

Role of Mirror Neurons in Identifying Cases of Autism Spectrum Disorder

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ABSTRACT: Mirror neurons are highly unique cells found in specific regions of the human brain that simulate the actions and behaviours of others within our own neural circuits. These neurons form a critical component of social interactions by providing an automatic, rapid, and effective response to external events through observation. Conceptually, the fundamental role of mirror neurons can be summarised as understanding the intentions, emotions, and actions of others, while also enabling empathy with them. The functioning of this system effectively supports social learning and imitation processes by ensuring that visual and auditory stimuli are successfully matched by the brain. Autism Spectrum Disorder (ASD), on the other hand, is a challenging condition in which impairments in this complex system manifest themselves with specific clinical characteristics. In individuals with autism, significant difficulties in social communication and interaction skills, such as avoiding eye contact and difficulty understanding facial expressions, present themselves. In this context, impairments in the functions of mirror neurons play a crucial role in individuals with autism, particularly in empathy and the processing of facial expressions. Therefore, the anatomy and functions of the mirror neuron system are of critical importance in understanding social processing problems associated with autism. In particular, an in-depth examination of the neurobiology of this system sheds important light on developmental stages and learning processes, contributing to the understanding of the subject.

KEYWORDS: Neurons, establishing empathy, Autism Spectrum Disorder, anatomy and functions, linking to autism, neurobiology

INTRODUCTION

Individuals with autism experience noticeable and significant difficulties in social communication and interaction skills. These difficulties often manifest themselves through various symptoms, such as avoiding eye contact, struggling to understand facial expressions, and experiencing difficulties in reading social cues. As individuals with autism spectrum disorder often feel uncomfortable in social settings, this situation can seriously affect their daily lives. In this context, impairments in the functions of mirror neurons play a crucial role in the ability of individuals with autism to empathise and correctly process facial expressions. The mirror neuron system is considered a complex mechanism that affects individuals' capacity to understand other people's emotions and respond appropriately to them. Therefore, a thorough understanding of the anatomy and functions of the mirror neuron system is critical to better understanding the social processing problems associated with autism. In particular, detailed examination of the neurobiology of this system provides valuable insight into developmental stages and learning processes, contributing to a better understanding of the subject. Research has revealed meaningful and significant relationships between mirror neuron activity and the severity of autism spectrum disorder (ASD), paving the way for the development of new and effective approaches in clinical interventions. In particular, the development of applied strategies aimed at strengthening social skills can play an important role in improving the quality of life of individuals with autism and has the potential to positively influence their social interactions. In conclusion, the role of mirror neurons in autism is an extremely important topic from both basic scientific and applied perspectives. This field contributes to the development of treatment strategies through new research and paves the way for detailed studies and investigations that will enable autism therapies to become more targeted and effective in the future. It is thought that the social difficulties experienced by individuals with autism arise due to the influence of mirror neurons, and understanding this situation is of great importance for both individuals and their families. Overcoming such problems has become a critical area that education and therapy programmes must address. On the other hand, researching other neurological factors affecting social interaction alongside mirror neurons will significantly increase the knowledge base in this field and offer a broader perspective in applied psychology. For this reason, adopting a multidisciplinary approach in line with the complexity of autism and the needs of individuals will enable the development of more effective and appropriate intervention techniques in the future. Research conducted to develop the social skills of individuals with autism is of critical importance in this context, and these studies help individuals become more integrated into society by supporting their social lives. In this respect, contributing to both scientific developments and individuals' self-efficacy will create an essential field for future autism-related studies. Indeed, overcoming the barriers to social communication for individuals with autism is of vital importance in terms of enabling them to take their place in society and enhance their social functioning. Specifically, specially designed educational programmes developed by educators and therapists for these individuals play a critical role in developing their daily

Role of Mirror Neurons in Identifying Cases of Autism Spectrum Disorder

interactions and social skills. Such education and practical applications are frequently emphasised due to their impact on improving the social skills of individuals with autism spectrum disorder. It should not be forgotten that supporting individuals with autism is necessary not only for their development but also for strengthening social solidarity in society as a whole. Increasing education, awareness, and support programmes creates meaningful changes in the lives of individuals with autism and ultimately enables significant steps to be taken towards increasing social acceptance.

