Empathy and Ontogeny: A Conceptual Approach

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ABSTRACT

The aim of this work is to describe the general process of development of empathy from the ontogenetic point of view and how this process is associated with the development of human empathy. The processes involved in the formation of empathy start in the fetal formation and conclude at the stage of young adulthood. Then, the formation of empathy in a subject is determined by biological and environmental factors and the interaction between these factors. These factors should be considered for any intervention in the curriculum relating to the introduction of empathy in the process of teaching and learning.

Keywords: Empathy, medical education, ontogeny

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INTRODUCTION

The concept of empathy is considered ambiguous (1). Hojat *et al* (2) describes empathy as a cognitive attribute associated with the possibility of understanding other people, while others (3) describe it as an affective or emotional attribute that essentially involves feeling the pain and suffering of another person. There are also some authors who suggest that empathy has both components - affective and cognitive (4–5).

Several authors propose the strict need that humanistic values and empathy should be the focus of the didactic/pedagogical process related to the education of dental students (6–7). The processes of intervention are difficult because, in the formation of empathy in any subject, multiple intrinsic and extrinsic factors are involved and the ‘resultant’ empathy depends on the type of ‘correlation’ existing between these factors and empathy itself, and how this specific correlation influences the formation of this construct in a particular subject (6) .

Therefore, the aim of this work is to attempt to describe the interaction of the processes that occur in ontogeny associated with the formation of empathy.

Development

The motor cortex, which is responsible for the precise control of our own movements, is activated by simply observing the movements of another person. In humans, this allows for the copying mechanism by which humans understand the intentions of others and are able to read others’ minds.

Indeed, "the ability to interpret the intentions of others is essential to successful cooperation and social interaction" (8). In the recognition and understanding of external movement, as noted above, mirror neurons (MN) and the Theory of Mind (ToM) are involved.

Mirror neurons are activated to a greater extent when the motor actions are in an environment with particular meaning to the observer, thus allowing the observer to interpret and identify the intentions of persons.

We can infer that human evolution has ensured the biological basis that favours identification processes to ensure survival. This mechanism creates the essential prerequisites for identification processes, for example, in the meeting between a son and his mother, in which an associative complex called “action/intention" occurs (8).

The face is one of the first stimulus received at birth and belongs to a visoperceptual, special category. It plays a central role in the development of skills for social interaction and language (9). The stimulus must be processed and there are several models that try to explain the facial-processing.

The best known are the functional model for face-processing and the Distribution Model for Neural Face Perception (10). The central idea of the first model is that facial-processing is a group of independent processes, so face recognition and identification are independent of the encoding dimensions of the face, such as gender or expression. The thrust of the second model is that many of the facial, perceptual functions are achieved by the coordinated participation of multiple regions (9).

The processing of spatial information, which comes from the eye and head position, involves the coordinated participation of the sensitive region to face (SOMETHING SEEMS MISSING FROM THIS SENTENCE) perception in the superior temporal sulcus and the system of spatial attention in the intraparietal sulcus. All of this ensures that, in the biological substrate of empathy, there are points of interconnection between the MN and neural components that recognize emotions.

Broche (11) indicates that the perception of emotional expression involves the coordinated participation of regions for the visual analysis of the expression and the regions that represent and produce emotions.

This model provides a description of functional subsystems which constitute the foundation of many aspects of social cognition. Studies that have been derived from these models to understand the neural basis of face- processing have concluded that there is no specific region related to facial recognition. There is only evidence of areas that may or may not converge in a region where the function is not only reduced to facial processing (9). In relation to the memory of faces, it has (SOMETHING SEEMS MISSING FROM THIS SENTENCE) argued that operates under the same mechanisms and has the same substrate as the remaining reports. While the face provides information about the identity, it also becomes a window to get information about the emotional state of others.

According to Cereceda (12), emotions play an essential role in acquiring experience, in survival and in human development. Personality is shaped through emotions, also perceptions of the world. The facial expression of emotions is important for the survival of individuals and is recognized as a major adaptive function, whenever it is involved as a powerful incentive and facilitator of behaviour (9). Emotions are able to organize various biological subsystems (facial expression muscles, tone of voice, the autonomic nervous system and the endocrine system) and, therefore, present the possibility of an effective body response (13). This leads to the important social function of emotions when it affects relationships by the proper recognition of emotions in others and the positive response to these emotions (9).

Emotional recognition is an essential component in the formation of emotional competencies and constitutes one of the basic elements for empathy. The recognition of emotional facial expressions can trigger an empathic response and the ability to interpret the reactions of people and predict resulting behaviours (14).

Ekman (15), suggests that those who exercise better recognition of the subtle expressions of emotion are more open to new experiences and tend to show more interest and curiosity about things. This affects the psychological well-being of the individual and his environment, because one who is more exposed to greater experiences may also develop his/her social skills and neural networks.

Emotions play an important role in the understanding of empathy. However, the role of experience in the ability to remember faces and recognize emotions at an early age, and how cognitive systems are configured in relation to the mechanisms formaturation, are still unknown. But this does not mean they are not subject to ontogenetic development, since emotion recognition and empathy both have a biological substrate whose ‘product’ is the result of complex interactions of many factors which act simultaneously. The final result is (specific correlates of the interaction of the factors responsible for the formation of empathy.

ToM allows us to interpret automatically and immediately the mood of others, especially when a communication occurs. ToM therefore enables the individual to act without difficulties in interpersonal relationships, and most importantly, it is possible to anticipate or predict and establish relationships, all of which are essential in the process of mating and reproduction (20).

