

## Young Children Display Contagious Yawning When Looking at the Eyes

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### Abstract

Although contagious yawning occurs commonly in adulthood, previous studies reported it to be uncommon in children below 4-5 years. However, these studies did not regulate eye contact, a factor that can induce contagious yawning. We therefore investigated whether a cue to make eye contact would influence contagious yawning, particularly in young children. Fifty-six children between the ages of 3 and 16 watched video clips of models either yawning or opening their mouths. Contagious yawning was observed from the age of 3 years, and was negatively correlated with age. Whereas children older than 8 years caught yawns only after the yawning clips, children under the age of 8 years yawned contagiously following both yawn and control clips. Additionally, frequent imitation occurred in children below the age of 8 years. Poor general attention skills or reduced attention to specific facial features (e.g. the eyes) may be responsible for the reduced yawn contagion previously described in young children.

**Keywords:** Contagious yawning; Children; Social orienting; Eye contact; Empathy

### Introduction

Contagious yawning is the onset of yawning in response to seeing, hearing, reading or thinking about another person yawning [1]. Although contagious yawning occurs commonly in adulthood in human and non-human primates [2-5], infants and pre-schoolers seem less susceptible to the social influences of yawning [6]. Whereas spontaneous yawning is present from before birth [7], several authors have reported that contagious yawning is uncommon in children before the age of 4 or 5 years, at which age susceptibility to yawn contagion increases dramatically [6,8,9]. A developmental trajectory for contagious yawning has also been observed in dogs. A recent study reported that dogs only start to yawn contagiously around 7 months of age [10]. Similarly, infant chimpanzees seem to show less susceptibility to yawn contagion than adult chimpanzees [11]. Thus, both human and non-human infants and toddlers seem less susceptible to yawn contagion.

A greater susceptibility to yawn contagion amongst older children and animals may be linked to aspects such as heightened self- or social awareness; skills which develop from around 4 years of age in humans [1]. There is reasonable evidence that contagious yawning is associated with empathy and social bonding [4,5]. Susceptibility to yawn contagion is influenced by emotional proximity to the yawner: Both human and non-human species are more likely to yawn contagiously if they are familiar with or socially close to the yawner [4,5,12]. Similarly, empathy is greater for kin and in-group members than it is for out-group members [13]. The suggestion that contagious yawning is related to empathy is also consistent with findings that individuals with deficits in empathy and social cognition (e.g. those with autism) do not show contagious yawning [9,14,15]. Therefore, young children with less well-developed social awareness might also display lower susceptibility to yawn contagion.

The developmental trajectory of contagious yawning may partly be influenced by the method used to induce yawning. Live stimuli may be more effective than videotaped or auditory stimuli [8-10], and as previously discussed, familiar faces may induce more yawns than unfamiliar faces. Using live stimuli, Helt et al. [9] reported contagious yawning in children as young as 2 years. Directing attention to the salient aspects of yawns may also increase frequency of yawn contagion. A recent study reported that individuals with autism show contagious

yawning when cued to make eye contact [16]. These results suggest that atypical face fixation, primarily reduced fixation on the eyes, accounts for the observed lack of yawn contagion in autism [16,17]. This raises the possibility, that increasing eye contact will increase susceptibility to yawn contagion, especially in young children, who may attend less to specific social or facial cues.

Hence, the purpose of the present research was to investigate relations between eye-contact and yawn contagion in young children. Specifically, previous research on yawn contagion in typically developing young children did not regulate eye contact. As eye contact is an important medium for conveying social information [18,19], and because eye contact induces yawn contagion among children with autism [16], we predicted that regulating face fixation by cuing eye contact would induce contagious yawning in young children.

### Materials and Methods

#### Participants

This study was approved by the University of Cape Town Psychology Ethics Committee. We recruited typically developing children between the ages of 36 months (3 years) and 17 years ( $N=56$ , mean age=8.56,  $SD=4.08$ , male:female=1:1). Exclusion criteria included a history of head injury, infantile meningitis, neurological conditions impacting the central nervous system, and a diagnosis or history of social disorders, such as conduct disorder or a pervasive developmental disorder. Both the children and their parents provided informed consent.

#### Stimuli and procedure

We based the protocol used here on that used by Senju et al. [14].