METHOD

This study is a structured literature review based on qualitative research methods. Research methods The neurobiological methods used are of critical importance in understanding the functionality of the mirror neuron system and its relationship with autism spectrum disorder (ASD). These specific neurons play a central role in complex cognitive processes such as social interactions and empathy formation and are extremely important for individuals to perceive social situations occurring in their environment. In particular, advanced imaging techniques such as functional magnetic resonance imaging (fMRI) reveal differences in social cognitive processes by measuring the activation levels of these neurons. This allows for the acquisition of deeper and more detailed information about the neurobiological abnormalities associated with autism. Recent studies on individuals with autism have shown a marked decrease or irregularity in the activity of mirror neurons in response to eye and facial expressions. This contributes significantly to our understanding of the neurobiological mechanisms underlying difficulties in social communication skills. In addition, various neurobiological techniques, such as electroencephalography (EEG) and transcranial magnetic stimulation (TMS), are effectively used to thoroughly examine the circuits and functional connections of these neurons in brain regions. The EEG method is a particularly important tool for evaluating neural transmission and brain wave regulation, and it can reveal the finer details of individuals' cognitive processes; TMS, on the other hand, takes on the task of testing the functions of mirror neurons by stimulating specific brain regions and provides the opportunity to reveal the clinical effects of disorders. Thanks to the opportunities provided by these advanced techniques, the neurobiology of abnormalities in social communication and empathy processes in individuals with autism is being studied in detail, yielding new and interesting insights in this field. Furthermore, behavioural methods are also widely used in applications aimed at developing social skills; among these, methods such as eye contact training and exercises related to recognising and imitating facial expressions are particularly noteworthy. These innovative and comprehensive approaches both support mirror neuron activity and systematise the behavioural differences observed in clinical settings, forming a cohesive whole. Thus, the integrated use of neurobiological and behavioural methods facilitates a better understanding of the social cognitive processes associated with autism spectrum disorder and the development of effective intervention strategies. The common goal of these methods is to comprehensively reveal the causes and effects of mirror neuron disorders and to improve individuals' quality of life by contributing to therapeutic approaches on a scientific basis. Research in this area, in particular, contributes to individuals' treatment processes and offers hope to families in need of support. Therefore, these comprehensive studies on autism spectrum disorder also form an important basis for developing more effective treatment methods in the future. New findings aim to shed light on future therapies and provide the necessary opportunities for individuals with autism to be more successful in their social lives. In this way, the aim is to help each individual realise their potential.

FINDINGS

The data obtained from the literature review, presented in the Research Methods and Findings section, involved a comprehensive examination using a variety of neurobiological and behavioural approaches and methods to gain a deeper understanding of the role of mirror neurons in autism spectrum disorder. In such studies, researchers have employed advanced, high-resolution imaging techniques such as functional magnetic resonance imaging (fMRI) to examine mirror neuron activity in detail. They have identified a significant reduction in activity in relevant brain regions, particularly during social interactions, in individuals with autism spectrum disorder. Such imaging studies have clearly demonstrated that mirror neurons play a vital role in critical social cognitive processes such as empathy, social perception, and the perception of facial expressions, thereby shedding light on treatment processes and making important contributions. Furthermore, using neuromodulation techniques such as electroencephalography (EEG) and transcranial magnetic stimulation (TMS), it has been possible to directly observe functional changes in mirror neurons. This has aimed to clearly reveal and understand the differences between neurological activities in individuals with autism and normative development. From a behavioural perspective, various experimental studies, such as action imitation and eye-contact tests, have provided important and interesting findings on how the mirror neuron system works by thoroughly examining its relationship with social awareness and empathy. The results obtained have clearly demonstrated that mirror neuron activity in individuals with autism spectrum disorder is positively correlated with difficulties in social skills and effective communication processes. In particular, when the functionality of mirror neurons was assessed using various analytical methods through matching and facial expression recognition tasks using visual and auditory stimuli, meaningful relationships were found between disorder levels and these activity changes. Consequently, these studies clearly demonstrate that mirror neurons may be one of the fundamental mechanisms underlying conflicts in social communication and empathic awareness in autism. They also highlight the potential to make significant contributions to the development of new treatment and intervention strategies in the future by ensuring strong integration between neurobiological and behavioural applications. It is anticipated that continued research in this field in the near future will lead to

