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## *Empathy*

### ABSTRACT

When we see a child crying, the urge to help him and to comfort him comes to us spontaneously. We understand what he is experiencing, and feel in us something of his sadness, his distress: this is what we call empathy. This sense of the other is the fruit of our evolutionary history and is hardwired in our biology. Empathy has interested a lot of thinkers and in particular the Scottish philosophers of the Age of the Enlightenment such as Adam Smith or Hume. More recently, the philosophers Robert Gordon (St Louis, Missouri) and Alvin Goldman (Tucson, Arizona) proposed the theory of simulation according to which when we understand the other, we simulate the other's point of view and we use this prospective to understand the other and predict his behavior. The French neuropsychologist Jean Decety adopted this point of view. He specifies that the empathy is the capacity to mentally simulate the subjectivity of the other, to put ourselves in the shoes of another: it lies on biological systems.

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## INTRODUCTION, DEFINITION

When we see a child crying, the urge to help him and to comfort him comes to us spontaneously. We understand what he is experiencing, and feel in us something of his sadness, his distress: this is what we call empathy. This sense of the other is the fruit of our evolutionary history and is hardwired in our biology. This allows us to take on a subjective prospective with respect to others, what is particularly important because the Man is a social species. But what is empathy about?

Several definitions have been proposed. For example the one according to which empathy is the “faculty to identify ourselves with someone and to feel what the other person is feeling”. Empathy has interested a lot of thinkers and in particular the Scottish philosophers of the Age of the Enlightenment such as Adam Smith or Hume. At that time, they did not talk about empathy, but about “sympathy”. So, for Adam Smith, the sympathy corresponds to the feelings we have for other people, to the capacity we have to take the prospective of others. For Hume, our minds are mirrors one of the others.

More recently, the philosophers Robert Gordon (St Louis, Missouri) and Alvin Goldman (Tucson, Arizona) proposed the theory of simulation according to which when we understand the other, we simulate the other’s point of view and we use this prospective to understand the other and predict his behavior. This simulation process is unconscious. Simulating the other consist in projecting ourselves in the situation being experienced by the other and therefore we would produce decisions, emotional states which we would produce ourselves in this situation

The French neuropsychologist Jean Decety adopted this point of view. He specifies that the empathy is the capacity to mentally simulate the subjectivity of the other, to put ourselves in the shoes of another: it lies on biological systems. It is a response triggered by the emotional state of the other, but it is also the recognition

and the more or less precise understanding of his (her) mental states. However, if it enables us to understand that the other one is similar to ourselves, it does not lead us to become confounded with the other (Berthoz, 2004).

#### VARIOUS TYPES OF EMPATHY, ONTOGENY, PHYLOGENY

##### *Various types of empathy*

Most authors distinguish different levels of empathy, requiring more and more complex cognitive processes. The first level, the most elementary, corresponds to a phenomenon called “emotional contagion”. What is it about? According to Favre et al. (2005), it is about an “innate, biological capability to be invaded...by the feelings of others, characterizing more particularly symbiotic states which ontogenetically precede the empathy.” You are yawning, and others” without visible reason “, yawn too. You are together with a joyful group, and too, you begin laughing. A baby begins crying, and the other babies of the nursery cry. This phenomenon has been observed in laboratory, as well as in other species: for example experimenters showed a video to chimpanzees: in this videoclip they could see other chimpanzees yawning and the first ones began yawning. It is not imitation, but contagion related to a bodily synchronization. This contagion does not require the consciousness: in a famous experiment, Ulf Dimberg put electrodes on the face of voluntary subjects to record the activity of the face muscles while they were watching a computer screen on which appeared happy or angry faces. He noticed that the subjects tended to activate the same muscles as the ones that were necessary for the facial expression seen on the screen (anger in case faces presented on the screen were the ones of angry persons and conversely for the happy faces). Later, he displayed faces on the screen in a subliminal way: faces always appeared, but during

a so short period that the subject did not have time to become aware of it. In this experimental situation also, the subjects activated muscles corresponding to the expression which had been presented to them. So, this type of emotional contagion does not require consciousness. Nevertheless, in spite of its rudimentary aspect, it can be used for the implementation of more complex behavior, as certain forms of learning by imitation. This type of empathy by contagion however remains a very primitive form of empathy; it does not require to understand what the other is feeling, or to help the other person. Some associate this level to an automatic, instinctive, non controllable process, which could come along with feelings. It is also termed as affective empathy.

