

Understanding the Complementary Role of Cognitive Neuroscience and Etiology in Cultivating Inclusive Academic Environments for Individuals with Autism – A Narrative Review and Holistic Framework

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Autism is a neurodevelopmental syndrome defined by deficits in social reciprocity and communication with restricted repetitive behaviors. In the school year (SY) 2018-19, the percentage of students with disabilities identified with autism was 11% and this percentage has increased from 4.97% in the SY 2008-2009 to 11% in SY 2018 -2019. Increasing enrollment of neurodivergent students necessitates the current education system to be more accommodating and inclusive. This review aims to consolidate the existing information to create a framework for a more inclusive and accommodating academic environment for students with ASD. Various components identified to be a part of the holistic framework are ASD-friendly learning modules, Universal design of learning, Peer-led support groups, Mental Health Counselors, Accessible diagnostic and therapeutic services, financial aids, awareness programs on ASD, Transition programs, ASD-trained faculty, ASD centric research, and surveys. Implementing this holistic framework requires establishing a dedicated unit that will serve as a single point of contact for all neurodivergent students. This department will work to enhance accessibility and undergo periodic reviews for improvement based on feedback received from the students. We are emphasizing a multi-dimensional focus rather than concentrating on a single aspect within our framework. By adopting this approach, we aim to cultivate a new generation of students who can not only thrive but also realize their full academic potential across mental, physical, academic, and social domains.

Keywords: Autism, Double empathy, Inflicted stigma, Masking, Neurodivergence, Framework.

Introduction

Autism is a neurodevelopmental syndrome defined by deficits in social reciprocity and communication with restricted repetitive behaviors¹. Autism is considered to be a form of neurodivergence, which includes individuals whose cognitive functions/neurodevelopmental differences fall outside of societal norms [Fig.1]. In 2000, the prevalence of ASD was 1 in 150 children whereas in 2020, it is 1 in 36 children who are diagnosed with autism. This increasing prevalence puts forward the question of whether current academic systems provide an environment that encourages inclusivity for all students, not just neurotypical ones². In 2015, an estimated 49,000 autistic students graduated high school and this number is increasing every year³. Driven by genetic and environmental factors, an estimated 15-20 percent of the world's population exhibits some form of neurodivergence⁴. Many students with ASD desire to pursue higher education, which will help them to develop adequate skills to thrive in adulthood. However, the current academic setting poses a variety of challenges such as afflicted and felt

stigma, overstimulating environments, absence of peer support, lack of support from faculty, and poor mental health support for comorbidities such as anxiety, depression, obsessive-compulsive disorder and many more⁵. These challenges present significant difficulties for students with ASD to graduate in comparison with neurotypical students. Newman et al. (2011) reported that fewer than 40% of students with ASD graduate. According to Article 26 of the Universal Declaration of Human Rights by the United Nations, everyone has the right to an education directed towards the full development of the human personality and the strengthening of respect for human rights. Additionally, Article 26 of the Convention on the Rights of Persons with Disabilities (CRPD) adds that this right should be fulfilled without discrimination and with equal opportunity. It is also mentioned that involved state parties should ensure that accommodations required by the individual should be provided along with support measures in environments that maximize academic and social development. This article was brought into existence in 1948, and its lack of implementation in the 21st century is a clear sign of the urgent need for inclusivity in academic systems. Thus, by not providing a supportive and

inclusive academic environment, schools and universities are not only inhibiting the growth and potential of students with autism, but they are also not allowing these students to exercise their rights⁶. The needs of an individual with autism can be diverse and sometimes invisible to their neurotypical peers and faculties. Gelbar et al found that students with autism reported needing not only academic support but also mental health support for issues such as anxiety and depression. Along with that, students also expressed the need for support in time management, social interactions, and self-advocacy⁷. Fabri et al also showed that 50Understanding the etiology and neuroscience behind ASD can help us not only to identify these invisible needs but also to address them effectively. A holistic framework for an evidence-based autism-friendly academic environment that is inclusive and accommodating is the need of the hour and a right for students with autism. It can help screen the students at risk for ASD, aid in early diagnosis, plan an early intervention, and provide effective support systems in academic environments. Our narrative review was underpinned by a comprehensive PubMed and Google Scholar review encompassing articles related to ASD, systematically coupled with each of the following terms: aetiology, neurodiversity, stigma, accommodations, masking, and double empathy from January 2000 to the present date. We diligently pursued relevant citations, allowing our search to cascade and attain saturation. The holistic framework development has been influenced by the discoveries, theories, and critical analyses present in the references, along with additional areas of research identified as significant in our initial search and incorporated into our snowballing strategy—such as exploring the concept of neurodiversity in autism.

Collating Research Findings

The figure 1 represents the constitution of neurodivergent and neurotypical students in the overall population of students. The peak of the curve is where most of the neurotypical students lie which is within the boundaries of societal norms. The farther we move away from the peak, the more neurodivergent the student becomes, with an increasing need for early diagnosis, intervention, and accommodation. Neurodivergent students are also at a greater risk of stigma since they fall out of the typical societal norms. The current academic system is built to accommodate neurotypicals and thus, further accommodations are required for neurodivergent students⁸.

Understanding the Etiology, Cognitive Neuroscience, and Factors Contributing to Autism

The etiology of ASD is complex, often involving multiple factors, and many times it is poorly understood. Identifying individuals who are at high risk for developing ASD may help us to screen them appropriately, and diagnose them early thereby

leading to enhanced intervention and improved outcome. Behavioral signs [table 1] considered to be the defining symptoms of autism, unfold only in the second year of life and cannot be used for early diagnosis. The delayed onset of symptoms is a significant setback since the current screening tools rely on behavioral symptoms for the diagnosis of autism. One of the possible ways to ensure earlier diagnosis is implementing an “infant sibling” study design which leverages the increased risk of occurrence of autism in children with siblings diagnosed with autism. This risk is approximately 20% for subsequent younger siblings with a 15-20-fold greater risk of being diagnosed with autism than the general population. Apart from ASD, the siblings of children with ASD have a higher incidence of developmental delays and other psychiatric disorders. Thus, utilising the infant-sibling design to screen high-risk individuals for ASD to provide early diagnosis and intervention is one of the possibilities to accelerate diagnosis⁹.