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The stimuli consisted of six clips of yawning models (7 s each), and six control clips of models opening their mouths (7 s each), presented on a 15 in. LCD laptop monitor. Three male and three female adults, unknown to the participants, served as models. The clips were presented in a pseudorandom order, separated by a 30 s silent cartoon. Before each clip, 1 cm×1 cm fixation stimuli (white crosses) appeared for 1 s in the position where the model’s eyes would be situated. Testing occurred in a quiet room. Participants sat about 35 cm from the screen. Before the video started, participants received instructions to focus on fixation points, as they appeared on the screen. The examiner sat next to the participant and reminded those who lost concentration to attend to the screen. A built-in web camera recorded participant responses. Three independent raters scored these recordings to determine the number of yawns caught. A yawn was identified as a response in which two or more raters observed three of the following criteria: stereotyped mouth movements (including opening the mouth, curling the lips, or a noticeable distortion of the mouth), eye movement (including closing the eyes, rapid blinking, or brief widening of the eyes preceding the yawn), flaring of the nostrils, chest expansion, raising of the shoulders, and covering the mouth with a hand. We counted all yawns taking place within 30 s of clips. Although neither described nor reported in previous studies on young children [6,9,14-16], the raters frequently observed “yawn imitations”, and coded them as such. “Yawn imitations” were defined as the opening of the mouth, with or without closing the eyes, with no visible signs of deep inhalation. Interrater reliability was high, with a Cronbach’s  $\alpha$  of 0.86 for yawn scores and 0.91 for imitation scores.

**Results**

The yawn frequency counts broken down by the type of clip on which the response was obtained, are given in Table 1. We observed yawns during and shortly after both the yawn and the open mouth control clips. Similarly, the children who imitated the actors did so after both the yawn and control clips (Table 1).

We observed contagious yawning in one out of the six (17%) 3 year olds. Contagious yawning was also present in 41% (7/17) of the 4-5 year olds, 29% (2/7) of the 6-7 year olds, and 15% (4/26) of the children 8 years and older. Although both types of clips elicited yawning, yawns occurred more often after yawn clips than after control clips. Particularly, children older than 8 years yawned only in response to yawning clips, and did not yawn in response to control clips. Children

aged 7 years and below also imitated frequently, which (barring one child) children older than 7 years did not do (Figure 1).

We examined the data using repeated measures Poisson regression, as this type of analysis is well suited to count data which is highly positive skewed, and has many counts of zero events [20]. Two Poisson analyses were done. Age and Type of Clip (yawn/control) were used to predict firstly Number of Yawns, and secondly, Number of Imitations. Age significantly predicted the number of yawns observed ( $\chi^2$  [1,  $N=56$ ]=12.25,  $p<.001$ ), though the type of clip did not. Contrary to expectations, younger children were more likely to yawn contagiously than older children. With a 1 year increase in age, children were 0.88 ( $e^{-0.133}$ ) times as likely to yawn. There was no significant interaction between age and type of clip in predicting number of yawns elicited (Table 2).

Age also significantly predicted the number of imitations observed, ( $\chi^2$  [1,  $N=56$ ]=14.82,  $p<.001$ ). With a 1 year increase in age, children were 0.76 ( $e^{-0.27}$ ) times as likely to imitate facial movement. Hence, imitation decreased with increasing age. The type of clip did not significantly predict number of imitations, though there was a trend towards more imitations after control clips than yawn clips. There was no significant interaction between type of clip and imitation frequency (Table 3).

**Discussion**

We investigated whether cuing eye contact would induce yawn contagion in children. Although some previous studies found that yawn contagion is infrequent in children below 4-5 years [8,9], in our sample, children between the ages of 3-5 years did show contagious yawning. This result is similar to that of Helt et al. [9], who showed the presence of contagious yawning from as young as 2 years.

