



## Forum Article

## Contagious yawning: a reflection of empathy, mimicry, or contagion?

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Yawning is a curious behavioural phenomenon that at times may be described as 'contagious', appearing to spread from one individual to another. Contagious yawning is seen in several primate species, including humans (Provine 1986; Baenninger 1997; Campbell et al. 2009; Palagi et al. 2009). Here we argue that contagious yawning, particularly the newly documented phenomenon of cross-species contagious yawning (Joly-Mascheroni et al. 2008), is an important avenue of research. In the discussion that follows, we hope to encourage further experimentation to identify the possible functions of and mechanisms underlying contagious yawning.

Yawning has several convenient properties that make it ideal for cross-species research. First, it is already in the behavioural repertoire of a broad spectrum of vertebrates, from fish to birds to mammals (Baenninger 1997; Gallup et al. 2009). Thus, cross-species

comparisons do not hinge on complex and error-prone training protocols. Because it occurs spontaneously at low frequency, cross-individual yawning in a temporally correlated but asynchronous way is easy to detect and difficult to explain as chance.

Our principal interest in cross-species contagious yawning is its potential link with social cognitive capacities. As described in a recent report by Joly-Mascheroni et al. (2008), 21 of 29 pet dogs, *Canis familiaris*, tested yawned after seeing human yawns while none yawned after seeing silent mouth openings. A prominently raised hypothesis in Joly-Mascheroni et al. (2008, page 447) is that 'contagious yawning of dogs may relate to their capacity for empathy'. This intriguing hypothesis is also proposed in findings of contagious yawning in nonhuman primates (Palagi et al. 2009) and as explaining the relative lack of contagious yawning in autistic children (Senju et al. 2007).

Empathy is notoriously difficult to define (Preston & de Waal 2002). While empathy is not defined in Joly-Mascheroni et al. or Palagi et al., and can be construed in many ways, a related letter (Senju et al. 2007) cites two references that both offer high-level definitions for the term. One refers to empathy as 'the capacity to predict and to respond to the behavior of agents (...) by inferring their mental states' (Baron-Cohen et al. 2005, page 819), and the other refers to contagious yawning as 'a consequence of a theory of

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mind' (Platek et al. 2003, page 233), a representational system for mental state attribution and reasoning. Yet, contagious yawning may be related to empathy in the 'theory of mind' sense only in that they co-occur; one may simply be a good predictor of the other. The relationship may also be causal, with the representational capacities thought to comprise 'theory of mind' (e.g. conceiving of humans as agents with mental states, capacity for false beliefs, etc.) being necessary in some way for an individual to 'catch' yawns.

Here, we consider two more parsimonious accounts that do not imply empathy in the 'theory of mind' sense: nonconscious mimicry and contagion. We further discuss empirical predictions that distinguish these alternatives from one another. Thus, we are in step with empirically based projects to distinguish empathy from related but distinct behaviours that may be considered by some to be part of a broader unified phenomenon (see 'perception action model', Preston & de Waal 2002).

Nonconscious mimicry ('chameleon effect') is well documented in humans and refers to an individual's tendency to imitate a social partner's behaviours without either party's awareness or intent (Chartrand & Bargh 1999). Chartrand and colleagues have shown nonconscious mimicry in humans is modulated by specific social motivations including the desire to affiliate or bond with the mimicker's social partner. Conversely, nonconscious mimicry can also increase liking and a sense of interaction smoothness on the part of the mimicked individual (e.g. Lakin & Chartrand 2003).

A cross-species chameleon effect was recently demonstrated by Paukner et al. (2009), who showed that capuchin monkeys, *Cebus apella*, affiliated more with humans who had previously mimicked their behaviours. Finding cross-species chameleon effects like these has important implications for animal cognition research. For example, dog–human nonconscious mimicry may have important implications for understanding canine domestication. If dogs' tendency to catch human yawns is driven by dogs' underlying desire to affiliate with humans, then perhaps an affiliative motivation facilitated early human–canid interactions. If, furthermore, dogs' tendency to engage in nonconscious mimicry increased their affective or social value to humans, we can speculate that early humans might have promoted this trait through selective breeding. Together, the effects of nonconscious mimicry throughout canine domestication may have contributed not only to modern dogs' tendency to attend to and look at humans more than do human-reared wolves, *Canis lupus* (Miklósi et al. 2003) but also to their remarkable skill in interpreting human social cues (Hare & Tomasello 2005).