Despite the efforts to diagnose children with ASD early, most of the studies in our literature review have not been successful in finding explicit behavioural markers associated with ASD risk in infants of 0 to 1 year¹⁰⁻¹². Although a small number of infants do display signs associated with ASD risk, the unfolding of symptoms related to ASD is often subtle and challenging to identify, resulting in potential missed diagnoses. Few small studies have used immune dysregulation in mothers as early as in the second trimester to predict the risk of ASD among their children by measuring inflammatory cytokines in the maternal and cord blood¹¹⁻¹³.

Apart from the behavioral signs, certain biological findings have been implicated to be accurate in predicting the risk of autism in individuals. One of the most consistent findings is the brain size of children with ASD which is normal at birth but significantly enlarged by 2-3 years¹⁴(12). Furthermore, a study on MRI (Magnetic Resonance Imaging) findings in ASD has shown that the High-Risk Autism group had faster growth of brain volume and an overall greater brain volume on average. In a study involving 106 infants at high familial risk of ASD, 15 were diagnosed with ASD at 24 months. These 15 infants had hyperexpansion of the cortical surface at 6 to 12 months and increased brain volume at 12 to 24 months. This study also linked the over-increase in brain volume with the social deficits associated with ASD¹⁴. Based on these studies, using an MRI to identify infants with ASD in clinical practice requires further confirmation by larger studies¹⁵, and further research in the clinical implementation of these imaging techniques to accelerate ASD diagnosis is required.

Recent studies have also shown infants who developed autism had excessive cerebrospinal fluid in the brain and spinal cord (CSF), and this finding precedes the manifestation of behavioral symptoms. Cerebrospinal fluid is an ultrafiltrate of plasma contained within the ventricles of the brain and the subarachnoid spaces of the cranium and spine. Disturbance in the production

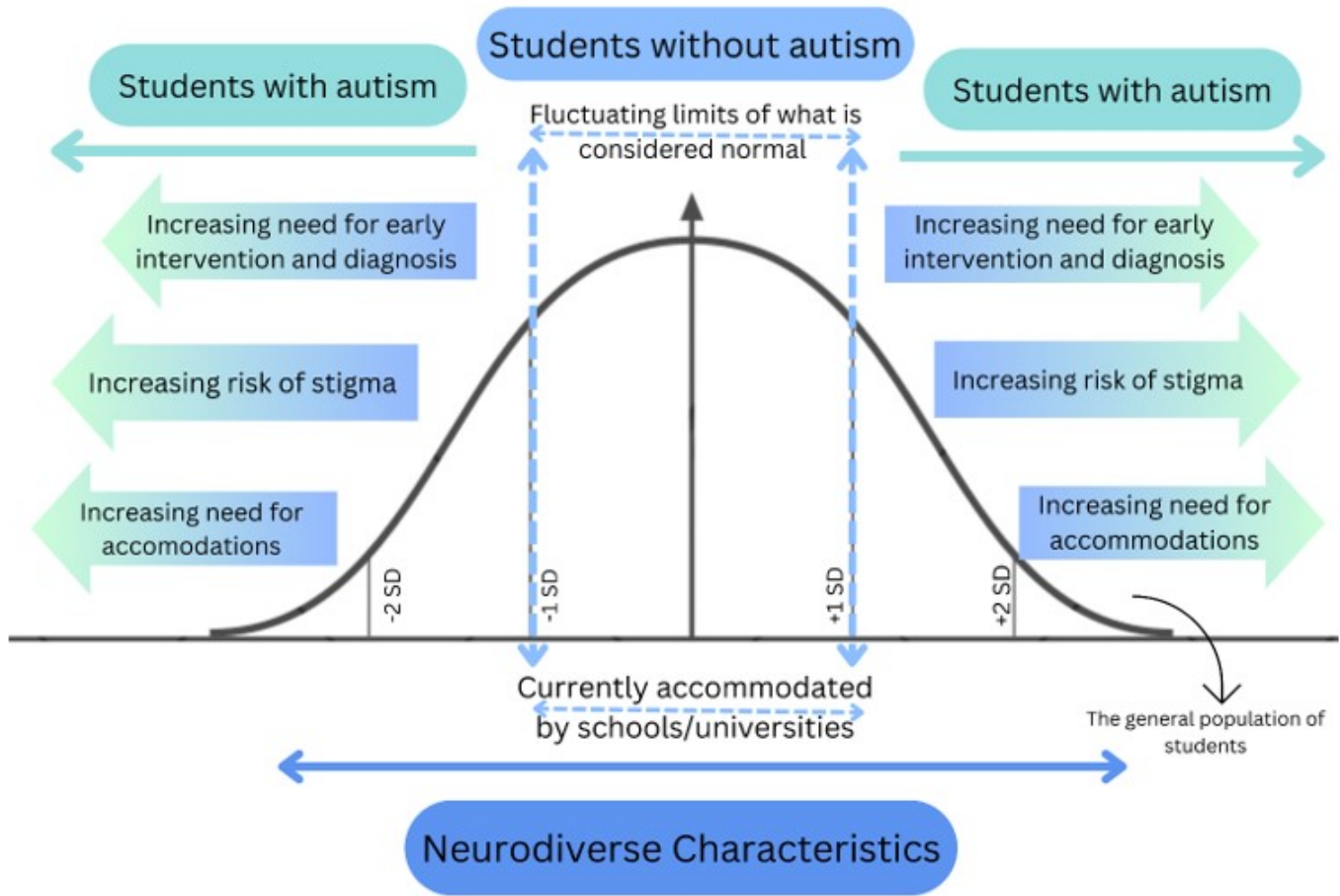


Fig. 1 Graphical Representation of The Composition of Neurodiversity in The General Population of Students.