A second level of empathy corresponds to the capacity to be worried by the other, for example by trying to comfort the other person if he is feeling sad. This second level requires the first level as well, because without the capacity of contagion which allows us to feel what the other one feels, there is no desire to help him (her). This desire to care of the other can be interpreted in various ways. For some people, helping others is a form of pure self-interest: I help the other person, because the emotional contagion gives me a negative emotion, from which I can be discharged by helping the other. For example, if I hear a child crying, this might produce a negative emotion, from which I can be released by comforting the child who, stopping crying, stops my negative emotion. This has nothing to do with altruism! However, there is also altruistic behavior that has a cost (for example the risk to lose something). In that case, it cannot be related to self-interest, but to another form of empathy, that Wispé (1986) also calls "sympathy". This capacity seems very old because researches in the field of prehistoric archaeology enabled to find bones of hominids with no teeth, paralyzed by rheumatisms, which would never have been able to survive of their own without an extensive help of their congeners. The mutual aid already existed thus in these

prehistoric times. The sympathy thus corresponds to the feelings of concern towards others.

Finally, there is the third level of empathy, which corresponds not only to the fact to worry about the other, to comfort him, but also to the fact to put yourselves in the shoes of the other, to understand his feelings, his intentions and his desires. It is about a capacity to enter in the other, even if his own mental universe is different of mine. For example, you want to make a gift to somebody on the occasion of his birthday and you offer him a present which corresponds to his tastes and his desires, even if you do not share them at all. Either, by seeing a disabled person, you propose him help to cross the street, even if you are in a rush and even when he asked for nothing. This capacity requires to go out of our prospective on the world at the first person (what I see, what I wish, what I need) towards a perspective at the 3rd person (what the other person sees, what the other person wishes, what the other person needs), and to behave accordingly. This type of empathy requires a process called “theory of the mind”, which corresponds to the understanding of the mental states of the other. This kind of empathy is also termed as “cognitive empathy”, to distinguish it from the affective empathy which corresponds to the sharing of emotional experience that characterizes the emotional contagion. Theory of mind and the aptitude to take the prospective of the other are components of cognitive empathy. This type of empathy also allows us to help the other without emotional contagion, and this can sometimes be useful to help really a person in trouble. Indeed, empathy is based on our capacity to recognize that the other is similar to ourselves, but without confusion between the other and ourselves. Indeed, an essential characteristic of empathy lies on the distinction between us and the other, and this in parallel with the experience of emotional sharing. This type of empathy integrates the representation of feelings, desires and faiths of the other.

It is thus necessary to be capable of reaching the mental life of the other by placing ourselves" in the place of the other" – even to think ourselves as the other and not only to think the others as myself (Ricoeur, on 1990). This can be achieved thanks to a mechanism of distinction between us and the other ones. It is here really about taking on a subjective prospective of the other; this is done in a controlled and intentional manner, and probably this is a capacity characteristic of the Human species. Pacherie goes even further. For him, the empathy is not simply an instrument of knowledge of the feelings of the other; it is also an instrument to build the self because being social is a part of a normalized context.

#### *Developmental aspect*

Do babies possess, from birth, knowledge of the emotions of others? They seem to have social expectations because if we present them human faces with no emotions, the baby looks away from it. We also know that babies are attracted in an innate way by social stimuli (faces, human smells, and human voices) because from birth, they make the difference between what is human and the rest. This capability comes along with a capacity to social imitation. Indeed, if an adult makes facial movements in front of a newborn child, the latter makes movements involving the same part of the face (Meltzoff and Decety, 2003; Meltzoff and Moore, 1997). This is termed as a matching perception-action. Starting from this matching, the subject would manage to decode the emotional states and the intentions of the other, by experiencing states associated to these mimickry. Starting from there, he could then build a theory of mind, which will then lead to the idea that others have intentions, faiths, etc..

