Clinical and Experimental Health Sciences

The Effect of Autism Spectrum Disorder on the Processing of Neural Response Metaphors

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Received: 22.12.2021 **Accepted:** 18.04.2022

ABSTRACT

Objective: The aim of this research is to describe the processing of neural response metaphors in individuals with autism spectrum disorder (ASD) speaking Turkish as their native language and to form the basis for further research in this field.

Methods: In this study, a single case study method was used. The data was collected by means of a structured questionnaire. The answers were recorded with the "Systematic Analysis of Language Transcripts" (SALT) program, and the data obtained was summarised using descriptive analysis.

Results: It was found out that the participant had difficulty comprehending, interpreting and using mimics and gestures. He struggled matching emotions and situations with expressions denoting them as well as determining how a person experiencing these emotions and situations might look like. The participant turned out to have reduced ability to interpret idioms and proverbs related to emotions, decide on what actions can be performed at the given place, and form a situation-effect relationship. The participant experienced problems interpreting and using new, formulaic, and malformed metaphors as well metaphors with literal meaning, and could hardly identify and correctly interpret conceptual metaphors within idioms and proverbs.

Conclusion: People with ASD experience difficulty with processing of neural response metaphors by the native speakers of Turkish. The disorders identified within the scope of our research result from the deficiencies of the theory of mind in individuals with ASD, which is supported by other studies on individuals with ASD having different mother tongues.

Keywords: Neurolinguistics, autism spectrum disorder, language disorder, neural theory of language, metaphor

1. INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impaired social interaction and communication, limited attention, and repetitive behaviour. This term was first used by Swiss psychiatrist Paul Eugen Bleuler in 1911 for individuals which completely isolated themselves from the outside world. In 1943, American psychiatrist Leo Kanner made a definition of autism in his study of 11 children displaying patterns of abnormal behaviour. Although Leo Kanner suggested that ASD is seen in children having emotionally cold parents, ASD is now known to be caused by some neurological, genetic, and environmental factors (1). Among these factors there are prenatal infection, metabolic disorders, and the use of anticonvulsant drugs to prevent epileptic seizures during pregnancy. Developmental delay, frequently seen epileptic seizures and increased head circumference indicate that ASD is a neuropsychiatric disorder (2). Studies aiming to reveal the genetic factors of ASD have shown that there is a large difference in comorbidity rates between monozygotic and fraternal twins, and the probability of ASD occurring in both siblings is higher in identical twins than in fraternal twins (3).

Analysis of retrospective reports indicates that the mean age of parents' first concerns about their child's development is 18 months (4). According to participants' reports, motor, sensory and social behaviour abnormalities are frequently observed in the first two years of life, but since they are clinically missed, the diagnosis can only be made between the ages of 2 and 4.

ASD is mainly associated with limited social interaction and repetitive behaviour patterns. However, DSM-5 also includes another symptom known as hypoactivity, a disorder characterized by lethargy, laziness, and slow response to sensory input, as opposed to hyperactivity (5). ASD-induced perception and communication disorders also restrict the development of motor skills. For this reason, individuals with

DOI: 10.33808/clinexphealthsci.1039708

ASD need to develop their motor skills using various therapy methods and special training (6). Motor development is known to have impact on children's communicative, social and cognitive development in the first years of life. In previous studies, delays in motor development have been associated with deficiencies in cognitive development and language (7, 8). Alongside with language delay, ASD is marked by stereotypical and repetitive behaviour, obsession, resistance to change and accompanying anxiety attacks, as well as inability to develop joint attention. Self-care problems, depression and inappropriate sexual behaviour can also be observed in adolescents with ASD (9-12).

Research shows that ASD is often accompanied by language disorders and various behavioural problems. About 50% of individuals with ASD are known to be unable to develop verbal communication until early childhood (13, 14). The difficulties encountered in verbal communication are the inability to use language according to the purpose, various problems in phonological processing, excessive intonation, abnormalities in tone, stress and rhythm, limited vocabulary, errors in advanced syntax production, and semantic mistakes (15). Echolalia, pronoun reversal, excessive use of atypical language and jargon, and difficulties based on pragmatic language use are also frequently observed in individuals with ASD (16, 17). Regarding nonverbal communication, people with ASD experience difficulties in interpreting other people's body language and inferring their intentions, and at the same time they can hardly use their gestures and mimics and express their own intentions. Studies have demonstrated that after non-linguistic barriers to communication are removed, individuals with ASD tend to have fewer perception-related problems than those related to production (18).

