Metafísica y Persona
Filosofía, conocimiento y vida

Metafísica y Persona, Año 10, No. 20, Julio-Diciembre 2018, es una publicación semestral, coeditada por la Universidad de Málaga y la Universidad Popular Autónoma del Estado de Puebla A.C., a través de la Academia de Filosofía, por la Facultad de Filosofía y Humanidades y el Departamento de Investigación. Calle 21 Sur No. 1103, Col. Santiago, Puebla-Puebla, C.P. 72410, tel. (222) 229.94.00, www.upaep.mx, contacto@metyper.com, roberto.casales@upaep.mx. Editor responsable: Roberto Casales García. Reservas de Derecho al Uso Exclusivo 04-2014-061317185400-102, ISSN: 2007-9699 ambos otorgados por el Instituto Nacional del Derecho de Autor. Licitud de Título y contenido No. (en trámite), otorgados por la Comisión Calificadora de Publicaciones y Revistas Ilustradas de la Secretaría de Gobernación. Impresa por Édere, S.A. de C.V., Sonora 206, Col. Hipódromo, C.P. 06100, México, D.F., este número se terminó de imprimir en octubre de 2017, con un tiraje de 250 ejemplares.

Metafísica y Persona está presente en los siguientes índices: Latindex, ISOC, REDIB, SERIUNAM, The Philosopher's Index, ERIH PLUS.

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ISSN: 2007-9699

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Año 10 — Número 20

Julio-Diciembre 2018

UNIVERSIDAD DE MÁLAGA

UPAEP

Contenido

Artículos

Philosophy and Neuroscience: Relation between Mirror Neurons and Empathy

Filosofía y neurociencia: relación entre neuronas espejo y empatía

Santiago de Arteaga Gallinal
Universidad Panamericana, Ciudad de México
sarteaga@up.edu.mx

Abstract

Giacomo Rizzolatti and his colleagues from the University of Parma identified, through brain imaging studies, the existence of mirror neurons in the human brain. The fundamental implication is the direct relationship between action and perception, which allows us to understand, for example, the phenomenon of empathy. Now, can we argue that empathy is only an epiphenomenon of the functioning of mirror neurons? This article confronts scientific discoveries on empathy with the philosophical thought of Theodor Lipps and Edith Stein, as well as with the contributions, that border between neuroscience and philosophy, of Vittorio Gallese. The article defends that, although empathy has an imitative basis that can be understood by the action of mirror neurons, it is not sensible to identify them absolutely: empathy, even if its biological basis is accepted, is a broader phenomenon not reducible to neuronal activity.

Keywords: Mirror neurons, Empathy, Lipps, Stein, Gallese

Resumen

Giacomo Rizzolatti y sus colegas de la Universidad de Parma identificaron, por medio de imágenes cerebrales, la existencia de neuronas espejo en el cerebro humano. La implicancia fundamental es la relación directa entre acción y percepción, que nos permite comprender, por ejemplo, el fenómeno de la empatía. Ahora bien, ¿podemos sostener que la empatía es únicamente un epifenómeno del funcionamiento de las neuronas espejo? Este artículo pone en diálogo los descubrimientos científicos en torno a la empatía con el pensamiento filosófico de Theodor Lipps y Edith Stein, así como con las contribuciones, que lindan entre neurociencia y filosofía, de Vittorio Gallese. El artículo defiende que, si bien la empatía tiene una base imitativa que comparte con las neuronas especulares, no resulta sensato identificarlas absolutamente: la empatía, incluso si se acepta su base biológica, es un fenómeno más amplio no reducible a una mera actividad neuronal.