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*Phylogenesis*

The emotional contagion has been observed also in lower mammals such as mice: indeed, if a mouse sees a congener suffering, this leads to an increase of its own sensibility, and even more if the mouse knows the other suffering mouse. Concerning mutual help, observers report the example of two dolphins that helped a third one which had been stunned by an explosion by maintaining it in stream. Similar cases of mutual aid were observed in elephants and primates. So, Hans Kummer, a rather famous ethologist, reports the example of young baboons trying in vain to climb a difficult passage in rocks. In front of their fruitless attempts, an adult settled down its back in front of the young, to allow him to cross the difficult passage. Or the example of elephants bringing some water to a congener that was agonizing. Other species go further. For example, an anecdote reports that Washoe, a female chimpanzee famous for its capacity to manipulate symbols, did not hesitate to search a small monkey who had fallen into the water, which required passing between two particularly dissuasive electric cords. To save this young, she thus undertook an action which had a cost (receive possibly an electric shock, and enter the water, what chimpanzees are horrified to do).

However, this capacity is not shared by the less evolved monkeys. Indeed, in small monkeys as macaques or baboons, no behavior of discomfort when confronted to individuals who suffer has been observed. Nevertheless, in a variety of small monkeys, Capuchin monkey, attitudes which denote a trend to the altruism have been observed. In an experiment realized by the team of Franz de Waal, Capuchin monkeys learnt to handle tokens to obtain some food. Certain tokens ended in a food reward (a piece of apple) for the monkey who had handled it; other tokens ended in a reward not only for the monkey who had handled the token, but also for a congener who had done nothing. What type of tokens was preferred by the Capuchin monkeys? They presented

a very strong preference for the “altruistic” tokens which not only brought them the reward, but also brought it to congeners. However, it is necessary to note here that this type of behavior costs nothing to the Capuchin monkey (it does not lose anything by handling the altruistic token, while Washoe had to lose a lot by venturing into the water to get back this young). So, when the behavior of empathy is accompanied by a high cost, it seems to exist only in a very limited number of species: Man, the great apes, cetaceans such as dolphin, elephants. Is there a common point between these species? In fact, two common points can be found: the presence of a high index of telencephalization and the capacity to recognize oneself in a mirror. What is this about? The index of telencephalization corresponds to the development of the most frontal part of the brain (the part of the brain which appeared lately during the process of evolution). In an interesting way, this index is high in species which possess the capacity to care about others, to put itself in the place of the others, which suggests a biological basis underlying this aptitude. Besides, these species also possess all a capacity which no other species possesses: that to recognize itself in a mirror. Indeed, if you place a mirror in front of an animal, the animal would interact with its image as if it was a congener: the animal goes to see the image in the mirror, to try to interact in a social way with this image, possibly to try to go to see what is located behind the mirror but without showing by its behavior that it recognized itself. It is also the case of the human baby before the age of 18 months. However, some species have a “sense of the self” allowing them to recognize themselves. This can be tested by placing a white spot on the front of the animal while they are anesthetized. Animals do thus not know that they have this spot when they wake up. If then we put them in front of a mirror, the animals which recognize themselves are going to use their image in the mirror to clean the spot. Only some species are able to do this, in particular certain great apes and elephants. So, the “sense of self” is needed to have a “sense of the others”.

For many, the theory of mind exists only in great apes, which is convergent with the idea that the forms of empathy requiring to project oneself in the other appears only very late in the evolution of the species. In an interesting way, in primates, the index of telencephalization is correlated to the size of the social group in which the subjects are living: the larger the social group, the higher this index. It really suggests that empathy and sociability have a cerebral substratum, even that the evolutionary pressure on the brain made it becoming a social organ.

#### THE BRAIN CIRCUITRY INVOLVED

We have seen 3 forms of empathy: the emotional contagion, the intention to help the other one, the capacity to take the perspective of the other. We have seen a link with the index of telencephalization, suggesting a biological basis to this aptitude. So, if there is a cerebral basis underlying these processes, what is it about? The question is at the same time fascinating, and disturbing, because it might also provide us with a biological basis to the absence of empathy.