Interestingly, whereas Helt et al. [9] used real-life models to induce yawning, the current study shows that videos of (unfamiliar) yawning actors can also induce contagious yawning in preschool children. These results are in contrast with a previous study using videos [8] that did not elicit contagious yawning in children under 6 years of age. A key difference between the studies is that in the current study children were prompted to look at the eyes, whereas previous studies did not include such a prompt. These results are consistent with the idea that young children show less instances of contagious yawning because they do

Clip Type		Number of yawns elicited					Number of imitations elicited				Total
		0	1	2	3	5	0	1	2	3	
Control	Yawn	49	5	1	1	0	41	9	3	3	56
	Control	42	10	3	0	1	44	7	5	0	56
<b>Total</b>		91	15	4	1	1	85	16	8	3	112

Table 1: Number of yawn and imitation responses elicited by the type of clip (yawn or open mouth control) shown.

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			e <sup>B</sup>	95% Wald Confidence Interval for e <sup>B</sup>	
			Lower	Upper	Wald $\chi^2$	df	p		Lower	Upper
(Intercept)	0.03	0.65	-1.24	1.29	0.002	1	.967	1.03	0.29	3.65
Control Clip	0.08	0.62	-1.14	1.31	0.02	1	.893	1.09	0.32	3.69
Yawn Clip	0							1		
Age	-0.13	0.07	-0.27	0.002	12.25	1	<.001	0.88	0.76	1.00
Control Clip * Age	-0.14	0.08	-0.29	0.02	2.92	1	.087	0.87	0.75	1.02
Yawn Clip * Age	0							1		
(Scale)	1									

Note: Corrected Quasi Likelihood under Independence Model Criterion (QICC)=105.76

Table 2: Parameters for the repeated measures Poisson regression predicting number of yawns by age and type of clip (yawn versus open mouth control).

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			e <sup>B</sup>	95% Wald Confidence Interval for e <sup>B</sup>	
			Lower	Upper	Wald $\chi^2$	df	p		Lower	Upper
(Intercept)	0.65	0.53	-0.39	1.68	1.49	1	.222	1.91	0.68	5.37
Control Clip	0.72	0.37	-0.01	1.44	3.78	1	.052	2.04	1.00	4.20
Yawn Clip	0							1		
Age	-0.27	0.07	-0.41	-0.13	14.82	1	< .001	0.76	0.67	0.88
Control Clip * Age	-0.07	0.06	-0.19	0.05	1.24	1	.265	0.93	0.83	1.05
Yawn Clip * Age	0							1		
(Scale)	1									

Note: Corrected Quasi Likelihood under Independence Model Criterion (QICC)=98.27

Table 3: Parameters for the repeated measures Poisson regression predicting number of imitations by age and type of clip (yawn versus open mouth control).