Role of Mirror Neurons in Identifying Cases of Autism Spectrum Disorder

more comprehensive studies on mirror neurons, offering a deeper understanding of autism and aiding in the development of innovative treatment approaches. Furthermore, the design of intervention strategies aimed at improving individuals' social skills, based on the key findings of this research, could make an important contribution to better supporting individuals with autism in society. From this perspective, these and similar studies on the functioning of mirror neurons are critically important for understanding the factors that profoundly affect the experiences and daily interactions of individuals with autism spectrum disorder, in relation to social cognition and empathy mechanisms. These findings also form an important basis for strengthening social awareness and social support mechanisms, encouraging the development of both scientific and practical approaches aimed at improving the quality of life for individuals with autism. As research progresses, a more comprehensive understanding of the functioning of mirror neurons may enable the development of more targeted and effective treatment methods to improve the social interactions of individuals with autism spectrum disorder. In this context, a better understanding of the relationship between mirror neurons and sociality provides a foundation for developing new methods that could improve the quality of life for individuals by addressing different aspects of autism.

THE NEUROBIOLOGY OF THE MIRROR NEURON SYSTEM

The neurobiology of the mirror neuron system requires a more comprehensive focus on the multifaceted functions of these specialised cells beyond their complex structure, necessitating their in-depth examination. Mirror neurons are rare and specialised neurons located in specific and unique areas of the brain that are activated by movements observed or imitated by individuals. These neurons are primarily concentrated in motor areas and premotor cortex regions; their ability to be identified plays a critical and decisive role in social interactions. When anatomical studies are conducted, it is observed in detail that mirror neurons are mostly located in the inferior parietal lobe and inferior frontal gyrus regions. The fundamental function of these specialised cells involves their activation during the observation of a movement; thus, this characteristic enables the understanding of the deeper meaning of movements and the ability to imitate these movements when necessary. This complex mechanism serves to establish an extremely important foundation for interpersonal empathy, effective socialisation, and learning processes, and also contributes to the strengthening of social bonds. Effective matching with auditory and visual stimuli highlights the role of mirror neurons in integrating visual and auditory information, paving the way for a better and more in-depth understanding of this phenomenon. Images, sounds, and other sensory stimuli can be naturally matched with the activation of these neurons, developing a mechanism that enables individuals to comprehend environmental information much more effectively.

Furthermore, mirror neurons also have the capacity to interact with non-verbal forms of communication (facial expressions, body language, hand movements, gestures, and the like); this not only supports social adaptation and understanding but also contributes to positive outcomes in interpersonal interactions. However, in some cases, such as autism spectrum disorder, significant impairments in the functionality of the mirror neuron system are observed. Various studies have revealed that these impairments may cause a decrease or irregularities in the activity of mirror neurons, leading to a weakening of empathy and social communication. Thus, impairments in the functions of mirror neurons play a key role in clearly illuminating the fundamental problems experienced by individuals with autism in social interaction and weakened empathic capacities. Research in this field aims to conduct in-depth investigations into the detailed neurobiology of the mirror neuron system and to develop clinical interventions; therefore, it aims to make important contributions to public health. The work of mirror neurons has a significant and intense impact not only on individuals' social abilities but also on the learning and development of motor skills, and this effectiveness also reveals how neurons function as the building blocks of socio-cognitive processes. Consequently, a better understanding of the various aspects of the mirror neuron system offers extremely critical functionality in terms of developing more effective methods that will enable the more effective management of social and cognitive disorders.