Apart from nonconscious mimicry, an even lower-level mechanism underlying contagious yawning is entirely possible. Referring to the spread of yawning from one individual to another as 'contagious' has an everyday meaning but also a specialized meaning in the animal cognition literature. 'Contagion' describes a short-term spread of a behaviour (Thorpe 1963) in which a special stimulus 'serves as a releaser to the unlearned behaviour of others' (Zentall 2001). According to the contagion hypothesis, therefore, contagious yawning could be built upon a specific behavioural fixed action pattern (see Provine 1986) that is hard-wired and simply needs a certain releasing stimulus (Tinbergen 1951). This releasing stimulus may be much less elaborate than the full live-action yawning event included in the Joly-Mascheroni et al. procedure (e.g. mere sounds of a yawn). Control experiments with more minimal yawning cues can help to address these possibilities and may yield different results for different species. For example, in a recent experiment in which dogs were shown silent videotaped yawns, the vast majority of dogs did not show contagious yawning (Harr et al. 2009). In contrast, in chimpanzees, *Pan troglodytes*, contagious yawning generalizes from videos of real conspecifics to 'cartoonized' computer animated conspecifics (Campbell et al.

2009). In humans, yawns are triggered just as frequently by a video of another person yawning as after reading written descriptions of yawning (Provine 1986). Recently, data on contagious yawning in gelada baboons, *Theropithecus gelada*, seemingly refuted the contagion hypothesis, since 'emotional proximity' rather than 'spatial proximity' lead to contagious yawns (Palagi et al. 2009); however, in our reading it could equally have been the case that observer baboons merely paid closer attention to those subjects that were their affiliates. Thus, attention differences (cf. Preston & de Waal 2002) with subsequent differences in levels of contagion, rather than empathy differences, could have been responsible for the yawning pattern observed.

We can empirically distinguish between the nonconscious mimicry and contagion hypotheses of contagious yawning. For example, the 'contagion only' hypothesis predicts that the range of possible contagious behaviours between individuals should be limited to a small number of unlearned behaviours. Also, we should be able to identify the releasing stimulus that triggers a contagious behaviour, like a yawn (or the sound of it), and to show that an isolated presentation of this stimulus is sufficient to induce yawning in an encapsulated way that is unmodulated by social contextual factors.

In its strong form, the nonconscious mimicry hypothesis predicts that individuals mimic a greater array of behavioural mannerisms. This prediction can be tested in Joly-Mascheroni et al.'s existing data set if both yawning and nonyawning mouth movements are coded. In the yawning condition, dogs' nonconscious mimicry would take the form of yawning as measured and reported by the authors. In the control condition, the human experimenter silently and repeatedly opened his mouth. Nonconscious mimicry predicts that dogs would display more nonyawning mouth movements in the control condition than in the experimental condition. This prediction is also somewhat supported by Palagi et al.'s results, where female baboons were found to mimic yawning mannerisms (e.g. yawning with covered teeth, with uncovered teeth and with uncovered gums) depending on the manner of the first yawn. Further predictions of the nonconscious mimicry hypothesis include modulation of nonconscious mimicry in a social context and affiliation goal, and consequences for perceived interaction quality and interindividual valuation ('liking'). To test for these latter predictions one could design interactions that modulate an individual's motives to affiliate with a social partner (competition/cooperation, reward/punishment), then look for modulation in their mimicking of incidental behaviours. If the social partner is human, as in Joly-Mascheroni et al. (2008) and Campbell et al. (2009), one could also assess modulation in humans' liking of the nonhuman partner and perception of interaction smoothness. That contagious yawning in monkeys was more frequent between highly affiliated individuals that frequently groomed each other further supports the nonconscious mimicry hypothesis (Palagi et al. 2009; but see also above for an alternative explanation).

We hope that laying out predictions made by the contagion and nonconscious mimicry hypotheses will guide future work to determine which of these (or other) hypotheses best explains this intriguing phenomenon of cross-species yawning in a variety of vertebrate animals.

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