Palabras clave: neuronas espejo, empatía, Lipps, Stein, Gallese

Recepción del original: 05/02/18
Aceptación definitiva: 20/05/18

Introduction

Ever since the discovery of mirror neurons in the ventral premotor cortex (area F5) of the macaque brain, in the late 1980s, by Rizzolatti and his University of Parma colleagues, the question was put forward whether the same type of neurons could be found in the human brain. Could it be possible that these same neurons, that activate not only when the monkey reaches for or takes a bite out of some sort of food -like a nut or a raisin- but also when someone picks it up to hand it to the monkey, are found in our brains? Rizzolatti and his colleagues went on to verify, through brain imaging studies, the assumption that, if monkey and human brains are similar, then it was most certainly possible. The finding mirror neurons has opened up many areas of inquiry; in the case of this essay, my aim is to link it to the philosophical inquiry concerning empathy. Some philosophers, cognitive scientists, neuroscientists and psychologists (Rizzolatti, Iacoboni, Ramachandran) have fondly greeted the discovery and immediately suggested that mirror neurons might be the answer to the everlasting question: why is it that we understand one another? As Iacoboni puts it: How do we "know what others are doing, thinking, and feeling?"[1] And, most importantly, why do we always have the sense that we too are feeling what the other is feeling? Certainly, others have denied this theory (Churchland, Hickok, Stump), some on the basis that empathy is definitely not a phenomenon dependent on the activity of mirror neurons, and others suggesting that, although they might be found to have some causal relation, empathy itself cannot reduced to such exertion. This article does not have the scope to consider all concepts of empathy nor to include all relevant studies on mirror neurons concerning its relation to empathy. That being so, I shall take the following path: 1) introduce mirror neurons: what they are, where they are and their implications; 2) consider some aspects of empathy from different areas of research and present Edith Stein and Theodor Lipps's ideas; 3) relate the philosophers' ideas to the discussion put forward by Iacoboni, Gallese, Rizzolatti and Ramachandran concerning mirror neurons and empathy.

What are mirror neurons?

Mirror neurons were discovered by Rizzolatti and University of Parma neuroscientists in the ventral premotor region F5 of the macaque monkey. Much has been written about them and they have been prematurely praised as being capa-

[1] Iacoboni, M., *Mirroring people: The Science of Empathy and How We Connect with Others,* New York: Picador, 2009, p. 4.

ble of explaining different phenomena that had been the subject of long and evasive research in the field of social cognition. A neuron is a nerve cell specialized in transmitting information through the nervous system; it is the fundamental functional unit of the nervous system. The human brain has some 86 billion neurons and every one of them can make contact (synapses) with thousands or tens of thousands of other neurons to transmit information. Mirror neurons are "a class of neuron that 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."[2] What is most surprising is that their activity is triggered by the execution of "purposeful, goal-related hand actions"[3] and also by the observation of said actions, and "that this activity shows a degree of action specificity"[4] which makes them different from other kinds of neurons concerned with motor or sensory functions. Some of these other motor or sensory neurons produce discharge when an action is perpetrated and some others when an action is observed, but there had been no previous knowledge of a same type of neuron which produces discharge in both cases. As Iacoboni puts it: "monkeys see, monkeys do." Mirror neurons require, in order to function by the presence of visual stimuli an interaction between the agent and the object.

Mirror neurons in humans

According to Arbib, brain imaging studies have shown that the human brain has a mirror system "*for grasping* (and other mirror systems as well)- regions that are more highly activated both when the subject performs a range of grasps and observes a range of grasps [...] activation for both the execution and observation of grasping was found in the frontal lobe of the human brain"[5] inside or near the region called Broca's area, located in the left hemisphere. Heyes specifies that studies using transcranial magnetic stimulation and functional magnetic resonance imaging have been understood to be sufficient proof of the existence of mirror neurons in human beings: "TMS studies show that passive observation of arm, hand and finger movements results in selective activation of the muscles involved in producing the observed movement."[6] Rizzolatti and Craighero state

[2] Kilner, J. M. & L.emon, R. N., "What We Know Currently About Mirror Neurons", *Current Biology*, num. 23, December, 2013, 1057-1062, p. 1057.
[3] Gallese, V., "The 'Shared Manifold' Hypothesis: From Mirror Neurons to Empathy, in *Journal of Consciousness Studies*, vol. 8, nums. 5-7, 2001, p. 35.
[4] Gallese, V., "The 'Shared Manifold' Hypothesis…", p. 35.
[5] Arbib, M. A., *How the Brain got Language: The Mirror System Hypothesis*, Oxford: Oxford University Press, 2012, p. 135.
[6] Heyes, C., "Where do mirror neurons come from?", *Neuroscience and Biobehavioral Reviews*, num. 34, p. 578.

that, through brain imaging, the Parma colleagues localized the cortical areas that form the human mirror neuron system:

> They showed that the observation of actions done by others activates, besides visual areas, two cortical regions whose function is classically considered to be fundamentally or predominantly a motor one: the inferior parietal lobule [...] and the lower part of the precentral gyrus [...] plus the posterior part of the inferior frontal gyrus [...]. These two regions form the core of the mirror neuron system in humans.[7]

