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*Original Paper*

# Characteristics of the Brain in ASD and Effective Ways of Teaching

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***Abstract***

*Autism Spectrum Disorder (ASD) is a sort of neurodiversity that is characterized by repetitive behavior, limited interests, struggling in social interaction, expressing feelings, and many more. It is an innate disorder and combines several previously used definitions of mental syndromes and diseases into one diagnostic unit. Its signs can be noticed in infancy or early childhood, at two years old, or a little later. For instance, the child practices non-verbal communication speaks very little, and repeatedly makes the same movement with his fingers, arms, or legs. Such a person may have intact intelligence and the ability to live in society, but ASD is often associated with cognitive impairments of varying severity. A single cause of the appearance of ASD has not yet been found. Scientists identify only factors that can affect the likelihood of its occurrence, for instance, mutations, problems with pregnancy, or difficult ecological situations.*

***Keywords***

*ASD, special education, socialization, communication, motor skills, cognitive abilities*

## 1. Introduction

The research claims that the reduced asymmetry was mainly related to the thickness of the cortex in different regions of the brain surface. In a healthy brain, this thickness differs between the left and right hemispheres. The cerebral cortex is a thin layer of gray matter covering them. It is the cortex that determines the functioning of the higher nervous activity of a person. “Results of structural Magnetic Resonance Imaging (MRI) studies dealing with total brain volume, regional brain structure, and cortical area are summarized. Using task-based functional MRI (fMRI), many studies have shown dysfunctional activation in critical areas of social communication and restricted and repetitive behaviors” (Yonsei University College of Medicine, Seoul 03722, Korea., 2015).

ASD people are less likely to have the typical asymmetry that determines, for example, the dominant hand when writing. However, the conclusions of these works are pretty contradictory; therefore, the anatomical data obtained by the authors on such a large sample are of interest. Some studies have found that the brain with ASD is too strongly connected, while others are too weak. However, scientists believe patterns emerge from this confusion, such as fewer connections between distant brain parts (and those connections are more fragile) and more ones over short distances (Katznelson, 2019).

The level of cognitive functions in autism ranges from disability to superintelligence. While it is no longer fashionable to associate autism with low IQ, recent studies show that almost half of children with ASD have average or slightly above-average intelligence. Scientists are beginning to acknowledge that this may be because standard IQ tests do not reflect the cognitive abilities of autistic children. In contrast to the rise in IQ, the overall trajectory of autism symptoms reported by parents, while highly variable among individuals, remained unchanged over this period.

## 2. Method

### *2.1 Language Areas of the Brain and ASD*

The human brain is anatomically and physiologically prepared from birth to perceive speech. Thus, in one-week-old infants' brains, human speech sounds are recorded in the left hemisphere, while non-speech sounds are recorded in the right hemisphere. Morphological studies have shown that the dimensions of Wernicke's area (the acoustic-gnostic sensory center of speech located in the posterior sections of the superior temporal gyrus on the left) are more significant in the left hemisphere. Moreover, this asymmetry is revealed already in embryogenesis (Katznelson, 2019). For this, Wernicke's area serves as the area of the auditory cortex, a part of the superior temporal gyrus. Broca's area is in the inferior frontal gyrus and is part of the motor cortex. Both areas are located in the left hemisphere, while structures in the other hemisphere are less associated with speech.

Considering that most speech centers are located in the left hemisphere, he began to be considered the leader in the organization of speech. But one cannot speak of the complete dominance of the left hemisphere in the function of speech. Studies of split-brain patients have shown that the right hemisphere can understand spoken and written language, nouns, and straightforward sentences. Clinical observations also show that if a child who has learned to speak has damage to the speech areas of the left hemisphere, then he develops aphasia or an inability to express speech. "The language segmentation task stimulates a connection between Broca's area in the left frontal lobe of the brain and Wernicke's area in the temporal lobe of the brain's dominant side (the left hemisphere in most). Broca's area is involved in language production and Wernicke's in comprehension" (Deweerdt, 2012).

