Roughly 80% of individuals with ASD experience sleep challenges. This is a commonly reported concern of caregivers. Sleep challenges may include difficulty falling asleep, nighttime awakenings, sleepwalking, sleep apnea, and others. Sleep difficulties can negatively impact a child's overall well-being. An inability to get a good night of sleep can result in poor health outcomes, which may further compound the core symptoms of ASD that the individual experiences. For example, poor sleep may cause a higher percentage of behavior challenges including self-injurious behavior and stereotypic behavior (Al-Beltagi, 2021).

Many sleep disorders are treatable. Addressing sleep disturbance symptoms may improve overall outcomes for the individual (Al-Beltagi, 2021). Environmental modifications such as bedtime routines and behavioral strategies are sometimes implemented to address sleep from a behavioral perspective. However, it is vital

that this is done in collaboration with medical professionals such as sleep specialists. Furthermore, medical conditions should be fully evaluated and medical interventions considered prior to behavioral intervention when medical conditions are suspected (Al-Beltagi, 2021).

Gastrointestinal (GI) Disorders

Research has found varying prevalence rates of gastrointestinal disorders and ASD. Studies have found anywhere between 9% and 90% of those with ASD also experience gastrointestinal (GI) disorders (Leader et al., 2021). It is, however, generally believed that 46%-84% of children with ASD experience GI challenges. GI disorders encompass a number of symptoms including but not limited to chronic constipation, diarrhea, gastroesophageal reflux, nausea, vomiting, food intolerance, ulcers, and more (Al-Beltagi, 2021).

GI disorders can often result in significant pain and discomfort. Children with ASD commonly experience deficits in their communication abilities, making it a challenge to communicate pain or discomfort. Instead, GI discomfort may be expressed behaviorally through aggression, self-injurious behavior, or other challenging or maladaptive behaviors. An inability to communicate discomfort can greatly impact caregivers' and medical professionals' ability to identify GI disorders. This highlights the importance of ruling out medical conditions before intervening behaviorally. Research has also identified links to GI discomfort and psychopathology. For example, a child who experiences frequent nausea may experience a higher level of anxiety or depression. Avoidant and conduct behavior may also be impacted by nausea and other GI challenges (Leader et al., 2021).

There is a strong connection between gastrointestinal symptoms and ASD severity levels. Children with a higher level of severity have been found to experience more severe GI symptoms. Furthermore, GI disorders can contribute to behavioral

challenges. Self-injury, aggression, and other maladaptive behaviors are exacerbated in children experiencing GI discomfort (Al-Beltagi, 2021).

Feeding and Eating Challenges

Feeding difficulties including food avoidance and restrictive food intake are common in children with ASD. A research review found no indication of ASD severity level being associated with feeding challenges, demonstrating that these challenges appear to occur across levels of need (Baraskewich et al., 2021).

There are many components to feeding and eating challenges that are common with children with ASD. One of the core symptoms of ASD is an insistence on sameness. One way this sameness may be exhibited is through one's diet. Children with ASD may insist on the same few food items. Sensory processing oftentimes further compounds this challenge, making it difficult for caregivers to encourage consuming novel foods. Limited diets in turn may result in GI discomfort, another ASD comorbidity (Baraskewich et al., 2021).

Obesity

Childhood obesity has been known to increase the risks of adverse health effects such as diabetes and heart disease. Individuals with ASD have a higher risk of becoming obese than that of the general population. The reason for this appears to be multifaceted. Some of the key factors for this increased risk in those with ASD include eating rigidities and disorders, lifestyle differences, secondary comorbidities, and medication use (Dhaliwal et al., 2019).

Attention Deficit Hyperactivity Disorder (ADHD)

ADHD and ASD have been well established as common comorbidities, with an estimated 60% of children with ASD presenting symptoms that also qualify under ADHD criteria. This high degree of overlap may result in challenges with

differentiating between diagnoses and therefore properly diagnosing a child with ASD, ADHD, or both (Rau et al., 2020).