Implications

The fundamental adduced implication behind the discovery of mirror neurons is the direct connection between perception and action, which permits us to comprehend all sorts of phenomena, especially empathy and inter-subjectivity. Ramachandran, in his article *Mirror neurons and imitation learning as the driving force behind the great leap forward in human evolution*[8], suggested that mirror neurons are the gateway to explain a diverse range of human social abilities: the biological implications behind action imitation as generator of culture; the reality of people's comprehending of the intentions behind others actions; the reason why autistic people cannot understand the thoughts of others, etc. As Gallese states: "It seems we're wired to see other people as similar to us, rather than different [...] At the root, as humans we identify the person we're facing as someone like ourselves".[9]

Empathy in Psychology, Neuroscience and Psychotherapy

The question of empathy can be addressed from diverse points of view. On a psychological level, some different attempts to unify or integrate a well-rounded concept of empathy have taken place. For example, the Decety-Jackson model adduces three main functional components that inter-

[7] Rizzolatti G. & Craighero L., "Mirror Neuron: a neurological approach to empathy", in Changeux, J.-P.; Damasio, A. R.; Singer, W. & Christen, Y. (Eds.), *Neurology of Human Values,* Berlin: Heidelberg & New York: Springer-Verlag, 2005, p. 111.

[8] Ramachandran V. S., "Mirror neurons and imitation learning as the driving force behind the great leap forward in human evolution", 2000. December 7, 2016, de Edge.org, Website: https://www.edge.org/conversation/mirror-neurons-and-imitation-learning-as-the-driving-force-behind-the-great-leap-forward-in-human-evolution

[9] Winerman, Lea, "The mind's mirror", 2005. December 7, 2016, de American Psychological Association, Website: http://www.apa.org/monitor/oct05/mirror.aspx

act to produce empathy in human beings: 1) "affective sharing between the self and the other, based on perception-action coupling that lead to shared representations"; 2) "self-other awareness. Even when there is some temporary identification, there is no confusion between self and other"; 3) "mental flexibility to adopt the subjective perspective of the other and also regulatory processes".[10] Gerdes and Segal call attention to the affective response to the other's emotions, the cognitive processing of the other's perspective and our own affective response, and the conscious decision to act empathically.[11] Lastly, Rameson and Lieberman constructed model based on the idea that information processing about the self and the others can have two modes, experiential and propositional. The former deals with automatic and affective experience and the latter entails a controlled cognitive process.[12]

Studies in neuroscience using diverse methods to collect data (neuroimaging, genetics, pharmacology, etc.) are largely common nowadays to determine how the phenomenon of empathy is produced in the brain and the effects it has on brain activity. As Zaki and Ochsner put it, the neural mechanisms underlying empathy is mostly a "tale of two systems", for it is focused on two subprocesses: experience sharing and mentalizing.[13] Although experience sharing and mentalizing are to ways of understanding and providing a response to somebody else's internal states, they do not share underlying neural systems. The mechanism subserving experience sharing is most commonly known as 'neural resonance', which consists on the "perceivers' tendency to engage overlapping neural systems when they experience a given internal state and when they observe (or know that) targets (are) experiencing that same state".[14] On the other hand, mentalizing "engages a system of midline and superior temporal structures broadly involved in 'self-projection': the ability to represent states outside of a perceiver's 'here and now' including the future, past, counterfactuals and targets' perspectives".[15] The trouble with this account is the fact that, since these processes are diverse, they constitute two different paths to empathy and thus suggest that there isn't a unique and integral intra-brain functionality that allows empathy.

[10] Jean, Decety & Jackson, Philip L., "The Functional Architecture of Human Empathy", in *Behavioral and Cognitive Neuroscience Reviews*, vol. 3, num. 2, June, 2004, p. 75.
[11] Gerdes, K. E. & Segal, E. A., "A Social Work Model of Empathy", in *Advances in Social Work*, vol. 10, num. 2, 2009, p. 120.
[12] Rameson, Lian T. & Lieberman, Matthew D., "Empathy: A social Cognitive Neuroscience Approach", in *Social and Personality Psychology Compass*, vol. 3, num. 1, 2009, pp. 94-110.
[13] Zaki, J. & Ochsner, K., "The neuroscience of empathy: progress, pitfalls and promise", in *Nature Neuroscience*, vol. 15, num. 5, May, 2012, p. 675.
[14] Zaki, J. & Ochsner, K., "The neuroscience…", p. 675.
[15] Zaki, J. & Ochsner, K., "The neuroscience…", p. 675.

