



**UNIVERSITY OF PADOVA**

**Department of Developmental Psychology and Socialization**

**Master's degree in Developmental and Educational Psychology**

**Final dissertation**

**The Dimensional VS Categorical Nature of Autistic Spectrum Disorder: Theoretical Considerations and A Systematic Review of Taxometric Analyses**

*Supervisor Dr Enrico Toffalini*

*Co-supervisor Dr Ambra Perugini*

*Candidate: Athanasia Vasileiadou*

*Student ID number: 2089679*

Academic Year 2024/2025

# **The Dimensional VS Categorical Nature of Autistic Spectrum Disorder: Theoretical Considerations and A Systematic Review of Taxometric Analyses**

Athanasia Vasileiadou

Department of Psychology

University of Padua

Master's degree in Developmental and Educational Psychology

Thesis advisor: Dr Enrico Toffalini

October 2024

## **Abstract**

The thesis takes a theoretical approach to one of the timeliest empirical controversies in Psychopathology, reviewing the question of whether Autism Spectrum Disorder (ASD) ought to be understood categorically or dimensionally through an analysis of every taxometric study yet published on ASD. Throughout history, ASD has always been conceptualized in two main ways, that is using the categorical approach which recognizes individuals either with or without ASD and the dimensional perspective which views autism spectrum traits on a continuum. These views are evaluated critically in this thesis through an examination of taxometric analyses and statistical techniques that differentiate categorical and dimensional constructs. Questioning whether ASD should be considered a spectrum of traits which present in different ways, or as a distinct condition. This shift is then debated as to its relevance for diagnosis, treatment, and research, indicating that an approach to the deeper understanding of the neurodevelopmental condition could enable more of a synthesis between categorical and dimensional approaches.

**Key words:** Autism Spectrum Disorder (ASD), Taxometric Analysis, Dimensional Approach, Transdiagnostic Approach, Systematic Review

## Table of Contents

<b>Introduction.....</b>	<b>4</b>
• Historical & Theoretical Background of ASD.....	5
• Development of Diagnostic Criteria and the Spectrum Concept.....	6
• Dimensional Framework & Broader Debate.....	8
• Taxometric Methods and Their Importance in ASD Research.....	10
• Transdiagnostic View in Neurodevelopmental Research.....	11
• Current Study.....	12
<b>Methods.....</b>	<b>14</b>
• Literature Search.....	14
• Data Extraction and Coding.....	17
• Coding Process.....	18
• Bias Considerations in Coding.....	18
• Summary of Records in the Qualitative Synthesis.....	19
<b>Results.....</b>	<b>21</b>
• Summary of Main Findings.....	21

<b>Discussion.....</b>	<b>25</b>
• Interpretation of Findings.....	25
• The Promise of Taxometric Analysis.....	26
• Implications for Diagnosis and Treatment.....	28
• Limitations and Bias in the Studies Reviewed.....	30
• Broad Utility of Categorical Approaches.....	32
• Future Research Directions.....	34
• Broader Context.....	36
<b>Conclusion.....</b>	<b>38</b>
<b>References.....</b>	<b>40</b>

## **Introduction**

Autism Spectrum Disorder, also known as ASD, is a neurodevelopmental disorder that impairs communication and social interaction and results in repetitive or limited behavior. The classification of ASD has evolved dramatically from its initial description, reflecting broader conceptual frameworks for neurodevelopmental disorders. Leo Kanner first described autism in 1943, under the impression that it was an uncommon form of childhood-onset psychosis. Kanner (1943) termed it "autistic aloneness," emphasizing profound social withdrawal and an "insistence on sameness." Around the same time in Austria, Hans Asperger described a group of children who displayed some symptoms associated with autism, such as a lack of non-verbal communication skills and social ineptness, but who nonetheless had functional language capabilities and normal or even high IQs. Early research led to the recognition of distinct types of autism, originally called Asperger's Syndrome. Nonetheless, until there was greater public knowledge and understanding of what autism actually is, most believed child schizophrenia was a type of autism.

It was only in 1980 that autism developed a very different clinical definition as the DSM-III (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition) recognized autism separately from Pervasive Developmental Disorders (PDDs). In the ensuing years, clinicians and researchers came to agree that autism is a spectrum disorder with symptoms of varying severity across a plethora of people. This form was solidified with the 2013 release of DSM-5, which absorbed previously distinct types like Asperger's Syndrome and PDD-NOS (Pervasive Developmental Disorder-Not Otherwise Specified) into one collective Autism Spectrum Disorder basket, moving away from an outdated model. This transition to a spectrum reflected an increased understanding of autism as a diverse condition with wide symptom diversity.

## **Historical & Theoretical Background of ASD**

The early clinical history of ASD classification assumed that the syndrome was a rare, severe, and distinct phenomenon. As views of autism began to shift, milder forms of the disorder, particularly Asperger's Syndrome, were recognized, and we gradually came to understand that Autism Spectrum Disorder (ASD) might not look the same in every person. Subsequent definitions, informed by advances in genetics, neuroscience, and developmental psychology, converge on the idea that autism is not a single condition but a spectrum of neurodevelopmental differences varying in intensity and impact.

Back in the early 1940s, two researchers, Kanner (1943) and Asperger (1944), offered foundational descriptions that shaped the way autism was viewed. Kanner's work focused on individuals showing intense social withdrawal and communication challenges, setting the tone for understanding autism as a distinct clinical condition. Asperger, however, highlighted a different group—individuals with autistic traits who also had average or higher cognitive abilities. This difference in early descriptions paved the way for deeper exploration into the diverse presentations of autism.

Even with these advances, there's still a debate on how to best classify ASD both clinically and theoretically. Should autism be understood as a set category, or is it more accurate to see it as a range of traits that vary in intensity? This question isn't just academic; it influences everything from diagnosis and treatment to how society views autism.

The spectrum model takes the view that ASD isn't a standalone condition, clearly separated from typical neurodevelopment. Instead, it suggests that autism exists along a continuum, blending into broader patterns of development without sharp diagnostic boundaries. This model works off the assumption that people with ASD are fundamentally and qualitatively different from non-autistic individuals.

In contrast, the dimensional model argues that "ASD traits"—such as social communication problems, restricted interests, and repetitive behaviors—are continuously distributed quantitative characteristics present to some extent in all individuals, falling along a severity dimension that includes those not meeting full diagnostic criteria.

The dimensional model of autism aligns well with the broad autism phenotype concept, which suggests that traits associated with ASD can vary along a continuum within the general population (Bralten et al., 2017). This perspective finds additional support in recent research developments, which show that genetic factors linked to autism-related traits, especially those on the milder side, are not exclusive to people with an ASD diagnosis. Autism traits don't just belong to those with a clinical diagnosis. Research shows these characteristics actually spread across a spectrum, meaning people in general might share some traits associated with autism to different extents. Researchers highlighted this insight, suggesting these traits might be more common across the population than once thought (Constantino & Todd, 2003). This approach opens up a fresh perspective—viewing autism through a flexible lens that combines set categories with a dimensional view, allowing for a fuller, more nuanced understanding of autism.

This debate over how to classify ASD has important real-world implications. A categorical approach can make diagnosis and service access clearer for those who meet certain criteria. On the other hand, a dimensional model fosters an inclusive perspective, acknowledging individuals with various levels of autistic traits even if they don't fully meet diagnostic benchmarks.

As research keeps advancing, taxometric methods will be key to uncovering autism's underlying structure. These methods could help clarify autism's nature, guiding policies, clinical practices, and interventions that effectively support those on different parts of the spectrum.

### **Development of Diagnostic Criteria and the Spectrum Concept**

Autism's understanding and diagnosis have evolved significantly over the years, particularly since the early insights from Kanner and Asperger. In 1980, the DSM-III marked a notable shift by establishing autism as a unique diagnosis rather than confusing it with schizophrenia, a frequent misclassification in earlier frameworks. This move framed autism under a new category known as Pervasive Developmental Disorders (PDDs), concentrating on challenges in social interaction, communication, and restrictive patterns of behavior (Coghill & Sonuga-Barke, 2012).