Individuals with ASD have similar vocabulary range and often use speech in idiosyncratic ways. Although individuals with ASD are more or less successful in the production of phrases and their first words, ASD is usually associated with speech retardation (19). When considering monolingualism and bilingualism as another factor affecting vocabulary acquisition and perception by children with ASD, bilingual children turn out to show better results than their monolingual peers, even if the difference is not very significant (20). Alongside with this, the vocabulary breadth of mothers of children with ASD is also known to determine the number of words known by their children. However, mothers' grammar skills don't seem to influence the grammatical competence of their children (21). Semantic methods based on the teacher's emotional response are not very beneficial for the vocabulary acquisition of children with ASD due to the lack of theory of mind (22). At the same time, the problems that children with ASD experience with receptive language and the limitations in fine motor skills cause various difficulties in the acquisition of writing skills. Children with ASD can only overcome these difficulties up to a certain point with the help of their parents and educators. At this point, the severity level of ASD seems to be of great importance. The more the person is affected by ASD, the more difficulties increase in literacy skills as well as in production and perception (16, 19).

The Neural Theory of Language was created by George Lakoff and Jerome Feldman. This theory is based on the view that thought is physical, and that reasoning occurs by activating certain neuronal groups in our brain (23). Metaphorical thinking is a mental function. Lakoff and Johnsen argue that metaphors emerge as a result of neuronal activities in the brain (24). According to structured connectionism developed by Jerome Feldman, all calculations are distributed over a single network, and nothing is built in. The meaning of the function cannot be assigned to a single neuron or a group of neurons. Mirror neurons modulate their activity both when an individual executes a specific motor act and when they observe the same or similar act performed by another individual. Mirror neurons are activated not only in these situations, but also when this action is perceived or imagined to be performed. Feldman claims that meaning is a mental analogy for physical concepts. Following simulation semantics, the neural theory of language proposes that the neural circuitry that defines the meaning of the word "grasp" is the same neural circuitry that is activated in mirror neurons when the act of grasping is performed or imagined (25).

The present study is aimed to examine and describe the way neural response metaphors are processed by an individual with ASD. There are three fundamental types of neural response metaphors: primary, structural, and conceptual. Primary metaphors form the basis for the creation of complex metaphors, the meaning of which can be inferred intuitively without giving the direct analogy. Structural metaphors are a form of metaphor in which an expression is transformed in such a way that evokes other expressions related to it. Conceptual metaphors can be described as a way of making an abstract idea or experience more easily understandable by framing it in terms of another more concrete concept. Conceptual metaphors are divided into two types: orientational metaphors involving spatial relationships and ontological metaphors based on the concretization of abstract metaphors (23, 24).

2. METHODS

Ethical approval was obtained from the Hamidiye Scientific Research Ethical Committee of University of Health Sciences (Approval date and number: 21/604).

In this study, a single case study method was used. The participant of the study was a 10-year-old male child with moderate autism spectrum disorder speaking Turkish as a native language. The participant's family was provided with the necessary information about the study and a consent form was obtained.

The data was collected by means of a structured questionnaire, consisting of ten steps. In the first step, the participant was asked to match the emotion icons with the names of the feelings they express. In the second step, he had to choose the right emotion based on the description of a person's appearance. In the third step, the participant was required to indicate the emotion that a person experiences

in the given situation. In the fourth step, he was given various idioms and asked to name the emotion expressed by them. In the fifth step, a true-false test evaluating the understanding of primary metaphors was applied. In the sixth step, a two-option multiple-choice test was prepared to reveal whether the participant is aware of the difference between wanting to do something and actually doing it. The seventh step was designed to find out if the participant is able to comprehend metaphorical fusions. The eighth and the ninth steps were related to conceptual metaphors and included true or false and multiple-choice questions. In the last step the participant was asked open-ended questions on proverbs/idioms and conceptual metaphors.

The oral answers were recorded by means of the "Systematic Analysis of Language Transcripts" (SALT) program, and the data obtained was summarised using descriptive analysis.

3. RESULTS

At the first stage of the research, the participant was shown emotion icons and asked to match them with the feelings. The participant read aloud the names of the feelings and did the matching task on his own. He matched the scared face expression with the word "happy", the happy face expression with the word "surprised", the surprised and upset face expressions with the word "sad", and the disgusted and angry face expressions with the word "angry". The words "scared" and "disgusted" were left unmatched. Even if the participant named 2 of the 6 face expressions correctly, it's necessary to note that he wrongly matched them with two other emotions as well.

At the second stage of the research, the participant was given a multiple-choice test and asked to choose the correct emotion based on the description of a person's appearance. When asked how a person being nauseous felt, he chose "disgusted" from the options "angry", "surprised" and "disgusted". When asked how a person clenching their teeth felt, the participant chose "happy" from the options "happy", "angry" and "sad". When asked how a crying person felt, the participant chose "disgusted" from the options "disgusted", "sad" and "surprised". When asked how a person whose face has gone pale felt, he chose "happy" from the options "scared", "happy" and "sad". When asked how a person whose eyes and mouth are wide open felt, the participant chose "angry" from the options "disgusted", "angry" and "surprised". When asked how a smiling person felt, the participant chose "surprised" from the options "surprised", "happy" and "sad". In this part of the research, the participant answered 5 of the test questions incorrectly and 1 of them correctly.