and absorption of CSF also causes significant consequences on cortical development by impairing the clearance of inflammatory proteins such as Amyloid-. In the study, infants who had more severe autism later had a more pronounced excess in CSF, particularly in the subarachnoid space and the frontal lobes. Excessive CSF in the first 6 months of life was also associated with deficits in motor skills^{15,16}. A study involving 125 children with autism and 69 typically developing children in the age group of 2.5 to 7 years, tested the hypothesis that individuals with autism have atypical development of white matter development across childhood. The study also aimed to identify the relationship between the severity of the disorder and altered white matter development. Andrews et al study showed that children who had an increase in their symptoms of ASD had slower developmental of fractional anisotropy (FA) in their white matter, compared to other children with autism. Fractional anisotropy is a diffusion tensor-based metric, that can be used to predict the progression of disability or decline in cognition. The clinical application of these brain imaging studies is dubious and yet to be implemented worldwide¹⁶.

Trans-diagnostic approaches have also been suggested for early diagnosis of ASD. As the risk factors of ASD and other psychiatric disorders overlap, new research studies have been focused on the intersection between ASD and other psychiatric disorders such as attention deficit hyperactivity disorder (ADHD). Central domains of behaviour such as regulation of attention and temperament, social communication and interaction, perception and motor skills are disrupted both in ADHD and autism¹⁷. Behaviours such as reduced orientation to name may be seen in infants with ADHD and ASD¹⁸. Similarly, there has been work in trying to improve our understanding of the intersection between anxiety disorders and ASD. These are not descriptive examples but serve as examples of the difficulty in distinction of various psychiatric disorders during diagnosis. The overlap between ASD and other psychiatric disorders possibly arises due to phenotypic and etiological similarities. Interventions for disorders such as ASD have a diminished impact when the diagnosis occurs later. Utilizing the overlap of characteristics between psychiatric disorders to implement a cross-disorder diagnostic approach and intervention is crucial. Specialized interventions addressing not only the symptoms of ASD but also the potential manifestations of other psychiatric disorders are critical for improving the overall outcomes of children exhibiting symptoms that cut across various neurodevelopmental disorders.

As ASD is a heritable disorder, identifying the genetic risk factors contributing to brain development, communication and social interaction can provide valuable leads in understanding the etiology of autism¹⁹. Autism is marked by behaviour in the three domains of social interaction, language and imaginative play. Thus, studies examining the role of genetics in these symptoms and their contribution to the pathogenesis of autism

are key to understanding the etiology of autism^{20,21}. Due to the association of genetics with the symptoms of ASD, other neurodevelopmental syndromes with ASD-like genes such as Fragile X syndrome show close relations with ASD. Our literature review showed that 18 to 67% of males with mutated Fragile X (FRAXA) gene *FMRI* meet the criteria for ASD^{22,23}. Clinically, individuals with the mutated *FMRI* gene have definite physical and behavioral attributes. Behaviorally, male individuals typically have individual disabilities, anxiety, attention-deficit hyperactive disorder, and sensory processing deficits, while female individuals have manifestations such as depression, social anxiety, excessive shyness, self-injury, poor eye contact, withdrawal, and phobias²⁴. However, the phenotype of autism is still vague due to wide-ranging genetic variations, and its interactions with ASD-like genes make interpreting ASD's pathogenesis difficult. Previous research in addressing these difficulties includes the identification of genetic mutation at specific chromosomal loci that are relevant in neurodevelopment in individuals. Some of the genes long considered to contribute to autism include *FOXP2*, *RAY1/ST7*, *IMMP2L*, and *RELN*²¹.

Due to the variety of ASD-risk genes, identifying the unknown biological underpinnings and pathophysiology of autism is complex as the phenotypic manifestations of these genes are harder to support when repeated in animal and cellular models. However, experts are optimistic that the examination of the convergence of genes, proteins and behaviour associated with ASD, will make significant contributions to our current understanding of ASD. So far, ASD-associated genes and proteins are expressed very early in the brain developmental period during the prenatal period^{25,26}. Despite the promise shown by the findings of genetic testing, its interpretation is difficult clinically. Predicting the levels of severity and phenotype of the disorder accurately remains challenging as genetic variation associated with autism shows variable levels of penetration in the general population²⁷. The most relevant to this review is considering the negative aspects of genetic testing when the clinician fails to detect a variant and addressing the anxiety of the families regarding the unexpected diagnosis of autism after a positive genetic test, guilt and shame associated with the inheritance of the variance which has contributed to their child's diagnosis. These concerns need to be addressed with empathy and consideration and should be accompanied by high-quality clinical research^{15,28}.

Growing evidence suggests that certain facets of the brain are responsible for social cognitive functions, such as understanding facial expressions and noticing the angle of eye contact, which are significantly impaired in individuals with autism. For example, the limbic system is considered to support functions such as motivation, long-term memory, motivation and olfaction. The amygdala and hippocampus, the main structures of the limbic system, contribute to emotion and memory²⁹. The amygdala might also be responsible for facets of social cognitive function

such as paying attention to facial expressions. If this is so, then the amygdala may be a prime location for impairment in ASD²⁸.

The Applications of Understanding the Etiology and Neuroscience of Autism

There is an imminent need for identifying biomarkers for autism but a problematic accomplishment to be made. The US National Institutes of Health (NIH) working group established the definition of a biological marker as “a characteristic that is objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes, or pharmacological responses to a therapeutic intervention”.