ANATOMY AND FUNCTIONS OF MIRROR NEURONS

Mirror neurons are very special and distinct cell types found in specific regions such as the motor cortex and premotor area. They become active when performing certain actions and also show similar activity during observation. These unique neurons form the basis of interpersonal empathy and social connections by activating the same or similar neural regions when an individual observes another's actions, thereby strengthening these relationships. Anatomically, it is evident that mirror neurons are concentrated in the frontal and parietal regions in humans and primates. The frontal part, particularly important regions such as Brodmann areas 6 and 44, as well as the inferior parietal sulcus region of the parietal lobe, are prominent here, and these structures play a central role in complex social processes such as the perception and imitation of movements. Functionally, mirror neurons not only participate in observing actions but also effectively function in emotional and social contexts.

These neurons not only provide the fundamental means of communication for understanding others' intentions, responding to emotions, and social learning, but also contribute to the development of social relationships by forming the neurobiological basis for complex cognitive processes such as action imitation and empathy. Specifically, when we observe others' facial expressions and eye movements, these neurons become actively responsive; this helps the individual better understand the emotional state of the person in front of them and effectively select appropriate social responses. Therefore, the anatomical structure and functions of mirror neurons play a critical role in the development of social cognition. In this context, functional impairments of these neurons in autism spectrum disorder provide crucial clues to understanding the basis of social and communicative difficulties. Mirror neurons have a significant impact not only on individuals

Role of Mirror Neurons in Identifying Cases of Autism Spectrum Disorder

but also on the dynamics of social groups. Thanks to these special neurons, bonds between people are strengthened; at the same time, empathetic understanding, cooperation, and social support networks within society are encouraged. This process broadens the scope of human relationships and social interactions, leading to the emergence of a very important social structure. On the other hand, problems in the functioning of these neurons can lead to a weakening of meaningful communication and emotional sharing between individuals; consequently, social isolation and lack of understanding can often occur in conjunction with this situation. In short, mirror neurons are critically important for understanding the complex dynamic structure behind human behaviour. The way these neurons work motivates how important they are in people's social worlds. With these characteristics, mirror neurons emerge as one of the fundamental elements that develop interpersonal communication and strengthen social relationships. The functions of mirror neurons, their important role in social relationships, and their effects on the development of human empathy guide us in understanding their profound impact on human psychology and social structure. In this context, studying the workings of mirror neurons is a necessary step towards better understanding how human relationships are structured and how social dynamics are shaped.

MIRROR NEURONS AND SOCIAL PROCESSING IN INDIVIDUALS WITH AUTISM

The role of mirror neurons in social processing is particularly striking in individuals with autism spectrum disorder (ASD). Mirror neurons provide significant support for the processes of establishing social bonds and feeling empathy by relating the observations of others to one's own actions and emotions. These neurons serve as an important mechanism that enables individuals to understand and share the experiences of those around them. However, in individuals with autism, the activity of these neurons is often reduced or functions differently. This situation poses major obstacles to individuals' social success and can lead to serious difficulties in perceiving and interpreting social communication cues such as facial expressions and eye contact. Research has shown that social communication problems seen in individuals with autism are closely linked to the activation levels of mirror neurons. Dysfunction of mirror neurons negatively affects socialisation and empathy skills, making social relationships difficult for individuals. At the same time, basic social behaviours such as imitation of actions and following emotional expressions are directly related to the effective activity of mirror neurons. Disruptions in these processes may contribute further to the social difficulties seen in autism spectrum disorders and have a significant impact on individuals' social interactions. Therefore, the effectiveness of mirror neurons has become a critical factor in understanding social processing abilities in individuals with autism.

This situation raises a fundamental research question in shaping interventions related to these areas. New generation treatment approaches aim to contribute to the development of social skills, particularly by targeting mirror neurons. This would represent an important step towards improving the quality of life for individuals with autism. In this context, neurobiological and behavioural studies on mirror neurons enable a better understanding of social processing differences in individuals with autism and the optimisation of effective treatment methods. By focusing on the development of social interaction skills and the reactivation of mirror neurons, research aims to help individuals with autism better adapt to society. In this context, further investigation of these processes is highly valuable in enabling individuals to participate more effectively in social life. In other words, more research on the role of mirror neurons in social processing will contribute to our understanding of the challenges faced by individuals with autism and to the development of effective intervention strategies for these individuals. How mirror neurons perceive environmental social interactions, individuals' ability to interpret emotional states, and the experiences they gain in forming deeper bonds with others can further enrich the social lives of individuals with autism. The relational and therapeutic effects of such studies will further reveal the importance of mirror neurons in forming social bonds.