On the field of psychotherapy, Carl Rodgers is seen as central figure to include empathy at the core of the psychotherapeutic relationship. Given his understanding of the human being as a being who is capable of comprehending himself and modifying his own self-image, attitudes and behavior, and, most importantly, of the preponderant role of intentionality in his assessment of human psychology, empathy consists on the effort to understand the interior world of the patient from his own perspective. The necessity to develop a "subtle perception to capture what the patient expresses or wants to express".[16] On the other hand, it also entails that the psychotherapist is able to capture the other's experience in terms of feelings and meaning. As Davis points out: "Rogers claimed that empathy occurs when therapists view clients with 'unconditional positive regard' and when they actively listen to clients, feeding back thoughts and feelings with sensitivity and accuracy. Healing in psychological sense would then result".[17]

Empathy in Lipps and Stein

This essay concerns itself with philosophical inquiry, as I have previously stated. However, the subject in question here is empathy in relation to the neuroscientific discovery of mirror neurons in the human brain by Rizzolatti and his Parma colleagues. In this section, I will draw on Edith Stein and Theodor Lipps's concepts of empathy to lay the theoretical ground for the discussion on the relation with Rizzolatti, Gallese and Iacoboni's theory of empathy as an emotional phenomenon depending on the activity of mirror neurons.

German philosopher Theodor Lipps understands empathy "as a kind of identification or fusion of oneself with the other, based on 'imitation' (*Nachahmung*) or mimicry of the other's 'expressions' or 'externalizations' (*Ausdrücken*, *Äußerungen*), which are signs of his or her internal life".[18] His earlier interest in empathy is related to his explorations in the field of aesthetics. In his 1903 work *Ästhetik*, Lipps makes a clear relation between aesthetic perception and the perception of another person as a being with another mind. Aesthetic empathy is the "experience of another human": we can perceive and enjoy something

[16] Fox, C., "La empatía y la psicología", in Susnik, M.; Fox, C.; Mosto, M.; Jasminoy, M. & Bertolini, A. (Eds.), *Manantial en el desierto: Ensayos multidisciplinarios sobre empatía y compasión*, Argentina: Ediciones El Rastro, 2016, p. 89.

[17] Davis, C. M., "What Is Empathy, and Can Empathy Be Taught?", in *Physical Therapy*, vol. 70, num. 11, 1990, p. 707.

[18] Moran, D., "The Problem of Empathy: Lipps, Scheler, Husserl and Stein", in Kelly, T. A. & Rosemann, P. W. (Eds.), *Amor Amicitiae: On the Love that is Friendship. Essays in Medieval Thought and Beyond*, Leuven/Paris/Dudley: Peeters, 2004, p. 277.

that is beautiful because through empathy we can make an analogy to another human body, the same way we realize that another person is a "minded creature" by means of empathy.[19] "Empathy in this context is more specifically understood as a phenomenon of 'inner imitation', where my mind mirrors the mental activities or experiences of another person based on the observation of his bodily activities or facial expressions. Empathy is ultimately based on an innate disposition for motor mimicry".[20] That is, empathy is an act of inner-imitation. In his 1903 article, *Einfühlung, Inner Imitation, and Organic Feelings*, Lipps asks how it can be that in empathy the difference between the subject and the object disappears and he is drawn to a discussion about one's raising of an arm and the perception of somebody else's arm-raising. The answer is mainly that either the latter raises the arm voluntarily, in which case there is no empathy present, or he does so unconsciously and with some kind of effort with no movement.[21] The inner disposition for motor imitation is the basis of Lipps's conception of empathy and it allows for: "In a word, I am now with my feeling of activity totally in the moving figure. I am also spatially, insofar as there can be question of spatial extension of the ego, in the place of that figure. I am transported to it. As far as my consciousness is concerned, I am totally identical with it".[22] Lipps soon after turned to a much broader sense of the concept of empathy; however, this essay is not concerned with the evolution of Lipps's thought. I wish to go no further but rather to emphasize the idea that empathy in this case signifies "inner imitation", for this I shall relate later to Rizzolatti and the Italians' theory and the liaison between mirror neurons and empathy.