One article highlighted the differences between ASD and ADHD (Mayes et al., 2012). In this article, researchers suggest that ASD can be easily differentiated from ADHD based on the primary symptom profiles. The core symptoms of ADHD including inattention, impulsivity, and hyperactivity are all common in children with ASD. However, the core symptoms of ASD are less common in those with ADHD. Therefore, it is believed that some children are misdiagnosed with ADHD because of the pronounced symptom overlap while the ASD diagnosis is missed (Mayes et al., 2012).

Executive functioning skills, such as goal-directed behavior and organization, are commonly observed deficits in children diagnosed with ADHD. Children with comorbid ADHD and ASD are at a higher risk for deficits in executive functions (Lee et al., 2021).

Depression

There is a high rate of psychiatric comorbidities with ASD. Depression, a mood disorder characterized by persistent sadness and loss of interest, is one well-established comorbidity with ASD. It is difficult for researchers to precisely predict prevalence rates of psychiatric comorbidities due to a lack of validated measurement tools. The challenges that are expressed in ASD, such as communication deficits, may further hinder the ability to measure depression and other mental health disorders. Current estimates range widely from 2% to 30% of those with ASD experiencing comorbid depression (DeFilippis, 2018). Individuals with ASD are four times more likely to experience depression across their lifetime, as compared to their neurotypical counterparts (Hudson et al., 2019). Current research also shows that individuals with lower severity levels (i.e., severity level

1) have higher comorbid rates of depression than those who experience higher severity levels (DeFilippis, 2018).

Bipolar Disorder and Disruptive Mood Dysregulation Disorder (DMDD)

Bipolar disorder is a mood disorder characterized by recurring episodes of depression and mania. Current estimates show roughly 7% of individuals with ASD also suffer from bipolar disorder, representing a small minority of those with ASD (Skokauskas & Frodl, 2015).

Bipolar disorder has been a controversial diagnosis to make during childhood, making it relatively rare for clinicians to provide a bipolar diagnosis during childhood or adolescence. During the late 1990s and early 2000s, a significant increase in bipolar diagnoses was being made among minors. However, researchers and clinicians were finding variations in the presentation of adults with bipolar disorder and the presentation of children who were diagnosed with the same disorder. Emerging research supported the notion that a separate diagnosis may be necessary. As with autistic disorders prior to the DSM-V, diagnostic criteria for bipolar disorder in children were also quite limiting. As such, in the 2013 release of the DSM-V, a new childhood mood disorder was added, disruptive mood dysregulation disorder (DMDD). This disorder is characterized by severe recurrent temper outbursts which are not consistent with the child's developmental level. These temper outbursts must occur three or more times per week across the last year. Further, the child's mood between these outbursts is characterized by persistent irritability for the majority of the day (Masi & Gignac, 2016).

There is limited research on the exact prevalence of ASD and DMDD comorbidity. One study found 45% of those with ASD also exhibit symptoms of DMDD (Mayes

et al., 2015). Frequent behavioral outbursts are common in those with ASD, demonstrating a significant overlap in symptoms (Mayes et al., 2015).

Anxiety Disorders

Comorbid anxiety disorders appear in roughly 40% of individuals with ASD. Anxiety can exacerbate the core symptoms of ASD by increasing challenging behaviors, strengthening resistance to change, and increasing repetitive behaviors (Zaboski & Storch, 2018).

There are a number of anxiety disorders. Some of the most frequently occurring anxiety disorders include social anxiety disorder, generalized anxiety disorder, panic disorder, and obsessive-compulsive disorder (OCD). All of these anxiety disorders are identified as comorbidities with ASD (Bandelow et al., 2017).

Anxiety disorders in the general population are commonly underrecognized. There are many overlapping symptoms in anxiety and ASD, which may hinder the accurate diagnosis of one or the other diagnosis. This overlap has also made it challenging for researchers to precisely identify prevalence rates between ASD and anxiety. Repetitive behaviors, for example, may overlap with the compulsive behaviors observed in OCD. While similar in nature, compulsions and self-stimulatory repetitive behaviors are not one and the same (Zaboski & Storch, 2018).