The first research in this domain consisted in studying the brain activation pattern at precise moments, using functional neuroimaging methods such as Positron Emission Tomography (PET) or functional Magnetic Resonance Imaging (fMRI). This enabled to observe that the same brain areas are activated when a subject is feeling an emotion, and when he perceives this same emotion in another. For example, if you are scared, an activation of a region called amygdala is observed. But if you see the face of a person who is afraid, it is also your amygdala that is activated. As if, by seeing another person being afraid, you recruit the brain area supporting your own fear. And in case of lesion of the amygdala, the person loses at the same time his capacity to feel fear, and its capacity to identify it in others. The situation is the same

for disgust: the insula is activated at the same time during the feeling of disgust, and by the facial expression of disgust seen in other persons. Again, the lesion of the insula produces a very impressive deficit of the capacity to feel disgust, and of the ability to identify it in others. Pain finally. If you feel pain, it produces an activation of the insula and the anterior part of the cingulate cortex which is related not so much to physical pain, but to the negative emotion associated to it. If you are looking at a film in which you see a needle entering slowly into the skin of a person, although it will not provoke any physical pain in you, you will display the same activation of the insula and of the anterior cingulate as when experiencing pain yourselves. It is interesting to note that this activation is correlated to the score of empathy: the more you feel empathy for the person you see on that film, the larger these brain areas are activated. This type of empathy thus results from a matching between your subjective emotional feeling and identical sensations perceived in others. Electrophysiological techniques (for example electroencephalography) allow collecting indications on the speed of cerebral processing. So, it was shown that when we see an emotional facial or gestural expression, the signal is treated by the visual areas within 100 ms. After 170 ms, the signal propagates to other brain areas such as the temporal cortex. They allow a contextual processing. Even later, after 200-300 ms, the prefrontal cortex is recruited: this allows the control of the behavior triggered off by the emotion of the others, and thus to go beyond the simple emotional contagion.

Another very interesting phenomenon has been observed at the level of the prefrontal cortex: the motor empathy or the motor resonance. When I see a person doing something (for instance picking up an object with the right hand), the premotor areas of my frontal cortex and of my parietal cortex are recruited, as if I was doing the same thing. And the activity that is triggered is specific: if the other person does something with the right hand, brain areas allowing to move my right hand will be activated; if

the person does something with the left hand, the same regions that would get activated if I pick up an object with the left hand would be activated, and so on. If on the other hand we present to the subject a movie with an impossible action (for example move the hand towards the back), then this area will not be recruited. One can also ask persons to imagine either an action they are going to undertake, or to imagine another person undertaking the same action. Again, we will see common points and differences. In an interesting way, the inferior parietal lobe is recruited specifically when I take the perspective of the other. Lesions of this region induce difficulties in this process.

When we postulate that one of the mechanisms underlying empathy involves a similarity of regions activated by our own feelings and by the feelings we infer in others, we describe a process involving brain areas. But what about observations made at another scale, as for instance the microscopic one? In that case, we focus on neurons. Are there neurons more particularly recruited by such processes? The answer is positive, and involves two types of neurons: the neurons of von Economo and the mirror neurons.

The neurons of von Economo (of the name of the one who discovered them: Constantin von Economo, died in 1931) are cells that are recognized very well in the microscope thanks to their specific shape: their cellular body is in the shape of a spindle (they are thus also termed as "spindle neuron") and they have only a single output (while the other types of neurons often have a large number of it). These neurons are important as they favor connexions between distant brain regions and one thinks that they are capable of receiving at the same time information from several regions of the brain, and of making a synthesis quickly. These cells are found only in Man and in great apes, in certain cetaceans (as dolphins and whales) and in elephants. Interestingly, these cells are not found everywhere in the brain but they are located in specific regions, as the anterior cingulate cortex and the fronto-insula cortex. We have already seen that these two regions are

activated during situations related to empathic reactions. These two regions are also activated when a person sees the image of a loved person, suggesting an involvement of these regions in attachment and social link. In autism, a pathology characterized by a deficit of the theory of mind and by social withdrawal, an abnormal development of these neurons has been observed. We can think that these neurons would hardly be implicated in the emotional contagion, because this kind of empathy exists in species (as mice) which do not possess neurons of von Economo. So, these cells would be involved in both forms of high level empathy. It is interesting to see that the cells which favor the relations with the other human beings work favoring relations between neurons. As if the process of upper level is found itself at the cellular level, like a fractal structure.