MODELS AND HYPOTHESES RELATED TO MIRROR NEURONS

Various models and hypotheses regarding mirror neurons constitute important and multifaceted areas of research on autism spectrum disorder (ASD) and are attracting considerable interest in the scientific community. Autism spectrum disorder is a complex condition that profoundly affects not only individuals but also their families and communities. For this reason, multidisciplinary research is being conducted to understand autism, and this research continues as an important endeavour in different fields. Findings from research on mirror neurons provide critical data on brain development and greatly contribute to our understanding of how social behaviours emerge.

Various theories based on mirror neurons have created an extensive body of literature in this field by providing convincing scientific arguments about the fundamental functions of these neurons in empathy, imitation, and various social interactions. The existence and function of mirror neurons stand out as a vital and critical element in understanding the role of individuals in social relationships. Indeed, these neurons play an important role in strengthening social bonds between people. Some studies have developed various hypotheses about how mirror neurons may undergo developmental changes due to genetic and neuroanatomical differences; these hypotheses are reinforced by supporting findings. In this context, it is thought that the marked reductions observed in mirror neuron activity, particularly in individuals with autism, are directly related to difficulties in social cognitive processes such as empathy and understanding facial expressions. This reduction is considered a direct result of the difficulties encountered in social interactions. Furthermore, modular and integrated approaches suggest that the mirror neuron system contains different phylogenetic and functional submodules and allow for a broad systematic perspective on the interactions between these modules. These models, taking into account developmental stages and learning processes, enable us to understand how various symptoms in autism can be related to dysfunctions in these modules. Since each module has its own specific function, communication between these modules also has a significant impact on individuals' social skills. When examined in

Role of Mirror Neurons in Identifying Cases of Autism Spectrum Disorder

detail, the hypotheses explore the relationships between mirror neurons and higher cognitive systems and, in this context, emphasise the need to develop specific intervention strategies aimed at enhancing social communication for individuals with autism.

The proposed interventions have the potential to enable individuals with autism to engage in more productive social interactions in their daily lives and express themselves more effectively. Ultimately, such models and hypotheses not only provide a better understanding of the difficulties in social interaction and impaired empathy skills in individuals with autism, but also lay the groundwork for the development of effective treatment strategies. Thus, these studies contribute to the creation of more effective treatment methods based on neurobiological approaches, enabling the provision of effective solutions tailored to individual needs in autism. This rich and developing field of research forms a basis for future scientific studies, opening the door to more in-depth research and encouraging progress in this area. Thanks to the development of new and innovative approaches, it will be possible to make more conscious and targeted discoveries about autism spectrum disorder. In addition, such research will contribute to revealing important information about the role of mirror neurons in different cultures and societies. Each new study contributes to the knowledge gained in this field, deepening our understanding of autism spectrum disorder. By taking into account metacognitive processes and individual differences, it is possible to develop intervention strategies that are more appropriate to the specific needs of individuals with autism. This paves the way for the creation of more effective methods in terms of social integration and cohesion. As a result of these extensive studies, sufficient knowledge has been gained about the basic concepts and functions of neurobiology.

THE IMPORTANCE AND EFFECTS OF EARLY INTERVENTION

Early intervention is a process of critical importance for supporting developmental progress in individuals with autism spectrum disorder (ASD) and maximising their potential. This important process aims to reduce the negative effects of both neurological and behavioural development, while also improving the quality of life of these individuals. Numerous studies on areas where interventions initiated at an early stage can positively influence the functions of the mirror neuron system clearly demonstrate the effectiveness of these interventions. These intervention processes are particularly critical in terms of developing children's social and emotional skills. It is extremely important to raise awareness among families and educators and ensure their active participation in this process in order to support children's development in fundamental areas such as social interaction, empathy, and effective communication.