The DSM-III reorganized autism criteria with a focus on clear, observable behaviors in those receiving the diagnosis. This shift brought consistency but couldn't quite reflect the full spectrum

of autism. Introducing Pervasive Developmental Disorders (PDDs) was a meaningful move towards embracing autism's complexity, yet it also showed that autism doesn't fit neatly into straightforward categories. People with autism often show a wide range of strengths and difficulties that go beyond these initial definitions, underscoring the need for evolving criteria that can better capture the entire spectrum.

When the DSM-IV came out in 1994, it took a different view of autism by including subcategories like Asperger's Syndrome and PDD-NOS (Pervasive Developmental Disorder – Not Otherwise Specified) within its definition of autism so that the diagnostic criteria were more inclusive about autistic traits, rather than prescribing narrow criteria based on cognition level alone. This update was in recognition that the presentation of autism could be very different across individuals, with some people needing little or no support while others needed significant levels (Happé & Frith, 2020). That sense of space is useful in understanding the broader field, but ultimately it has also served to contribute towards a much-needed move away from an overly unified concept (a singular autism) which was promoted by DSM-IV by sectioning off subtypes and breaking down the diagnosis into individual components, there now existed a more flexible concept.

Yet, as useful tools for further defining autism subtypes, they also created some confusion. For example, individuals who were diagnosed with Asperger's Syndrome frequently had difficulties in social interactions, yet they did not have the language delays that are usually affiliated with classic autism. This mainly limited access to appropriate support and services. Ultimately, it became recognized amongst families and clinicians that an adequate framework for autism had to be more generalized — many times the distinction between one subtype of this disorder or another was fairly arbitrary in observation since individuals typically exhibited traits from multiple subtypes.

In 2013, the DSM-5 redefined autism yet again, integrating the previous subtypes under a single, inclusive label: Autism Spectrum Disorder (ASD). This change reflected a growing awareness of autism's diverse presentations, capturing the condition's spectrum nature. By shifting from subtype distinctions to a broader spectrum, DSM-5 emphasized the common themes in autism—such as social and communication difficulties and repetitive behaviors—while also recognizing individual differences (Fletcher-Watson, 2023).

The DSM-5's approach marked a significant paradigm shift, advocating for a holistic view of autism that acknowledges the full range of neurodevelopmental experiences. It allowed for a more flexible understanding of autism, accommodating individuals who may have previously fallen outside the diagnostic criteria due to their atypical presentations. This integrative approach is further reinforced by the International Classification of Diseases (ICD-11), which followed a similar model, adopting the spectrum concept to represent autism's varied symptoms and intensity (Astle et al., 2021).

These changes in diagnostic criteria have increased autism diagnoses, acknowledging less typical presentations and bringing attention to the wide range of functioning levels within the autism community. The broadening of autism's scope has sparked ongoing discussions about whether autism should be seen as a distinct category or as a dimensional trait that varies within the general population.

### **Dimensional Framework & Broader Debate**

The question of how to classify Autism Spectrum Disorder (ASD) is a big topic in psychology right now. Some believe autism should be seen as a spectrum, with traits that range in intensity and can show up to some extent in anyone. This dimensional view suggests that traits tied to autism (i.e. social struggles, repetitive actions, or strong, specific interests) do not just appear in people with an ASD diagnosis but can be found across the board, even in neurotypical individuals. For example, Constantino and Todd (2003) introduced the idea of a "broader autism phenotype." They suggested that relatives of people with autism, and sometimes even others in the general population, might display these traits, though in a milder way. This finding supports the idea that autism exists on a continuum, rather than as a strict "yes-or-no" condition.

Research in neurodevelopment backs up this idea, showing that genetics, environment, and biology all influence autism traits. Some of these factors are also present in typical development. A study by Bralten et al. (2017) found that genetic links to autism can overlap with those affecting regular growth, suggesting autism traits fit into a wider spectrum of human traits.

Others, however, see autism as its own unique condition. They argue that autistic traits aren't just extreme versions of everyday behaviors but unique clusters that do not appear in typical development. This categorical view is supported by studies that identify autism as a specific set of characteristics. Haslam and colleagues (2020) conducted a meta-analysis showing that people with autism have unique patterns that don't simply mirror neurotypical behaviors.

Deciding whether ASD is best understood as a spectrum, or a specific category impacts several areas:

- **More Accurate Diagnoses:** A clear approach can help identify people who might not fully meet current criteria but still need support.
- **Better Support:** Viewing autism as a spectrum could lead to more personalized interventions that fit each person's unique traits.
- **Resource Allocation:** Recognizing autism's range could help direct resources toward those who need them, even if they don't meet strict diagnostic requirements.
- **Guided Research:** A clear understanding of autism's place within human traits can shape research on its causes and its connection to other conditions.

This discussion is also happening as part of a broad re-framing on understanding neurodiversity. The neurodiversity movement is a social movement which claims that autism and other neurological differences are natural parts of human variation; different ways we think, not traits needing to be cured or fixed. Fletcher-Watson (2023) notes that this approach challenges the "medical model," an older way in which autism, ADHD, or dyslexia generally are seen as problematic conditions that need to be cured.

As research advances, a synthesis of both may produce the most comprehensive view of autism. By balancing the specific and communal elements within autism, it might be possible to create a broader yet more respectful representation of the spectrum.

## **Taxometric Methods & their Importance in ASD Research**

Taxometric methods help researchers decide if Autism Spectrum Disorder (ASD) is better understood as its own category or as part of a spectrum of traits. These techniques are important in autism research because they allow scientists to examine whether autism stands out as a distinct condition or if its traits flow along a continuous line with other neurodevelopmental differences.

In the field of autism research, methods like Maximum Likelihood Taxometrics, Latent Variable Models, and more recently CFA (Confirmatory Factor Analysis) along with taxometric analysis of variance are key to revealing how differences in individual expression translate into common underlying structures. These approaches permit researchers to identify whether autism-related traits naturally merge into discrete categories or lay along a continuum. Haslam et al. (2020) approached autism traits from a Maximum Likelihood Taxometrics view, looking at latent factors to decide whether the features of autism should be seen as categories in conditions or along different severities. Taxometric Analysis of Variance tests for differences between autistic and non-autistic groups in the traits, whereas Latent Variable Models determine patterns among the items.

These methods have provided valuable insights. In one study, Frazier et al. (2023) found that autism might be best understood as a unique category, which supports the need for clear diagnostic criteria.

Understanding the structure of autism has real benefits:

- **Clearer Diagnoses:** It helps define autism's boundaries, aiding in accurate identification for those who may not fit current categories but still need support.
- **Tailored Support:** Knowing if autism traits are grouped or on a spectrum can lead to more personalized treatment plans.
- **Trustworthy Research:** These methods ensure that research findings reflect autism's true nature.

- **Resource Allocation:** Policymakers can use these insights to provide support and resources for the diverse needs within the autism community.

Taxometric methods play a key role in moving autism research forward. They help bring clarity to autism's diagnosis and treatment, with real effects on support and resources.

These analyses also help us understand autism's relationship with other neurodevelopmental conditions, like ADHD and dyslexia. By using these tools across different groups, researchers can explore how these conditions overlap or differ, which deepens our knowledge of neurodiversity.

Overall, taxometric methods are essential tools in autism research, offering insights into autism's structure and guiding studies that focus on effective, individualized support for people with autism.

### **Transdiagnostic View in Neurodevelopmental Research**

In recent years, the transdiagnostic approach has really started reshaping neurodevelopmental research. Researchers are discovering that traits in conditions like autism (ASD) and ADHD do not always stay within neat boundaries; instead, these characteristics often overlap. Moving beyond rigid diagnostic labels, this approach examines traits that show up across multiple conditions, helping scientists get a fuller picture of neurodevelopment as a whole. Shifting to a dimensional perspective offers a clearer view of the spectrum and the connections within it.

Happé and Frith (2020) make a good point by noting that social communication and executive functioning struggles aren't limited to ASD. These traits often turn up in different neurodevelopmental disorders, hinting at an underlying connectedness. This way of looking at things promotes a dimensional model for ASD, one that places it as part of a larger neurodiverse framework, rather than something separate.

On a similar note, Fletcher-Watson (2023) argues that looking at symptom dimensions instead of set diagnoses could be a more effective way to understand the differences within and between conditions. This view aligns with the neurodiversity model, which sees cognitive differences as part of natural human variation, not as something to “fix.” Viewing autism (ASD) through a transdiagnostic and neurodiversity lens supports the idea that it lies along a continuum. This perspective recognizes that certain traits are common across multiple neurodevelopmental conditions, encouraging research into shared genetic and biological markers that could deepen our understanding of neurodevelopment in its entirety.