Section 5 Personal Reflection

What effect can comorbidities have on the presentation of the symptoms of ASD?

Section 5 Key Words

Attention deficit hyperactivity disorder (ADHD) - A disorder characterized by inattention, hyperactivity, and impulsivity.

Anxiety disorder - A common comorbidity, affecting 40% of individuals with ASD. Anxiety is characterized by persistent and excessive feelings of worry.

Bipolar disorder - A mood disorder characterized by recurring episodes of depression and mania, affecting about 7% of those with ASD.

Comorbidity - The presence of additional diseases or disorders which coexist with another, primary disorder or disease.

Depression - A mood disorder characterized by persistent sadness and loss of interest. Depression affects those with ASD four times more than neurotypical peers.

Disruptive mood dysregulation disorder (DMDD) - A childhood mood disorder characterized by severe recurrent temper outbursts which are not consistent with the child's developmental level, as well as general irritability between outbursts.

Down syndrome - A genetic disorder characterized by physical growth delays and developmental and intellectual disabilities. 40% of those with Down syndrome also have ASD.

Epilepsy - A neurological condition that results in abnormal brain activity, causing seizures or other periods of unusual behavior.

Executive functioning skills - Skills required for everyday tasks such as planning, organization, self-control, task initiation, and time management.

Fragile X syndrome - A genetic disorder that can result in inherited intellectual disability and autism.

Gastrointestinal (GI) disorders - A group of disorders related to the gastrointestinal system. Symptoms include chronic diarrhea and/or vomiting, reflux, food intolerance, ulcers, and others.

Genetic disorders - Disorders resulting from inherited genome abnormalities. Down syndrome and fragile X syndrome are common comorbid genetic disorders associated with ASD.

Intellectual disability (ID) - A comorbid condition that is present in 65-75% of individuals with ASD. ID results in deficits in intellectual functioning and adaptive functioning.

Obsessive-compulsive disorder (OCD) - An anxiety disorder characterized by intrusive thoughts or fears, which result in compulsions. Repetitive behaviors observed in those with autism often overlap with symptoms of OCD.

Sleep disturbances - A label that covers a broad range of sleep-related symptoms and disorders.

Section 6: Treatments for ASD

ASD is considered a lifetime disorder, affecting an individual throughout their lifespan. As such, there is no cure for ASD. There is, however, a wide range of treatments currently available to treat both the core symptoms of ASD as well as comorbid diagnoses. While ABA is commonly considered the "gold standard of care," there are many other potential treatments that may be used in conjunction with ABA or on their own. With ASD having a wide spectrum of manifestation of symptoms, treatment is individualized to the unique needs of each individual.

This section will review the research on treatment modalities for ASD. This is a general overview of many of the commonly used treatments. It is important to remember that many of these are not within the scope of behavior analysis. However, it is beneficial to understand the other methods used, including their benefits, drawbacks, and how they may relate to other treatments.

A 2016 National Survey of Children's Health looked at the most commonly used treatments for children with ASD. The study surveyed the caregivers of 43,032 United States children between the ages of three and seventeen. Of these 2.6%, or 1,115 children were diagnosed with ASD. The survey results showed that 43.3% of the families surveyed received behavioral treatment only. 6.9% of those surveyed reported that they used pharmaceutical treatment only. 20.3% of families reported using a combination of behavioral and pharmaceutical treatments. A further 29.5% of respondents reported using neither behavioral nor medication treatments. These findings add many questions regarding the current use of treatments for addressing the symptoms of ASD. When roughly 30% of children with ASD are not receiving behavioral or pharmaceutical treatments, there is a concern as to whether families are accessing the individualized care that they need. The study was limited, however, in that it only assessed for behavioral and medication treatment. They also did not differentiate between the types of behavioral treatment (i.e., CBT, ABA) (Xu et al., 2018).

Applied Behavior Analysis (ABA)

ABA is often considered synonymous with ASD, as the primary treatment mode used with individuals with ASD. The primary population that the ABA field works with is children with ASD. Around 71% of BCBA® s work with autistic children, representing a large majority of the field (BACB, 2022). A large body of research has been developed over the last several decades on the effectiveness of ABA, in general, and with the autism population. ABA is an ever-evolving field, with research continuing to demonstrate its efficacy (Roane et al., 2016).

