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# THE ROLE OF MIRROR NEURONS IN EMPATHY AND HUMANIZATION OF MEDICAL PRACTICE

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## ABSTRACT

Empathy is essential for humanized clinical care, and its development during medical school is of paramount importance. The ability to put oneself in the other's shoes, understand their emotions, and respond sensitively can transform the relationship between doctor and patient, promoting more effective and comprehensive care. This competence is not only a desirable skill; It is essential for medical practice, as it directly influences treatment adherence and patient satisfaction. To foster empathy among future doctors, it is crucial to understand the processes that precede it and the foundations that support it. A central aspect in the discussion about empathy is the role of mirror neurons, since studies point to them as the biological basis of social skills, including empathy, as it ranges from motor activities to emotional modulation in the face of external stimuli, being able to foster the impact of an experience and induce empathic behavior. Thus, this work sought to enrich the knowledge about the intrinsic relationship between neuroscience and the development of empathy, in order to foster humanization in Medical Education.

**Keywords:** Mirror Neurons. Empathy. Medical Schools. Social Skills.

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## INTRODUCTION

Mirror neurons (NE) are a cognitive system that enables the understanding of the biological bases in relation to human abilities related to interpersonal relationships, in addition to language and empathy. Interpersonal relationship skills are essential for the human species, thanks to the social interaction that governs the various spheres of our society. Thus, social skills have Homeric relevance in the daily lives of individuals, due to the behaviors of interaction and adaptation to a situation, corroborating problem solving (Soares & Del Prette, 2015).

Thus, mirror neurons, which were discovered in the late 1990s (Ferreira et al., 2017), have been pointed out as responsible for imitation behavior, but also for complex affective phenomena, such as empathy and various social skills (Corradini & Antonietti, 2013), since interactions in society urge the correct interpretation of the actions of others.  based on analyses, such as body language. Thus, observation, imitation, and intention are important in the processes of social cognition and empathy. (Rodrigues & Silva, 2012). In view of this, mirror neurons in humans respond to these environmental analyses, as there are numerous stimuli in the environment, where attention should be focused on the relevant impulses and, thus, the interpretation of actions in accordance with the current context should be prioritized. Such action is indispensable for social interaction, because it can simulate behaviors and their various meanings (Pfister, Dignath, Hommel, & Kunde, 2013).

In other words, an individual's mirror neurons encode sensory information, which allows for reciprocity, through the ability to understand other people's actions.

The environmental analysis performed by the EN can identify behaviors that will provoke emotions, because when distinguishing a certain emotion in another person, the individual feels internal physiological reactions, which will provide the brain with resources to succeed a behavioral response consistent with the social context. Consequently, thanks to the perceptions of the EN and the recognition of the emotional reactions of others, the brain is able to interpret other people's intentions, in order to choose a consistent and effective behavior (Mirabella, Iaconelli, Spadacenta, Federico & Gallese, 2012).

Furthermore, empathy and this ability to react to the current context in the social environment are central to the doctor-patient relationship. Since the twentieth century, medical education and health practices have centered on a biopsychosocial model of clinical intervention. Therefore, empathy is one of the pillars of person-centered care and humanized medical care (Roter, 2000).

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In this sense, low levels of empathy in the doctor-patient relationship are associated with higher chances of medical error (West et al., 2006), in addition to the fact that individual-centered care is capable of increasing patient satisfaction, reducing complaints about medical care, reproaching the volume of complementary exams and attenuating referrals to specialists, thus reducing costs to the patient and the health system (Lacombe et al., 2021).

Therefore, the ability to recognize and interpret the clinical environment, in addition to feeling empathy for the situation of the patient being cared for, are important in medical care and, therefore, the presence of their learning and critical development in undergraduate medical courses is indispensable, in order to ensure the training of a competent and humanized professional, in addition to fostering this knowledge in the context of medical education focused on empathetic conduct (Batista & Lessa, 2019). Thus, understanding what precedes empathy is an important theme when establishing its indispensability in medical education, since learning to establish a good doctor-patient relationship, based on listening, observation and empathetic reaction to the social scenario of others, is essential for the formation of a good professional. In the meantime, among the hypotheses raised to explain the development of empathy, the presence of mirror neurons is defined as the best biological basis for the behavioral understanding of this social skill, since, in order to put oneself in another person's place, it is necessary to observe them and mirror their condition in relation to the individual limbic system, in order to generate their own emotions and trigger a reaction consistent with the current social environment and role.

## METHODOLOGY

This systematic review used the Scientific Electronic Library (SciELO) and PubMed databases as the primary search source, selecting articles in Portuguese and English from the last 26 years. The keywords used were: "Mirror Neurons", "Mirror Neurons", "Empathy", "Medical Students", "Social Skills", "Social Interaction" and "Doctor-Patient Relationship". The articles underwent a careful review in order to distinguish those with greater scope and scientific relevance to be selected and included in this project. In addition, the Boolean operators were adopted as follows: ("Mirror Neurons"[Mesh]) AND ("Empathy"[Mesh]) AND ("Students, Medical"[Mesh]). Then, the total number of articles went through a careful filter in order to select the works published from 1998 onwards and that have the full text available and relevant to the proposed theme.