Astle et al. (2021) emphasizes how valuable this approach is for navigating the complexity of neurodevelopmental conditions like ASD and ADHD. By studying the symptoms and characteristics that overlap across these conditions, researchers can develop a wider understanding of neurodevelopment, which is especially useful for appreciating the diversity within the autism spectrum.

## **Current Study**

The review will then critique these studies against recent work, such as that by James et al. (2016) and Ingram et al. (2007), indicating that ASD might possess categorical and continuous features. Rather than finding symptoms of ASD are categorically present or absent, these studies propose that several features may define the disorder by where they fall along a continuum—some significantly separating them from neurotypical development while many more parallel typical variation in severity and developmental trajectory.

This perspective aligns with the idea of a broader autism phenotype, where many autism-related traits are seen throughout the general population, just at lower levels of intensity or frequency (Constantino & Todd, 2003). By placing ASD on a continuum, these studies add to a growing body of research supporting a dimensional view of autism, one that acknowledges the range of traits and the varied ways they can appear.

Furthermore, similar studies in high-risk infants suggest a continuous distribution of traits from the normal to ASD traits (i.e., dimensional) and that these characteristics appear early on any possible spectrum. Research has shown that early behavioral indicators, such as atypical social responsiveness, can predict later diagnoses of ASD, reinforcing the idea that traits develop along a continuum rather than in discrete categories (Happé & Frith, 2020).

The question about how ASD is best conceptualized (as categorically or dimensionally) has important implications for diagnostic practices as well as treatment approaches and future research. This study will provide suggestions for making sense of ASD and where it fits into the larger group of neurodevelopmental disorders by synthesizing current evidence.

This review aims to combine insights from taxometric and empirical studies to clarify the diagnostic boundaries of ASD and its connections with other neurodevelopmental conditions. Understanding whether ASD is a distinct category or part of a larger spectrum has crucial implications for more accurate diagnoses and personalized intervention approaches.

In essence, the study hopes to shape conversations around neurodevelopmental conditions like ASD, providing insights that could improve diagnostic guidelines and foster a greater acceptance of neurodiversity.

## Methods

### Literature Search

This systematic review was conducted to explore the taxometric evidence for the dimensional vs categorical classification of Autism Spectrum Disorder (ASD). An exhaustive literature search was conducted following the PRISMA guidelines to ensure that it would be clear and reproducible by others in the future. Leveraging several electronic databases (Scopus, PsycInfo, PubMed and Web of Science) the present search took place in May 2024.

Search terms included "taxon\*", "MAXCOV", "MAMBAC", "MAXEIG", "L-Mode", "taxometric\*", "asd", "autism spectrum disorder", "autism\*", "Asperger\*", "autistic\*". These terms were combined using AND/OR operators to find studies focused on taxometric methods, for instance, searches like "Autism AND taxometric analysis" or "ASD AND MAXCOV OR MAMBAC" helped focus on taxometric approaches. To be more precise, the search query used was as follows: ("taxon\*" OR "MAXCOV" OR "MAMBAC" OR "MAXEIG" OR "L-Mode" OR "taxometric\*") AND ("asd" OR "autism spectrum disorder" OR "autism\*" OR "Asperger\*" OR "autistic\*").

All articles had to:

1. Be **empirical studies** that use taxometric analysis methods to analyze data (study design).
2. Involve participants with **ASD** or **Asperger's** syndrome (**population**).
3. Specifically **focus on taxometric analysis** as a method to determine the latent structure of "autism-related traits" or diagnoses (analysis focus).
4. Incorporate **Peer-reviewed journal articles, dissertations, or conference papers** (publication type).

Titles and abstracts were first reviewed to check for key terms related to taxometric methods (like MAXCOV, MAMBAC), and those that seemed relevant were moved to a full-text review stage. Any study that didn't fit the criteria (e.g., non-ASD populations, non-taxometric methods) was excluded, and the reason for exclusion was recorded. In this manner, a total of 1123 articles were detected. More specifically, 347 articles were identified on PsycInfo, 145 on PubMed, 352 on Scopus and 279 on Web of Science. Subsequently, all articles were added in one common library on Zotero, in order to be managed and organized throughout the screening process. Upon deduplication, a total of 399 articles were eliminated, leaving us with 724 articles to examine.

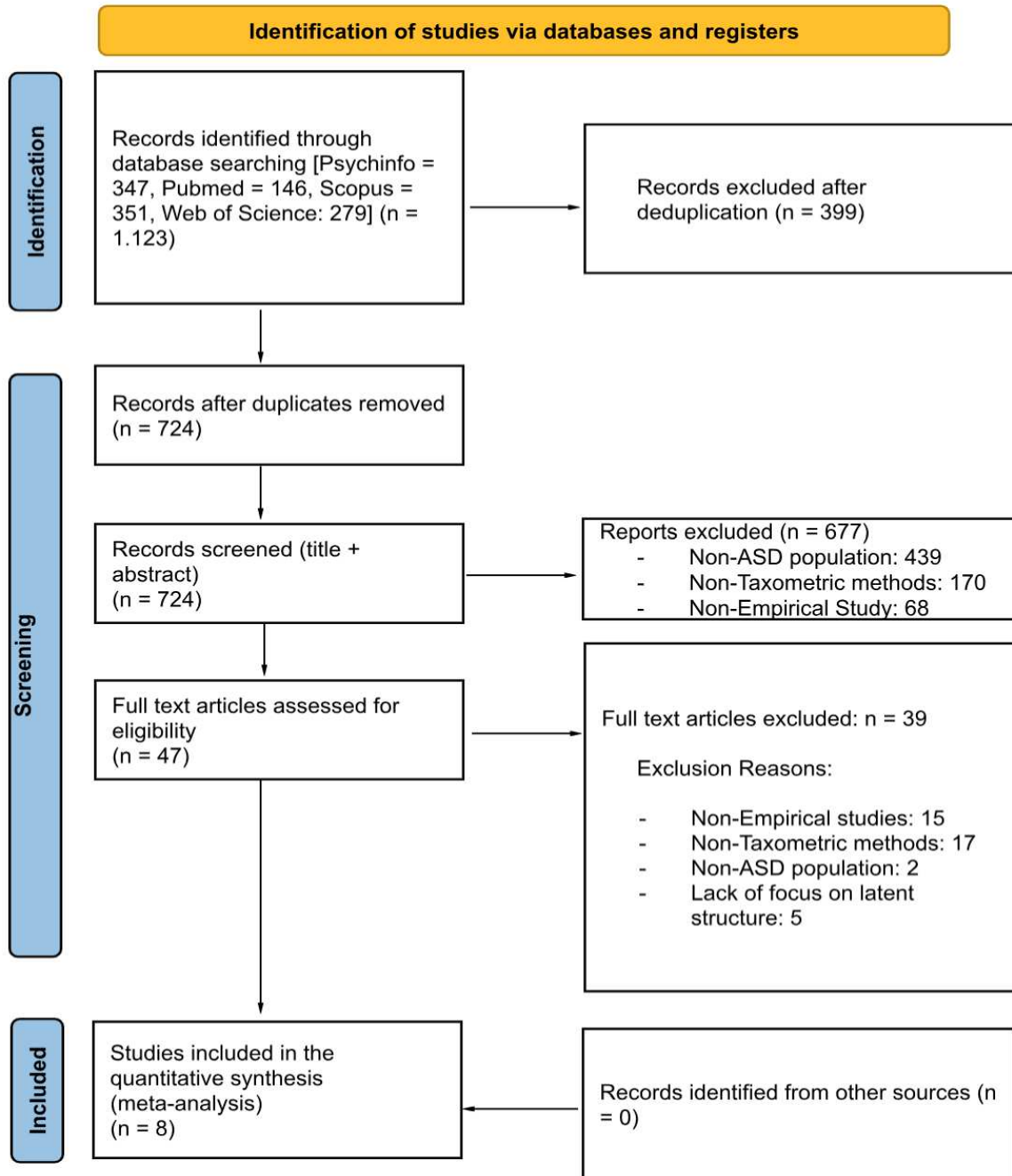
The remaining articles underwent careful evaluation, resulting in the exclusion of 677 studies for the following reasons: non-ASD populations (n=439), use of non-taxometric methods (n=170), and non-empirical research (n=68). Upon completion of the screening phase, 47 articles were deemed eligible based on inclusion criteria for full-text review.

