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Dogs catch human yawns

Ramiro M. Joly-Mascheroni, Atsushi Senju* and Alex J. Shepherd

School of Psychology, Birkbeck, University of London, Malet Street, London WC1E 7HX, UK
**Author for correspondence (a.senju@bbk.ac.uk).*

This study is the first to demonstrate that human yawns are possibly contagious to domestic dogs (*Canis familiaris*). Twenty-nine dogs observed a human yawning or making control mouth movements. Twenty-one dogs yawned when they observed a human yawning, but control mouth movements did not elicit yawning from any of them. The presence of contagious yawning in dogs suggests that this phenomenon is not specific to primate species and may indicate that dogs possess the capacity for a rudimentary form of empathy. Since yawning is known to modulate the levels of arousal, yawn contagion may help coordinate dog–human interaction and communication. Understanding the mechanism as well as the function of contagious yawning between humans and dogs requires more detailed investigation.

Keywords: yawning; contagious yawning; dog; empathy; social cognition

1. INTRODUCTION

Contagious yawning (i.e. yawning triggered by perceiving others yawning) is a well-documented phenomenon (e.g. Moore 1942; Provine 1986; Platek *et al.* 2003; Senju *et al.* 2007). Although some claim that contagious yawning is a response to an innate releasing mechanism (Provine 1986), the relationship between the susceptibility to contagious yawning and self-reported scores of empathy (Platek *et al.* 2003), as well as the absence of contagious yawning in individuals with autism spectrum disorder (Senju *et al.* 2007), suggests that it may be related to the capacity for empathy (Preston & de Waal 2002). Even though spontaneous yawning is widespread among vertebrate species (Baenninger 1987; Heusner 1946), contagious yawning has been reported to occur only in humans and chimpanzees (*Pan troglodytes*; Anderson *et al.* 2004). Stumptail macaques (*Macaca arctoides*) also yawn in response to observed yawns, although it is unclear whether this behaviour is similar to contagious yawning found in other species or simply reflects stress (Paukner & Anderson 2006).

The current study examined whether contagious yawning can be observed in domestic dogs (*Canis familiaris*). Dogs are unusually skilled at reading human social and communicative cues. They can follow human gaze and pointing (Hare *et al.* 2002; Miklósi *et al.* 2003; Miklósi & Soproni 2006), they can show sensitivity to others' knowledge states (e.g. indicating the location of a hidden toy more frequently to someone not involved in hiding it than to someone who did the hiding, Virányi *et al.* 2006) and they are even able to match their own actions to observed human actions (Topál *et al.* 2006). Dogs' unique social skills in interacting with humans may be the result of selection pressures during the process of domestication (Hare & Tomasello 2005; Miklósi *et al.* 2003, 2007). Therefore, there is the potential that dogs may also have developed the capacity for empathy towards humans, and may catch human yawns. However, no empirical studies have been reported, which systematically investigate contagious yawning in dogs.

In the current study, dogs observed a human experimenter yawning (yawning condition) or demonstrating non-yawning mouth movements (control condition). If dogs have the capacity for contagious yawning, they should yawn more in the yawning condition than in the control condition.

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2. MATERIAL AND METHODS

Dogs older than 14 weeks participated in the study ($n=29$, mean age: 6.4 years, 12 females, 17 males; see the electronic supplementary material table for details). Testing was conducted in places familiar to each dog, between 11.00 and 16.00 and after they had finished walking and had one of their two daily meals. Informed consent was obtained from their owners. The study was approved by the Research Ethics Committee of the School of Psychology, Birkbeck, University of London.

The testing consisted of two conditions. Each condition lasted 5 min, separated by a 5 min interval. The dogs were given a small edible treat before starting each condition. In the yawning condition, the experimenter, who was a stranger to the dogs, attracted the dog's attention by calling them by name, and then acted a yawning movement with vocalization when the dog established eye contact with the experimenter (see the electronic supplementary material, figure). The experimenter repeated this sequence for 5 min. The number of presented yawns varied between subjects (range, 10–19), mainly owing to individual differences in the time required to re-establish eye contact with the experimenter after each yawn. No feedback was given to any of the dog's responses. The control condition was exactly the same as the yawning condition, except that the experimenter displayed non-yawning mouth-opening actions without vocalization, instead of yawns (see the electronic supplementary material, figure). The order of testing conditions was counterbalanced between subjects (see the electronic supplementary material table for details). During the testing, the owner sat behind the dog quietly.

During the experiment, the experimenter recorded the number of yawns elicited. In addition, the dogs' behaviours were video-recorded and coded by an independent observer who was not informed of the purpose of the study. The number of yawns recorded by the second coder was identical to that of the experimenter for all of the dogs, which demonstrates a high reliability of the coding.

