

Helena Bulińska

Graduate School for Social
Science

Polish Academy of Science

Warsaw , Poland

hbulinsk@sns.waw.pl

Mirror neurons as a proximal mechanism of social interaction

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Abstract

One of the most fundamental human social attributes is the ability to interact. Through interaction humans learn by imitation and share collective centers of attentions that lead to common knowledge. Social organization is based on the way we interact with one another. Previous sociological studies were focused on the development of those social processes but they did not concern those proximal aspects. The discovery that was made in the last decade of the twentieth century revealed the neurobiological mechanism that seems to enable social interactions. Mirror neurons are the motor neurons that function not only when we perform an action but also when we observe it. Moreover, mirror neurons allow us to understand intentions and emotions hidden behind actions. The ability to understand intentions of others is considered as a fundamental mechanism that determines social relations and, thus, influences social organization. Mirror neurons are the main factor that coordinates imitation and, hence, they are responsible for social conditioning. Mirror neurons provide explanation for social processes that are based on interactions such as common knowledge and social norms. Furthermore, mirror neurons are considered as a biological mechanism that makes social relations possible.

Key words

social interactions, mirror neurons, emotions, imitation

Mirror neurons as a proximal mechanism of social interaction

1. Introduction

The main approach in this paper is a question of proximal mechanisms that are responsible for the complex processes of social interaction. Based on neurobiological theory of mirror neurons as a fundamental mechanism of imitation I intend to show how it influences social processes and, therefore, social structures.

Social sciences in general intend to describe the main rules that make the social processes possible. Nowadays we know that people understand each other, imitate, exchange information, enter into complex corporate interaction, have common symbols, obey the same social rules and norms, celebrate rituals and create common representations. However, we do not know precisely what mechanism is responsible for those sophisticated processes.

Mirror neurons are probably the answer to that question. Thanks to them all social action has developed to the current state. It seems that neurological mechanisms can not only provide explanation about origins of some abilities but they also point to the way they have evolved. Investigating features that are typical for social interaction from the perspective of its foundation is useful to many different areas of science. For example, understanding the key role of mirror neurons in interactions opens perspectives to research on many social disorders such as autism. Furthermore, we can figure out what might influence our everyday behaviors and impulsive reactions and thus show the best ways to solve some social issues. Mirror neurons, by supplementing our views on society, constitute important input to contemporary social sciences.

In this paper I introduce the issue referring to the well known and described social facts. Nevertheless, for the first time I am going to reveal the neurological mechanisms that are fundamental for those processes. The discussion about the role of mirror neurons and its consequence in relation with complex social actions allows one to look at social interaction from an innovative point of view. Moreover, it gives a chance to find out what features are typical for central structures regulating those processes. To briefly present my conclusion I prepared a graph that illustrates the main questions. At first I will briefly explain basic ideas and then describe each element of this approach.

Coming back to the fundamental assumption, the main issue refers to the proximal mechanism of social interaction. Even though the discussion is based on familiar phenomenological discourse, the conception of ultimate solution of social factors is new. Linking traditional ways of describing social processes with new propositions gives a chance to create comprehensive approach.

This discussion definitely creates a bridge between different, usually independent, areas of science. Furthermore, it links the separated levels of organization of the social actions. To illustrate this I will briefly present many various scientific perspectives connected with the topic. Humanism as a scientific approach required abilities to gain from many different resources to achieve a goal – in this case –the complete theory about origins of interactions. The interdisciplinary character of this question provides both innovative and probably the most comprehensive explanation of the most proximal mechanism of all social actions.

Main approaches and thesis in this conception oscillate between social theories. Most used notions are well known. However, for better understanding some short definitions are required. To explain this question clearly and coherently the key words are defined below. I will explain the understanding of each as following:

Social interaction - is a situation in which participants are observing each other and interpreting the actions. Both participating subjects must be active. It is required because each action is a response to (anticipated) actions conducted by an interaction partner. Key words regarding social interaction are: observation (recognition of stimuli) and common

attention (focused interaction).

Mirror neurons – the group of (moto)neurons that are located in human's premotor cortex (F5 area of the brain) discovered by Giacomo Rizzolatti in Parma in the 1990s; they are active not only when one is conducting some action but also when he or she is observing such action. It is assumed that mirror neurons play a fundamental role in recognition (understanding) of moto-action and more complex and sophisticated behaviors (Rizzolatti 2005 ; Iacobini, 2005 ; Gallese, 2005).

Proximal mechanism can be understood as a basic mechanism that makes it possible for some phenomenon to function. Moreover, we can understand its function (in ultimate sense – adaptation to environment, fitness, the strategy of resolving a problem). The proximal mechanism explaining "how" to achieve some goals or needed function.

Imitation – taking an action based on the observation of a particular behavior. By imitating the transformation of a pattern, action should be as similar to the original behavior as possible. It is also important that observation of such action leads to a specific goal-oriented reaction (Meltzoff 2005).