ABA is the application of the science of behaviorism with human subjects. The goal of ABA is to modify socially significant behaviors. The early model of ABA was the early intensive behavioral intervention (EIBI), as developed by Ivar Lovaas, heavily based on discrete training (DTT). Since then, many new ABA models have

been researched and developed. Early Start Denver Model (ESDM), Pivotal Response Training (PRT), verbal behavior approach and natural language paradigm (NLP) are a few of the well-known and implemented offsets of ABA (Roane et al., 2016).

The principles of behavior are quite versatile. They can be applied in many different formats, for different skills, and with various populations. While discrete trial training (DTT) is often beneficial for the development of specific skills such as pre-academics, naturalistic and development-based models are often more beneficial for developing an early mand repertoire. This versatility and individualization have made ABA therapy a commonly recommended treatment for children with ASD (Roane et al., 2016).

A meta-analysis was conducted on the effectiveness of ABA for children with ASD (Makrygianni et al., 2018). The findings of the analysis demonstrated high effectiveness in the use of ABA for improving intellectual functioning. A moderate to high effectiveness was observed in the area of improved expressive and receptive communication skills. The analysis further demonstrated moderate effectiveness in improving adaptive behaviors and social skills. Low effectiveness was identified in improving activities of daily living. Prior to the 2018 meta-analytic study, nine meta-analyses were conducted and published between 2009 and 2012 each finding moderate to high effectiveness of ABA interventions for the treatment of symptoms of ASD (Makrygianni et al, 2018).

ABA therapy utilizes a number of evidence-based practices. These include DTT, differential reinforcement, antecedent-based interventions, naturalistic interventions, pivotal response training, prompting, social skills training, and task analyses among others (The National Clearinghouse on Autism Evidence and Practice, 2020).

Cognitive Behavioral Therapy (CBT)

Anxiety is a frequently occurring comorbidity with ASD, with an estimated 40% of individuals with ASD experiencing one or more anxiety disorders. This is more than double the rate of the general public. It is estimated that 19% of the general adult population in the US experiences an anxiety disorder (National Institute of Mental Health, 2017).

Comorbid anxiety may exacerbate the symptoms of ASD such as increased repetitive behaviors, rigidity in routines, and reduced social interactions. ASD with comorbid anxiety may also further aggravate other common comorbidities. For example, a child with ASD who also has comorbid anxiety may experience more severe sleep disturbances. With all of this, beyond treating the core symptoms of ASD, it is beneficial for anxiety to be treated in those with comorbid anxiety (Zaboski & Storch, 2018).

Cognitive behavioral therapy (CBT) is a treatment used to reduce the symptoms of depression, anxiety, and other mental health challenges. With the significant overlap between ASD and anxiety and depression, a growing body of research has delved into the efficacy of CBT with children and adults with ASD. CBT is a combination of cognitive and behavioral therapies with the goal of both modifying thoughts and behaviors. Several studies have been published which demonstrate positive outcomes on anxiety symptoms in individuals with ASD. Because of the unique communication challenges experienced by individuals with ASD, cognitive behavioral therapy in its primary form is less successful. Instead, modifications are often made including modification of session structure, visual cues, and caregiver involvement (Kaniturk Kose et al., 2018).

CBT efficacy on the symptoms of anxiety as a comorbid diagnosis of ASD has yet to be conclusively established. A meta-analysis identified eleven studies that addressed the effectiveness of CBT with ASD/OCD comorbidities (Kaniturk Kose et

al., 2018). With the limited number of studies demonstrating experimental control, the researchers were unable to make any conclusions as to the efficacy. However, all of the studies analyzed did present promising information regarding the effectiveness of CBT. As such, additional research is necessary to further determine CBT's effectiveness with this population (Kaniturk Kose et al., 2018).