At the third stage of the research, the participant was presented a situation and asked to predict what emotions a person would experience in this situation. When asked what a person would feel if something smelt bad, the participant selected "fear" from the options "happiness", "disgust" and "fear". When asked what a person who had received good news would feel, he selected "disgust" from the options "happiness", "sadness" and "disgust". When asked what a person being chased by a dog would feel, the participant selected "fear" from the options "angriness", "sadness" and "fear". When asked what a person who had found themselves in an unexpected situation would feel, the participant selected "angriness" from the options "astonishment", "disgust" and "angriness". When asked what a person would feel if a friend of them had damaged their belongings, the participant selected "angriness" from the options "angriness", "happiness" and "fear".

At the fourth stage of the research, the participant was asked to explain the feelings expressed by the idioms. After being informed that he had given the correct answer to the question what the idiom "ağzı kulaklarına varmak" (grin from ear to ear) meant, the participant gave the same answer (happiness) to the questions concerning other idioms (ağzı açık kalmak – drop one's teeth, yüreği ağzına gelmek – jump of one's skin, ateş püskürmek – breath fire, burnunun direği sızlamak – be down in the mouth, içi almamak – be reluctant to do something).

At the fifth stage of the research, the participant had to match places with the activities done there and state whether the given statements were true (T) or false (F). The participant marked the statement "Someone who wants to sleep goes to the bedroom" as true (T). After the enquirer said that this was the correct answer, the participant marked all other statements (someone who wants to sleep goes to the kitchen, someone who wants to eat goes to the bedroom, someone who wants to get dressed goes to the kitchen, someone who wants to read a book goes to the toilet) as true (T).

At the sixth stage of the research, the participant was asked to choose the statements that could be inferred from the given situations. The participant answered 5 of the questions incorrectly and 1 of them correctly. When asked which one would have a fish, someone who likes fishing or someone who is fishing, the participant answered, "Someone who likes fishing". When asked which one would finish a book, someone who is reading a book or someone who wants to read a book, the participant answered, "Someone who wants to read a book". When asked which one would finish their homework, someone who is doing a homework or someone who has a homework, the participant answered, "Someone who has a homework". When asked which one can catch a ball, someone who is looking at the ball or someone who is trying to catch it, the participant answered, "Someone who is looking at the ball". When asked which one can touch a cat, someone who has a cat or someone who is thinking about a cat, the participant answered, "Someone who has a cat". When asked which one can hold a glass, someone who is trying to reach the glass or someone who is pointing at the glass, the participant answered, "Someone who is pointing at the glass".

At the seventh stage of the research, the participant had to determine whether two people which have something in common are the same person. Being given the statements

"My mother is a woman", "My father's sister is a woman", and "My mother's sister is a woman", the participant marked the statement "My mother, my father's sister, and my mother's sister are different people" as true (T) and the statements "My mother's sister is my mother" and "My father's sister is my mother's sister" as false (F). Being given the statements "The policemen is married", "The doctor is married", and "The teacher is married", the participant marked the statements "The policemen is a doctor", "The doctor is a teacher", and "The policemen, the doctor, and the teacher are the same person" as true (T). The participant was able to differentiate between the concepts of "mother" and "aunt". However, when asked to make the same distinction between the professions, he failed the task and marked all the options incorrectly.

At the eighth stage of the research, the participant was introduced to the conceptual metaphor "bad things are dark" illustrated by the examples of "kara baht" ("dark fate") and "kara bulutlar" ("dark clouds"), after which he was asked to mark other metaphors containing the word "dark" as true (T) or false (F). The participant marked the novel metaphor "kara zamanlardan geçtik" ("we have passed through dark times") as false, the conventional metaphor "kara bulutlar dolaşıyor dört yanında" ("dark clouds are hovering all around") as true, and the statement "ekran ne kadar karanlık" ("how dark is the screen") where "dark" is used in the literal meaning as false. However, when asked if the statement "I have dark luck" was wrong, the participant gave the correct answer.

At the nineth stage of the research, the participant had to choose the right meaning of the conceptual metaphors "kör talihini yenemedi" (he/she couldn't beat his/her blind luck) and "karanlık günler çok yakın" ("dark days are close"). He incorrectly matched the meaning of the first one with "good luck" instead of "bad luck". However, the participant correctly identified the meaning of the second metaphor and chose the "bad days" option.

