

Contagious yawning in chimpanzees

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Six adult female chimpanzees were shown video scenes of chimpanzees repeatedly yawning or of chimpanzees showing open-mouth facial expressions that were not yawns. Two out of the six females showed significantly higher frequencies of yawning in response to yawn videos; no chimpanzees showed the inverse. Three infant chimpanzees that accompanied their mothers did not yawn at all. These data are highly reminiscent of the contagious yawning effects reported for humans. Contagious yawning is thought to be based on the capacity for empathy. Contagious yawning in chimpanzees provides further evidence that these apes may possess advanced self-awareness and empathic abilities.

Keywords: chimpanzees; contagious yawning; videotape; development; self-awareness; empathy

1. INTRODUCTION

Experimental evidence supports the common observation that seeing other people yawn can induce yawning (Provine 1986, 1989; Platek *et al.* 2003). Studies have shown that between 42% and 55% of human adults will yawn during, or shortly after, seeing a videotape of repeated yawns of other humans. The only systematic study to our knowledge of children, however, found that children aged younger than 5 years do not show this contagious yawning effect (Anderson & Meno 2003). Although yawning is widespread among vertebrate species, contagious yawning has been reported only in humans (Lehmann 1979; Baenninger 1987; Smith 1999). It has been suggested that contagious yawning reflects a basic capacity for empathy (Lehmann 1979), and a recent study linked human individual differences in susceptibility to contagious yawning to differences in empathic tendencies, self-recognition ability and theory of mind (Platek *et al.* 2003). We assessed whether chimpanzees—humans' nearest phylogenetic neighbours—are prone to contagious yawning when exposed to videotapes showing yawning of conspecifics. Evidence of contagious yawning would provide further evidence of similarities in the evolution of self- and other-awareness between great apes and humans.

2. MATERIAL AND METHODS

(a) Subjects

We tested six socially reared, group-living adult female chimpanzees (*Pan troglodytes*) living at the Primate Research Institute of Kyoto University. They were individually invited to leave their outdoor

enclosure and enter a familiar test booth; three of them brought their 3-year-old dependent infants with them. The chimpanzees had extensive experience with experiments on learning and cognition (Matsuzawa 1985, 2003; Kawai & Matsuzawa 2000; Morimura & Matsuzawa 2001), but none had previously observed video stimuli of the type used here. This experimental work complied with the Guide for the Care and Use of Laboratory Primates, Primate Research Institute, Kyoto University.

(b) Experimental apparatus

We prepared two 'yawn' and two 'open-mouthed' videotapes. Yawn videos contained 10 naturally occurring yawns by chimpanzees, each separated by 6–10 s of a blue, blank screen (see figure 1 for an example). Open-mouthed videos were equated for total duration, and showed chimpanzees displaying eight or ten open-mouthed faces but not yawning (for example, while pant-hooting or grinning), again separated by a blank screen. The videos displayed chimpanzees in various postures and orientations, the most salient feature being the yawns or open-mouthed expressions. One yawn video presented yawns by familiar chimpanzees from the subjects' own group, and the other presented yawns by unfamiliar chimpanzees in the wild. The videos were shown silently on a 35 cm monitor (Panasonic TH-14RF2) positioned on a small table 30 cm high and ca. 8 cm from the front of the glass-walled booth.

(c) Experimental procedure

Two videotapes were shown in each session. Five minutes after the chimpanzee entered the booth, the monitor was switched on and the first video ran until completion of the last yawn or open-mouth (3 min). The monitor was then switched off and the chimpanzee was observed for 3 min. A 5-min distraction period then followed, after which the second video was shown (3 min), followed by another 3-min observation period. Each chimpanzee was tested during four sessions, with the following order of video combinations presented in each session: (i) familiar yawn, unfamiliar open-mouth; (ii) unfamiliar open-mouth, familiar yawn; (iii) familiar open-mouth, unfamiliar yawn; (iv) unfamiliar yawn, familiar open-mouth. All sessions were videotaped through the glass walls of the booth, using three fixed-position cameras, two of which were operated manually. The three authors were present but remained passive throughout, except that T.M. occasionally encouraged the chimpanzee to watch the monitor if her attention appeared to wane. All yawns by the subject chimpanzees were scored in real time and then verified by subsequent video analysis; agreement between the three authors was 100%.