CBT is considered a type of talk therapy. With roughly 40% of the autistic population being nonverbal, this presents particular challenges in applying this treatment to children with ASD. While nonverbal does not mean one cannot communicate, the communication skills necessary to see beneficial results in CBT may not be present in many individuals with ASD and other intellectual disabilities. In fact, authors in the meta-analysis found that all of the participants in the CBT studies that were analyzed had low severity ratings of the core symptoms of ASD (Kaniturk Kose et al., 2018).. Each also had an IQ above 69. Research on CBT with ASD level 2 or 3 severity ratings is noticeably underrepresented in the literature. Nonetheless, the existing research shows a potential benefit of CBT on anxiety as an ASD comorbidity when conducted with individuals with low severity (Kaniturk Kose et al., 2018).

Speech and Language Therapy

For individuals experiencing articulation disorders, fluency of speech challenges, receptive or expressive language delays, aphasia, or other speech and language-related disorders, speech therapy is a common therapeutic approach. Individuals with ASD commonly experience social communication challenges, making speech and language therapy a common treatment to address communication skills (Informed Health, 2020).

It is estimated, based on a survey of speech and language pathologists (SLPs), that 16% of patients receiving speech therapy have an ASD diagnosis (Hsieh et al., 2018). Speech therapy can be beneficial to address errors in communication which

speech-language pathologists have extensive knowledge of (Hsieh et al., 2018). For example, one language disorder, aphasia, results in challenges with understanding, speaking, reading, or writing. Aphasia is comorbid with ASD in around 8-11% of ASD cases. Aphasia is one area that speech and language pathologists may be best equipped to intervene in. However, the rigidities and behavioral challenges commonly associated with ASD may make speech therapy a challenge. As such, a combination of speech and behavioral therapy is often recommended, as opposed to speech therapy alone when addressing communication challenges (Karanth, 2020).

Evidence-based interventions used in speech therapy include practices such as Augmentative and Alternative Communication (AAC), prompting, reinforcement, incidental teaching, FCT, visual supports, and modeling (Hsieh et al., 2018). The goals of speech therapy are individualized, based on the child's needs, and identified via a speech and language assessment process. Language disorders, speech disorders, and swallowing challenges all may be addressed via speech and language therapy (Informed Health, 2020).

Occupational Therapy (OT)

Occupational therapists commonly provide treatment to children with ASD. The DSM-V included sensory challenges in its diagnostic criteria of ASD. With this, came an increased focus on OT's role in the treatment of ASD symptoms (Miller Kuhaneck & Watling, 2015).

OT encompasses a broad scope of treatment, with methods used to address everyday activities one would engage in at work, school, home, and/or in social settings. OT provides support to improve one's ability to engage in activities of daily living (Miller Kuhaneck & Watling, 2015).

One area of reported benefit of OT is the focus on sensory processing and other sensory-related challenges. One of the four functions of behavior is automatic reinforcement. Occupational therapists can be of support in teaching body and emotional regulation, specifically for those behaviors that are automatically reinforced (Miller Kuhaneck & Watling, 2015).

OT goals may include activities related to daily living such as toilet training, brushing teeth, or other hygiene or self-care activities. Fine motor skills are another common area addressed through OT. Other skills addressed include visual perceptual skills, play, problem-solving, and body awareness. OT practices often contain a variety of activities including physical activities, play, developmental activities, and adaptive strategies (AOTA, 2018).

Music Therapy

Music therapy is a systematic treatment process wherein a board certified music therapist addresses treatment goals through musical experiences. The goals of music therapy are individualized based on the needs of each child. However, improving social interactions, increasing adaptive behaviors, and improving speech are common goal domains in music therapy. A meta-analysis on the efficacy of music therapy for children with ASD found significant improvements in social reactions; however, their analyses did not show improvement in social adaptive behaviors or speech development (Ke et al., 2022).