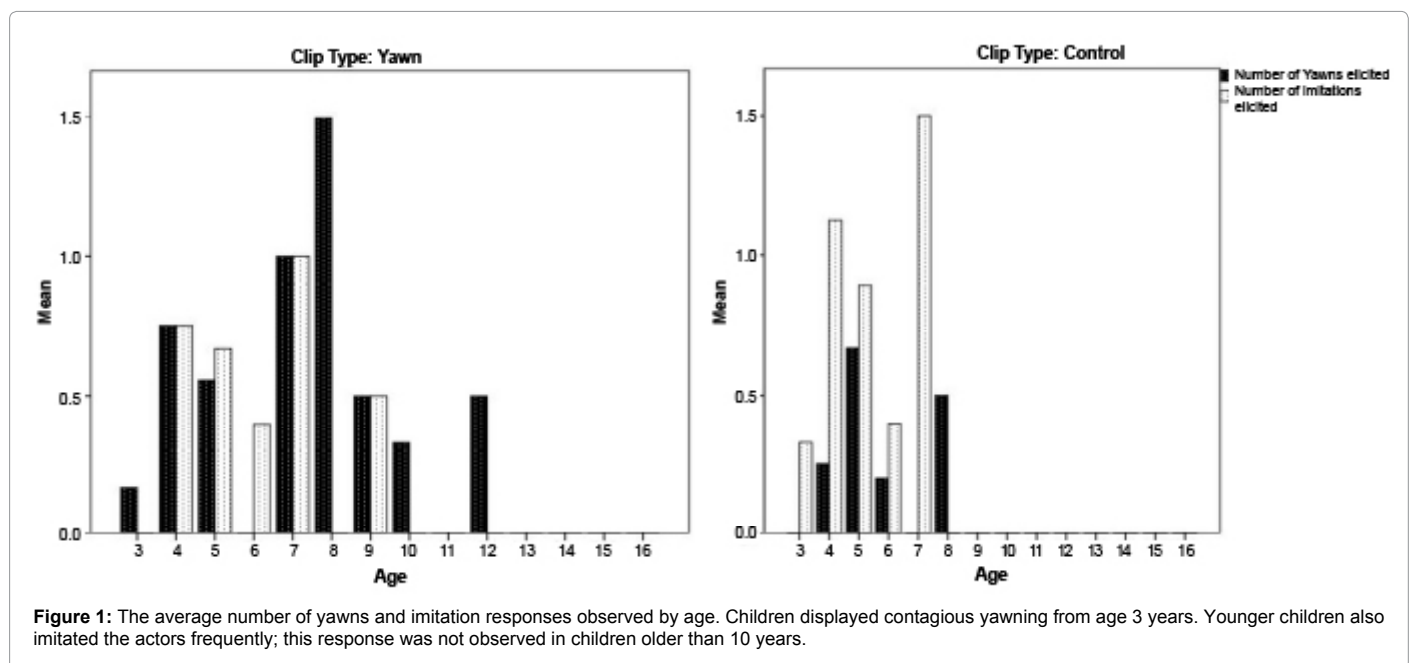


Figure 1: The average number of yawns and imitation responses observed by age. Children displayed contagious yawning from age 3 years. Younger children also imitated the actors frequently; this response was not observed in children older than 10 years.

not attend to faces, and in particular the eyes, as much as older children and adults do. However, similar to previous studies, the frequency of yawn contagion seemed to increase at around 4 years of age [9]. In this regard, our stimuli did not change the age at which yawn contagion becomes more prevalent.

It is unclear why explicitly cuing eye contact makes a difference in how contagious yawns might be for young children; after all, infants start to make eye contact within the first few months postpartum [18]. It may be, as Millen and Anderson [6] suggested, that young children are less susceptible to the various psychological influences of yawning, and therefore, their gaze needs to be directed to the most important stimuli for yawn contagion. This suggestion is at least plausible and supports the argument put forth by Senju et al. [16] that personal differences in social orienting may mediate associations between susceptibility to contagious yawning and the capacity for empathy.

It is also possible that poor general attention skills in very young children, which may result in a lack of attention to social cues, is responsible for the reduced yawn contagion that has been previously described in children under the age of 6 years. The finding that children under the age of 8 years yawned after both yawn and control clips may indicate that young children attend less to specific facial features of the model (they might not yet discriminate minor differences between yawn and control conditions) than older children. An equally viable

explanation for this finding is that young children have longer yawn latency periods than older children. Therefore, though these children may have yawned in response to a yawning clip, this only occurred after a control clip had already occurred. Different latency periods for contagious yawning have also been found in dogs—younger dogs typically have longer latency periods than do older dogs [10]. Future research can make use of order effects testing to see whether contagious yawns after control clips are indeed due to longer latency periods.

Contrary to our expectations, frequency of contagious yawning reduced with increasing age. It may be that older children felt more social pressure to suppress yawns than younger children did. Awareness of social norms increases with increasing age [21]. With an observer present behind the participant, older children may have thought it inappropriate to yawn during a testing situation.

The current study also found that children under 8 years frequently imitated the actors. The high level of imitation among the younger children is not surprising as infants as young as 12-21 days old imitate open mouth movements [19]. Imitation among infants is thought to serve social and communicative functions [22]. The current results suggest that the tapering off of imitation responses typically found among children may only occur after the age of 7-8 years, and may vary among children.

A limitation of the study is its relatively small sample size. It would

be beneficial to use narrow and defined age bands in future research, to determine whether a developmental trajectory for yawn contagion can be identified. The use of longer interim periods between video clips may clear up uncertainty surrounding what factors influence young children's tendency to yawn following control clips. Future research should also make use of an eye tracker to determine the exact areas of fixation of a participant's gaze.

In conclusion, when cued to look at the eyes, contagious yawns occurred in children from the age of 3 years. We also observed frequent imitations of yawns, especially amongst younger children, which have not been noted in previous research. The current findings suggest that future research control for eye fixation when investigating contagious yawning (or the lack thereof) in very young children.

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