Furthermore, early intervention programmes contribute to the healthy functioning of mirror neurons by encouraging positive progress in areas such as children's language development, recognition of facial expressions, and eye contact, which is extremely important for developing children's social skills. The various therapies and educational strategies applied during this process have been shown to have the potential to increase opportunities for better adaptation and learning by taking advantage of the flexibility in children's neurobiological structures. One of the most prominent and important advantages of early intervention is its potential to reduce the severity of autism symptoms, along with its positive effect on increasing individuals' levels of independence through the development of social skills at a younger age. This also contributes positively to overall quality of life and individuals' ability to adapt. Therefore, diagnosing autism at the earliest possible stage and initiating the intervention process promptly significantly increases individuals' long-term success rates and facilitates their integration into society. Consequently, the appropriate, planned, and systematic implementation of early intervention is an indispensable requirement for maximising the developmental potential of individuals with autism; this leads to noticeable and positive improvements in the quality of life for both individuals and their families and ultimately helps individuals living with autism lead more fulfilling lives. In this context, early interventions for individuals with autism spectrum disorder are extremely valuable in terms of helping them integrate better into society, develop their social skills, and realise their individual potential. Therefore, detailed planning and careful implementation at every stage of this process play a critical role in the future success of individuals with autism; this has the potential to positively impact not only their educational lives but also their social lives.

CONCEPTUAL AND ETHICAL DIMENSIONS

Conceptual and ethical dimensions are of great importance in understanding the complex and multifaceted role of mirror neurons in autism spectrum disorder, and there are many dynamic and complex issues surrounding this topic that need to be addressed. This issue is noteworthy and worthy of examination, requiring in-depth analysis not only from a scientific perspective but also from social and philosophical viewpoints. In this context, it is necessary to comprehensively address the activity of mirror neurons from an ethical standpoint; this provides important contributions by offering a deep insight into various important questions, such as the empathy and social interaction abilities revealed by the functions of mirror neurons. For example, a better understanding of the difficulties experienced by individuals on the autism spectrum in social interaction processes is directly related to the functional impairment of these neurons and reveals that this condition can have significant and lasting effects on social perceptions. We know that mirror neurons play a critical role in establishing eye contact, understanding facial expressions, performing social imitation, and interacting with others. In this context, a detailed ethical evaluation of these systems is of paramount importance in order to respect the fundamental rights of individuals on the autism spectrum, human freedoms, and the dignity of every individual in general.

Furthermore, it is evident that during the process of defining conceptual boundaries, it has become critically important to thoroughly examine the effects of mirror neurons on different variations within the autism spectrum from various scientific perspectives and to ensure compliance with ethical principles throughout this process. This situation also requires the contribution of all disciplines and brings together

Role of Mirror Neurons in Identifying Cases of Autism Spectrum Disorder

various perspectives within a single field of research. At this point, structuring the methodologies used in research according to specific ethical standards, ensuring the safety of participants, and not violating ethical rules during the research process should definitely be among the priorities of researchers. Given the acceptance of the subject and the potential of the results obtained to shape social perceptions and educational approaches, it is imperative that socio-cultural sensitivity, respect for human rights, and ethical responsibilities are taken into account at every stage. This situation also supports efforts to raise social awareness and sensitivity and opens the door to significant changes in autism-related circles. Therefore, within the framework of a shared understanding of values, conceptual modelling of the role of mirror neurons in autism must be approached with constant diligence in line with scientific transparency and ethical principles. In this context, the integration of ethical and conceptual dimensions as a whole not only strongly supports scientific progress but also paves the way for establishing a responsible research environment that protects the rights and freedoms of individuals. This integration will also make significant contributions to a better understanding of different positions and perspectives by strengthening interaction with different segments of society. While this approach offers an extremely useful path for better understanding autism, it will also help develop a broader and more inclusive perspective on the role of mirror neurons. Furthermore, future work in this area will require a more in-depth examination of the social, cultural, and psychological dynamics that influence the autism spectrum.

