The Psychological Record, 1991, 41, 453-460

SOME ANTECEDENTS AND CONSEQUENCES OF YAWNING

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Abstract

Attempts were made in three experiments to induce human subjects to yawn reliably in the laboratory. In subjects who believed they were not observed, reading about yawning did increase their frequency of yawning, compared to reading about scratching or day dreaming. In the second experiment, performing a spontaneous yawn decreased skin conductance, but "faked" yawns did not have this effect. In subjects under observation during the third experiment neither boredom, vigilance, nor reading about yawning induced the act.

Article

It is commonly believed that yawning is caused by boredom, lack of oxygen, and seeing other persons yawn. Such an oddly disparate set of antecedent stimuli might seem to, make yawning a focus of interest for those who study biosocial aspects of behavior. But this has not been the case, and relatively few psychologists have studied yawning. As a result we are still uncertain about the precise circumstances under which these common beliefs about yawning are true (or not true). Provine, Tate, and Geldmacher (1987) found that changes in oxygen and carbon dioxide levels did not affect yawning frequency, whereas Provine and Hamernik (1986) found that concentration on boring stimuli, such as TV test patterns, did increase yawning frequency.

A comparably diverse set of neuroendocrine pathways has been found to regulate yawning. Neurotransmitters such as dopamine (Yamada, Nagashima, Kimura, Matsumoto, & Furukawa, 1990), acetylcholine (Cowan, 1978; Urba-Holmgren, Gonzalez, & Holmgren, 1977), and serotonin (Urba-Holmgren, Holmgren, & Gonzalez, 1979) have been implicated, as well as steroid hormones such as estrogen and testosterone (Phoenix & Chambers, 1982), oxytocin (Argiolas, Melis, Stancamp, & Gessa, 1990), and ACTH or adrenocorticotrophic hormone (Argiolas, Melis, & Gessa, 1988). Yawning has been found in all the major vertebrate classes, including several mammalian orders (e.g., primates, carnivores, and rodents), fish (Baenninger, 1987), birds (Dumpert, 1921), reptiles (Barthalmus & Zielinski, 1988), and amphibians (Cramer, 1924). Thus, the evolution and physiological correlates of yawning both present intriguing questions. In itself, the fact that so many apparent mechanisms are associated with yawning, in so many different species, suggests that the act is of some general importance.

In primates yawning may have evolved as a form of nonverbal communication. Deputte (cited by Redican, 1982) found that yawning was contagious among individual nonhuman primates of similar age and social status. He interpreted this contagion as an adaptive means for synchronizing activities (especially the sleep/waking cycles) of the individuals in a mobile troop of primates. One implication of this view is that troop leaders would likely initiate more yawning than subordinates, and Hadidian (1980) found that this was the case. Males also yawn more than females among nonhuman primates, although not in humans (Schino & Aureli, 1989). Dominant males may simply be making more threat displays that involve mouth opening, although Phoenix and Chambers (1982) found that testosterone injections increased yawning frequency by both male and female rhesus macaques. Sauer and Sauer (1967) proposed that yawning induces relaxation of social tension in groups. This would account for yawning contagion, but does not explain why nonsocial animals would yawn, or why social animals, such as humans, yawn when they are alone.

In humans yawning also has a social contagion aspect. Moore (1942) reported that people in college libraries and church services yawned in response to seeing a trained actor yawn. But Moore's observations were rather poorly controlled and have proved difficult to replicate within the confines of the laboratory. In our laboratory we have consistently failed to find contagion of yawning when human subjects are being openly observed; in one study an actor yawned during a reading delivered in person or via TV and there were virtually no yawns in response by 40 laboratory subjects (Baenninger, 1987).

In the studies reported here we have attempted to increase the frequency of solitary human yawning as a way of gaining stimulus control over the act; the relatively low baseline frequency of yawning is, of course, a stumbling block for research. In these studies we have also begun to examine some physiological correlates of yawning as a way of trying to understand what bodily functions it may serve.

Experiment 1

In this experiment we sought to determine whether reading about yawning increases its likelihood in subjects who believed that they were not being formally observed. Some preliminary measures of skin conductance were also made before, during, and after yawns.

Subjects

Participants were undergraduate volunteers (14 males, 16 females) enrolled in Introductory Psychology.

Apparatus

A microcomputer controlled the experimental procedure and recording of skin conductance data during yawning episodes through an HRM Biofeedback Microlab program, and skin conductance sensors that were attached with Velcro straps to fingers of the nonpreferred hand.

Procedure

Subjects were initially told that they would be participating in a study concerning the effect of imagery on a physiological response. During the first part they would read a written passage and answer a brief questionnaire, and for the remaining period their skin conductance activity would be monitored while they imagined themselves in different situations.

The experimenter greeted subjects at the door of a room where a confederate of the experimenter was seated; they were led into a second room where they were seated alone but in a position such that the confederate could observe them unobtrusively. The experimenter then read the instructions to them, explained that they should try to ignore the person in the other room (the confederate) whose presence was necessitated by a shortage of lab space, gave them the reading material and questionnaire, and left the room.

Ten subjects were randomly assigned to each of three treatment groups and tested individually; all subjects were run during the early afternoon. The experimental Group Y (Yawn) was given a page of material to read that concerned yawning, whereas control Group 5 (Scratch) read a page about scratching, and control Group D (Daydream) read a page about daydreaming; all subjects then responded to a brief questionnaire about the activity relevant for their group.