Broca's center is a kinetic-motor verbal analyzer in which primarily proprioceptive information is processed. With the defeat of this center, the so-called Broca's aphasia occurs, characterized by the impossibility of combining individual speech movements into a single speech act. Wernicke's area is a

part of the cerebral cortex, which, like Broca's area, is associated with speech. It is involved in the assimilation and understanding of written and oral speech. Aphasia occurs when Wernicke's area is affected, receptive, or fluent. It distinguishes it from motor aphasia, or Broca's aphasia, in which the patient uses meaningful words but cannot connect them and speaks in a "telegraphic" manner. A patient with aphasia can easily connect words, but his phrases are meaningless (Brennan, 2021).

The group of nerve fibers through which information is transmitted from the auditory cortex to the motor cortex and vice versa allows the coordination of the work of Broca's and Wernicke's areas in humans. If it is damaged, the person cannot repeat the words he has heard. Therefore, the research claims that "connections between Broca's area and Wernicke's area, brain regions involved in producing and understanding language, respectively, are impaired in people with autism" (Geggel, 2013).

*2.2 Enhanced Rationality and Brain Function in ASD*

ASD is "a wide range of developmental disabilities, have been presumed to be associated with a problem in cortical and sub-cortical dynamics of coordinated activity, often involving enhanced local but decreased long-range coordination over areas of integration" (Luis García Domínguez, 2013). ASD is not only a disorder of social abilities and communication but also of the sensory and motor systems. The brain structure in autism leads to a wide range of sensory and motor impairments. The connection between the department responsible for perception and movement and the cerebral cortex is weakened.

Some studies have found that the brain with ASD is too strongly connected, while others are too weak. These discoveries form the basis of the "intense world" theory. "The proposed neuropathology is hyper-functioning of local neural microcircuits, best characterized by hyper-reactivity and hyper-plasticity. Such hyper-functional microcircuits are speculated to become autonomous and memory trapped, leading to the core cognitive consequences of hyper-perception, hyper-attention, hyper-memory, and hyper-emotionality" (Markram, 2010).

The local hyperconnectivity in some brain areas leads to over-functioning, leading to hyper-receptivity to information and extreme work of attention and sensory processing. It doesn't sound too bad and may explain the geniuses' abilities. Still, the weak connection of distant sites makes it difficult to understand all this incoming information and the ability to prioritize the source of information because the information needs to be adequately integrated. It quickly overloads the mind, so people with ASD try to cope with sensory overload by withdrawing from society or immersing themselves in repetitive activities, which help create a sense of stability and keep an overly bright world within limits. And although this is an interesting theory, it should be treated with caution until it is adequately studied. The severity of the disorder "depends on the severity of the molecular syndrome expressed in different brain regions, which could uniquely shape the repertoire of symptoms of an autistic child (Markram, 2010).

"Empirical evidence strongly suggests that individuals with ASD display enhanced rationality: judgments that are more objective and decision-making that is less biased than that of neurotypical individuals" (Liron Rozenkrantz, 2021). People with autism-related disorders are much less likely to

make irrational decisions and are less likely to be influenced by their suspicions. Decision-making is a very complex process that involves both intuition and analysis. Intuition allows them to make decisions faster but less accurately, relying on heuristics or "hunches". This analysis requires calculation and "rational" thinking, but this process is slow.

