

Brain Development Differences in Autism
B&K's Studio Research Center Department
Aaroh Deshpande

Brain Development Differences in Autism Overview

When it comes to development, our brain is one of the best examples of adaptability in the human body. Much of what we think, remember, feel, and what we are able to do is acquired during the critical and/or sensitive periods of development. These periods are very important because the brain is highly responsive to learning and taking in many different kinds of information. During this process, neural connections are being formed, strengthened, and changing constantly as we interact with our environment. As development progresses, these changes help in shaping the structure and the function of the brain which influences how we process information throughout our lives. In autism, researchers have uncovered evidence that certain aspects of brain development may follow different patterns like synaptic development and neural connectivity. Studying these differences can help researchers better understand the relationship between early brain development and autism.

Neural Connectivity & Synaptic Development

As a result of using PET scans(Positron Emission Tomography), researchers have found a correlation between the number of synapses and the brain of autistic adults. The brains of autistic adults are more likely to have fewer synapses compared to an allistic person and show more autistic features. The Yale School of Medicine found this correlation was found from a study where participants filled out self-report questionnaires about their experience with having autism throughout their life like social interaction difficulty. In the study, 12 autistic adults and 20 neurotypical adults participated in the study and went through a brain scan which used MRI and PET technology. Results showed that autistic people had about a 17% lower synaptic density

across the whole brain compared to neurotypical individuals. Lower synaptic density was also highly correlated to the number of social-communication differences which includes reduced eye contact, repetitive behaviors, and other symptoms. These findings suggest that the fewer synapses a person has, the higher number of autistic traits that are shown in an autistic individual.

Structure and Brain Regions

While brain development involves many changes in brain functions, it also has its effects in the physical structure and organization of the brain. Many studies started using task-based fMRI which has shown dysfunctional activation in the critical areas of social communication and RRBs. One review of neuroimaging studies found evidence of accelerated brain-volume growth in children with autism around the ages of 2-4. This is followed by slower growth later in development. Researchers have also reported differences in brain regions such as the frontal and temporal lobes, the amygdala, hippocampus, basal ganglia, anterior cingulate cortex, etc. Abnormalities in regions like the Broca's area and the Wernicke's area could be related to defects in language processing and social attention skills. Zielinski measured cortical thickness in many regions of ASD brains and reported that individuals with ASD tend to have thinner cortices and reduced surface area by age-related effects. Although these differences can vary across individuals and different age groups, these findings suggest that autism can involve differences in both the overall pattern of brain development and the structure of particular regions.

Genetics & Biology

Genetic factors play an important role in shaping brain development and in the differences in genes that are involved in neurodevelopment which can contribute to the development of autism. The Autism Spectrum Disorder is classified as a highly inheritable disease with the degree of heritability being estimated between 40-90%. A significant proportion of genetic risk factors remain undefined however. As technology develops rapidly, the inherited risk factors of ASD have been identified through data in patient cohort studies. Genetic and/or environmental risk factors of prenatal and perinatal or postnatal period could cause ASD alone. Environmental factors can include heavy metals, Vitamin D deficiency, older parental age, and birth/pregnancy complications have been shown to be significant risk factors of ASD. Research has identified many genetic variations associated with autism which includes inherited variants, de novo mutations, and the changes in the number of copies of certain genes. These variations can affect biological processes involved in brain development like gene regulation, cell growth, neural communication, and the development of brain structures. Some autism-related genetic variations can also influence the development of the cerebral cortex which can potentially contribute to structural differences observed in individuals with autism.

Brain Development Across the Lifespan

Brain development in autism can follow different patterns at different stages of life. For instance, autism is characterized by an overgrowth of the brain at earlier ages rather than older ages which is when decreases in structural volumes and the number of neurons are observed. An MRI study examining brain growth from childhood through adulthood with subjects ranging from 12 months to 50 years of age found that autistic individuals showed an early brain overgrowth during infancy and toddler years in autistic boys and girls. This is soon followed by

an accelerated rate of decline in size. These findings suggest that differences in brain development could change greatly over time. These age-related patterns are especially important in understanding why brain differences found in young autistic individuals may not be present in the same form later in life. Overall, these findings suggest that autism involves changes in the progression of brain development and timing rather than a fixed pattern which remains constant throughout the lifespan.

Conclusion

Brain Development is a complex process that continues from before birth through adulthood. Research has shown that this process can differ significantly in individuals who are diagnosed with ASD. Differences have been observed in brain structure and regional development, synaptic density, neural connectivity, and also genetic/biological factors that influence early development. These differences can also change in different stages of life, showing that autism isn't associated with one fixed pattern of brain development. Even though researchers have made significant progress in identifying these differences, there is still much to learn about how individuals with ASD develop and how they relate to the wide range of characteristics and symptoms seen in autism. Further research into the biological and developmental processes of the brain can provide a larger and deeper understanding of differences in autism and its complexity. As research methods continue to improve as time goes on, scientists may be able to better understand how these developmental differences emerge and change over time. A more sophisticated understanding of brain development may help researchers better explain the diversity of experiences among autistic individuals.

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