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Video-induced yawning in stumptail macaques (*Macaca arctoides*)

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This study reports the first experimental exploration of possible contagious yawning in monkeys. Twenty-two stumptail macaques (*Macaca arctoides*) were presented with video clips of either yawns or control mouth movements by conspecifics. At a group level, monkeys yawned significantly more often during and just after the yawn tape than the control tape. Supplementary analysis revealed that the yawn tape also elicited significantly more self-directed scratching responses than the control tape, which suggests that yawning might have been caused by tension arising from viewing the yawn tape. Understanding to what extent the observed effect resembles contagious yawning as found in humans and chimpanzees requires more detailed experimentation.

Keywords: stumptail macaque; contagious yawning; video tape; scratching

1. INTRODUCTION

Observational studies of yawning in monkeys have provided no evidence that the behaviour is contagious, which is in contrast to the picture in humans (Baenninger 1987; Troisi *et al.* 1990; Deputte 1994). Yawning is considered to be contagious only in humans by some authors (Lehmann 1979; Walusinski 2004), but this view was recently challenged by a study on chimpanzees (Anderson *et al.* 2004). The latter study used an experimental video-based approach similar to that used for studying contagious yawning in humans (e.g. Provine 1986; Platek *et al.* 2003). Individually tested adult female chimpanzees watched on a television monitor a series of yawns or a series of non-yawn facial expressions by chimpanzees. Two of the six subjects showed a significantly greater frequency of yawning in response to the yawn stimulus tapes compared to the non-yawn tapes. The reported contagion effect in 33% of adult chimpanzees compares with 45–60% typically reported for humans.

Some authors consider contagious yawning to be a response to an innate releasing mechanism (e.g. Provine 1986). Another hypothesis about contagious yawning in humans is that it is based on empathy (Lehmann 1979). In other words, seeing another individual yawn makes one think about oneself yawning, which elicits the response. The likelihood of yawning in response to video images of yawning is positively correlated with measures of empathy and visual self-recognition (Platek *et al.* 2003). Recent studies investigating the neural correlates of contagious yawning also support the empathy hypothesis in that activation was found in areas related to self-processing when viewing someone yawn (Platek *et al.* 2005), but not in the human mirror neuron system, which suggests that yawning is not a truly imitative act (Schürmann *et al.* 2005). Since there is convincing evidence for both self-recognition and empathy in chimpanzees but not in monkeys (De Waal 1996; Anderson & Gallup 1999), it may be predicted that, unlike chimpanzees and humans, monkeys do not show contagious yawning.

Like other macaque species (Hadidian 1980; Deputte 1994), stumptail macaques (*Macaca arctoides*) yawn when waking up and occasionally throughout the day. Also, especially in adult males, 'tension yawns' may occur during potential or actual agonistic situations (Bertand 1969). Yawning occurs frequently during staged male–male encounters, with the dominant individual producing more yawns than the subordinate (Adams & Schoel 1982). There is no suggestion in the literature that stumptail macaques are prone to contagious yawning; however, no relevant study in any monkey species has used a video-based approach of the type that has been used with humans and chimpanzees. Here, we report the first such attempt. Based on the emerging view that contagious yawning is associated with self-recognition and empathic abilities, we predicted that there would be no evidence of yawning elicited by video images of yawning in stumptail macaques.

2. MATERIAL AND METHODS

(a) *Subjects*

Twenty-two stumptail macaques (*Macaca arctoides*) were tested, 18 females (16 adult, 2 sub-adult) and 4 males (2 adult, 1 sub-adult, 1 infant), all captive-born and group-reared (mean age: 13 years, range 1–23 years). They were housed in five social groups of 2, 3, 3, 5 and 9 individuals in large indoor enclosures (2.7×2.8×4.8 m), furnished with wooden logs, metal shelves, ropes and ladders. The monkeys also had access to a cage system in the adjacent room via slide doors. They were fed once a day with fresh fruit and vegetables, monkey pellets, dried fruits, seeds and nuts, and given scatter-feeds (seeds) in the late afternoon. Water was available *ad libitum*.

(b) *Apparatus*

The largest group of monkeys was filmed on two separate days, and clips were edited into one yawn tape and one control tape. The yawn tape contained 10 naturally occurring yawns by adult male, adult female and juvenile monkeys (captured in relaxed contexts, not tension yawns; see figure 1*a*), separated by 5 s of black, blank screen. Each yawn was on average 4.5 s long. The control tape consisted of 10 non-yawn facial movements by adult male, adult female and juvenile monkeys, and contained scenes such as teeth chattering, vocalizations, or chewing (no foods visible; see figure 1*b*). These clips were also separated by 5 s of black, blank screen and were matched for total length (1 min 30 s) with the yawn clips. A 17″ TFT Colour LCD monitor (S760A) was used to present these videos to the monkeys.