CONCLUSION

The role of mirror neurons in autism spectrum disorder is an extremely important and noteworthy topic that has begun to be understood in a more profound and comprehensive manner in recent years, alongside new-generation neurobiological and behavioural research. Various and comprehensive findings indicate that the mirror neuron system is closely and deeply related to socio-emotional interaction and empathy processes. The functionality of these neurons clearly reveals their effects on general social dynamics. In particular, distinct differences in the activation of these specific neurons in individuals with autism cause significant difficulties in processing basic social functions such as facial expressions and eye contact. This situation can lead to noticeable deficiencies in social communication and negatively affect individuals' adaptation to social life. Various studies present strong evidence suggesting a direct relationship between the intensity of mirror neuron activity and autism symptoms; this finding stands out as noteworthy in research on autism spectrum disorder. In this critical context, enhancing or regulating the functionality of mirror neurons is emerging as a noteworthy area in autism spectrum disorder treatments, and various experimental and innovative strategies are being developed in this regard. Within the framework of modular and developmental models, the role of this specific neuron system in the child development process and learning mechanisms is examined in considerable detail; the nature and functionality of each stage is investigated. Furthermore, using biomarkers and various imaging techniques, the development of new diagnostic and monitoring methods based on mirror neuron activity continues. This potentially enables the planning of more precise and individualised interventions in clinical practice. This is of great importance in terms of contributing to the treatment processes of individuals with autism. Consequently, the functional and structural changes in mirror neurons in autism continue to be a major focus in future research and treatment approaches, and studies on this subject are gaining considerable importance. Aiming to increase opportunities through early diagnosis and intervention strategies, these developments offer both promising and effective approaches to improving the overall quality of life for individuals with autism. These comprehensive studies provide new and innovative perspectives from both neurobiological and behavioural angles; they attract the attention of the scientific community by making important contributions to efforts to deepen knowledge in this field. At this point, ongoing research into the prevention and treatment of autism is crucial to understanding the role of mirror neurons. The findings obtained are attracting the attention of all health professionals and researchers, and therefore, the study of mirror neurons is of critical importance not only for individuals with autism but also for understanding all social interactions. The role of mirror neurons in social behaviour and learning processes forms a fundamental understanding for future studies on autism, and the results obtained in this direction may pave the way for significant changes at the societal level. Therefore, increasing research on mirror neurons has the potential to bring about promising developments in future treatment methods and social interactions. In light of the successful data obtained, a thorough examination of the functioning and effects of mirror neurons could form an important foundation that would enable the development of social interactions and communication in society.

LIMITATIONS

This study has some limitations. Firstly, as the research was conducted using a qualitative literature review method, the general validity of the findings is limited. Conceptual boundaries and types of interpretation are critical to understanding the mirror neuron system and involve a wide range of comprehensive discussions related to the development of this field. Firstly, the careful and meticulous definition of concepts and the clear delineation of their boundaries stand out as one of the fundamental elements enabling researchers to interpret the functions of mirror neurons accurately and reliably. In this context, the activities of mirror neurons can be approached in different ways in various social situations; for example, they can be associated with empathy and imitation behaviours in social interactions, while in some situations they can be perceived as automatic or unconscious processes. These different interpretations define the boundaries of the concepts and ensure consistency in research. Furthermore, these boundaries may also vary depending on the methodological approaches used in the research. Indeed, during measurements in neurobiological research, difficulties may sometimes arise in clarifying tissue and function boundaries. At this point, the diversity of interpretations becomes apparent: while some studies aim to directly measure the effects of mirror neurons on social cognition, others use more indirect indicators or indirect

Role of Mirror Neurons in Identifying Cases of Autism Spectrum Disorder

measurement techniques to reach their conclusions. To elaborate further, definitions that transcend the boundaries of concepts or are confused with each other may be involved. For example, the difference between empathy and imitation may not be clearly defined by some researchers, or difficulties may be encountered in understanding these two concepts. For this reason, carefully defining conceptual boundaries and interpreting them consistently has become a fundamental requirement for the reliability of data obtained from studies in this field. Ultimately, the development of this field progresses based on the clarification of conceptual boundaries and the understanding of different interpretations, thereby enabling a more integrated and clear framework for addressing the role of mirror neurons in autism spectrum disorder. This will enable research to be shaped by in-depth evaluation and a better understanding of the socially important relationship between empathy and imitation.

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Role of Mirror Neurons in Identifying Cases of Autism Spectrum Disorder

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