Of these 47 articles, 39 were excluded for the following reasons:

1. **Non-Empirical Studies:** Reviews, theoretical papers, or meta-analyses that did not include original data (n=15).
2. **Non-Taxometric Methods:** Studies applying methods other than taxometric techniques, such as standard regression or factor analysis without taxometric components (n=17).
3. **Non-ASD Populations:** Studies focused on other conditions besides ASD or Asperger's (n=2).
4. **Lack of Focus on Latent Structure:** Manuscripts that did not exclusively study the latent structure of "autism-related traits", or where autism-related themes did not meet criteria for latent structure analysis (n=5).

As a result of this process, 8 articles were deemed eligible for inclusion in the final stage. In the next page, the screening process is depicted in an analytical manner in **Table 1**.

**Table 1. PRISMA flow diagram illustrating the selection process of studies included in the systematic review**



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: <http://www.prisma-statement.org/> **Qualitative synthesis**

## Data Extraction and Coding

Data from each of the eight studies were systematically gathered, focusing on the following variables:

- **Study ID:** Listing the authors and publication year.
- **Sample Size and Diagnosed Cases:** The total number of participants and the count of ASD-diagnosed cases within each sample.
- **Recruitment Strategy:** Description of how each sample was recruited, noting any differences in recruitment for ASD-diagnosed individuals and controls, such as clinical settings or community-based sampling.
- **Socio-Demographic Information:** Age range, mean age, and gender composition of each sample where available.
- **Taxometric methods:** Specifying methods of each study, such as MAMBAC, MAXCOV, and L-Mode
- **Key findings:** Whether the study supported a categorical or dimensional model of ASD.
- **Measures Used for Analysis:** Specific assessments or measures collected for the taxometric analysis, such as the Adult Autism Spectrum Quotient (AQ) and eye-tracking data.
- **Primary outcomes:** Main ASD traits or dimensions analyzed, like social communication and repetitive behaviors.

The data abstraction approach adhered to a standardized framework to gather core details about each primary study. The Sample Size and Population column indicates whether each study was conducted exclusively on participants diagnosed with Autism Spectrum Disorder (ASD) or included a mixed sample based on population criteria. Where available, age range and demographic characteristics (e.g., toddlers, adults) were also mentioned. Every study applied at least one taxometric approach to analyze the underlying structure of ASD, such as MAMBAC (Mean Above Minus Below a Cut), MAXCOV (Maximum Covariance), or L-Mode. These techniques are essential in exploring the latent dimensions of ASD. Additionally, specific measures, such as the Adult Autism Spectrum Quotient (AQ) and eye-tracking data, were noted where applicable, as these provided valuable data points for taxometric analysis.

Based on this evidence, studies were classified as supporting either a categorical, dimensional or mixed model, facilitating meta-analytic grouping. The results highlighted various ASD dimensions across studies, including social communication issues, repetitive behaviors, and developmental psychopathology.

### **Coding Process**

The data extraction process focused on accurately capturing the methodological choices and key findings of each study. Particular attention was given to how population characteristics (e.g., merging of controls and ASD populations) might influence the study's results, as this could affect whether ASD was categorized dimensionally or categorically.

For example, in 2023, Frazier et al. utilized eye-tracking and clinical observations to lend support to a categorical model of ASD traits. In contrast, Boisjoli's 2010 study suggested a dimensional structure in toddlers at risk for ASD, implying that traits in this group are more continuous.

Studies that included both ASD and control groups, like Ingram et al. (2007), often presented mixed findings. Social communication challenges tended to support a categorical view, while traits like repetitive behaviors were more likely to show a dimensional pattern.

### **Bias Considerations in Coding**

During data extraction, it became apparent that some studies might introduce bias by combining ASD-diagnosed individuals with control groups. This blending can obscure categorical distinctions since the presence of neurotypical controls may reduce the contrast between ASD-specific traits and typical developmental traits, often leaning toward a dimensional view of ASD. In contrast, studies that kept control and ASD groups separate were more inclined to support a categorical structure. In order to mitigate this potential bias, the following steps were implemented:

- **Separate Coding for Population Types:** Studies were categorized by whether they focused solely on ASD-diagnosed individuals or included a mix of populations. This approach helped identify patterns, particularly if mixed groups showed a consistent tendency toward dimensional results.
- **Highlighting Study-Specific Sample Characteristics:** Detailed records of each study's sample were kept to make transparent how differences in population composition could influence the findings. This differentiation was designed to highlight any biases that might arise from merged samples.
- **Comparative Analysis of Categorical and Dimensional Results:** Studies that also had mixed diagnostic populations were directly compared to studies exclusively examining ASD participants to assess for systematic differences. Through this comparison, we were able to ascertain whether findings could be biased toward one model or the other based on population type.

Overall, in each of these studies, there was substantial potential for ascertainment bias resulting from the combination of control groups with ASD-diagnosed cases. Studies that merged both populations into a single sample may have reinforced support for a dimensional structure at the expense of evidence for categorical distinction. Nevertheless, overall, studies that separated control and affected populations more explicitly favored a categorical format of ASD (Frazier et al., 2003), (Ingram et al.).

### **Summary of Records in the Qualitative Synthesis**

A total of eight studies were included in this systematic review, all of which used taxometric methods to examine the latent structure of Autism Spectrum Disorder (ASD). The primary taxometric techniques employed across the studies were MAMBAC (Mean Above Minus Below A Cut), MAXCOV (Maximum Covariance), and L-Mode (Latent Mode Factor Analysis). These taxometric methods were applied to samples of individuals diagnosed with ASD to evaluate

whether the disorder is more accurately characterized as categorical or dimensional. The results across the eight studies were somewhat mixed — some supported the idea of ASD as a distinct, categorical condition (clearly separating it from typical development), while others pointed towards a more continuous, dimensional spectrum of traits.

## Results

### Summary of Main Findings

This section highlights major findings from various studies examining whether Autism Spectrum Disorder (ASD) should be viewed as a distinct category or as part of a broader spectrum of neurodevelopmental traits, using taxometric analysis. These studies offer valuable insights that deepen our understanding of ASD's place within the range of neurodevelopmental conditions. Here is a brief overview of the main findings:

- **Beauchaine (2003):** In his work on developmental psychopathology, Beauchaine leans more towards a dimensional understanding of ASD, suggesting that categorical approaches with regards to behavioral disorders (including ASD) might overlook significant within-group heterogeneity. Although specific sample details are not provided, Beauchaine emphasizes that dimensional models may better capture the continuous variation seen in ASD-related traits, especially within diverse developmental contexts.
- **Ingram et al. (2007):** In this study, 200 children were analyzed, with 100 diagnosed with ASD and 100 neurotypical controls. The children with ASD were recruited from clinical settings, while controls were drawn from community samples, ensuring a diverse population. Utilizing the MAMBAC and MAXCOV taxometric methods, this study found that certain subgroups within the ASD population—particularly those with prominent social communication deficits—could be categorized distinctly. However, when it came to traits like repetitive behaviors, the results suggested a more continuous, rather than categorical variation across individuals. This suggests that ASD may encompass both categorical and dimensional aspects, depending on the trait examined.
- **Frazier et al. (2009):** This study recruited a large, unselected, clinically ascertained sample of 1,500 participants—with 750 diagnosed with ASD and 750 neurotypical controls. Participants were recruited from specialized ASD centers as well as the general population. Using the MAMBAC and MAXCOV taxometric methods, the study focused on social

communication and behavioral traits and provided compelling evidence for a categorical structure, with ASD individuals appearing qualitatively distinct from typically developing controls.