Biomarkers can serve as a diagnostic tool, help us in the identification of the severity of ASD at presentation, be a prognostic marker, and most importantly, aid us in the early detection and intervention of disorders. Autism biomarker studies can help us to flag high-risk individuals and alert them for early intervention. Some biomarkers include cortical surface area growth, increased CSF, and impaired white-matter connectivity, whose significance has been discussed earlier in the review.

While it is clear that neuroimaging studies mentioned above have ample potential for detecting biomarkers, the sample sizes of these studies are modest and have many challenges. Other biomarkers studies focusing on physiological and molecular biomarkers are also being conducted, but to date, no biomarkers have been approved for clinical use by the Food and Drug Administration³⁰ need for larger sample sizes and multiple comparisons along with large-scale replication cohorts are necessary for these studies to be implemented clinically. The social implications of biomarker studies and early intervention have been up for debate as it can lead to parents inhibiting the child’s opportunity due to prejudices about their child’s diagnosis and when the process of intervention is not provided by a clinician trained in dealing with families in these situations, they may do more harm than good. Thus, a holistic approach where the psychosocial aspect of biomarkers and early intervention is considered along with the biological aspect is key towards establishing progress towards better outcomes for the child overall³¹.

Conventional screening tools diagnose ASD after the age of 2 years leading to the loss of age-specific window. The first two years of age are associated with the highest neuroplasticity. Neuroplasticity is defined as the ability of the nervous system to change its activity in response to intrinsic or extrinsic stimuli by reorganizing its structure, functions, or connections³². Thus, providing interventions when the brain is most susceptible to adapting itself according to external stimuli leads to the best possible outcome⁹. Preliminary evidence shows that early diagnosis followed by intervention is associated with better long-term outcomes among children with ASD³³, and can reverse some of the symptoms of ASD³⁴. These improvements are due to the changes in the structural and functional components of the brain

possibly due to the innate ability of the brain to re-organise and rewire itself. Few studies have suggested that neuroplasticity is not limited to early age developmental age^{35,36} but is also seen during puberty³⁷, and adulthood^{38,39}.

Understanding genetics associated with ASD can help us to accurately screen for high-risk individuals and create a personalized intervention program. Prediction of severity and comorbidities of ASD using genetics will aid in implementing a generalized intervention program for individuals with similar genetics and severity.

A major setback for providing individualized and targeted treatments is the heterogeneity of Autism and its wide range of symptoms. Biological markers and genetics can help to bridge the gap and frame clear biological subtypes that are not completely dependent on behavioural symptoms. Biological subtypes can help to group individuals with similar pathophysiology (like excess cerebrospinal fluid) and create an efficient and precise framework for the provision of targeted treatments, interventions, and accommodations at various levels. More biomarker-driven studies are required to test the hypothesis of using the neuroplasticity associated with the first two years of age for better outcomes.

Examining the Challenges of the Current Academic System

In the United States, students with autism made up 12% of the nation’s schoolchildren with disabilities in 2021-22, compared with 1.5% in 2000-01⁴⁰. In a study on 27,143 first-year students in the Netherlands, from 2010 to 2016 the proportion of students with ASD in college significantly increased from 0.20% to 0.45%⁴¹. The factors contributing to the increasing prevalence include an increase in community awareness and public health response, advancements in case identification, changes in the case definition, and an increase in community capacity⁴²Newman et al. reported that less than 40% of students with ASD completed postsecondary education, unlike their neurotypical peers, with a college graduation rate of nearly 60%⁴³. This is of major concern since education can contribute to a better quality of life. A report from the U.S. Department of Commerce has suggested an income gap of one million dollars between an individual with a college degree and a worker with a high school diploma (U.S. Department of Commerce U.S. Census Bureau). This gap tends to widen over the years and demonstrates the potential role of post-secondary education in a better quality of life (Professional School Counseling on JSTOR, 2023.) Nicholes Gelbar et al. conducted a study of 35 students with autism and reported that most students had high levels of academic success but found difficulties in social experiences and executive functioning tasks, such as time management and study skills. These difficulties are often invisible and overlooked by universities and schools and require due consideration⁷.

The current academic system is geared towards neurotypical

students and poses a plethora of visible and invisible challenges to neurodivergent students. Understanding the cause and perpetuation of these challenges is necessary to implement changes that will effectively address these problems, providing long-term solutions that make a real impact on inclusivity.

This can include

1. Overwhelming environments and overstimulation
2. Inflicted and felt stigma.
3. Difficulty in accessing accommodations and services provided
4. A dearth of positive and holistic representation of neurodiversity in media
5. Scarcity of awareness and support regarding neurodiversity and mental health
6. Masking and social camouflage
7. Dealing with anxiety and depression
8. The double empathy problem

A large part of these challenges is caused by the fact that the world is not designed to consider the diverse needs of individuals with neurodiversity and/or disabilities and a lack of awareness surrounding the topic of mental health. The ASD-friendly environment in academic institutions plays a significant role in the provision of a support system.

1. Specific environments that are visually cluttered, loud, or crowded can often be overstimulating for individuals with autism. Schools and universities with overstimulating environments can make it an overwhelming and unpleasant experience⁴⁴. Black et al suggested that individuals with autism have differences in processing sensory information in comparison with neurotypical individuals. Certain aspects like layout of classes, wall colors, decors, sound proofing, placement of windows and blinds can make the environment more inclusive and friendlier to everyone including individuals with ASD. Without the appropriate support system or accommodations, such environments can lead to the manifestation of stimming or repetitive behaviors. In some cases, individuals may resort to unhealthy coping strategies as a response to stress and anxiety^{45,46}. New surroundings with unfamiliar peers may present an uncomfortable environment for individuals with ASD which may necessitate stimming or other coping behaviors for stress control. However, due to the new environment, individuals may not be comfortable with stimming or other “noticeable” coping behaviors due to past experiences with stigma. This perpetuates masking or social camouflage

to “fit in” or appear “less autistic”. In a study involving 35 individuals (with and without autism), both individuals with and without autism reported negative effects on mental health and self-esteem due to masking and camouflage. Despite the common negative effects, only individuals with autism seemed to describe sensory suppression and masking leading to suicidal ideation⁴⁷.