(c) *Procedure*

Monkeys were tested twice daily, once in the morning and once in the afternoon *ca* 2 h after their daily feed at lunchtime. They were only tested when they appeared to have finished eating and foraging. The video stimuli were presented through a viewing window (1×0.88 m) at the front of the rooms which allowed unobstructed visual access to the entire room. Doors to the adjacent cage area remained open throughout the experiment. This arrangement meant that some monkeys missed part or whole of the video presentation, and these individuals were excluded from data collection for those sessions. Monkeys were presented with either the yawn video or the control video, with order of presentation counterbalanced between groups, followed by 3 min of blank screen. An experimenter positioned at the viewing window

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Figure 1. Frame sequences from sample videos. (*a*) Yawn sequence, (*b*) control sequence.

conducted all-occurrence sampling of yawning. For the present study, yawning was defined as a long inspiration with gaping mouth, followed by a shorter expiration. As yawning is thought to be a stereotyped motor act (Provine 1986), its occurrence was easy to recognize (see also figure 1*a*). We ran a total of 14 yawn and 14 control sessions.

3. RESULTS

No direct social responses were elicited by any of the video clips. With the exception of one adult female, all monkeys yawned at least once during at least one test session. All observed yawns were judged to be 'natural' yawns by the experimenter. No 'threat yawns' (associated with agonistic behaviours) were observed. On average, each monkey yawned 2.4 times during or in the 3 min following the control video, compared to 4.3 times for the yawn video, which constitutes a significant difference between conditions (Wilcoxon: $z=-2.33$, $p=0.02$; figure 2). Overall, 13 monkeys yawned more when presented with the yawn tape, 5 monkeys yawned more when presented with the control tape and 4 monkeys showed the same number of yawns in the two conditions. There was no significant correlation between the number of yawns and either age or dominance rank of the monkeys. Sex of subject and familiarity with the models also failed to significantly impact on yawn frequency (all $p>0.05$).

In the final six test sessions, the latency of first yawn, the social context of yawns and the number of self-scratching bouts were also recorded for both conditions. These data revealed that on average, the first yawn occurred 2 min 26 s into the yawn condition and 2 min 29 s into the control condition. Further yawns occurred on average every 49 s in the yawn condition and every 67 s in the control condition. Yawning monkeys always appeared relaxed or resting, either sitting or lying down alone, or huddling/being groomed by others. There was a significant difference between conditions in the frequency of self-directed scratching, with the yawn condition (average 12.3 bouts) generating significantly more bouts of scratching than the control condition (average 9.1 bouts; Wilcoxon: $z=-1.97$, $p=0.049$). Fourteen monkeys scratched more in yawn sessions, five scratched more in control sessions, and three scratched equally often in yawn and control sessions. However, there were no correlations between the number of scratching bouts and the number of yawns in the yawn condition (Pearson: $r=0.249$, $p>0.05$) or the control condition (Pearson: $r=-0.013$, $p>0.05$).

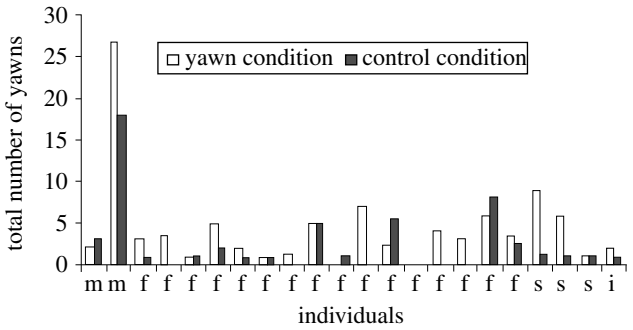

Figure 2. Total frequencies of yawns in yawn and control conditions. Individuals are categorized as m, adult male; f, adult female; s, sub-adult; i, infant; and presented in descending age.

4. DISCUSSION

This is the first experimental demonstration of yawning induced by video images of yawning conspecifics in monkeys. Although there were no significant differences between conditions for any individual subject, there was a clear increase in yawning in the yawn video condition compared to the control video condition at group level. This finding contradicts our prediction of no effect. Also, although it is possible that the monkeys were influenced by seeing yawning by group members, any such effect is unlikely to explain the difference between conditions.