One of the most common methods of music therapy for children with ASD is Improvisational Music Therapy (IMT). Through this mode, the therapist and child each play musical instruments, expressing various rhythms, patterns, and timbres. In this manner, the therapist addresses skills such as imitation skills, joint attention, and turn-taking. A meta-analysis on IMT with children diagnosed with ASD showed participants improved joint attention and social engagement in response to this therapeutic approach (Marquez-Garcia et al., 2019). Studies also

demonstrated reduced stress levels, improved self-esteem, a reduction in anxiety symptoms, and nonverbal communication skill development (Marquez-Garcia et al., 2019). Some studies have, however, reported limited to no improvement in ASD symptom severity based on ADOS scores pre and post-intervention. One study with the largest sample size and highest methodological quality revealed no significant difference in the severity of ASD core symptoms following five months of music therapy intervention (Bieleninik et al., 2017)

Medication

At the present time, there are no U.S Food and Drug Administration (FDA)-approved medications to directly treat the symptoms of ASD. However, there is a significant body of research that has delved into the potential benefits particular medications have on the symptoms of ASD, as well as the comorbid symptoms. As such, it is common for children with ASD to be prescribed medications including antipsychotics, antidepressants, and mood stabilizers, among others. The FDA has approved certain antipsychotic medications including risperidone and aripiprazole to treat irritability commonly associated with ASD (Wink et al., 2017).

With a high level of medical and mental health comorbidities in children with ASD, medications are often considered a component of one's treatment plan, whether to treat core symptoms or symptoms relating to comorbidities that may be exacerbated with ASD symptoms (Wink et al., 2017).

Anti-inflammatory Medications

Immune dysfunction and an abnormal immune response are common in those with ASD, as reviewed in the comorbidities section. There is some evidence to suggest a link in focal brain inflammation in those with ASD (Hafizi et al., 2019). As such, anti-inflammatory drugs have been one area of interest in the pharmacological treatment of ASD (Hafizi et al., 2019).

A 2019 meta-analysis on anti-inflammatory medications to treat ASD found limited evidence to support any improvement in core symptoms of ASD, in response to anti-inflammatory medications (Hafizi et al., 2019). The research review did, however, find potential benefits of certain anti-inflammatory medications in the reduction of maladaptive behaviors and irritability. The medications that were found to be effective in behavior management include amantadine, celecoxib, galantamine, N-acetylcysteine, palmitoylethanolamide, pentoxifylline, pioglitazone, riluzole, and topiramate. It was noted in the literature review that the research into anti-inflammatories for ASD is much in its infancy, with much of the research being inconclusive. Most of the studies analyzed in the meta-analysis lacked scientific control. Further research is needed to clarify what benefits, if any, anti-inflammatory pharmaceuticals may benefit children with ASD (Hafizi et al., 2019).

Antiepileptics

Epilepsy is another common comorbidity with ASD. As such, many of those with ASD are prescribed antiepileptics to prevent seizure activity. However, some research has supported the use of antiepileptic drugs for aggression and impulsivity. The research is largely inconclusive at this time. The main studies which showed benefits in the use of antiepileptics were used in combination with antipsychotics (Hirota et al., 2014).

Sleep-supporting Medications

With sleep disorders affecting a large portion of the ASD population, pharmaceutical and over the counter supplements are often considered for children with ASD-related sleep challenges. Melatonin is one of the most well-known non-prescription supplements. Melatonin is a hormone naturally produced in the pineal gland. For those who struggle to fall asleep, melatonin supplements are often tried as a natural solution. Melatonin is believed to be a generally safe

and effective supplement for reducing the time it takes one to fall asleep. An obvious downside to melatonin is that it does not have any effect on a child's ability to stay asleep. For children who struggle to stay asleep throughout the night or have other sleep-related disorders, melatonin may have minimal to no benefits (Relia & Ekambaram, 2018).

There are a number of other medications and supplements used to address sleep difficulties in children with ASD. These range from supplements such as iron to antipsychotics and even Alzheimer's medications. Post-mortem brain studies have shown similar abnormalities in the brains of those with Alzheimer's disease and those with ASD (Relia & Ekambaram, 2018). This has led to an interest in treating the symptoms of ASD in a similar manner as the symptoms of Alzheimer's disease. Donepezil, a medication used to treat Alzheimer's, has been found to be effective in improving both behavioral challenges and attention deficits in those with ASD. Donepezil has also been found to be effective in increasing REM sleep duration and decreasing the latency of REM sleep (Relia & Ekambaram, 2018).