2. One of the most difficult challenges is the stigma around autism and neurodiversity in general. Stigma is defined as “a socially constructed concept; any attribute that is seen as unfavorable and that seemingly discredits an individual, leaving them to be viewed as less valuable than the rest of society”⁴⁸. Thus, the stigma surrounding autism stems from the notion that autism is an unfavorable trait and misinformation about autism. Stigma from the surroundings is called public/enacted stigma, which can in turn lead to self-inflicted stigma, or stigma felt by oneself. It can have a profound negative impact on the mental and physical health of an individual and can lead to masking/camouflage. It can also lead to reluctance to seek diagnosis and intervention for autism⁴⁹. The fear of stigma from peers is also one of the invisible factors with can contribute to the overwhelming experience of being in new situations and can lead to building negative associations with new situations and also masking/camouflaging. While there are plenty of theories explaining the concept of stigma, Link and Phelan’s conceptualization of stigma argues that stigma develops from identifying and labelling the differences that people might have among them⁵⁰. The other factor associated with stigma is loss of status and feelings of exclusion or discrimination. For example, Stigma against autism may have begun by labelling people with certain characteristics like unfriendliness and antisocial behavior with autism which finally led to alienation from society, leading to an ‘us (neurotypical’) versus ‘them (people with autism) mindset’⁵¹. This stigma can manifest in academic institutions where students with autism may not be considered potential candidates for Leadership roles or group activities due to their neurodiversity. Thus, several factors are contributing the the stigma surrounding the autistic community which hinders the inclusivity and belonging that are crucial for the mental health and well-being of students with ASD⁵².
3. Accommodations are the support system provided by academic institutions to meet the needs of students with ASD. A feedback study on accommodation services provided by academic institutions among students with autism reported that very few institutions provide ASD-friendly accommodation. Students also expressed having difficulty accessing diagnostic services due to the cost, lack of support from faculty and inability to provide personalized accommodations based on special needs^{48,53}. Students also hesitate to ac-

cess their accommodations due to fear of negative response and stigma. Students reported not wanting to be seen as “different” because they utilized these accommodations and also being afraid of being seen as “lesser” due to their request. Certain students had concerns where they didn’t want their identity to be defined by their disability. Students in a study also reported feeling like faculty and staff were lacking knowledge of disability which discouraged them from accessing accommodations⁵⁴.

4. Media plays an important role in people’s view of neurodiversity with their stereotypical portrayal of individuals with ASD as unfriendly, and needy, using degrading terms like ‘crazy’ or ‘stupid’, overfocusing on sensory issues but not representing social issues like stigma associated with autism. Most media portrayals use autism as a plot instead of a holistic portrayal of the personality of a character with autism. Lack of diversity associated with these portrayals and stereotyping of these characters as white heterosexual males can form inaccurate and discriminatory perspectives that hinder the interactions of the viewers with neurodivergent peers for their lifetime⁵⁵.
5. Poor support services may lead to unhealthy coping strategies called masking among students with autism due to stress and anxiety⁴⁶. Masking or social camouflage is one such coping mechanism in which the individual utilizes certain mannerisms and behaviours to cope with the predominantly non-autistic social world – thus ‘camouflaging’ their autistic traits⁵⁶. New surroundings with unfamiliar peers may present an uncomfortable environment for individuals with ASD which may necessitate stimming or other coping behaviors for stress control. However, due to the new environment, individuals may not be comfortable with stimming or other “noticeable” coping behaviors due to past experiences with stigma. This perpetuates masking or social camouflage to “fit in” or appear “less autistic”. In a study involving 35 individuals (with and without autism), both individuals with and without autism reported negative effects on mental health and self-esteem due to masking and camouflage. Despite the common negative effects, only individuals with autism seemed to describe sensory suppression and masking leading to suicidal ideation⁴⁷. Other studies show that there is not enough evidence to show that camouflaging mediates mental health problems among students with ASD³⁶. Thus, an environment that perpetuates feelings of exclusion will lead to lowered mental health and increased masking.
6. Lack of awareness among the faculty plays a significant role in the accessibility of accommodation services for students with ASD⁵⁴. In a study examining the awareness and attitudes of faculty towards neurodivergent students, re-

searchers found that faculty were unable to perceive autism as a disability due to its ‘invisibility’, thus denying students’ accommodations as they didn’t ‘look’ disabled. The mentality of using what is available can be observed as certain services such as mental health support were not available and instead, students were asked to utilize the services for physical disability. Certain faculty also expressed the need for training and programs to educate themselves about autism and neurodiversity. It is important to note that even trained healthcare professionals and faculty in dealing with students with ASD may face difficulty in real-life situations. For example, UK professionals involved in a study displayed adequate confidence in their knowledge of autism but were not as confident in working with individuals with autism during their daily practice⁴⁸.