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## RESULTS

Empathy, as presented by Batista and Lessa (2019), is a fundamental attribute in clinical care and in the promotion of a good doctor-patient relationship. The daily practice of medicine is intertwined with the social process based on human interactions in all its dimensions; humanistic, ethical and technical. Therefore, empathetic relationships corroborate the improvement of clinical care and, consequently, the reduction of complaints, improvement in treatment adherence and vituperation of legal proceedings against the physician. With regard to empathy, Stepien and Baernstein (2006) consider it a multidimensional skill, which allows, according to the individual perspective, to analyze and understand the feelings of others. In addition, empathy is one of the learning objectives named by the American Association of Medical Schools, which explains its significant influence on the academic development of medical students. Given its importance, understanding what precedes empathy is a theme that has been raised a lot in the literature, essentially in the areas of neurology and psychology. In this sense, thanks to the multidimensional character that permeates empathic development, behavioral and neurological studies seek to unravel the biological bases of this social skill. In the meantime, Ferreira, Cecconello and Machado (2017) point out the possible relationships between the functioning of mirror neurons, a neurological discovery in the late 1990s, and social skills, which dictate the behavior of human beings in the face of the environment and the various scenarios that seek to adapt the individual response.

NEs were discovered at the end of the twentieth century by scientists Giacomo Rizzolatti, Leonardo Fogassi and Vittorio Gallese during an experiment with primates of the Rhesus species, in which neurons were found in the cortical area F5 that were activated when motor actions were visualized, causing the animal to imitate the action performed. According to Lameira, Gawryszewski and Pereira (2006), since the evidence of the mirror cell system in non-human primates, neuroimaging tools have tried to map this system in the human brain. Thus, in humans, these "mirror neurons" were identified in regions of the premotor cortex, inferior rostral parietal lobe and frontal lobe, with functions and activation similar to those visualized in the brains of the monkeys studied, as pointed out by the review by Casile, Caggiano and Ferrari (2011). Furthermore, Buccino et al. (2004) pointed out the activation of frontal areas through NE analysis by means of functional magnetic resonance imaging (fMRI), in which the inferior frontal gyrus and the premotor cortex were activated by the observation and execution of different actions performed. Therefore, it is

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known that mirror neurons are activated by the observation of another person, being appointed, in the first instance, as controlling neurons of the motor repertoire.

However, it is not just any movement that activates the NE system; an intentionality, that is, a meaning, is necessary. This understanding of the actions of others, according to Ferreira, Cecconello and Machado (2017), opens up the possibility of mirror neurons interfering in the behavioral interpretation of another person and, thus, defining the individual reaction, through the mirroring system.

Mirroring, as highlighted in the study by Corradini and Antonietti (2013), is based on the observation of the acts of others, codifying their objectives and establishing the behavioral relationship between what is seen and the intention of that action. Thus, the neural fibers that constitute the mirror neuron system act in the mirroring process and, therefore, are the best candidates for the biological pillar that governs human social skills of interpretation and reaction to social life.

Furthermore, according to Pfister et al. (2013), imitation resulting from mirroring is the basis of social interaction between humans. In this bias, Cattaneo and Rizzolatti (2009) point out the involvement of NE in understanding the actions of others and the intentions behind them, which is the basis of observational learning.

According to Radfahrer (2020), thanks to the motor primacy and social possibilities of NE, this cognitive system acts differently in people's lives, since it adds the ability to simulate actions, but also cognitive concepts related to language, pain, and empathy. Mirror neurons project information from the environment into the individual interior and contextualize the individual's reaction, who puts himself in the place of the interlocutor. Furthermore, through imitation, learning is achieved. For example, for a child, the act of observing and imitating adults is the basis for acquiring language skills. Through repetition and practice, the child learns to speak his or her mother tongue, internalizing not only the vocabulary but also the emotional and social nuances that permeate communication. This ability is not limited to childhood; Adults also benefit from this function when learning a new language. By mimicking the pronunciation and intonation of native speakers, for example, they can hone their communication skills. This skill also permeates other environments, such as a hospital, in which students learn not only medical technique, but also how to relate to patients and colleagues by observing actions and simulating them. This ability to simulate and imitate is vital for the development of interpersonal skills, which are central to success in the medical profession. By observing how experienced professionals handle

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challenging situations, students can internalize appropriate behaviors and thus build a solid foundation for their future practice. Thus, mirror neurons not only facilitate the imitation of actions, but also play a critical role in the formation of social and cognitive skills.