Antipsychotic Medications

Antipsychotics are a class of medications used to treat schizophrenia, psychosis, bipolar disorder, depression, and Alzheimer's disease. The FDA has approved two antipsychotic medications to treat irritability associated with ASD. Risperidone and aripiprazole (Abilify) are the two approved as of the present time.

While research provides promising information in regard to the use of antipsychotics for treating ASD, there are major downsides to the use of antipsychotics. Antipsychotics run a significant risk of negative side effects. Common unwanted side effects of antipsychotic medications include weight gain, anxiety, and fatigue (D'Alo et al., 2021).

Stimulant Medications

Stimulants are a class of medications that work by increasing activity in the central nervous system. Stimulants are commonly prescribed to increase attention and reduce hyperactivity, most commonly in individuals with ADHD. As ADHD is a highly co occurring disorder with ASD as they have symptoms that overlap, researchers have sought to determine whether stimulants can also be beneficial for individuals with ASD, whether with or without comorbid ADHD. Stimulants for those with ASD are most commonly prescribed to manage irritability, similar to antipsychotics' primary use.

Section 6 Personal Reflection

How might a multidisciplinary approach to treatment result in the best possible outcomes for children with ASD? Consider the multifaceted symptomatology and comorbidities that come along with ASD. How might multidisciplinary approaches result in barriers to treatment? Reflect on professional and ethical manners of addressing this type of barrier to treatment.

Section 6 Key Words

Alzheimer's disease - A type of dementia that affects one's memory, thinking, and patterns of behavior. Post-mortem brain scans have shown similar results in those with ASD and those with Alzheimer's.

Antidepressant - A class of drugs used to treat depression, anxiety, and other mental health challenges.

Anti-inflammatory medication - A class of drugs used to treat or reduce inflammation or swelling. Anti-inflammatories are sometimes used to treat brain inflammation in those with autism.

Antipsychotic medication - A class of medications used to treat symptoms of schizophrenia, mania, dementia, and personality disorders. Two antipsychotics are also FDA-approved to treat irritability associated with ASD.

Aphasia - A communication disorder characterized by challenges with understanding, speaking, reading, or writing.

Applied behavior analysis (ABA) - A therapeutic approach to modifying behaviors, based on the science of behaviorism.

Aripiprazole (Abilify) - An antipsychotic medication that is FDA approved to treat irritability that is common in those with ASD diagnosis.

Board certified music therapist - A certified professional who specializes in the application of music therapy.

Cognitive behavioral therapy (CBT) - A treatment method based on both cognitive therapy and behavioral therapy, most commonly used to treat the symptoms of anxiety and depression.

Discrete trial training (DTT) - A method of teaching new skills used in ABA. Each learning opportunity is presented with a clear start and ending. DTT uses a three term contingency of SD→Response→Consequence.

Melatonin - A hormone produced in the pineal gland. Melatonin supplements increase the hormone in an individual's body, resulting in a faster ability to fall asleep.

Music therapy - A treatment provided by a board certified music therapist, where treatment goals are addressed via musical experiences.

Occupational therapist - Certified professionals, trained in the implementation of occupational therapy.

Occupational therapy - A broad scope of treatment to address activities of daily living related to one's home, work, or leisure skills.

Risperidone - An antipsychotic that is FDA-approved to treat comorbid irritability in individuals with ASD.

Stimulant - A class of drugs that aim to increase attention and reduce hyperactivity by increasing activity in the central nervous system.

Speech and language pathologist (SLP) - Certified practitioners who evaluate for speech, language, and swallowing disorders, and subsequently implement treatment goals to address speech and language challenges.

Speech and language therapy - Treatment for various speech and language-related disorders such as aphasia, receptive or expressive language delays, and articulation disorders.