7. Individuals with autism are more likely to experience depression and anxiety in comparison with neurotypical individuals. Recent meta-analysis suggests individuals with autism are 4 times more likely to suffer from depressive disorders than neurotypical individuals^{57–60}. Social isolation and loneliness are linked with the development of anxiety and depression disorders among individuals with ASD. A survey conducted across 14 colleges found that students with autism reported poorer physical and mental health, and increased symptoms of anxiety and depression even after considering other disabilities they may have experienced⁶¹. In another study, students with autism and other disabilities also showed worse outcomes in areas such as mental and physical health, social communication and bullying. While these challenges may be attributed to the psychiatric comorbidities associated with autism, these challenges may be perpetuated even further due to the stigma, alienation and lack of support that they experience. In a study by Holmes et al, group group-based psycho-educational program on healthy relationships for 55 individuals with ASD in the age group of 20 to 43 years was found to be a promising intervention for the improvement of depression and anxiety⁶⁰.
8. Double empathy problem is a disjuncture in understanding between two differently conditioned social actors—in this case—referring to the gap in communication between a neurodivergent and a neurotypical individual^{62,63}. A study of 40 adults with 20 individuals with ASD and 20 neurotypical individuals showed that neurotypical individuals formed less than favorable first impressions of their neurodivergent peers and displayed less intention to further pursue social interaction with them. The lack of depth and understanding in neurotypical-neurodivergent interactions is often attributed to perceived deficits in social skills among neurodivergent individuals. However, this viewpoint is not only unfair but also hinders neurotypicals

from making efforts to understand and educate themselves about neurodiversity. The double empathy problem can help neurotypicals perceive the role they might play in their interactions with neurodivergent peers. Further research aimed at understanding the barriers faced by neurotypical students while interacting with neurodivergent individuals can provide deeper insights into the application of this concept in creating inclusive environments where neurodivergent individuals feel comfortable and seen by their neurotypical peers^{64,65}. The annual per-child cost of ASD relative to no ASD diagnosis was \$3930 according to the National Health Interview Survey (NHIS) Sample Child Core questionnaire and \$5621 according to the Medical Expenditure Panel Survey⁶⁶. Thus, a diagnosis of ASD places a huge burden on the family and makes them vulnerable to financial crises. At the government level, financial aid is needed to establish diagnosis and intervention, and at the community level, they need scholarships and funding for education⁶⁷⁻⁷¹.

Ongoing Efforts to Mitigate the Challenges Faced

Despite the lack of ASD-friendly environment in academic institutions, it is important to acknowledge the progress that has been made. The most common accommodations for students with autism in schools and colleges are excess test time, distraction-free examination, flexible deadlines for projects and assignments, clear directions, and teaching using visuals and group activities. Some schools and colleges also provide peer-led support groups where students can share their experiences and connect with other peers with autism. One such group, named “In My Shoes,” is a peer-led, teacher-supported, school-based intervention that showed promise in improving the school participation and connectedness of students on the spectrum. This support group provided online teacher training, and support, peer training, lesson plans relating to the health curriculum, activity ideas to involve key messages in school and weekly parent handouts and invitations to join the intervention. Their main aim was to increase understanding of differences in the way students experience ASD, increase inclusivity and acceptance, and confidence in identifying when someone needs help and how to provide it. In the study, the support groups were shown to be effective in increasing peer understanding and acceptance of autism while increasing interactions between the students with ASD and their peers. Parents and teachers also reported an increase in confidence in the students with ASD and empathy from their peers. At the school level, support groups were successful in reducing the stigma surrounding neurodiversity, increasing awareness about ASD, and making them understand the importance of seeking help and being empathetic towards each other⁷². Such efforts can also encourage students to seek out early interventions and diagnostic services for a better qual-

ity of life⁵⁵. Studies show that stereotypical and discriminatory portrayal of autistic characters in media can lead people to form negative views of people with autism, whereas the opposite can actually lead them to attribute positive traits to people with autism. Thus, Positive representation in media which includes shows and movies may help in destigmatizing the disorder and engaging new discussions about neurodiversity. It may also help young children in forming positive associations with the term “autism.” New technology such as the *Auti-sim* can help us to provide a new perspective for neurotypical individuals on what it means to be on the spectrum. *Auti-sim* is a virtual simulation that aims to reduce stigma by allowing neurotypical people to experience sensory overload and experience overstimulation. Such technology in schools can help children develop a more empathetic attitude towards their neurodivergent peers through novel experiences like the *Auti-sim*³⁵. Similarly, a study showed that virtual reality simulations help promise in helping non-autistic individuals put themselves in the shoes’ of an individual with autism. The individuals showed better awareness and knowledge of autism after experiencing the simulation⁷³.

Though these strategies contribute to a more inclusive environment, they are scattered and not comprehensively available at all institutions, thus inhibiting their potential to aid neurodivergent students across all aspects. Thus, there is a clear need for a more comprehensive and efficient system that provides accommodations and fulfills all aspects of support that may be required by students.

Discussion

The primary implication of our review is to establish a holistic framework for supporting neurodivergent students through a dedicated academic unit within the institution, emphasizing continuous adaptation based on regular feedback from these students. Each of the topics reviewed above was thoroughly examined to incorporate the pertinent and corroborative findings of the research study into the formation of a comprehensive framework. This framework aims to create an inclusive and aware environment essential for accommodating students with ASD. The purpose of this study was not to review all the individual findings from the literature but to provide an overview of those findings relevant to accommodations services at academic institutions. A limitation of this study is that the majority of the data used to produce this paper is derived from studies conducted in developed nations. This is due to the scarcity of resources representing developing nations, and as a result, the findings may not be fully representative of the current state of academic environments worldwide. The outcome for individuals with ASD is dependent on early diagnosis, followed by the initiation of intervention at a younger age. The first two years of life are associated with the highest neuroplasticity of the brain, where the maximum efficacy of intervention can be

achieved. Identifying the high-risk autism group based on the infant sibling study design and screening them with MRI brain imaging early in infancy can increase the accuracy of diagnosis and aid in the provision of early intervention. Biomarker studies, relying on inflammatory markers and genetic analyses, have the potential to identify ASD early but require further validation through larger studies before being applied in clinical practice. Accompanied by accurate diagnosis, trained clinicians with empathy providing parents with the right information about ASD, and understanding the factors contributing to the etiology of autism can be a powerful tool to support individuals with autism even before they reach school age.