Drawing on Lipps and Husserl's[23] disquisitions, Edith Stein's approach in her work *On the Problem of Empathy* (1916) considers it a 'nonprimordial happening' that we find ourselves experiencing after it has occurred to us. In a strictly phenomenological sense, Stein understands empathy as an *intentional act*, but a special one, since its object "is the experience of the other [...] deals with the *givenness*, to oneself, of this foreign experience; and it is through empathy that *foreign experience is comprehended*".[24] For Stein, the presence of the other's experience is disclosed to us by empathy, but we cannot comprehend it or

[19] Karsten, S., "Empathy", *The Stanford Encyclopedia of Philosophy* (Fall 2016 Edition), ed. By Edward N. Zalta, URL = <https://plato.stanford.edu/archives/fall2016/entries/empathy/>.
[20] Karsten, S., "Empathy".
[21] Jahoda, G., "Theodor Lipps and the Shift from 'Sympathy' to 'Empathy' ", in *Journal of the History of the Behavioral Sciences*, 41, 2, Spring 2005, p. 154.
[22] Lipps, T., "Einfühlung", *Inner Imitation, and Organic Feelings*. Cited in Gustav, Jahoda, "Theodor Lipps and the Shift from 'Sympathy' to 'Empathy' ", in *Journal of the History of the Behavioral Sciences*, vol. 41, num. 2, Spring 2005, p. 155.
[23] I decided not to include Husserl in this article because he was inspired by Lipps and is also well represented in the thought of Edith Stein.
[24] Meneses, R. W., "Edith Stein and the Contemporary Psychological Study of Empathy", in *Journal of Phenomenological Psychology*, num. 43, 2012, p. 162.

access it as first-person; rather, the experience with which we empathize is not in us, but always in the other. That is why she calls it an intentional experience. Criticizing Lipps, she states that there must always be a difference between he who empathizes and the empathized other, thus negating the idea that in the empathic experience there is such thing as a fusion between the empathizer and he whose experience is object of empathy. As Thompson states, for Stein empathy is characterized as "the experience of feeling led by an experience that is not one's own" and there are three levels that need not be necessarily accomplished: the experience of another, where the other emerges and "faces me as an object"; the possibility of inquiring into the "content of the experience" and the underlying tendencies (in this case, we are directed to the object in an intentional act by which we "imaginatively transpose" ourselves to the other's place in order to understand, from his point of view, the object of their experience); now the experience turns to us again, "but now in a clarified or explicated way".[25] Thompson gathers from these levels present in Stein's thought four possible kinds of empathy, from which I want to point out one for it will be considered upon delineating the Italians' theory of empathy: "the passive association of my lived body with the lived body of the Other".[26] This type is not initiated voluntarily by the subject, it is previous to reflection and belongs fundamentally to the body; moreover, it is the basis of others. Why does Stein believe that these experiences of empathy can take place? The reason is that we perceive the Other as animated by his own "fields of sensation", which gives place to 'sensual empathy'. Beyond the emergence of the Other through the presence of his body, we can realize that, for example, when the body lies in some way on a sofa, it does not lie there as a dead body, but as a lived body through which we can perceive certain sensations that are present in the way-of-lying of the body.

As in the case of Lipps, I do not wish to show the full scope of Stein's theory of empathy, but to point out the ideas that I will later relate to the issues on mirror neurons. On concluding these two accounts, it is important to bear in mind two main points: that Lipps reduces empathy to an "interior imitation" and Stein allows for a theory of empathy in which there is, as either a preliminary or special type of the experience, a "passive association of my lived body with the lived body of the Other." From a phenomenological framework, we might further consider the contributions to the problem by Husserl (from whom Lipps and Stein obtained their first insights on the subject), Scheler, Merleau-Ponty, Moran and Zahavi.

[25] Thompson, E., "Empathy and Consciousness", *Journal of Consciousness Studies*, vol. 8, nums. 5-7, 2001, p. 16.

[26] Thompson, E., "Empathy and Consciousness", p. 17: The for kinds of empathy described by Thompson are as follows: 1) the passive association of my lived body with the lived body of the Other; 2) The imaginative transposal of myself to the place of the Other; 3) The interpretation or understanding of myself as an Other for you; 4) Ethical responsibility in the face of the Other. Save number four, these kinds of empathy.