The general idea in proposed model is based on those related concepts. Assuming that mirror neurons are the proximal mechanism of social interaction I presume that social processes, especially interactions, do have the evolutionary origins. They are the consequence of biological adaptation. The existence of ability to imitate probably increased human fitness. Fast, unconscious and efficient imitation allows one to adopt some vital behaviors. Saving time and constantly learning, humans were able to develop more and more sophisticated ways of survival. Capacity for imitation gave our ancestors a much needed opportunity to endure. People are able to avoid enemies, to copy best behaviors, to deceive and to understand each other thanks to the ability to imitate. Imitation is one of the most essential skills that allows humans to develop and to survive.

Imitation is possible because of the ability to understand others' intention. An adequate response for particular action depends on the accomplishment to correct estimate of

others' goals. Mirror neurons make such inference possible. Thanks to this neurological mechanism humans are able to read others' emotion and behavior in the correct way. In consequence, one can easily and instinctively interpret others' actions and generate adequate behavior in response. Empathy is one of the key factors that determinates interaction . It is corresponding with intersubjectivity which means that one not only understands others' actions, but he or she can think about others as a person „just like me“. Empathy integrates social behavior and mutual understanding (Prinz, 2005). Imitation requires proper understanding of goals. Correct imitation of behavior or gestures depends on right interpretation of the meaning of such copied action (Becchio, Adenzato, Bara, 2006).

While imitation was one of the most important factors that contributed to better adaptation to environment, interaction is its consequence. Interactions are indispensable part of our social lives. Owing to the ability to imitate, people were able to create new social standards. Social organization, language and symbols, common knowledge – all these forms of social institution are based on interaction. Such processes are creating culture by linking abstract ideas or patterns of behaviors and translating them for all members of particular society. Paradoxically, culture has biological origins. According to this notion, the basic purpose of culture was to increase human chance to adopt. Taking this further, the complete understanding of our social nature requires taking into consideration both cultural and biological factors.

Mirror neurons might be the answer for the question of ground of culture and social processes. To understand the rules that make the social relations possible one needs to find their elementary parts and foundation. Mirror neurons can be seen as essential part of imitation and, through this, of interaction.

Following this further, the mirror neurons create social structures. In order to organize this inference I have prepared a graph that illustrates the proposed model.

As mentioned above, this theory creates a link between neurology and social science. Therefore, I suggest to define it as a **neurosociology**. Both interdisciplinary character and social orientation support this characterization. Neurosociology's main interest focuses


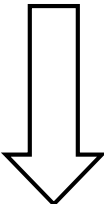

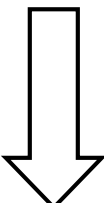

on social processes and their fundamental mechanisms. Neurological basis allows individuals to participate in society and makes it possible to understand the external world. Neurosociological research concerns proximal mechanism of social actions. It might precisely describe the emerging theories regarding mirror neurons. Owing to the instant progress in medicine, especially in neuroscience, we should be prepared for greater participation of new neurological facts revealed in contemporary social science. On the whole, neurosociology creates a bridge between evolutionary basis of human social behavior and its products such as social institution and culture. Summarizing, the neurosociology describes proximal, neurological mechanisms of social processes.

2. Neurosociological graph model

To fully understand the importance of mirror neurons and their influence on social interaction I made an assumption that there are three main levels of social organization. Those three levels are related with social coordination. In conclusion, there are three social integration levels: a) individual level, b) social interaction level , c) group level. At each of those levels I single out core regulating structure. Those central structures are divided into a number of parts: mirror neurons -> imitation -> language and symbols -> identity -> observation -> ->individual learning -> social learning -> common knowledge -> culture.

The last separated part of this graph points out phenomenological disciplines.

Summarizing, the schemes that illustrate the role of mirror neurons in social interaction include three main steps of social organization, core structures and phenomenological perspectives.

Stages of system of organization of cognitive process and social coordination	Central regulatory structure	Phenomenological perspectives	Individual level
<p>Mirror neurons – action and reaction / recognition and understanding / observation</p>	<p>Mirror neurons</p>	<p><i>Goal and intention recognition/ action generation</i></p> <p><i>Mirror neurons mechanism</i></p> <p><i>Sensory - motored coordination of reaction</i></p> <p><i>Action execution and observation</i></p>	
	<p>imitation</p>	<p><i>Intention and goals understanding</i></p> <p><i>Tomasello /Meltzoff</i></p> <p><i>Proximal mirror mechanisms</i></p> <p><i>Empathy / intersubjectivity</i></p> <p><i>Cognitive psychology, classification and notion structures</i></p>	
<p>Social interaction</p> <p>co-operation language → communication</p> <p>↓ learning ← ↻ observation</p> <p>Problem of activation of conflict mechanism <i>case of aggression</i></p>	<p>Imitation</p>	<p><i>Behavioral psychology</i></p> <p><i>Symbolic interactionism</i></p> <p><i>Social exchange theory</i></p> <p><i>game theory –3 main approaches</i></p> <p><i>mimicry and imitation-> Signal theory</i></p> <p><i>emotion / identification /empathy observation -> synchronization -> information transformation</i></p>	<p>Social interaction/ behavioral level</p> 
	<p>language/ symbols</p>	<p>Individual learning</p> <p><i>Morality ->emotion> imitation</i></p> <p><i>Conditioning/ learning -> attention ->stimuli correlation-> socialization</i></p> <p><i>Ritual/ automatisisation</i></p> <p><i>Language/ symbols and signs/ as a tool of shared knowledge</i></p>	
<p>Culture -> Common knowledge: =effects/results of interaction => behaviors ; institutions ; rituals ; norms ; shared attention</p>	<p>Group identity/ identification</p>	<p>Common knowledge /social learning</p> <p><i>Imitation as a social integrator „social glue“ theory</i></p> <p><i>Common knowledge -> shared attention and notions</i></p> <p><i>Social institution and rituals Identity Learning</i></p>	<p>Group / social level</p> 