- **Boisjoli (2010):** In contrast, a study involving toddlers at risk for developmental disabilities used taxometric analysis and pointed to a dimensional structure for ASD. This study, involving 150 toddlers at risk for developmental disabilities (including 50 considered at risk for ASD), applied taxometric analysis to explore early ASD traits. Participants were recruited from early intervention programs. The study used MAMBAC and L-Mode methods and concluded that ASD traits are distributed along a dimensional spectrum in young children, suggesting a continuous rather than categorical structure during early development.
- **Coghill & Sonuga-Barke (2012):** In their review of taxometric studies, the authors emphasized that empirical evidence supports both categorical and dimensional approaches to child and adolescent mental disorders, including ASD. It synthesized findings from various taxometric studies on child and adolescent mental disorders, including ASD, with recruitment strategies and sample sizes varying across studies. This review suggested that ASD might show evidence of dimensionality when considering certain traits, though the taxonic model is prominent in specific analyses. For instance, social communication traits were often found to support a categorical model, while other traits leaned towards dimensionality. The authors emphasized that both approaches offer valuable insights into ASD's complex structure.
- **James et al. (2016):** a detailed taxometric analysis of the Adult Autism Spectrum Quotient (AQ) was performed in this study, revealing a distinct categorical structure. By recruiting a sample of 371 adults (with 185 diagnosed with ASD), this study performed a taxometric analysis based on the Adult Autism Spectrum Quotient (AQ), a widely used measure for assessing "autism-related traits" in adults. The participants were employed from clinical settings and evaluated using MAMBAC and MAXCOV methods. In addition, the study described a high-severity group within the spectrum that may represent unique subtypes which could potentially add to future diagnostic criteria. The findings revealed a categorical structure, with a high-severity subgroup within the spectrum, which may represent unique subtypes that could contribute to refined diagnostic criteria.

- **Haslam et al. (2020):** An expansive meta-analysis of taxometric works addressing diverse psychological constructs found ASD to be one of the only entities with considerable level support for a categorical solution. This meta-analysis reviewed multiple taxometric studies across various psychological traits, including ASD. While specific sample sizes varied across studies, Haslam and colleagues found that ASD is one of the few conditions with substantial support for a categorical model. The findings for ASD pointed to marked boundaries, in contrast with many features more effectively represented dimensionally, supporting its apparently distinct place among neurodevelopmental disorders.
- **Frazier et al. (2023):** This study adopted a comprehensive, multi-method approach, drawing from seven independent samples with a total of 16,755 participants (of whom 8,500 were diagnosed with ASD). By incorporating a multi-faceted approach that included the use of MAMBAC, MAXCOV, as well as eye-tracking data and clinical observations, this study offered robust support for a categorical model. Recruited using mixed strategies, participants were evaluated for social interaction traits and eye-tracking metrics, reinforcing the view that ASD represents a distinct category within the broader population. The findings firmly supported a categorical understanding of ASD, aligning closely with established clinical diagnostic criteria and reinforcing the idea that autism exists as a distinct condition.

In conclusion, these findings illustrate the complex interplay between categorical and dimensional perspectives on ASD. While some studies provide strong support for a categorical understanding, others highlight the importance of recognizing the continuous variation of traits across individuals. This ongoing dialogue emphasizes the need for flexible diagnostic practices and tailored intervention strategies.

**Table 2** below provides a summary of these core data points.

**Table 2. Summary of Data Extraction and Coding**

<b>Study ID</b>	<b>Sample (ASD/Total)</b>	<b>Age (Range)</b>	<b>Gender (M/F)</b>	<b>Recruitment Strategy</b>	<b>Taxometric Method(s)</b>	<b>Key Findings</b>	<b>Measures</b>	<b>Outcome Focus</b>
<b>Beauchaine (2003)</b>	Not specified	Not specified	Not specified	Not specified	MAMBAC, L-Mode	Dimensional	Behav.	Behavioral heterogeneity
<b>Ingram et al. (2007)</b>	100/200	8 (6-10)	60/40	Clinics, community	MAMBAC, MAXCOV	Mixed	Social, Behav.	Social & repetitive traits
<b>Frazier et al. (2009)</b>	750/1500	12.5 (8-18)	55/45	Clinics, population	MAMBAC, MAXCOV	Categorical	Social, Behav.	Social deficits
<b>Boisjoli (2010)</b>	50/150	2.5 (2-3)	80/70	Intervention programs	MAMBAC, L-Mode	Dimensional	Early childhood	ASD traits in toddlers
<b>Coghill &amp; Sonuga-Barke (2012)</b>	Review	Not specified	Not specified	Various	MAMBAC	Mixed	Various	Social & communication traits
<b>James et al. (2016)</b>	185/371	28 (18-40)	70/115	Clinical settings	MAMBAC, MAXCOV	Categorical	AQ	High-severity subtypes
<b>Haslam et al. (2020)</b>	Meta-analysis	Varies	Varies	Varies	MAMBAC, MAXCOV, L-Mode	Categorical	Various	Distinct from other neurodevelopmental disorders
<b>Frazier et al. (2023)</b>	8500/16755	10 (10-15)	60/40	Mixed strategies	Multi-method	Categorical	Eye-tracking	Social, eye-tracking criteria

## **Discussion**

The findings of this systematic review highlight an active debate over whether Autism Spectrum Disorder (ASD) should be classified using a dimensional or categorical approach. By analyzing a range of empirical studies, the review brings out the intricate mix of both perspectives, showing that ASD cannot be fully captured by one method alone. This discussion will unpack these findings, consider what they mean for understanding autism, discuss some limitations in current research, and point to promising areas for future investigation.

### **Interpretation of Findings**

Frazier et al. (2023) employ a broad, multi-method approach to support the view that ASD-related traits can be fundamentally different from those seen in neurotypical development. Their findings point to certain key characteristics, such as substantial difficulties with social communication and a tendency toward restricted, focused interests, as indicators that ASD might represent its own classification within neurodevelopmental disorders rather than a variation along a continuum.

In contrast, Ingram et al. (2007) propose that while some ASD characteristics are distinctive, other features, like repetitive behaviors, do not always fit neatly into categorical definitions, suggesting more gradual variation. This approach calls for a broader understanding of ASD that acknowledges both unique and overlapping traits, making rigid diagnoses less effective.

Beauchaine (2003) builds on this dimensional perspective, noting that traits associated with autism appear in varying degrees across the general population. This supports a model of ASD as part of a wider range of behaviors, where traits aren't exclusive to those diagnosed but exist in different degrees even among non-autistic individuals.

Furthermore, recent research into autism focuses primarily on formally diagnosed individuals, but a more dimensional view indicates that many genetic and biological correlates of autism are not limited to diagnosed individuals. Bralten et al. Genomic relationships between autism and general population neurodevelopmental traits (2017) This overlap indicates that these characteristics make up a spectrum that people are born with throughout the population, and this also supports the concept of a continuum.

Adding complexity, Coghill and Sonuga-Barke (2012) bring a balanced view, showing that while certain aspects—like difficulties in social communication—align well with categorical models, other behaviors fit more comfortably within a spectrum framework. Their research emphasizes ASD’s variability, suggesting the need for diagnostic models that reflect this diversity rather than forcing a strict classification.

Differences in these research findings may be influenced by a variety of factors, including the age and sex of participants, the research methods used, and the specific traits being analyzed. For instance, age and developmental stage can significantly affect how ASD traits present, often acting as key factors in shaping ASD characteristics and influencing classification choices. The context in which traits are studied also plays a crucial role, providing essential insights that help professionals make well-informed assessments.

In conclusion, this review suggests that no single model, categorical or dimensional, entirely encompasses ASD’s complexity. A combined approach that incorporates elements of both frameworks appears better suited to capture the wide range of traits seen in autism, allowing for more tailored interventions and recognizing the varied experiences of those on the spectrum.

### **The Promise of Taxometric Analysis**

Taxometric analysis is proving to be a valuable method for understanding whether psychological conditions, such as Autism Spectrum Disorder (ASD), should be viewed as clear-cut categories or, alternatively, as points along a spectrum. This approach equips researchers with statistical tools

to navigate the intricate nature of psychological issues, which is particularly useful for classifying neurodevelopmental disorders.

One major advantage of taxometric analysis lies in its ability to address the ongoing debate on how psychological traits are best categorized. Traditional methods tend to use rigid boundaries, which can oversimplify our understanding of these conditions. Taxometric techniques like Maximum Likelihood Taxometrics (MLT) and Latent Variable Models allow researchers to explore how traits are distributed among individuals, potentially offering a clearer picture of whether conditions like ASD represent distinct types or exist along a continuum.