3. RESULTS

The yawning condition elicited yawns for 21 out of 29 dogs (one example is shown in figure 1), and no dogs yawned in the control condition ($p<.001$, McNemar's test; McNemar 1947). No yawns were observed during the interval between conditions either. On average, dogs yawned 1.9 times in the yawning condition (range, 0–5; see the electronic supplementary material, table). On average, it took 1 min 39 s for the dogs to yawn (s.d., 1 min 28 s; range, 5 s to 4 min 47 s), after the experimenter had presented 4.5 yawns (s.d., 4.4; range, 1–17). The number of yawns in the yawning condition did not differ significantly between sexes ($z=-1.30$, $p>0.1$, Wilcoxon signed-rank test) and was not affected by the order of testing (i.e. yawning or control condition

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Figure 1. A yawn response during the presentation of a human yawn. The experimenter's face can be seen at the top of each image, which was recorded in the mirror placed behind the dog. The dog (*a*) observed the experimenter yawning, (*b*) started yawning as the experimenter finished yawning and (*c*) then completed yawning.

first, $z=-1.27$, $p>0.1$, Wilcoxon signed-rank test). Age did not correlate with the number of yawns ($r=0.14$, $p>0.1$, Spearman's test). The correlation between the number of presented yawns and the number of elicited yawns did not reach significance ($r=-0.36$, $p>0.05$, Spearman's test).

4. DISCUSSION

The current study demonstrates that human yawns are possibly contagious to dogs. The presentation of human yawning elicited yawns in 72 per cent of the dogs tested, which is higher than the rate reported in humans (45–60%) and chimpanzees (33%). This effect cannot be attributed to a general effect of the mere presence of unfamiliar humans, or to the observation of human mouth movements in general, because no dogs yawned in the control condition. This study is the first to demonstrate that the observation of yawning elicits yawning in a non-primate species, as well as the first demonstration of possible contagious yawning between different species. Since yawning is known to modulate the level of arousal (Daquin *et al.* 2001), such temporally synchronized occurrences of yawning may help coordinate interactions as well as communication between humans and dogs.

The high yawning rate may be due to displaying 'live' acted yawns rather than video-recorded yawns that have been used in some previous studies (Anderson *et al.* 2004; Paukner & Anderson 2006; Senju *et al.* 2007). It is, however, highly unlikely that the present results could be influenced by the experimenter unintentionally reinforcing dog's yawning in the yawning condition. The main analysis is based on dichotomous data (i.e. the dog yawned or did not yawn in each condition). Reinforcement of chance yawns could only account for a difference in absolute number of yawns per dog, and not the presence/absence of yawns for a dog in each condition.

There are at least two possibilities why human yawns elicit yawning in dogs. First, the susceptibility to contagious yawning of dogs may relate to their capacity for empathy. In humans (Platek *et al.* 2003; Senju *et al.* 2007) and chimpanzees (Anderson *et al.* 2004), several studies have suggested that contagious yawning relates to the capacity for empathy, although the mechanism underlying this relationship is still unclear. As described above, dogs have exceptional capacities to decode social signals from humans, possibly as a result of the domestication process (Hare & Tomasello 2005; Miklósi *et al.* 2003, 2007). Therefore, it is also possible that they have the capacity for empathy, such as representing humans' actions and modulating their own behavioural and autonomic responses accordingly (see also Topál *et al.* 2006), and that this underlies contagious yawning. Alternatively, dogs may have developed the capacity for contagious yawning during past synchronous yawning experiences with humans (e.g. Heyes & Ray 2000), either by sharing (e.g. boring) experiences with humans or by observing human's yawns contagiously to dog's yawns.

Second, it is also possible that the dogs' yawns may have been induced by mildly heightened tension or stress. For example, macaques are known to exhibit 'emotion yawns' or 'social yawns' during antagonistic social encounters (Deputte 1994; Smith 1999; Paukner & Anderson 2006). Thus, we cannot rule out the possibility that human yawns are perceived as antagonistic to the dogs. Previous studies have demonstrated that dogs may yawn in response to an encounter with novel humans (Beerda *et al.* 1998; Hennessy *et al.* 2006). Some have argued that it is a response to acute stress (Beerda *et al.* 1998), although this argument is not supported by more recent empirical studies (e.g. Hennessy *et al.* 2006; Rooney *et al.* 2007). However, as physiological measurements of stress, such as saliva/blood cortisol or heart rate, were not available for the current sample, and because there has not been enough consensus and standardization on how to interpret dogs' behaviours (Diederich & Giffroy 2006), further studies, ideally with concurrent physiological measurements, are required to test whether contagious yawning between humans and dogs is mediated by a stress- or tension-related response. At least, the current results cannot be attributed to more general factors related to stress, such as an encounter with a strange human or to the recording equipment, as no dogs yawned in the control condition.

Although the current study cannot discriminate between these two possible explanations, further studies could explore the mechanism underlying, as well as the evolutionary origin of, contagious yawning and its relationship to the capacity for empathy. For example, the current study demonstrated that dogs appear to catch human yawns. However, for practical reasons, we did not examine whether they yawn contagiously to conspecifics' yawns. If the dogs' capacity for contagious yawning has evolved with the capacity for reading human communicative signals, it is possible that dogs are more sensitive to human yawns than dogs' yawns. By contrast, if they have

acquired the capacity for contagious yawning as an adaptation for within-species social interaction and communication, which has transferred to dog–human interaction, they may be more sensitive to the yawns of conspecifics. Such contrasts may help highlight the functional specialization of contagious yawning in dogs and, possibly, in other species as well.

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