These capabilities are supported by the so-called "simulation theory", studied by Gallese and Goldman (1998). These scholars postulated that the emotions observed in other people are understood through the internal states that these emotions provoke in the observers themselves. This simulation process involves a complex process, which includes the limbic system, the insula, and the mirror neurons (NE). In this bias, empathy is formed by an extensive neural network. Mirror neurons play an essential role in this mechanism, as they are responsible for capturing and processing the actions, gestures, and facial expressions of the interlocutor. By observing these signals, the NEs are activated and allow the individual to internally simulate the emotional experience of the other. This simulation is not just a passive reproduction; It involves an emotional resonance that allows the observer to better understand what the other person is feeling. The information obtained by the NEs is then directed to the insula, a brain structure that integrates bodily and emotional sensations. The insula acts as a link between the perception of other people's emotions and internal emotional responses, processing this information and transforming it into one's own emotional states. This flow of information culminates in the involvement of the limbic system, which is responsible for regulating emotions, motivation, and the formation of memories. Thus, by activating these brain areas, the observation of the emotions of the other provokes an emotional response that is reflected in the individual's behavior and attitudes. This understanding of simulation theory underlines how mirror neurons not only contribute to the imitation of actions, but also establish a motor-sensory basis of empathy.

Thus, the physiological mechanisms of mirroring are also robustly supported by the theory of social psychology, explained by Iacoboni (2009). According to her, the activation of mirror neurons is intrinsically linked to the ideomotor structure, which reveals a representational configuration that facilitates processes such as imitation and mimicry. The idea that imitation is automatic and pervasive is important, as it suggests that in social situations, humans are naturally predisposed to reproduce other people's behaviors and emotions. This phenomenon is not just a matter of copying; It is a process that occurs at a deeper level, where the experience of the other is internalized to the limbic system, inducing more complex emotions and individuality. This ability is fundamental for the formation of social bonds. Furthermore, mimicry is considered a precursor of empathy, as it creates an

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emotional resonance, mediated by mirror neurons, capable of helping to perceive the emotions of the other and also provoke an emotional response. Thus, the act of "mirroring" becomes a channel for empathy. This process also has significant implications for social interaction and relationship building. By recognizing that mirroring is an automatic and natural mechanism, we can better understand how emotions are transmitted from one person to another, and how this dynamic influences the formation of social bonds and community cohesion. The empathy that results from this interaction is vital not only in clinical settings, but in all spheres of human life, including education, work, and personal relationships.

Thus, mirroring performs essential functions in living in society, being present in skills that permeate empathy and learning, both for psychosocial adjustment in early childhood education, and in the development of pro-social actions and attitudes at the higher level of education, since they improve the quality of experiences in the university context and foster the academic performance of any student in an undergraduate course that requires a well-interpersonal interaction developed, as well as studied by Soares and Dell Prette (2015). This process is even more present when it is delved into medical courses, since interpersonal relationships are the basis of the doctor-patient relationship, which must be improved and developed during all clinical care to ensure the improvement of professional competence and, therefore, must be the basis for the graduation of young medical students.  who are instructed to build an empathetic relationship with the patient, whether acquired through personal actions or beliefs, as written by Lacombe et al. (2021). As pointed out by West et al. (2006), being an empathetic physician is advantageous for both the practitioner and the patient, since an empathetic physician not only connects emotionally with the patient, but is also better able to identify important nuances in the individual's complaints and concerns. Good communication is therefore an essential pillar for medical practice. Effective dialogue not only allows healthcare professionals to better understand the clinical condition of patients, but also actively involves them in the care process. This active participation is essential, as it promotes a sense of responsibility in relation to one's own health and encourages adherence to treatment. Thus, there is a notable reduction in the probability of clinical errors through good empathetic and assertive communication, as dialogue is fundamental for the construction of the biopsychosocial model of collective health and well-being, as highlighted in the study by Roter (2000).

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## CONCLUSION

Thus, it is concluded that the activation of mirror neurons (NE) in the physician plays an essential role in the development of empathy, which, in turn, significantly improves humanized care. Empathy, as already discussed, is a central element in the doctor-patient relationship, as it allows the professional to understand the patient's emotions and experiences, in addition to ensuring the humanization of care. The integration of knowledge about mirror neurons into medical education can have a transformative impact on care. When future physicians are educated about the importance of EN and how their activation can facilitate empathy, they become more aware of their own emotional reactions and the dynamics that occur in interactions with patients during clinical care. This awareness can lead them to adopt more thoughtful and humanized approaches. Thus, medical training is not limited to technical aspects of clinical practice, but expands to include the development of emotional and social skills essential for professional performance.

In addition to promoting humanized care, the emphasis on empathy can also result in significant improvements in clinical outcomes. Patients who feel understood and well treated tend to follow medical guidelines better and report greater satisfaction with the care received. Treatment adherence rates increase, leading to more positive health outcomes. In addition, professionals who are able to establish a genuine connection with their patients often report greater satisfaction in their work, reducing feelings of burnout and stress. The realization that they are making a real difference in people's lives can revitalize enthusiasm for the profession and reinforce a commitment to quality care.

Finally, the inclusion of the topic of mirror neurons in medical training can have a positive effect on students' academic performance. By developing empathy and communication skills, they can become more effective in their studies and clinical practices, as interaction and understanding are fundamental to learning in medicine.

Therefore, the proposal to integrate knowledge about mirror neurons and their implications in medical education is excellent for teaching, since promoting learning that values empathy and humanized care is central to the training of physicians.

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