Issues with existing academic systems

Despite the recent efforts to provide an environment adapted to the needs of ASD, a lot of them are not practical and are also not effective in some cases. The main issue with the current framework is that these accommodations are being framed from a neurotypical perspective and require modifications based on the consistent feedback obtained from the students. This is important since the experiences of each student differ and one perspective will not be sufficient enough to support the majority. For example, students in Gelbar et al reported the need for mental support in addition to academic support, which is often overlooked⁷. Additionally, all of these components of accommodation services are usually accessible through different points of contact which cause hassle and make it difficult to access.

Holistic framework

Our holistic framework (Fig 2 and Table 2) aims to provide actionable solutions for every challenge mentioned in the previous section, with seamless integration and provision from a single dedicated unit. This dedicated unit would serve as a comprehensive provider of all accommodations and services, making sure all students with autism are provided with these accommodations without the need for request or hassle. We have also incorporated the principles of universal design into the components of our framework. The universal design approach aims to design spaces that are comfortable for a wide variety of people, rather than just neurotypical individuals. Universal Design is defined as “the design of products and environment to be usable to the greatest extent by people of all ages and abilities”. It employs the core principle of the creation of a simple, flexible, equitable, and intuitive model⁷⁴. It applies to the mode of instruction, student services, technology, and accessible spaces. Universal Design doesn’t aim to fix or correct a student’s behavior to fit the environment but rather focuses on how an environment can be designed to fit more people. Shifting to a universal design can be beneficial in reducing overstimulation and will be a better-adapted model for neurodivergent

individuals^{75,76}.

A. Academic aspect of our holistic framework:

1. Incorporating transition programs and pre-university experiences can help in familiarizing students with new environments and preparation for the change from school to university which can be a difficult transition. Providing neurodivergent mentors or counselors on campus will also aid in providing positive representation and can make asking for accommodations less daunting⁷³.
2. Timetables would be flexible and students should have the option to attend it online or in person, depending on their needs. Students should be given flexibility in their note-taking methods and tutoring programs. Professors should be available separately from the regular lectures, so assistance can be provided for students struggling in certain areas of their academics.
3. Considering the challenges faced by neurodivergent students, the deadlines for assignments and worksheets should be personalized and flexible. Extended test time and the option to take tests in ASD-friendly spaces should be provided. This will not only improve their academic performance but also make exams a less daunting experience.
4. Faculty training and awareness programs should be held regularly to enhance their ability to support students with ASD. The presence of in-house mental health counselors to help students with comorbidities such as anxiety and depression should be mandatory.

B. Environmental aspect:

The availability of safe spaces and autism-friendly rooms is crucial for emotional and mental health since overstimulation can be common in lecture halls and crowded classrooms. Such spaces should be multi-sensory and stimulating while ensuring it’s not overstimulating or overwhelming. Black et al study showed that improving the built-in environment using simple spatial layouts, compartmentalizing and zoning spaces into specific activity sections and providing retreat spaces provides an inclusive environment for everyone including students with ASD⁴⁵.

C. Social and mental health provisions:

1. Organizing support groups and clubs where students can share their experiences and special interests can cultivate new friendships between individuals with autism and also help to battle stigma and misconceptions. At the school level, teacher-led organizations will encourage bridging the gap between neurodivergent peers and their neurotypical counterparts. These organizations would not only be limited to students, but the involvement of parents and family

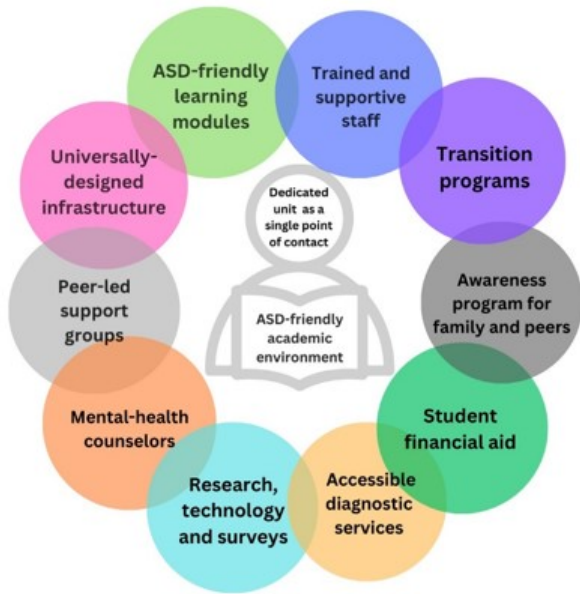


Fig. 2 Showing the Components of The Holistic Framework of Possible Accommodations for Asd Asd-Friendly Environment. The picture is a diagrammatic representation of some of the possible accommodations that can be provided for students with autism in schools and colleges. The accommodations have been organized into 10 broad sections elaborated in Table 2.

members would also improve awareness immensely. These groups would aim to stimulate healthy and productive discussions about mental health and neurodiversity. These groups would also be examples of how to be supportive of neurodivergent peers and help resolve the double empathy problem that has been mentioned earlier in this review. As participants of these groups, neurotypicals would understand the role that they play in their interactions with neurodivergent peers and comprehend the barriers that neurodivergent peers face in their day-to-day life.

2. Trained counsellors specialized in interactions should be present on campus along with disability advocacy units who can aid the students in tackling issues they might face in the university.
3. While it is not yet clear how universities can alter the portrayal of characters with autism in media, recognition and encouragement of the achievements and progress of students with neurodiversity can help ensure that potential applicants with autism are encouraged to apply and continue in their pursuit of education.

Currently, there is a gap between etiology and its applications that needs to be bridged to create a comprehensive, evidence-based plan for an inclusive and accommodating academic en-

vironment. Understanding the etiology and cognitive neuroscience can help in analyzing the needs of the individual with ASD and also compare their needs to other individuals with similar pathophysiology or biological subtypes. The aforementioned dedicated unit for the neurodivergent students department would be equipped with all the pre-existing data and history of the respective students' mental health and neurodiversity and its etiology. This would also help in framing a personalized support system that can also be changed to suit the needs of other individuals with similarities in brain structure, genetics, or social factors. Future studies about the genetics and etiology contributing to ASD and its effects on behavioral and intellectual symptoms can help improve our current understanding of ASD and this information can be applied in the provision of accommodations as well.

