

Empathy: Its ultimate and proximate bases

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There is disagreement in the literature about the exact nature of **the phenomenon of empathy**. There are emotional, cognitive, and conditioning views, applying in varying degrees across species. An adequate description of the ultimate and proximate mechanism can integrate these views.

Proximately, the perception of an object's state activates the subject's corresponding representations, which in turn activate somatic and autonomic responses. This mechanism supports basic behaviors (e.g., alarm, social facilitation, vicariousness of emotions, mother-infant responsiveness, and the modeling of competitors and predators) that are crucial for the reproductive success of animals living in groups.

The "Perception-Action Model" (PAM) together with an understanding of how representations change with experience can explain the major empirical effects in the literature (similarity, familiarity, past experience, explicit teaching and salience). It can also predict a variety of empathy disorders.

The interaction between the PAM and prefrontal functioning can also explain different levels of empathy across species and age groups. This view can advance our evolutionary understanding of empathy beyond inclusive fitness and reciprocal altruism and can explain different levels of empathy across individuals, species, stages of development, and situations. (a juvenile chimpanzee comforts a distressed adult)

Empathy and contagion of yawning: A behavioral continuity related to a behavioral discontinuity ?

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Abstract : While yawning is an example of behavioral continuity within mammals, the contagion of yawning, that is yawning after seeing someone else yawning, is only present in humans. We proposed that contagion of yawning is only possible in species showing altogether empathy, TOM and imitation and other perspective-taking capabilities.

Preston and de Waal claimed that the PA Model might help explaining and making testable predictions about empathy. **This model might also explain contagion of yawning.** It might as well predicts batting average in baseball or someone touching his head when hit by a falling apple as Newton might have done and many other phenomena from reflexes to cognitive empathy.

But, contrary to other mentioned phenomena, cognitive empathy and other phenomena, like imitation, theory of mind and perspective-taking requires representations of other's feelings, knowledge or actions.

A fit-all model becomes useless. Yet the issue of behavioral continuity supported by a structural continuity (homology) remains a valid and interesting question. Before presenting our argument, we would like to raise some semantic problems. It should be reminded that when a label is given to a concept, it has also been defined, initially and this initial definition should always be first

recalled, instead of an ad hoc one. In addition as items in a category share at least one feature, a concept has at least one feature that distinguishes it from other more or less related concept (cf empathy, sympathy, contagion communication). Using a concept definition loosely or forgetting the feature that makes a concept unique leads to confusion that might preclude to clarify the actual issues.

Empathy is a phenomenon that implies an "other". It may be then one of the properties of at least social species. However, empathy should not be confounded with other social phenomena. Communication is not empathy: reacting to other's actions, as in agonistic interactions or even in play, does not necessarily imply sharing his feelings. In these actual interactions, complementarity, yet differences in affective and emotional states, is the rule. Complementarity is also involved in many other cases of social adjustment. Reacting to newborns or infants expression of discomfort does not at all imply that the potential caregivers have a representation of the peculiar feelings of an infant, specific to this age class.

In many vertebrate species infant's features function as strong releasers for older conspecific. Alarm contagion might be achieved by a mere conditioning at an individual level in absence of perception of others' feelings and fear state. Therefore communication should not be taken as a synonymous of empathy and vice versa. And contagion should not be confounded with synchronization of activities triggered by an external or internal stimulus perceptible or perceived by several individuals independently.

Contagion of yawning and empathy. Yawning is a behavior that is homologous in all mammals and is claimed to be present in many vertebrate species (Deputte 1974, 1994). However it shows some differences within mammals. While it is frequently associated with stretching in many carnivore and rodent species (Räkeln syndrom, Tembrock 1962), it is often divorced from this association in primates. While, in nonhuman primates, there is a close relationship between testosterone and yawning (Goy & Resko 1972, Deputte et al. 1994), leading to adult males yawning much more frequently than adult females, such a relationship does not exist in humans (Provine & Hamernik 1986). And finally "Infectiousness" in yawning (Provine 1989) is a feature that is characteristic in humans. This contagion should not be confounded to the synchronization that is documented for "rest yawns" in some species of monkeys (Deputte 1994). Individuals from all age-sex classes yawn most frequently when they wake up from night sleep or midday drowsiness. As these phases are synchronous for all members of the group, "rest yawns" are consequently also synchronous. Though yawns from different individuals might follow each other within a delay of 2 minutes, there is only few instances where one individual yawns after perceiving the yawn of a conspecific as predicted by the PAM. Therefore contagion in yawning is absent in monkeys and present in humans.

This is not that surprising as many other behavioral phenomena are also specific to humans despite continuity in structures within primates. **Contagion in yawning** does imply the perception of other's yawn before yawning. However there is no emotion to be shared in contagious yawning only state of drowsiness or sleep/awake cycle phase. Therefore contagion of yawning is no empathy. Contagion of yawning is not imitation either. Though the contagion of yawning remains a puzzling issue, we proposed that it is related to other phenomena involving perspective taking. Such perspective taking phenomena range from imitation, to "theory of mind" (TOM) and to empathy. All these phenomena, but empathy, have been demonstrated only in humans and apes (Premack & Woodruff 1978, Visalberghi & Frigaszy 1990...). We then suggest that "true empathy", as a conscious act, is also restricted to these species. As proposed by the authors, empathy, especially "cognitive empathy", is a property of the great development of neurological frontal structures. In humans, infants do not show contagion of yawning before 2 years of age, when

they also show self-recognition and imitation. In addition only humans show the Gilles de la Tourette syndrome, which is an excess of imitation. Therefore there is convergent evidence that showing a general capacity of representing others' mind, knowledge, feelings, in social contexts leads also to contagion of behaviors which involve only basic state, like yawning.

If a continuity is claimed for empathy, the presence of contagion of yawning, as derived from empathy, only in humans, questions this continuity. It remains to study yawning and its possible contagion in apes to document further this possible discontinuity due to the great development of cerebral frontal structures.