Mirror neurons are cells which are activated when a subject executes a movement (as picking up an object) and when the subject does not move his hand, but follows another subject conducting these same actions: this explains why they are termed as “mirror neurons”. These cells were described in the 1990s by Giacomo Rizzolatti’s team, at the University of Parma. These neurons are in a region called “region F5” of the inferior frontal cortex of the macaque. One can also find them in regions of the inferior parietal cortex. There are two types of mirror neurons: those who are activated when an exactly identical action is executed (for example when the macaque takes an object with the left hand and when he sees another macaque taking the object with the left hand) and those who get also activated when the action is not exactly the same, but is related to the same aim (when the macaque picks up an object with the left hand and when the congener takes the object using the right hand). These neurons are capable of reacting also to abstract actions or to partially hidden actions (for example a neuron reacting when the subject is picking up an object with the hand can be also activated when the subject is viewing a scene partially hidden by a screen, from which he can make the deduc-

tion that an object was seized by the hand: it is not necessary that the whole scene was seen). Even more abstract: the same neuron can be activated when a primate squashes a peanut with the fist and when the macaque hears the noise of a crushed peanut: an image in a case, a sound in the other one. Even better: these cells can be activated during tasks linked to specific intentions. Indeed, certain neurons are activated only when the subject executes an action linked to a specific intention (for example a neuron can be activated when a person is picking up food with the intention to eat it, and not he is picking it up with the intention to place it in a box). The same neuron will be activated when the monkey sees a congener executing the action with the same intention as the one that he had, and not in the other case. These cells allow thus not only to encode abstract information favoring the understanding of the behavior of others, but they could be also involved in the understanding of the intentions of others. For numerous researchers, these mirror neurons correspond to the cerebral system underlying the capacity to understand intentions of others as well as the theory of mind, two processes that are crucial to the most elaborated forms of empathy.

So far, we have only focused on brain regions and neuronal types in relationship to empathy, but there are also hormones strongly involved in sociability, among which we can quote oxytocine. Oxytocine is a small peptide well known for its role during birth (it favors the contractions of the uterus), in maternal behavior but also empathy. Some researchers have been interested in genes coding for oxytocine in Man and they showed that there are two variants of this gene: an "A" variant and a "G" variant. As every trait is linked to the expression of two genes, a person can thus have either the AA combination, either the GG, or the AG. Studies showed that the persons with GG rate higher in empathy scales than those carrying the A allele (AA or AG). Does this mean that the empathy is genetically programmed? Things are of course not as simple because the environment has a very crucial

contribution to this phenomenon too. This was demonstrated by twin studies. In 2008, Knafo et al. compared the empathy scores of 409 couples of twins. They observed that around 40 % of the variability of this trait was of genetic origin, the rest (60 %) being explained by the environment. Briefly spoken, even if certain genetic variants can improve the capacities of empathy, social environment as education contributes to it in an even more important way.

#### THE DEFICITS OF EMPATHY IN PSYCHOPATHOLOGY

Are there deficits of the empathy and of the functioning of the brain structures that underlie this process in certain psychiatric pathologies? Answer to this question seems positive. For example, bipolar patients when in the depressive phase of their cycle present abnormalities of the recognition of emotional facial expressions (Schaefer). Juvenile delinquents have difficulties extracting from their own point of view associated to incapacity to make deductions on the intentions or the faiths of others (Anastassion-Hadjicharalambous and Warden, 2008). These changes are accompanied with modifications of the recruitment of the brain areas associated with empathy. Borderline patients present an hyper-reactivity of the amygdala towards emotional facial expressions, (Rosenthal). Also, alexithymic subjects present reduced amygdala activation when exposed to faces expressing sadness (Kugel).

We can thus suppose that this link is partially causal, and that by improving attention toward others, we can reduce pathological behavior.

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