Section 7: ASD Prevalence

The prevalence of ASD has varied significantly since its conception in the 1940s. As previously mentioned, autism was originally thought to be quite rare. At the time, autism was first conceptualized as a developmental disorder. Researchers estimated it to affect only three to seven children in every ten thousand children. As advances in research developed, as well as a better understanding of how to diagnose autism with clearer diagnostic criteria, prevalence rates increased drastically. The most recent research has shown an overall prevalence of about one in forty-four individuals. This prevalence rate specifically looks at children at eight years of age. This is because a vast majority of individuals who are diagnosed with ASD receive a diagnosis by this age. Additionally, when looking at adults, the prevalence rate is lower, as many adults who may have ASD were not diagnosed as children due to challenges in diagnostic criteria at the time or a general lack of

awareness and understanding of autism. An increasing number of adults have sought ASD diagnoses in recent years, as a result of increased awareness and diagnostic criteria shifting (CDC, 2022).

At the turn of the century in the year 2000, autism was estimated to have a prevalence of 1 in 150 children. By the time the 5th edition of the DSM was released in 2013, that estimate shifted dramatically to 1 in 69 children. The most recent estimate was released by the CDC in 2018, with a prevalence rate of 1 in 44 (CDC, 2022).

Significant increases in prevalence may be alarming to some, particularly due to concerns of environmental factors at play. While it is not possible to definitively state that this is not the case at the present time, as discussed in section four, research has leaned more toward genetic heritability as opposed to environmental toxins causing ASD (Chaste & Leboyer, 2022). As such, many have speculated as to whether ASD rates are truly increasing or if improved diagnostic practices have resulted in more individuals being diagnosed. As discussed in section 1, the diagnostic criteria has shifted considerably over the last several decades, since the disorder was first identified. It is clear, based on the evolving diagnostic criteria, that many individuals who would qualify for an ASD diagnosis today, would not have qualified even just 15 or 20 years ago, much less 42 years ago when autism was first included in the DSM. The DSM-III's diagnostic criteria was very limiting, resulting in those who might have been diagnosed with ASD as we know it today, not receiving a diagnosis at the time (Chaste & Leboyer, 2022).

One challenge in estimating prevalence rates and in particular, comparing them to previous years, is that many of the studies looking at prevalence are not comparable in either the methods used or the populations observed. However, it is most likely that the increased rates of ASD diagnoses are due to both improved

diagnostic criteria and a general increased awareness of and education on ASD (Chaste & Leboyer, 2022).

Since the earlier identification of autism, one thing was evident. ASD diagnosis occurs at significantly higher rates in males than females. The most recent research indicates that boys are 4.2 times more likely to receive an ASD diagnosis than females (CDC, 2021). As of the present time, it is not clearly understood why. One hypothesis is that the sex chromosome is involved in the development of ASD. Hormonal influences in utero are also thought to have an impact (Chaste & Leboyer, 2022). Neither of these theories have been well established as of yet. A bias toward males is similarly common in those with other neurodevelopmental disorders such as ADHD, dyslexia, conduct disorder, and Tourette syndrome. However, this bias toward males has a more pronounced presentation in ASD (Baron-Cohen, 2011).

Another potential reason for the discrepancy between ASD in males and in females is that females may be better able to conform to social expectations, or "mask" the symptoms of ASD (Cage & Troxell-Whitman, 2019). Research is also focusing on whether the diagnostic tools for assessing ASD are able to detect subtle ways in which autistic symptoms may present in females (Baron-Cohen, 2011).

One study conducted found a lower male to female ratio in adults than in children (Posserud, 2021). These findings appear to suggest that ASD does in fact present differently in males and females. It is possible that the high male to female ratio in childhood is due to females obtaining a diagnosis later in life, thus reducing the overall ratio. (Posserud, 2021)

Section 7 Personal Reflection

How might you respond to caregivers or other professionals inquiring about concerns they have in regard to the increasing rates of ASD?

Section 7 Key Words

Male bias - The term used to describe the increased prevalence of a particular disorder in males, as compared to females.

Prevalence - The proportion of a given population who experience the same condition, symptom, or characteristic.

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