This level of detail can reveal if something like ASD forms a distinct group (or "taxon") or is part of a spectrum that stretches across various traits. With these methods, researchers might uncover whether ASD traits form specific clusters or blend into the broader population.

Taxometric analysis is all about uncovering the structure within the data itself. Techniques like MAMBAC and MAXCOV offer researchers a way to look at the patterns within traits—an approach particularly useful for conditions like ASD, which can present in many different ways. Findings from researchers such as Frazier et al. (2023) and Ingram et al. (2007) show that taxometric methods can sharpen diagnostic criteria and even guide clinical treatment strategies.

This method might also help answer a crucial question: Is ASD a separate type of disorder, or does it sit somewhere on a spectrum of traits? Understanding ASD's structure could reveal which traits are uniquely tied to it and which might simply be part of typical development. This insight is key, as it doesn't just refine how we diagnose ASD but also how we tailor support.

In addition, taxometric approaches can help clarify the relationship between ASD and other neurodevelopmental disorders, such as ADHD or language disorders. Patients with these conditions have many features in common but also differ from one another. The findings could lead to better diagnostic accuracy and individualized support plans.

Of course, taxometric analysis has its limits. The reliability of results relies on good methodology, especially with sample quality. Several studies have faced challenges where the necessary conditions for taxometric methods weren't met, which can distort the findings about ASD's structure. In the future, a high bar for these methods will need to be held in any research using such approaches if they are going to provide significant insights into an accurate picture of ASD.

Taxometric analysis, at its root, presents a method of determining if Autism Spectrum Disorder (ASD) and similar conditions are best conceptualized as discrete categories or lie on a theoretical continuum. Not only does this approach lead to more accurate diagnoses, but it also advocates for a broader perspective on neurodevelopmental strengths.

### **Implications for Diagnosis & Treatment**

The findings from this systematic review have substantial implications for diagnostic practices in Autism Spectrum Disorder (ASD). Standard diagnostic frameworks like the DSM-5 tend to group people into broad categories without accounting for how autism traits can differ among individuals. Given that this binary diagnosis focuses on individuals either meeting the criteria for ASD or not, those who manifest autistic traits or symptoms below diagnostic thresholds, but which still have debilitating effects upon their everyday lives and quality of life could potentially be marginalized (Happé & Frith, 2020).

Constantino and Todd (2003) claim high support for the concept of the broader autism phenotype, which hypothesizes that traits associated with autism spectrum disorder present to varying extents within the general population. They showed that those characteristics exist in people with no official diagnosis. Such evidence supports a dimensional view of autism, suggesting that autism may reflect a continuum of traits and not just a set of traits associated with clinical diagnoses.

An alternative dimensional view, as illustrated by the mixed results from studies such as Ingram et al. (2007), may lead to increased diagnostic precision based on a view of autism traits as distributed continuously (Beauchaine 2003). Understanding this may help better identify individuals with subthreshold symptoms at earlier ages and intervene through strategies that can

greatly improve developmental outcomes. Such early signs of social communication difficulties in children, even if they do not meet criteria for a full diagnosis with ASD, may be best supported by targeted support services that focus on building strong friendships and overcoming anxiety relating to social situations.

In addition, a dimensional view assists in tailoring treatment options to the affected person. Those interventions could be personalized based on particular traits rather than being bound by categorical diagnoses. For example, there may be a need to use different therapeutic interventions for someone with intense social communication difficulties versus problems with repetitive behaviors. Allowing for nuance in treatment plans is important, as it acknowledges that each person on the spectrum has a part of them that presents strengths as well as areas needing support (Frazier et al., 2023).

Furthermore, when clinicians embrace a dimensional construct of ASD, they can develop much more broad and productive treatment plans that cover the wide array of structured support persons need. Through multi-domain assessments (such as social skills, executive functioning, and sensory processing), clinicians can target a wide array of problems that those with ASD experience, in order to develop more comprehensive intervention plans. This type of detailed planning is critical for school-based contexts, where educators and therapists may work together to put in place individualized education programs (IEPs) specifically designed around the unique profiles presented by students on the autism spectrum (James et al., 2016).

The results from this review may further inform the training and education of physicians. Such an understanding, facilitated by recognition that autism is a spectrum condition and not specific to very narrow behavioral characteristics, better prepares those working in the field of health to both recognize and meet the various presentations of this disorder. Emphasizing the dimensional nature of ASD in training programs can increase accuracy during assessments and improve interventions, resulting in better outcomes for individuals with autism (Frazier et al., 2023).

It is also worth noting the broader implications for society in framing autism as a dimensional rather than categorical disorder. If we recognize that autism is a spectrum, ideas around it can also reflect acceptance and promote societal awareness regarding neurodiversity. By changing our

mindset regarding autism, we can reduce stigma all around us and instill a more inclusive environment for autistic people so that they can contribute their share on different fronts of life.

The findings of this review thus speak to a need for diagnostic processes that are adaptable and can accommodate the full heterogeneity seen within ASD. It would facilitate the inclusion of dimensional approaches in diagnosis and treatment strategies for people with autism, thus improving efficient intervention programs and life quality. Supporting neurodiversity through a spectrum approach advances, as the concept of ASD develops within society.

### **Limitations and Bias in the Studies Reviewed**

This review offers key information on the way ASD could be categorized in a general sense, yet various restrictions and potential biases must be kept in mind when interpreting such outcomes.

- **Sample Size and Diversity:** Many of the studies in this review have small sample sizes, which limit generalizability to autistic people more broadly. If the samples are too small, they may not represent the full range of the autism community, leading to conclusions that don't reflect everyone with ASD (Ingram et al., 2007). Another significant problem is that many of these samples were quite homogenous, often made up largely or entirely of Caucasian, middle-class individuals. This restricts the generalizability of their results across diverse cultural or socioeconomic backgrounds. Because autism manifests differently among populations, future research would benefit from more inclusive groups to increase the generalizability of results (Happé and Frith, 2020).
- **Ascertainment Bias:** This bias, or participant selection bias, occurs when the chosen sample does not accurately reflect the larger population, leading to skewed results. For instance, some studies combine control groups with individuals who meet ASD criteria,

introducing a mix that can lead to misleading conclusions about autism's structure. As noted by Frazier et al. (2009) and Ingram et al. (2007), understanding this aspect is essential. Future studies should address this issue by recruiting participants in a way that clearly separates control and affected groups.

- **Methodological Variability:** The methodologies employed in these studies are so diverse that the field appears somewhat fragmented when it comes to interpreting results. Studies use a range of taxometric methods, sample selection criteria, and assessment tools, which can result in inconsistent findings. While some apply rigorous methods like MAMBAC and MAXCOV (James et al., 2016), others rely on less precise approaches. This variability makes it challenging to establish clear guidelines for ASD diagnosis and treatment.
- **Violation of Taxometric Assumptions:** To conduct a valid taxometric analysis, certain prerequisites must be met, such as the independence of observations and appropriate variable selection. Failing to meet these assumptions can produce biased results and incorrect interpretations regarding the categorical or dimensional nature of ASD (Coghill & Sonuga-Barke, 2012). This indicates that some results from these studies may not be as dependable as they first appear.
- **Limited Focus on Autistic Traits:** Some studies concentrate narrowly on traits like social communication, often overlooking other critical dimensions of autism, such as sensory processing or executive function challenges. A fuller understanding of autism would require future research to consider a broader array of traits beyond social cognition (Frazier et al., 2023).
- **Publication Bias:** Publication bias may also influence the current literature, as studies with significant findings are more likely to be published. This trend could create a skewed view of the evidence, favoring one classification model over others. This bias highlights the need for caution when interpreting the existing literature, as null or negative results may be underreported (Haslam et al., 2020).

In summary, while this review offers valuable perspectives on potential ASD classification strategies, these constraints necessitate careful interpretation. Understanding these limitations can guide future research and encourage methodological improvements to ensure that ASD's underlying structure is captured more faithfully, supporting better clinical practice.

### **Broad Utility of Categorical Approaches**

Despite the ongoing controversy over the dimensional-categorical classification of Autism Spectrum Disorder (ASD), there is substantial evidence to justify considering autism as a separate taxon. This category is useful for a variety of reasons, including diagnostic clarity and targeted intervention techniques.