Empathy and mirror neurons

Rizzolatti, Craighero, Gallese, Iacoboni and Ramachandran find a direct relation between the functioning of mirror neurons and social emotions such as empathy. In fact, they are certain that the discovery of mirror neurons signifies definite empirical evidence for some ideas put forward by philosophers. Being neuroscientists, their approach to the matter is usually non-philosophical, however, Gallese has produced some work where he attempts to explain from a philosophical standpoint the implications of the mirror neuron discovery. Lipps's theory that empathy is mostly inner-imitation -at least in his earlier conceptualization- is present in Iacoboni and Gallese's work. Moreover, Gallese's article *The 'Shared Manifold' Hypothesis*, lays the philosophical ground for the discussion from the work of Lipps, Husserl, Stein and Merleau-Ponty. Iacoboni has a co-written article, *Neural mechanisms of empathy in humans: a relay from neural systems for imitation to limbic areas*, in which his main conceptual frame is empathy as inner imitation as conceived by Lipps. Ramachandran, in *Reflections on the Mirror Neuron System: Their Evolutionary Functions Beyond Motor Representation*, deals specifically with the areas of the brain that trigger empathic responses and, as Rizzolatti and Gallese, articulates the liaison between empathy and mirror neurons through action understanding and imitation. Rizzolatti, in cowork with Craighero, *Mirror neuron: a neurological approach to empathy*, involves intention understanding and emotion understanding in the matter.

I now want to bring back the two chosen ideas from Lipps and Stein. First, that according to Lipps empathy is a question of inner imitation. Second, that Stein allows for a theory of empathy which implies a type of experience that is a "passive association of my lived body with the lived body of the Other." What should we gather from these ideas and how do they relate to the issues at hand? The term "mirror neuron" signifies exactly what it suggests: that this specific kind of neuron mirrors or imitates emotional or mental states. "With the help of the term "mirror neurons", scientists refer to the fact that there is significant overlap between neural areas of excitation that underlie our observation of another person's action and areas that are stimulated when we execute the very same action. A similar overlap between neural areas of excitation has also been established for our recognition of another person's emotion based on her facial expression and our experiencing the emotion".[27] Rizzolatti[28] and Gallese[29] state that actions are primarily perceived visually; in that case, there is clearly a significant relation between our capacity to perceive through vision and our possi-

[27] Karsten, S., "Empathy", *The Stanford Encyclopedia of Philosophy*, ed. by Edward N. Zalta, URL = <https://plato.stanford.edu/archives/fall2016/entries/empathy/>.
[28] Rizzolatti Giacomo & Craighero Laila, "Mirror Neuron…", p. 108.
[29] Gallese, V., "The 'Shared Manifold' Hypothesis…", p. 34.

bility for an empathic response. Human beings recognize themselves as minded creatures that have -and are having in that moment- emotions when they are in presence of each other, that is, when they are face to face; in that sense, mirror neurons, which are activated when we take an action and when we see someone else take the same action, are understood by neuroscientists as the center of inter-subjective relations between minded creatures. Gallese draws on Lipps's theory and states that mirror neurons constitute imitative brain activity that allows us to see others as minded creatures and apprehend their emotional or mental states. Given these ideas, empathy has to be understood as a biological capacity to imitate mental states and emotions.

The trouble with this reductive interpretation of empathy to imitation is fourfold. First, while imitation of mental and emotional states does entail a receptivity to the other on a biological level, -which can be argued to be one of empathy's constituents- it fails to explicate a more *active* role of the subject in the true fulfilled empathic experience: the fact that, as Stein puts it, the phenomenon in its full richness comprises a "possibility of inquiring into the 'content of the experience' and the underlying tendencies". Second, how are we to explain from a non-materialist standpoint the leap from biological imitation to emotional imitation, and most importantly, the manner in which we understand that something that has to be imitated? To say that empathize is what we do when we reproduce in ourselves the mental or emotional state of the other is not only reductive but naïve: imitation must be mediated by understanding or it is not such. Third, even if every "time we are looking at someone perform an action, the same motor circuits that are recruited when we ourselves perform that action are concurrently activated",[30] the evidence that mirror neurons are the actual 'first-movers' is not conclusive until through experimentation we can actually produce empathy through stimulation and notice the causal sequence from one to the other. Four, that this happens "because of this neural-somatic match to a self-performed action that the Other's movement is understood as a goal-directed action"[31] begs the question if there is some ulterior phenomenon that helps us relate the goal-oriented character of the action as an action with which we can actually empathize.

