

# THE THEORY OF MIND CONSTRUCT

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## Authors' contributions

**JCLV:** conceptualization, data collection, research, writing the original manuscript, and revising the final manuscript. **FJP:** research, writing of the original manuscript and revision of the final manuscript.

## Ethical responsibilities

The authors state that no experiments on humans or animals have been performed for this research.

The authors declare that they have followed their center's protocols on the publication of patient data.

The authors declare that no patient data appear in this article.

## Conflicts of interest

The authors declare that they have no conflicts of interest.

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*Je pense, donc je suis*  
René Descartes, *Discours de la méthode* (1637)

Dear Editor:

After reading our peer Parra-Medina's manuscript entitled "Mente y cerebro: From the Egyptians to Cajal and the neuromyths",<sup>1</sup> we agree with the author regarding the contributions of some philosophers before Santiago Ramón y Cajal (1852-1934), as well as with the ideas of the Spanish physician on the subject of consciousness and human mind. However, we consider that despite the uncertainty about a well-defined primary location for consciousness and/or human mind, this has become an important topic for medical and psychosocial research. Presently, the understanding about "social cognition", by means of the questions, such as what are mental states, how are they represented, and how does our brain allow us to understand other mind, is the basis of the theory of mind (ToM).

The ToM seeks to explain the innate mental capacity to attribute cognitive states to everyday situations, both for oneself (meta-cognition and meta-representation) and for other subjects. This represents a theoretical mechanism created to explain human rationality within a social environment. Thus, the theory of mind, also known as "Machiavellian thinking", "mindreading", "mentalizing", "théorie de l'esprit", among others, is a multidimensional concept about the complex system of human cognition, which acts as a key determinant in self-organization and affective regulation. Such system allows us to conduct ourselves in a practical way as social interactors by representing an important ability to interpret, understand, predict and control the behavior of ourselves and others within the scenarios of daily life.<sup>2</sup> In turn, ToM is involved in mental processes concerning the reasonableness of beliefs, desires, feelings and emotions (e.g., religion, pain, love, hate, deceit, deception, etc.). For this reason, two systems or neural subprocesses have been proposed to be involved: the cognitive ("cold") component and the affective ("hot") component. According to this proposal, the process of social cognition requires both parts to be intact in order to complete the proper functioning of the human mind, as well as to understand the emotional, visual or cognitive perspective of another individual.<sup>2-7</sup>

Some authors have proposed that the development of ToM is an innate mechanism. It activates during the second year of life and is only directed towards mental reasoning (theory of mind module, ToMM). However, as in the theory of evolutionary adaptation, the genesis and maturation of the neural network could be modulated by experience.<sup>2</sup> Furthermore, this native system gives rise to "self-recognition" and "metarepresentation" within the cognitive process. In these terms, metacognitive faculties emerge with the development of theory of mind, an awareness of the "self" itself within the content of other people's minds. Pando-Orellana<sup>8</sup> explains that our brain needs connections capable of detecting molecular signals, from within ourselves, or external, e.g., languages or ideas. These mental processors undergo an adaptive development to form a lifelong association that, in turn, establishes interactions between geological and atmospheric processes.



In other words, the models with which the brain compares information are the product of the average person's daily life experience (learning).

From the epistemological point of view, the phenomenon of theory of mind has been explained by two philosophical views.<sup>8</sup> Reductionism holds that reality, including biological phenomena and it can be reduced to a minimum number of basic entities or components. According to this position, the concept of mind can and should always be interpreted by referring to explanatory factors belonging to more basic levels of organization: molecules, neurons, neuronal micro-networks, active field, neuronal macro-networks, brain, and so on.

Thus, ToM could be reduced to synaptic activations taking place in different parts of the brain. However, in neurobiology the transition from neuronal function to a functional circuit is not always predictable. It is evident that neuronal micro- and macro-networks possess different properties that can be deduced from an understanding of a neuron. In other words, the properties of a circuit exceed the sum of the properties of the neurons that comprise it, and moreover, neuronal properties represent more than the sum of their molecules. Thus, emergentism proposes that when complexity grows at different levels of organization, totally new properties, called emergent properties, appear. The concept of emergentism implies that there is a transition of properties at each level of organization and, in essence, this transition is not explainable from more basic levels. Thus, mental activity, thoughts and subjective experiences emerge from brain activity.<sup>9</sup>

Now, from a functional point of view, neuroimaging studies have provided evidence for the existence of a disaggregation between the two components of ToM. Neuroimaging have assessed cognitive versus affective ToM processing areas by examining their activity in response to cognitive tasks (e.g., the "false belief task") and affective tasks (e.g., the "faux pas task").<sup>10</sup> According to Abu-Akel and Shamay-Tsoory,<sup>7</sup> there is evidence regarding the location of affective processing specific to ToM and its place of development in the prefrontal cortex, the orbitofrontal cortex (Brodmann's area 11/12/47) and the ventral medial prefrontal cortex (Brodmann's area 10/32). Likewise, the dorsal medial prefrontal cortex (Brodmann area 8/9) and the dorsolateral prefrontal cortex (Brodmann area 9/46) have been mostly implicated as the cognitive ToM processing areas.<sup>11</sup> In turn, there are dense connections between the amygdala and the involvement of the ventral medial prefrontal cortex, orbitofrontal cortex and inferolateral frontal cortex, which are strongly involved in the affective processing of ToM.<sup>12</sup>

As conclusions we can mention that, although there is no specific location for the determination of the origin of consciousness, or the content of thought itself, we can establish the existence of neuronal processes and subprocesses that lead to the genesis of a philosophical and metacognitive concept that allows us to locate our social thinking. Such a fact could explain the impairment in executive and socio-emotional functions (e.g. verbal and non-verbal language difficulties) associated with certain neurological and psychiatric conditions, without neglecting the functioning of the brain as a whole in the different tasks we carry out day by day in society.

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