- **More Precision in Diagnosing PDD:** By labeling autism as a category, we can use stricter definitions to recognize patients with ASD. This high level of specificity is vital in therapy settings to ensure proper diagnosis, treatment plans, and patient access to needed resources. Categorically, this may ensure that those presenting with significant problems in social communication and behavior are appropriately labeled to then enter critical early intervention strategies (Frazier et al., 2009; Happé & Frith, 2020).
- **Facilitation of focused Interventions:** A categorical understanding of ASD enables therapists to create focused interventions that address the specific requirements of people with autism. Recognizing autism as a unique category, for example, helps guide the development of specialized therapeutic programs that address the disorder's main obstacles, such as difficulty with social interaction, communication deficiencies, and restricted behaviors (Beauchaine, 2003). This personalized approach allows practitioners to implement therapies that are more effective in addressing the specific characteristics and obstacles that people with autism confront, improving treatment outcomes.
- **Support for Educational Strategies:** In educational settings, categorizing autism can help with the development of individualized education plans (IEPs) that address the unique requirements of individuals on the spectrum. Identifying autism as a distinct category allows educators to design and apply teaching strategies that are tailored to individuals with ASD's unique learning profiles. This could include specific social skills training, sensory

accommodations, and structured learning environments that address the strengths and challenges of neurodiverse students (James et al., 2016). As a result, a categorical approach can provide an inclusive educational atmosphere that promotes the intellectual and social growth of kids with autism.

- **Informed Policy Development:** Treating autism as a distinct disorder has implications for policymaking and resource allocation. Policymakers can use categorical classifications to develop tailored programs and financial initiatives that meet the needs of people with autism and their families (Haslam et al., 2020). Recognizing autism as a unique category allows policymakers to fight for resources that explicitly support diagnostic services, therapeutic therapies, and educational programs for people on the spectrum. This tailored strategy may eventually lead to better support services for the autism population.
- **Facilitating Research and Understanding:** Categorical techniques can also help researchers better grasp the underlying causes of autism. By developing unambiguous diagnostic criteria, researchers can more successfully recruit study participants and ensure that their findings are applicable to the ASD population (Frazier et al., 2023). Understanding why social behaviors fail in this way can lead to more reproducible findings and make it easier to investigate the genetic, neural, and environmental bases of non-social autism symptoms. In doing so, a clear definition of autism can help in identifying any comorbidities that cluster with ASD (e.g., high rates of anxiety disorder and attention-deficit/hyperactivity disorder (ADHD) among children with an existing diagnosis; Coghill & Sonuga-Barke, 2012) to advance overall knowledge about neurodevelopmental disorders.
- **Advocacy activities:** Categorizing autism can help to boost advocacy activities focused on raising awareness and acceptance of neurodiversity. By emphasizing the unique aspect of autism, advocates can help to eliminate stigma and promote a better awareness of the issues that people with autism encounter (Happé & Frith, 2020). Viewing autism as a distinct category could lead to a greater appreciation of neurodiversity, encouraging a more inclusive society that values the unique insights of those on the spectrum.

**Conclusions and Considerations:** While the categorical approach has clear strengths, it's also important to consider the value of the dimensional perspective. Seeing autism as a spectrum of

traits can make treatments and support more adaptable, offering flexibility that benefits a wider range of individuals. Together, categorical and dimensional frameworks provide a fuller understanding of autism, potentially boosting diagnostic precision and making interventions more relevant to each person's unique needs within the ASD community.

## **Future Research Directions**

Given the complexity surrounding the classification of Autism Spectrum Disorder (ASD) and the findings of this systematic review, numerous important pathways for future research appear. These topics not only fill gaps in the existing research, but also contribute to a better understanding of autism as a complex neurodevelopmental disorder.

- **Longitudinal Studies:** Another potential direction for future research would be to utilize longitudinal studies examining how autistic features change over time. This type of research may play an important role in examining how particular traits present and evolve from early childhood into adolescence and adulthood. By observing individuals across the lifespan, researchers can identify patterns of both change and stability that characterize autism-related phenotypes (James et al., 2016). This approach might further facilitate identifying critical intervention windows and associated determinants in developmental trajectories, enabling more successful early screening and support strategies.
- **Various Populations:** Future research should prioritize the inclusion of various populations to ensure that the findings are representative of the larger autistic community. This includes evaluating people from different cultural, socioeconomic, and geographic origins. Studies should look into how sociocultural factors influence autistic symptoms and the availability of diagnostic and intervention services (Frazier et al., 2023). Understanding how autism intersects with diverse demographic factors will improve the applicability of study findings and promote more equitable assistance for people on the spectrum.
- **Genetic and Neurobiological Underpinnings:** Future study should focus on the genetic and neurobiological bases of ASD's categorical and dimensional characteristics. Recent advances in genetics and neuroimaging are shedding insight on autism's basic foundations (Beauchaine, 2003). Researchers are getting closer to understanding the underlying causes

of autism by discovering particular genetic markers associated with both unique and spectrum-like features. This knowledge could lead to therapy alternatives that are personalized to each individual's needs. Furthermore, studying how brain anatomy links to autistic traits may help uncover biomarkers that improve diagnostic accuracy and our understanding of autism's neurological underpinning.

- **Intervention Effectiveness:** Research should also look into the efficacy of various intervention strategies adapted to different types of autism. Understanding which approaches produce the best results for various features or combinations of traits is critical for creating tailored treatment strategies (Happé & Frith, 2020). Comparative effectiveness study could assist in identifying the most effective therapy for people with different features on the autism spectrum, giving clinicians and caregivers with evidence-based information.
- **Exploration of Comorbid Conditions:** Given the high frequency of comorbid conditions among people with autism, future research should investigate the relationship between autism and other neurodevelopmental or mental health issues. Understanding how ASD features overlap with diseases like Attention-Deficit/Hyperactivity Disorder (ADHD), anxiety disorders, and learning difficulties can help inform holistic treatment approaches that address an individual's entire set of needs (Coghill & Sonuga-Barke, 2012). This research could also shed light on the mechanisms underlying co-occurring illnesses, providing insight into how they affect general functioning and quality of life for those on the spectrum.
- **Public Policy and Advocacy Research:** Finally, research that examines the impact of public policy and advocacy efforts on individuals with autism and their families is crucial. Understanding how education, healthcare, and social service policies affect access to diagnosis and treatment might help guide future advocacy efforts (Haslam et al., 2020). Furthermore, research into the effectiveness of public awareness initiatives in eliminating stigma and encouraging acceptance of neurodiversity can help to drive societal change that benefits people with ASD.

In summary, future research directions should focus on longitudinal studies, diverse populations, genetic and neurobiological underpinnings, intervention effectiveness, comorbid conditions, and public policy impacts. By addressing these critical areas, researchers can deepen the understanding of ASD and contribute to the development of effective, evidence-based interventions and supports that enhance the quality of life for individuals on the spectrum.

## **Broader Context**

The conclusions of this systematic analysis must be interpreted in the context of neurodiversity, a concept that recognizes the natural variances in human cognition and behavior. Neurodiversity promotes acceptance and tolerance of those with neurological differences, especially those diagnosed with Autism Spectrum Disorder (ASD) (Happé & Frith, 2020). Recognizing autism as a variant of human experience rather than a disability is critical for creating an inclusive society that values varied viewpoints and skills.

Recognizing neurodiversity is transforming how autism is viewed in schools, healthcare, and policy. The focus is shifting away from trying to “fix” individuals toward appreciating and supporting each person’s unique qualities and needs (Frazier et al., 2023). Increases in ASD-related traits based on the current literature (e.g., Constantino & Todd, 2003; 2017) support the notion that the expression of such traits is not exclusive to those with clinical diagnoses. These studies show that such traits exist throughout the general population indicating that autism is part of a continuum and fits within the neurodiversity paradigm. Considering all of this helps develop a more holistic understanding and eliminates stigma. It cultivates communities that provide an authentic and accepting environment for autistic individuals to be themselves and inspire change through inclusive and respectful treatment.

Recognizing autism spectrum variability in educational settings can lead to more inclusive practices that cater to a plethora of learning styles and demands. Educators who accept the neurodiversity model are more likely to use instructional practices that build on neurodiverse students' strengths while making necessary modifications for their issues. Flexible teaching

strategies, for example, can create an environment in which students with ASD thrive alongside their neurotypical peers, encouraging collaboration and mutual understanding (James et al., 2016).