3. RESULTS

The adult chimpanzees yawned, on average, 4.7 times during and after the open-mouth videos, and this rose to 10 yawns during and after the yawn videos. The data were analysed both at the group level and individual level. There were no significant effects at group level, as assessed by paired *t*-tests. However, two chimpanzees (Ai, Mari) showed significantly higher frequencies of yawning during or shortly after exposure to yawn videos (totals: 24 and 25) than to open-mouth videos (2 and 9; both $p < 0.01$, binomial tests). Figure 1 shows a chimpanzee yawning during exposure to a yawn video, and figure 2 presents the data for all of the adult chimpanzees. Social familiarity of the chimpanzees in the videos did not affect yawning frequency. No chimpanzee showed significantly more yawning in response to the open-mouth videos, and open-mouth videos did not elicit facial expressions. None of the three infant chimpanzees yawned at any time during the tests.

4. DISCUSSION

Higher frequencies of yawning in response to yawn stimuli compared with the open-mouth control stimuli indicate a contagion effect in 33% of the adult chimpanzees. This percentage is only slightly lower than the percentages reported for adult humans exposed to visual yawn stimuli (Provine 1986; Platek *et al.* 2003). It can be argued that the percentage of chimpanzees showing contagious yawning is even more impressive, given that adult human participants are usually aware of the phenomenon



Figure 1. A yawn response during presentation of a yawn videotape. Ai watches a yawn on the screen (top left), starts to yawn as the stimulus yawn ends (top right), continues to yawn (bottom left), and completes the yawn while the screen is blank (bottom right). See electronic Appendix A.

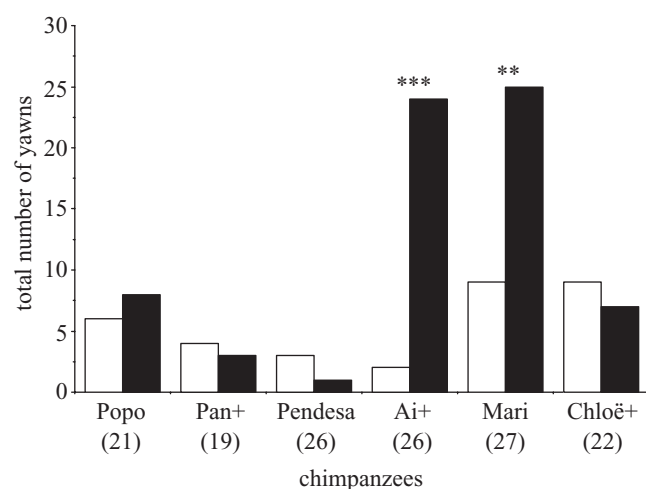


Figure 2. Total frequency of yawns by six adult female chimpanzees during or after exposure to open-mouth videos (open bars) and yawn (filled bars) videos. Ages in years are given in parentheses. A plus sign indicates females that were tested with their infant. ** $p < 0.01$; *** $p < 0.001$.

being studied, and simply thinking about yawning may induce yawns (Provine 1989). The chimpanzees had no knowledge of what the experimenters were interested in, and had no idea of what was expected of them. Unlike Old World monkeys (Deputte 1994), chimpanzees do not appear to show a sex difference in their frequency of yawning.

None of the infant chimpanzees that accompanied their mothers showed any yawning, even though they watched the videos and saw their mothers yawning. This absence of contagious yawning in infant chimpanzees recalls the absence of contagious yawning in human toddlers reported by Anderson & Meno (2003). Further work on the young chimpanzees will clarify the extent to which contagious yawning in chimpanzees resembles the same behaviour in humans.

Chimpanzees display self-recognition in mirrors (Gallup 1970; Povinelli *et al.* 1997), a sign of objective self-awareness that has been linked with the capacity for empathy

(Gallup 1982). Monkeys do not show self-recognition (Anderson 1994), and observations of social behaviour reveal much more convincing evidence of empathy in chimpanzees than in monkeys (de Waal 1996). Observational studies of spontaneous yawning in monkeys indicate that it is not contagious (Baenninger 1987; Deputte 1994). Given the distribution of self-recognition and social cognitive abilities among primates, we predict that susceptibility to contagious yawning will be found in other great apes, but not monkeys, and that individual differences in susceptibility to contagious yawning may be related to differences in self-recognition and empathy.

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