Recent criticism on the relation between mirror neurons, action understanding and empathy has given certain important points. On the issue of action understanding, the state of critical literatatrue finds works such as those of Steinhorst and Funke, and Hickok, to name a few. Steinhorst and Funke, reluctantly employing the "narrow neuroscientific definition of action understanding", that is, "the capacity to recognize several movements as belong-

[30] Thompson, Evan, "Empathy and Consciousness", p. 17.
[31] Thompson, Evan, "Empathy and Consciousness", p. 17.

ing to one action", which equates understanding and recognition, challenge Iacoboni's and Sinigaglia's claim that there is a direct relation between mirror neuron activity and action understanding.[32] The basic claim of their criticism is that, while many articles postulate that mirror neuron activity is proof for action understanding, testing monkey's mirror neuron activity and making assumptions on human action understanding, this is incorrect for different reasons: 1. An experiment is valid when it tests both the independent variable (mirror neuron activity) and the dependent variable (action understanding); in this case, studies are only testing the independent variable, "by conducting single cell recordings on monkeys" and assuming that neural activity in mirror areas is evidence that the monkeys understood the action. However, cognitive processes are not reducible to just one neural area, on account, for instance, of the 'multiple realizability' argument put forward by Putnam, which sustains that a single mental state can be "implemented by different physical states". 2. To state that mirror neuron activity is an indicator for action understanding renders the argument tautological. "If mirror neuron activity indicates action understanding, then action understanding has to occur if mirror neuron activity appears".[33] The problem Steinhorst and Funke point out is that a tautology is not falsifiable and is therefore not to be considered a scientific theory, based on Popper's falsifiability criterion. 3. It is not possible to equalize human and macaque action understanding (such an equalization has not been proven and is not provable); only this would allow us to generalize the results of studies on monkeys onto humans. 4. A motor-based action understanding does not derive directly from a hypothetical proof that mirror neuron activity in monkeys is proof for human action understanding, as Rizzolatti states. The authors conclude that existing results of experiments do not allow us to draw the conclusions we are operating on.[34]

[32] Steinhorst, A. & Funke, J., "Mirror neuron activity is no proof for action understanding", in *Frontier in Human Neuroscience*, vol. 9, num. 333, May 22, 2014, published online: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4033129/#fn0001

[33] Steinhorst, A. & Funke, J., "Mirror neuron activity…".

[34] Hickok adds to the difficulty when he encounters eight fundamental problems concerning the mirror neuron theory of action understanding, which will only be named: 1. No evidence can be found to sustain conclusively that mirror neurons support action in monkeys; 2. We can understand actions by means other than mirror neuron mechanisms; 3. The fact that mirror neurons have been found in the primary motor cortex (M1) of macaque monkeys make it possible to assume that mirror responses are "nothing more than the facilitation of the motor system via learned associations"; 4. Macaque mirror neurons and the human mirror system have an either non-parallel or undetermined relation; 5. Examples can be found that the mirror system function in human beings dissociates from action understanding; 6. There is much evidence that action understanding and action production are not necessarily correlated but rather dissociable; 7. Action understanding deficits is not correlated with damage to the inferior frontal gyrus; 8. Empirical findings fail to sustain the mirror system generalization to speech recognition. See: Hickok, Gregory, "Eight Problems for the Mirror Neuron Theory of Action Understanding in Monkeys

Lamm and Majdandzic argue that, although it has been widely tempting to assume that mirror neurons play a fundamental role in empathy, mainly because of the reception of "rather uncritical popular science books" (like those of Ramachandran, for example) and early publications in social neuroscience "who linked the two phenomena quite liberally, but without much hard evidence", there are, however, various reasons why we should not succumb to this problematic assumption. First, due to its lack of empirical support and, second, to its ample and yet misleading implications for our general understanding of empathy.[35] Lamm and Majdandzic sustain that, while it is plausible that motor resonance processes, 'mirrored' by these neurons, can have some role in empathy, it is not possible to reduce emotion resonance to motor resonance as such; yet, it might be a "starting point that interacts with and needs to be supplemented by additional mechanisms, foremost affective resonance".[36] Furthermore, the authors add that motor resonance is probably not a necessary condition for empathy, due to the fact that empathy takes place quite regularly without activations brain areas that present mirror neurons in monkeys, for example, in cases where emotional responses are activated without the perception of a specific action. "For instance, simply reading in a novel or newspaper about the joy or plight of others, may elicit strong empathic sentiments".[37] Moreover, there are many ways to awaken empathy, as in the cases of persons with psychopathy who do not show empathy automatically but rather when instructed to; precisely, this is not coherent with a conception of empathy where it is triggered by the activity of mirror neurons alone. Perhaps the authors' most compelling suggestion is that the implications from the view that mirror neurons are the necessary condition for empathy are far from being desirable. The characteristics of mirror neurons found in macaque brains make us presume that mirror neurons are "hard-wired in their sensorimotor couplings" and that, as a result, mirror neuron responses are automatic. The idea derived from this line of thinking is precisely that empathy is biologically predetermined and automatically triggered. This is not desirable since it does not include the active side of empathy, reducing it to automaticity in an excessively naturalistic approach that does not take into account factors such as learning experiences, culture and socialization, which are more likely to have a role in empathy's automaticity.