Moreover, the concept of neurodiversity can aid in overcoming divisions between different disability populations. Recognizing the intersection of neurological differences with other kinds of diversity, such as race, gender, and socioeconomic position, advocates may collaborate to remove the systemic hurdles that individuals with autism and other disabilities encounter (Coghill & Sonuga-Barke, 2012). This intersectional approach creates unity across varied communities by fostering a comprehensive understanding of disability that recognizes each group's unique difficulties and capabilities.

Furthermore, the implications of neurodiversity apply to public policy and lobbying initiatives. Policymakers that view autism through the lens of neurodiversity are better able to develop inclusive policies that ensure individuals with autism have access to critical services and supports (Haslam et al., 2020). Advocacy organizations can use neurodiversity to build awareness campaigns that dispel myths about autism and highlight the contributions of neurodiverse people to society. Advocates can help to create a fairer society by campaigning for legislation that protect the rights and inclusion of people with autism.

Additionally, the concept of neurodiversity can help bridge gaps between various disability communities. Recognizing the intersection of neurological differences with other kinds of diversity, such as race, gender, and socioeconomic position, advocates may collaborate to remove the institutional barriers that individuals with autism and other disabilities encounter (Coghill & Sonuga-Barke, 2012). This intersectional approach creates unity across varied communities by fostering a comprehensive understanding of disability that recognizes each group's unique difficulties and capabilities.

In short, the neurodiversity perspective highlights autism as a natural variation in human thinking, not something that needs to be “fixed.” This approach encourages greater acceptance and supports inclusive practices in schools, healthcare, and policy. It also strengthens advocacy efforts for individuals with autism and their families. By bringing neurodiversity principles into conversations about ASD, we can create a society that values and respects everyone’s unique contributions, embracing neurological differences as part of what makes us human.

## Conclusion

This review delves into the ongoing debate over how to best classify Autism Spectrum Disorder (ASD), weighing both dimensional and categorical perspectives. Taxometric studies show that opinions are split: some researchers argue for a categorical approach to ASD, while others believe a dimensional framework better captures the variety of autism traits. This ongoing debate highlights autism's inherent diversity and underscores the need for diagnostic practices that respect individual differences (Frazier et al., 2023; Ingram et al., 2007).

The review goes beyond theory, revealing important practical implications. Binary classifications like those in the DSM-5 may leave individuals with milder symptoms without support. Recognizing autism as a spectrum could improve diagnostic precision and provide earlier interventions for those who don't meet full ASD criteria (Happé & Frith, 2020). A flexible, spectrum-based approach could also enhance clinical care and foster inclusivity in educational and healthcare settings, supporting neurodiversity (Beauchaine, 2003; James et al., 2016).

The review does point out two major drawbacks, however. Many studies are limited by small, homogeneous samples. The use of inconsistent methodologies makes it difficult to understand the fundamental nature of ASD, and biases such as ascertainment bias (which affects who agrees or is able to join a study) and publication bias can cause systematic errors in findings. This underscores the need for research that captures a broad range of autism traits (Coghill & Sonuga-Barke, 2012; Frazier et al., 2009).

In the future, longitudinal studies in more varied populations may help clarify the genetic and neurobiological underpinnings of ASD. Findings from such research could be useful for tailoring interventions to specific characteristics unique to autism and for investigating connections between ASD traits and other conditions, thus expanding support for individuals on the autism spectrum (Haslam et al., 2020).

In sum, this review contributes to the evolving understanding of ASD classification. Blending categorical and dimensional perspectives may offer a more comprehensive view of autism's complexity, leading to improvements in diagnostic and intervention practices. Embracing

neurodiversity principles helps build a society that values and respects the unique contributions of all, regardless of neurological differences.

## References

- Astle, D. E., Holmes, J., Kievit, R., & Gathercole, S. E. (2021). Annual research review: The transdiagnostic revolution in neurodevelopmental disorders. *Journal of Child Psychology and Psychiatry*, *63*(4), 397–417. <https://doi.org/10.1111/jcpp.13481>
- BEAUCHAINE, T. P. (2003). Taxometrics and developmental psychopathology. *Development and Psychopathology*, *15*(3), 501–527. <https://doi.org/10.1017/s0954579403000270>
- Boisjoli, J. A., & Boisjoli, J. (2010). A taxometric analysis of autism spectrum disorders in toddlers. *A Taxometric Analysis of Autism Spectrum Disorders in Toddlers*. [https://doi.org/10.31390/gradschool\\_dissertations.2816](https://doi.org/10.31390/gradschool_dissertations.2816)
- Bralten, J., van Hulzen, K. J., Martens, M. B., Galesloot, T. E., Arias Vasquez, A., Kiemeneij, L. A., Buitelaar, J. K., Muntjewerff, J. W., Franke, B., & Poelmans, G. (2017). Autism spectrum disorders and autistic traits share genetics and biology. *Molecular Psychiatry*, *23*(5), 1205–1212. <https://doi.org/10.1038/mp.2017.98>
- \*Chown, N., & Leatherland, J. (2020). Can a person be ‘a bit autistic’? A response to Francesca Happé and Uta Frith. *Journal of Autism and Developmental Disorders*, *51*(2), 749–751. <https://doi.org/10.1007/s10803-020-04541-0>
- Coghill, D., & Sonuga-Barke, E. J. S. (2012). Annual research review: Categories versus dimensions in the classification and Conceptualisation of Child and Adolescent Mental Disorders – Implications of recent empirical study. *Journal of Child Psychology and Psychiatry*, *53*(5), 469–489. <https://doi.org/10.1111/j.1469-7610.2011.02511.x>
- Constantino, J. N., & Todd, R. D. (2003). Autistic traits in the general population. *Archives of General Psychiatry*, *60*(5), 524. <https://doi.org/10.1001/archpsyc.60.5.524>
- Fletcher-Watson, S. (2023). What’s in a name? the costs and benefits of a formal autism diagnosis. *Autism*, *28*(2), 257–262. <https://doi.org/10.1177/13623613231213300>
- Frazier, T. W., Chetcuti, L., Al-Shaban, F. A., Haslam, N., Ghazal, I., Klingemier, E. W., Aldosari, M., Whitehouse, A. J., Youngstrom, E. A., Hardan, A. Y., & Uljarević, M. (2023). Categorical versus dimensional structure of autism spectrum disorder:

- A multi-method investigation. *JCPP Advances*, 3(2).  
<https://doi.org/10.1002/jcv2.12142>
- Frazier, T. W., Youngstrom, E. A., Sinclair, L., Kubu, C. S., Law, P., Rezai, A., Constantino, J. N., & Eng, C. (2009). Autism spectrum disorders as a qualitatively distinct category from typical behavior in a large, clinically ascertained sample. *Assessment*, 17(3), 308–320. <https://doi.org/10.1177/1073191109356534>
- Happé, F., & Frith, U. (2020a). Annual research review: Looking back to look forward – changes in the concept of autism and implications for future research. *Journal of Child Psychology and Psychiatry*, 61(3), 218–232. <https://doi.org/10.1111/jcpp.13176>
- Happé, F., & Frith, U. (2020b). Dimensional or categorical approaches to autism? Both are needed. A reply to Nick Chown and Julia Leatherland. *Journal of Autism and Developmental Disorders*, 51(2), 752–753. <https://doi.org/10.1007/s10803-020-04728-5>
- Haslam, N., McGrath, M. J., Viechtbauer, W., & Kuppens, P. (2020). Dimensions over categories: A meta-analysis of Taxometric Research. *Psychological Medicine*, 50(9), 1418–1432. <https://doi.org/10.1017/s003329172000183x>
- Ingram, D. G., Takahashi, T. N., & Miles, J. H. (2007). Defining autism subgroups: A taxometric solution. *Journal of Autism and Developmental Disorders*, 38(5), 950–960. <https://doi.org/10.1007/s10803-007-0469-y>
- James, R. J., Dubey, I., Smith, D., Ropar, D., & Tunney, R. J. (2016). The latent structure of autistic traits: A taxometric, latent class and latent profile analysis of the adult autism spectrum quotient. *Journal of Autism and Developmental Disorders*, 46(12), 3712–3728. <https://doi.org/10.1007/s10803-016-2897-z>

\*= works not directly consulted