At the tenth stage of the research, the participant was given a number of sentences containing conceptual metaphors and asked to answer the questions. When asked if the person described by the words "tencere dibin kara, seninki benden kara" (the bottom of the pot is black, yours is blacker than me) is good or bad, he replied, "The pot is black". When asked how a person "who has not seen the light of day" ("gün yüzü görmemiş") might have spent their day, the participant repeated the words of the enquirer by saying, "He has not seen the light of day". However, after being given a clue by the enquirer who asked whether the person might have had a good or a bad day, the participant chose the "bad day" option. When the participant was asked which side of another person's character a person who said, "I won't see him/her again after I saw his/her dark side" might have faced, with the help of additional questions such as "Was it his/her good or bad side?" and "Has he/she done something good or something evil?", the participant responded that it was the bad side.

4. DISCUSSION

The aim of this research was to reveal the effect of ASD on the processing of neural response metaphors. It was determined that the participant with ASD, who was a native speaker of Turkish, had problems understanding, expressing and interpreting situations based on facial expressions, appearance and emotions caused by certain events. The theory of mind of healthy children develops by the end of early childhood, while children with ASD appear unable to build the mental model of other minds (26). The research findings show that individuals with ASD find it hard to interpret nonverbal images and their main and connotative meanings due to the lack of theory of mind (27). In this respect, the results of our study involving a native speaker of Turkish are supported by studies conducted on speakers of other languages.

The participant gave correct answers to the first questions in tasks that required interpreting idioms and the feelings they express and matching the place with the action that can be performed at that place. After being told that his answer was correct, the participant made a hasty generalization and gave the same answer to all the subsequent questions regardless of whether it was right. Similar results have been obtained in other studies involving participants with ASD having different mother tongues (5, 28).

In another part of the study, the participant was asked to predict the consequences that the given situations may lead to and to identify the names of relatives and professions that have something in common. The participant proved to be unsuccessful fulfilling these tasks being able to match only those relatives that he is likely to frequently spend time within daily life. The inability of individuals with ASD to estimate the situation and the results related to that situation is also discussed by Frith and Happe (1994) (27). As for the findings concerning matching the names of relatives and professions, similar results were obtained by De Fossé (2004) (15).

The participant also scored low in that part of the study that dealt with conceptual metaphors. However, the participant turned out to show better results after being provided some clues and scaffolding. This finding is supported by other studies on the perception and interpretation of metaphors by individuals with ASD (24, 29, 30).

5. CONCLUSION

All individuals with ASD, which is a lifelong neurodevelopmental disorder, have a certain set of characteristics that distinguish them from others belonging to this group. These features vary depending on the severity of ASD and are affected by individual differences. For this reason, the aim of this case study was to examine the effect of ASD on the processing of neural response metaphors by a single subject, to reveal individual differences, and to compare the results obtained with other studies on individuals with ASD having different mother tongues.

The results of the study show that individuals with ASD have difficulty comprehending, interpreting and using mimics and gestures, which are an important part of nonverbal communication. They struggle matching emotions and situations with expressions denoting them as well as determining how a person experiencing these emotions and situations might look like. Individuals with ASD are not good at interpreting idioms and proverbs related to emotions, deciding on what actions can be performed at the given place, and forming a situation-effect relationship. They have problems interpreting and using new, formulaic, and malformed metaphors as well metaphors with literal meaning, and can hardly identify and interpret conceptual metaphors within idioms and proverbs.

The most important reason for these disorders is the lack of theory of mind seen in children with ASD. Healthy children's theory of mind develops by the end of early childhood and enables them to correctly interpret all the components of language as well as the imaginary structure of abstract language at the moment of communication. Theory of mind enables individuals to imagine themselves outside the situation they are currently in. The disorders identified within the scope of our research result from the deficiencies of the theory of mind in individuals with ASD, which is supported by other studies on individuals with ASD having different mother tongues.

Funding: *The author(s) received no financial support for the research.*
Conflicts of interest: *The authors declare that they have no conflict of interest.*
Ethics Committee Approval: *Ethical approval was obtained from the Hamidiye Scientific Research Ethical Committee of University of Health Sciences (Approval year and number: 21/604).*
Peer-review: *Externally peer-reviewed.*
Author Contributions:
Research idea: B.S.
Design of the study: B.S.
Acquisition of data for the study: B.S., Y.K., G.A.
Analysis of data for the study: B.S., Y.K., G.A.
Interpretation of data for the study: B.S., Y.K., G.A.
Drafting the manuscript: B.S., Y.K., G.A.
Revising it critically for important intellectual content: B.S., Y.K., G.A.
Final approval of the version to be published: B.S., Y.K., G.A.

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How to cite this article: Sakın B, Kaftar Y, Albay G. The Effect of Autism Spectrum Disorder on the Processing of Neural Response Metaphors. Clin Exp Health Sci 2023; 13: 228-233. DOI: 10.33808/clinexphealthsci.1039708