Empathy and ToM share the same processes, but it is often regarded as different entities. Autistic persons have social cognitions deficiencies and produce physiological and cognitive response, sometimes exaggerated, in stressful situations, while psychopaths are unable to empathize, but have no difficulties in the process of awareness.

Some researchers postulate that ToM is innate and intuitive, while others regard it as the result of experience and learning. The evolution of the ToM module works in conjunction with the process of brain maturation because it requires the development of brain structures and the formation of precise neural networks. Ultimately, the ability of the ToM includes a variety of cognitive processes that take several years to develop during ontogeny (8).

In the first six months of life, the child can remember simple representations, but cannot find a hidden toy object in his presence. At eight months, he can manage to find the hidden toy object. This behaviour suggests an ‘embryonic’ form of executive functions (25). The child is able to use information that is not present to achieve an objective. In the first year of life, the ability to suppress dominant responses also emerges, and this is the first form of inhibition observed in humans (17), but these embryonic forms, with executive functioning, are very fragile and easily alterable. The ability to manipulate and transform information begins between 15 and 30 months of age (18).

At the age of three, the first signs of regulating behaviour through internal mechanisms can be seen, but it is not until four years of age that evaluation capacity and self-regulated cognitive processes (metacognition) emerge (17). The development and subsequent consolidation of metacognition directly affects the child's ability to solve the problems it faces. Four-year-olds can solve two movement problems, while eight-year-olds can resolve three movements. Like other executive processes, the ability to plan and organize follows a development process covering a broad time period and reaches adult levels at age 12 (19).

The development of executive functions is associated with the maturation of the prefrontal cortex. The gradual development of the tasks arising from it depends on changes that occur in this structure (20), and those changes start in the intrauterine stage. After birth, the prefrontal grey matter expands its volume until 12 years, then decreases gradually. Between 5 and 11 years, the cortex with greater thickness, is located in the dorsolateral, prefrontal and parietal lobes (21–22).

By contrast, the volume of the prefrontal, white matter continues to increase during childhood and adolescence. The increased volume of prefrontal, white matter has been attributed to the myelination process of cortico-cortical pathways associated with this brain region.I In the prefrontal cortex, the myelination process ends before in the orbitofrontal, rather than the dorsolateral prefrontal cortex. These prefrontal regions may have different anatomofunctional origins which could determine their belonging to different brain systems and could explain their differences in patterns of maturation. (23).

In addition to macroscopic changes, microscopic changes over the period of childhood and adolescence are also produced. Such changes will better enable the convergence and integration of information between the two cerebral hemispheres and thalamus (24).

From the metabolic point of view, between 6 and 8 months, the side portions of the prefrontal cortex show functional activity and between 8 and 12 months, activity is observed in the dorsal and medial regions. At the end of the first year of life, patterns of metabolic activity in this brain region are qualitatively similar to those observed in adults (24). Moreover, the metabolism of glucose in this region increases 2.5 times between three and nine years, in relation to the adult brain, to reach the same levels as those in the early 10 years of age (25). The knowledge about relationships between changes in the prefrontal cortex and the specific transformations of executive functions is not extensive (16).

The findings reveal that the functions of the prefrontal cortex are more efficient as the child grows and require less activation of this brain region to carry out the executive tasks (16–25). The development of cognitive functions associated with the prefrontal cortex depends not only on brain maturation, but also on the maturation of other regions, and existing connections between them and the prefrontal cortex (16). The extensive network of connections allow the prefrontal cortex to ‘watch’ the information at different levels of complexity in order to control and regulate human behavior.

There are different theoretical models regarding the explanation of the functional changes that occur in parallel with the neuroanatomical changes observed in the first years of life. Of these models, it seems that the most widely accepted are those that are based on the perspective of interactive specialization and learning skills hypothesis, but should not be seen as mutually exclusive. Current developments reveal that during the first years of life is possible to observe how the various cognitive abilities emerge that will constitute executive functions that are important for the formation of empathic response.

There are two phases in the development of these functions: the first includes the first three years of age when the basic skills emerge to enable later proper executive control; the second is characterized by an integration process in which the basic capabilities previously emerged would be coordinated (25). Diamond (18) suggests that children at the age of five have partially developed three key components of executive functions: working memory, inhibition and cognitive flexibility. The first involves monitoring, handling and updating of information; the second refers to the ability to deliberately inhibit the production of predominantly automatic responses when it is required; the third, is the ability to flexibly switch various mental operations or schemes (25).These three components have unequal development. The specific correlation depends on the development of the age, and therefore the time, which is slow and progressive. For this reason, as Garcia (16) says "... it is not surprising that their vulnerability range is exceptionally wide. Normal development of executive functions is crucial for cognitive functioning, but this operation is also important for the social and emotional development of children. "

CONCLUSION

The ideas outlined above may constitute elements that allow us to understand the variability found by some authors, between countries, and health professional students within the same country. The ideas provide the basic conceptual elements to infer that the empathic processes begin at an early age in children and, therefore, the task of health professionals, in general, is to understand these processes in pediatric patients.

In addition, we infer that the teaching and learning processes of empathy in health professional students cannot be reduced to traditional conceptions of pedagogy and teaching, and those methods traditionally associated with them. The possibility of 'empathic intervention in the teaching/learning processes could mean that the strategy, methods and conceptions of how empathy can be taught in health professional schools is an issue that has not been studied with sufficient depth and is an unresolved problem.

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