The study claims that a significant difference in decision-making among people on the autism spectrum may be in the amygdala. This brain region plays an essential role in the emotional realm. The study showed that the decision-making process depends on the work of the amygdala. In people with autism spectrum disorder, the amygdala tends to differ from most people—not in size but the density of nerve cells. "While altered structure and activation in limbic and reward brain regions may contribute to difficulties in emotion and reward processing in ASD, they may also confer advantages in decision-making by reducing the influence of reward and emotion on cognition. On the other hand, another study found that when controlling for difficulty identifying emotions, ASD individuals are still less influenced by the framing of loss versus gain" (Liron Rozenkrantz, 2021)

*2.3 ASD People and their Emotional Life*

Anyone with experience working and interacting with children and adults with autism will tell you the same thing. Studies have shown that people with autism may express their emotions. Their emotional expression is much less likely to involve eye contact, and sometimes their emotional responses are not typical. However, without any doubt, they experience emotions. "ASD individuals display more rational and less intuitive choice selection (e.g., in the attraction effect or conjunction fallacy) when emotions and reward do not seem to be involved" (Liron Rozenkrantz, 2021). Nevertheless, people with autism are not "emotionally distant". They direct their emotions to others less frequently with eye contact and sometimes get emotional about different things, but they certainly have emotion" (Nuske, 2014).

In autism, perceiving other people's emotions requires much more effort and time. Recent research has uncovered patterns suggesting that children with autism take longer to sense and respond to facial expressions of emotion such as happiness, anger, fear, and so on. It is consistent with data from earlier studies, which means that in everyday social situations, which are very dynamic and changeable, people with autism have difficulty, as they often emotionally "fall out" or "lack up" with social interaction partners.

Some forms of emotional expression are easier for people with autism to perceive than others. In general, people with autism have a more challenging time perceiving emotions expressed in the face, voice, or body movements than those described in other ways, such as through writing or music. However, who exactly expresses the emotion, whether a stranger or someone you know, plays a significant role. Recent studies have shown that children with autism respond more typically to emotions expressed by people they know than people they don't know (Nuske, 2014).

Working with ASD children requires speech and language therapy and occupational therapy. However, they often cannot understand other people's feelings due to a lack of empathy (Houston, 2019). Educators

or parents who want to support the emotional development of a child with autism can use a variety of exercises and games to practice emotion-related skills. It is strongly recommended to start with five basic emotions: joy, sadness, anger, disgust, and surprise. Psychologists and photographers agree that these are the only emotions people can identify by the face. Other emotional states require consideration of body language and situation. So, children with autism can start with the five emotions, as this will allow them to generalize this knowledge with different people and photographs. However, be prepared to teach your child more complex emotions.

For these skills, Israeli therapists use card games with photos of different emotions and write the corresponding feeling on the back. In the beginning, two opposite emotions are enough. For example, “happy” and “sad”. The adult puts down the photo and asks the child to name the emotion on the card. After that, the child turns the card over and checks whether he is right or wrong. If the child guessed correctly, he or she received a reward. For example, an adult can portray an exaggerated emotion to make the prize natural. After that, you can ask the child to show his version of this emotion. An adult and a child or several children can guess feelings, taking a card for themselves in case of a correct answer. Whoever has more cards, as a result, is considered the winner and can receive a prize—usually a cookie or a candy.

## 3. Discussion

### ASD and learning languages

ASD children often have perseveration—they often “get stuck” on the same topic or subject. In this case, they seem obsessed or cannot switch from them (Morin, 2022). Thus, students who study EFL can recite the same verse, retell the same story or explain the difference between Present Simple and Present Progressive tenses even if nobody asked them to do it. They might realize some grammar tenses very well and ignore others. The same happens when they catch specific words from the topic, pay attention to some episodes in the story for reading comprehension and skip the others. ASD people often cannot realize other people’s feelings and emotions. As a result, they misunderstand the story or lose the plot thread. Moreover, they don’t notice that other people get tired and don’t want to listen to them anymore. “When it comes to foreign languages, neurodivergent students may experience cognitive processing delays even when their intellect is intact. Some foreign language learning activities such as listening and speaking require a quick reaction, and the described delays may lead to a failure to conduct them successfully” (Papers, 2022). To enhance the process of studying EFL, teachers should use such activities as role-playing in various social situations, for instance, in a store, in the airport, in a hotel, or at the doctor’s. Moreover, it’s a fun and age-appropriate way to work on social and communication skills in a foreign culture. It also provides an opportunity to discuss the features of these skills in their native language. Furthermore, the technique of small talk is helpful for ASD kids in real life because it enables them to make social contacts.