Conclusion

The increasing incidence of neurodivergent students mandates the urgent need for a holistic framework for supporting neurodivergent students through a dedicated academic unit within the institution, emphasizing continuous adaptation based on regular feedback from these students. A holistic framework that supports the mental, academic and social needs of neurodivergent students and is accompanied by a supportive and progressive faculty and peer group. This approach will nurture a new generation of students who will not only exercise their right to an inclusive education but can also thrive and realize their full potential across all domains. We suggest institutions adopt this framework by conducting surveys to discern the specific requirements of neurodivergent students within their community. Subsequently, assemble a dedicated unit of individuals committed to addressing the needs of neurodivergent students.

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Table 1 *

Illustrates the diagnostic criteria for ASD, which states that the child must have deficiencies in each of three areas of social communication as well as two of four types of repetitive and restrictive behavior at minimum (Diagnostic Criteria — CDC 2023.)⁹

Persistent deficiency in social communication and social interaction	Signs of restriction and repetition in routines, behaviors, and activities	Other criteria
<ul style="list-style-type: none"> • Deficiency in social-emotional response • Unique social perspective • Lack of effective back-and-forth dialogue • Reduced mutual engagement and feelings • Inability to initiate or respond to social engagements 	<ul style="list-style-type: none"> • Stereotyped movements, use of objects, or speech basic motor patterns (e.g., lining up toys or flipping objects) • Repeated echoing of words or phrases • Use of idiosyncratic phrases 	<p>The symptoms manifest during the early developmental phase, although they may not become fully apparent until individuals face social demands that exceed their capabilities or might be concealed by adaptive strategies.</p>
<ul style="list-style-type: none"> • Deficiency in nonverbal communicative behaviors used for social interaction • Limited synchronization of verbal and nonverbal communication • Atypical eye contact and body language. • Challenges in understanding and utilizing gestures. • Scarcity of facial expressions and nonverbal communication abilities 	<ul style="list-style-type: none"> • Insisting on sameness, inflexible conformity to routines, or ritualized patterns of verbal or nonverbal behavior • Extreme unease in response to minor alterations • Difficulty adapting to changes • Inflexible cognitive processes • Establishing specific greeting routines • A strong preference for following identical daily routes and same food. 	<p>The symptoms result in notable impairments in one’s present social, work-related, or other essential aspects of functioning.</p>
<ul style="list-style-type: none"> • Deficiency in nurturing, sustaining, and comprehending relationships • Difficulties in adapting behavior to diverse social situations • Challenges in participating in imaginative play or forming friendships • Minimal interest in peers 	<ul style="list-style-type: none"> • Unusually intense restricted/hyperfixated interests • Intense affection for uncommon items • Excessive fixation on limited or repetitive interests • Increased/decreased response to sensory stimulation or unusual interest in sensory aspects of the environment • Lack of responsiveness to pain or temperature • Negative reactions to particular sounds or textures • Overly frequent smelling or touching of objects. • Compelling visual fixation on lights or motion. 	<p>Co-occurrence of intellectual disability and autism is common; to diagnose both autism and intellectual disability, social communication skills should fall below the expected level for general development.</p>

Table 2 the Support Services Required to Address the Special Needs in Each Domain of The Holistic Framework of ASD-Friendly Environment.

A. Academic Aspect	1 ASD-friendly learning modules	<ul style="list-style-type: none"> - Flexible deadlines - Options for online/offline attendance - Visual and auditory teaching methods - Extended test time and accommodations - Provision of note-takers - Academic advisors
	2. Transition Programs	<ul style="list-style-type: none"> - Opportunities to move in before the beginning of the semester - Introduction to faculty before the school year - Offer early registration for classes
	3. Trained faculty and staff	<ul style="list-style-type: none"> - Inclusive and supportive staff - Equipped to deal with students with ASD - Willingness to address special needs/accommodations
B. Environmental aspect	1. Universally designed infrastructure	<ul style="list-style-type: none"> - Provision of autism-friendly spaces - Flexible environment according to special needs - Separate test-taking centers - Classrooms with a reduced number of students
C. Social and mental health	1. Peer-led support groups	<ul style="list-style-type: none"> - Moderated discussions on common difficulties - Safe spaces for sharing experiences - Clubs for special interests - Foster discussions based on inclusivity, neurodiversity, and mental health - Cultivate new friendships among peers
	2. Mental Health counselors	<ul style="list-style-type: none"> - On-campus psychologists - Moderate support group sessions - Group therapy sessions - Help in learning healthy coping mechanisms - Expertise in dealing with individuals with ASD - Conduct regular awareness programs for peers and family members.
	3. Awareness program for family and peers	<ul style="list-style-type: none"> - Battle stigma and misconceptions - Regularly held by mental health counselors with inputs from the ASD community
D. Healthcare, technology and finance	1. Research, technology, and surveys	<ul style="list-style-type: none"> - Further research led by individuals with ASD, rather than 'on' individuals with ASD (Neurodiversity studies: mapping out possibilities of a new critical paradigm) - Research should focus on solving the problems that individuals with ASD have, rather than the problem they are portrayed as. - New technology such as Auti-sim can help new perspectives about ASD emerge - Regular surveys to gauge which accommodations are effective.
	2. Accessible diagnostic services	<ul style="list-style-type: none"> - Easy access to diagnosis and interventions. - Provide access to speech, behavioral, and occupational therapy - Department equipped with pre-existing diagnostic health data of the student
	3. Student financial aid	<ul style="list-style-type: none"> - Scholarship for Students with ASD - Free Diagnostic services and Treatment

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