Understanding mirror neurons as the most fundamental factor implying assumption according to which social interaction depends on presented conclusion. Each of singled out levels contains important elements that gathered together create a complex ability to interact.

The first individual level has mirror neurons as a core regulating structure. Mirror neurons are responsible for coordination of moto-sensoric processes, which means action, observation and understanding (interpretation) of others' behavior. Understanding goal-oriented action and inferring intention from movement are basic skills that allow one to develop internal representation of the external world. Phenomenological perspectives at this level are connected with the question of understanding intentions of others. This knowledge has significant contribution to the imitation (Tomasello 1999, 2005 , Meltzoff 2005). Other perspectives that concern this issue are: fundamental mechanism of empathy and intersubjectivity (Prinz 2005). Mirror neurons mechanism can also complete cognitive psychology theory, especially regarding cognitive structure and stimuli classification (Nęcka 2006, Mruszewski 2002).

At the second level, the main process is social interaction. The imitation is the core structure here, implying both observation and understanding others' intentions. Phenomenological perspectives that are connected with interaction are: behavioral psychology, exchange theory, symbolic interactionism (Blumer 1969) and game theory (Maynard Smith 1982). All of these approaches use interaction as a central factor within the theory. The relationship between imitation and empathy is one of the most important in scientific research in this approach. This relationship should be a subject of research taking into consideration the emotional context and also the mechanism of organizing and transferring information and emotion during observation. Interaction contains also intersubjectivity as an important part of coordination of the process of imitation.

In addition, at this level there can also be found the problem of ambivalent meaning of stimuli, misunderstanding the intention and internal conflict connected with interpretation.

Case study of aggression / research project

This ambivalent reaction can be checked during the test verifying the reaction to aggression. The goal of such experiment is to verify the reaction in situation in which two contradictory stimuli affect mirror neurons. In other words, to test the difference in reception of conflicting stimuli on neurological level.

I decided to choose the case of aggression because it is the most significant, and therefore easy to recognize, action. Usually the research on mirror neurons concerns positive feedback/correlation between stimulus and activation of mirror neurons. In reverse, I intend to check the ambivalent situation. I would like to figure out the cognitive deformation.

In the experiment the human brain will be monitored by PET (Positron Emission Tomography) during conflicting stimuli exposition. The researched person will be exposed to the offender's and victim's patterns of behavior(face expression). This exposition should activate neurons responsible for both action and reaction. Perhaps one of stimuli will activate mirror neurons more intensive than another (for example: neural representation of aggressive behavior will be stronger than of victims attitude). I assume that such situation leads to strong cognitive deformation and biases. This might also distort the sense of behaviors and context based social roles.

Between the second and third level two main structures separated due to better specialization. On the one hand, from observation the individual learning is distinguished. On the other, interaction is implying mechanism creating common senses and mutual understanding – via language and symbols.

The last presented level concerns group processes. The main regulating structures are manufacture of interaction: common knowledge and culture (common representation) and identity, both individual and social. Analyzing those phenomena is supported by phenomenological theories: imitation as a social integrator /social glue (Dijksterhuis 2005),

group identity, social institution and knowledge understanding as an abstract mirror mechanism.

The first two levels: individual and that which refers to social interaction are more tightly related with the mirror neurons. However, also group processes depend on this mechanism. Graph model represent the possible way of understanding the contribution of mirror neurons in social interaction.

3. Conclusion

In conclusion, mirror neurons are the proximal mechanism responsible for social interaction. This neuronal mechanism influence our comprehension of others' emotion and goals. Thanks to mirror neurons people can correctly read intentions and interpret each other behavior. Such cognitive ability allow one to imitate. Subsequently imitation determinate conscious interaction. Understanding the key role of imitation in interaction allows to create a complex theory that not only describes the social processes but also explains their fundamental mechanism and allows us to understand their origins.

Neurosociological research concerns the contribution of mirror neurons in social interaction. Mirror mechanism gives one possibilities to understand others' emotion and intentions. The proper interpretation of other goal-oriented action. Mirror neurons are responsible for proper organization and classification of others' action. I am strongly convinced that mirror neurons play a significant role in our social life.

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