Studying a foreign language has a very significant potential for developing children with ASD. It enables children to learn speaking skills through role-play activities, making exciting dialogues with peers, and observation. They also help train language skills such as regulating volume, speed, and intonation of oral speech. Learning the grammar of a foreign language helps improve understanding of aspects of the language, such as sentence structure. Memorizing phrases and colloquial clichés will provide an opportunity to expand the existing vocabulary of both a foreign and a native language. Discussing cultural differences and different social situations will also be incredibly beneficial. The language for such children will become much more straightforward, transparent, and logical.

Learning English provides many opportunities to develop language and communication skills while providing children with a more balanced and varied education. In addition, it helps train the brain to multitask. If people need to speak two languages to different people simultaneously, they must be able to shift without effort from one structure to the other. It might be difficult even for neurotypical people, but ASD ones need to develop the skill of moving from one place, activity, or language to another. Therefore, improving this skill could help them learn to transition less challenging. That is why many remedial EFL teachers offer kids with ASD to play a game of translator or interpreter, improving their vocabulary, transition, and communication skills.

## 4. Conclusion

ASD does not have a single known cause. It is believed that genetics plays an essential role in it (autism occurs in relatives, the likelihood of its occurrence in both identical twins is higher than in fraternal twins etc.). However, it is not clear what is happening: there is no one “autism gene” but only a complex set of interactions. However, some genes are responsible for abnormal brain development in ASD. “Specific core regions have been suggested to mediate clinical phenotypes of ASD such as the frontotemporal lobe, frontoparietal cortex, amygdala, hippocampus, basal ganglia, and anterior cingulate cortex” (Yonsei University College of Medicine, Seoul 03722, Korea, 2015).

Most people with autism have uneven cognitive abilities. Many autistic people have skills in some very high areas of cognition, while other areas of cognitive functioning are below what is expected for their age. This “uneven cognitive profile” often leads to problems during schooling. On the other hand, some cognitive features in autism may be strengths of autistic people.

Cognitive style is primarily determined by central coherence—the ability to combine parts into a coherent picture. Neurotypical people with strong central coherence are good at seeing the big picture. They integrate different information to determine the underlying meaning or central coherence. Autistic people are more focused on details, and it is called weak central coherence, but we can also call this feature as a heightened attention to the point. “Differences in brain anatomy examined in ASD are relevant to specific clinical symptoms and features of ASD. ASD is likely a ‘neural systems’ condition mediated by abnormalities in regionally distributed cortical networks rather than separated brain regions.

Therefore, ASD has also been referred to as a 'developmental disconnection syndrome" (Yonsei University College of Medicine, Seoul 03722, Korea, 2015). Difficulties in understanding and using figurative language, such as metaphor and irony, which are common among people on the autism spectrum, may also be related to weak central coherence.

In some countries, studying a foreign language is often reduced to the rote memorization of grammar, and learning to read has nothing to do with speech and communication. And not only in ordinary schools but also in correctional ones. There is an over-emphasis on preparation for standardized exams in the classroom. But if you pay attention to the characteristics of students with ASD and creatively approach the organization of education, this subject can become exciting, practical, and educational for such children. It is worth trying and looking for suitable "keys" to teach ADS kids EFL because it can significantly contribute to their general development. Once it becomes a child's hobby, it can help them to choose their future profession. Many ASD people make good translators and computer programmers. The main goal is not to pass the exam but to improve communication skills and understanding of social situations.

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**Biography**

Julia Koifman was born in Ukraine and graduated from Simferopol State University in 1995. She moved to Israel in 1999, and she still lives there. She teaches English in a special education school. She is a regular conference presenter and has published numerous articles about special education needs and learning disabilities. Currently, she is a Ph.D. candidate at Atlantic University, USA. The topic of her research is "Special Needs and Inclusive Education".

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