On the other hand, Gallese's 'shared manifold hypothesis' involves different levels that make intersubjective communication and mind-reading

and Humans", in *Journal of Cognitive Neuroscience*, vol. 21, num. 7, July, 2009, pp. 1129-1243, published online: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2773693/#R71

[35] Lamm, C. & Majdandzic, J., "The role of shared neural activations, mirror neurons, and morality ion empathy – A critical comment", in *Neuroscience Research*, num. 90, 2015, p. 19.

[36] Lamm, C. & Majdandzic, J., "The role of shared neural activations…".

[37] Lamm, C. & Majdandzic, J., "The role of shared neural activations…".

possible. Inserting himself in discussions on intersubjectivity within philosophical phenomenology, where a movement beyond empathy is proposed (Zahavi)[38], Gallese establishes empathy in the first *phenomenological level*,

> the one responsible for the sense of similarity, of being individuals within a larger social community of persons like us, that we experience anytime we confront ourselves with other human beings. It could be defined also as the *empathic* level, provided that empathy is characterized in the 'enlarged' way I was advocating before. Actions, emotions and sensations experienced by others become meaningful to us because we can *share* them with them.[39]

This 'enlarged' way of understanding empathy means that all aspects of behavior through which we can establish meaningful bonds with others are included. Of course, Gallese provides evidence that there is a connection between mirror neurons and our capacity to establish bonds because "the representation and understanding of the observed behavior of others is made possible through a simulation mechanism that matches action observation and execution onto the same neural substrate". The problem in this case is not the reduction of empathy to a biological comprehension but rather the amplification of the concept that threatens to vanish its proper sense. We cannot enlarge terms capriciously without endangering their signifying integrity and thus impairing our possibility for sense-transmitting. To say that empathy represents all behaviors that allow us to establish meaningful bonds is not to say much about empathy. Apart from this, Gallese's attempt to gather inside the concept of empathy so many diverse emotional and mental phenomena is a way of tampering with meaning to serve the objective of promoting mirror neurons as a viable source for empathy: certainly, if it is so many things at a time that it basically means nothing definite, then mirror neurons can be said to be at its heart.

Rizzolatti and Craighero, after dealing with questions on action and intention understanding turn to emotion understanding. Same as Gallese, they both comprehend that empathy is not only addressed to action. They ask the following questions: "Which mechanisms enable us to understand what others feel? Is there a mirror mechanism for emotions similar to that for cold action understanding?"[40] Their response is that there are two basic mechanisms for emotion understanding that differ from one another: "cognitive elaboration of sensory aspects of others' emotional behavior" and a "direct mapping of sensory aspects of the observed emotional behavior on the motor structures that determine, in the observer, the experience of the observed emotion". The first

[38] Zahavi, D., "Beyond Empathy: Phenomenological Approaches to Intersubjectivity", *Journal of Consciousness Studies*, vol. 8, nums. 5-7, 2001, pp. 151-167.
[39] Gallese, V., "The 'Shared Manifold' Hypothesis…", p. 45.
[40] Rizzolatti Giacomo & Craighero Laila, "Mirror Neuron…", p. 116.

one is dismissed because there is no emotion involved in the observer, for the other's emotion can be deduced from facial expressions. On the other hand, the sensory-motor mapping mechanism works on account of the recognition occurring because the emotion observed "triggers the feeling of the same emotion in the observing person". In the case of Rizzolatti and Craighero, although from a strictly neuroscientific point of view there can be evidence that mapping the activity of neuron function shows the same emotion is triggered in the observer after the observation, I cannot but wonder how the interaction takes place. Hume's critique of causation comes to mind when the relation is intra-organic and most of all when there is no organic connection whatsoever between cause and effect. Moreover, what if the cause and effect relation was to be inverted? Could it be that the activity of mirror neurons is no more than the effect and we should look for the cause elsewhere?

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