It is not clear from the present results that a contagious yawning effect occurs as has been observed in humans, and possibly chimpanzees, as there was also a significant increase in self-directed scratching in the yawn sessions. Self-directed behaviours, including scratching and yawning, are considered to be indicators of tension or anxiety (Maestripieri *et al.* 1992). The question then arises, why did the monkeys show more self-directed behaviours in the yawn condition than the control condition? One possible reason is that the yawn videotape contained more images of yawning by an adult male (a total of six yawns) than the control tape which contained images of an adult male engaging in other acts (one non-yawn facial movement). Yawning is a way of displaying the canine teeth, and some yawns by adult males are considered threat signals (Hall & DeVore 1965; Bertrand 1969). Conceivably, therefore, increased yawning accompanied by scratching during the yawn video might have been due to greater uneasiness arising from seeing an adult male yawning repeatedly. There is a clear need for further experimentation on this issue, for example presenting

stimulus videotapes that feature only one age–sex category (infants, adult males, adult females) yawning or showing other activities. Indeed, similar systematically controlled experimentation on great apes would clarify the extent to which these primates are also prone to human-like contagious yawning.

The existence of a 'possible facilitative' effect of seeing another individual yawn has been alluded to in macaques (Hadidian 1980). However, with the exception of tense male–male situations (Darwin 1872/1999; Adams & Schoel 1982) in which yawning may be triggered as a 'canine contest', until now there has been no evidence for the experimental elicitation of yawning by visual conspecific stimuli in non-ape primates. The subject clearly merits further research, not only with the aim of clarifying the psychological mechanisms underlying the expression of yawning, but also because of its implications for our understanding of the emergence of empathic abilities in primates.

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Adams, D. B. & Schoel, W. M. 1982 A statistical analysis of the social behavior of the male stumptail macaque (*Macaca arctoides*). *Am. J. Primatol.* **2**, 249–273. (doi:10.1002/ajp.1350020303)

Anderson, J. R. & Gallup Jr, G. G. 1999 Self-recognition in primates: past and future challenges. In *Animal models of human emotion and cognition* (ed. M. Haug & R. E. Whalen), pp. 175–194. Washington, DC: American Psychological Association.

Anderson, J. R., Myowa-Yamakoshi, M. & Matsuzawa, T. 2004 Contagious yawning in chimpanzees. *Proc. R. Soc. B* **271**(Suppl. 6), S468–S470. (doi:10.1098/rsbl.2004.0224)

Baenninger, R. 1987 Some comparative aspects of yawning in *Betta splendens*, *Homo sapiens*, *Panthera leo*, and *Papio sphinx*. *J. Comp. Psychol.* **101**, 349–354. (doi:10.1037/0735-7036.101.4.349)

Bertrand, M. 1969 *The behavioral repertoire of the stumptail macaque*. Basel: Karger.

Darwin, C. 1872/1999 *The expression of the emotions in man and animals*. London: HarperCollins.

Deputte, B. L. 1994 Ethological study of yawning in primates. I. Quantitative analysis and study of causation in two species of Old World monkeys (*Cercocebus albigena* and *Macaca fascicularis*). *Ethology* **98**, 221–245.

De Waal, F. 1996 *Good natured: the origins of right and wrong in humans and other animals*. Cambridge, MA: Harvard University Press.

Hadidian, J. 1980 Yawning in an Old World monkey, *Macaca nigra* (Primates: Cercopithecidae). *Behaviour* **75**, 133–147.

Hall, K. R. L. & DeVore, I. 1965 Baboon social behavior. In *Primate behavior* (ed. I. DeVore), pp. 53–110. New York: Holt, Rinehart & Winston.

Lehmann, H. E. 1979 Yawning: a homeostatic reflex and its psychological significance. *Bull. Meninger Clin.* **43**, 123–136.

Maestripieri, D., Schino, G., Aureli, F. & Troisi, A. 1992 A modest proposal: displacement activities as an indicator of emotions in primates. *Anim. Behav.* **44**, 967–979.

Platek, S. M., Critton, S. R., Myers, T. E. & Gallup Jr, G. G. 2003 Contagious yawning: the role of self-awareness and mental state attribution. *Cogn. Brain Res.* **17**, 223–227. (doi:10.1016/S0926-6410(03)00109-5)

Platek, S. M., Mohamed, F. & Gallup Jr, G. G. 2005 Contagious yawning and the brain. *Cogn. Brain Res.* **2–3**, 448–452. (doi:10.1016/j.cogbrainres.2004.11.011)

Provine, R. R. 1986 Yawning as a stereotyped action pattern and releasing stimulus. *Ethology* **72**, 448–455.

Schürmann, M., Hesse, M. D., Stephan, K. E., Saarela, M., Zilles, K., Hari, R. & Fink, G. R. 2005 Yearning to yawn: the neural basis of contagious yawning. *Neuroimage* **24**, 1260–1264. (doi:10.1016/j.neuroimage.2004.10.022)

Troisi, A., Aureli, F., Schino, G., Rinaldi, F. & de Angelis, N. 1990 The influence of age, sex, and rank on yawning behavior in two species of macaques (*Macaca fascicularis* and *M. fuscata*). *Ethology* **86**, 303–310.

Walusinski, O. 2004 *Bâillements et pandiculations*. Brou (France): Oscitatio.