After 10 min the experimenter returned and told the subject that a problem with the apparatus would result in a short delay. During both the first 10 min and this subsequent 20-min "waiting period" the confederate surreptitiously recorded any yawns emitted by the subject. The confederate did not know to which treatment group the subject belonged. At the end of the 20-min waiting period the experimenter returned, apologized for the 20-min delay, and escorted the subject into the third room where she attached the sensors to the subject's fingers. The subject was told that because of the 20-min delay an abbreviated (5-min) version of the testing would have to be done.

Each subject's yawns were then recorded during five 1-min periods. In Period 1 the subject was asked to relax in order to get a baseline conductance reading. In Period 2 subjects were asked to imagine situations in which they would be prone to yawn and to imagine the whole sensation of yawning. In Periods 3, 4, and 5 they were asked to imagine being in those situations; if they did not yawn spontaneously they were asked to fake a yawn by opening their mouths wide while taking deep inspiration and exhalation. The onset and end of each yawn were defined by opening and closing of the mouth.

Results

During the 30-min period prior to GSR recording, while subjects were waiting for the experimenter to connect them to the apparatus, the subjects in the yawn group yawned 33 times, compared to subjects who read about scratching (20 yawns) or daydreaming (18 yawns). A onetailed Mann-Whitney test showed this difference between the yawn and control groups to be significant ($U = 62$, $p < .05$). This anticipated difference between experimental and control subjects was still apparent later during the 5-min period when subjects'skin conductance was being recorded (Mann-Whitney $U = 58$, $p < .05$, one-tailed test).

During the 30-min period prior to skin conductance recording Group Y subjects yawned at a rate of 0.08 yawns/person-minute. In previous observations in this laboratory (Baenninger, 1987) a comparable rate of 0.15 yawns/person-minute was found. When subjects were asked to imagine situations conducive to yawning their rate of yawning increased slightly to 0.25 yawns/person-minute, even though they were attached to the recording apparatus and knew they were under observation by the experimenter. During the interval when conductance was recorded ail subjects in Group Y yawned at least once (including both faked and spontaneous yawns) whereas four in Group D and two subjects in Group S failed to yawn at ail. Mean duration of ail yawns was 4.95 sec, with no group differences. There was no significant difference between male and fernale subjects in yawn frequency or duration.

The most striking finding in the skin conductance record occurred during the 4-sec interval after yawns. In ail 36 cases where a trend was apparent skin conductance decreased following yawns. Although individuals differed, there was no clear general effect of yawning on skin conductance during the 4-sec interval before each yawn: Conductance increased in 17 cases, decreased in 14 cases, and there was no trend in 7 cases. During the yawns themselves the conductance increased in 15 and decreased in 5 cases. Only the downward trend in post-yawn conductance was statistically significant (sign test, $p < .0005$).

Experiment 2

In experiment 1 merely reading about yawning increased the frequency of yawning, as did asking people to imagine yawning. A secondary finding was the reliable decrease in skin conductance in the 4 sec following the end of a yawn, a trend that suggests a change in arousal level. In Experiment 2 an attempt was made to maximize the likelihood that subjects would yawn in the presence of the experimenter and recording apparatus, to enable further analysis. Previous research in our laboratory has been hampered by subjects' reluctance to yawn while being observed, or while having physiological functions monitored (Greco & Baenninger, 1989).

Method

The apparatus used was the same as in Experiment 1, and the nine undergraduate volunteer subjects (four female and five male) were observed after lunch in the same laboratory, while it was softly illuminated. Innocuous background music was playing quietly, and subjects were seated in a comfortable reclining armchair. We attempted by these means to maximize the likelihood of yawns.

Procedure

Subjects were told that the study concerned effects of reading unfamiliar material on the conductance of their skin. Sensors were then attached to their fingertips with Velcro straps, and the subjects were asked to relax for 5 min while baseline measurements were made. They were then given a reprint of a technicai journal article on yawning and were asked to keep the hand with the sensors attached as still as possible while reading the article. They were also told that activities like moving, scratching, sneezing, or yawning were fine as long as they did not move the hand with sensors attached. Subjects were then asked to fake two yawns as a way of checking that the physiological recording equipment was accurate. Subjects were then asked a series of questions about their smoking habits, caffeine consumption, most recent meal, how much they slept the night before, and whether they had any respiratory ailments.

Results

Not one subject yawned spontaneously during the 10-min observations which were designed to engender a relaxed mood. Ali subjects were capable of faking two yawns when asked to do so, and six of the nine subjects then yawned spontaneously following the two faked yawns. No consistent trend of skin conductance was found during the 4 sec following the faked yawns (seven increases and seven decreases) but, as in Experiment 1, conductance always decreased following unfaked yawns (in those cases where any trend occurred). Increases and decreases in skin conductance were equally likely before or during the yawns. Responses to the questions asked did not show any particular pattern and were unrelated to yawning or skin conductance.

Experiment 3

In Experiment 2 unfaked yawns did not occur unless faked yawns occurred first, and the effects of spontaneous yawning on skin conductance appeared to differ from the effects of faked yawns. Normal scientific procedures for recording yawns and their physiological concomitants require an observer and recording apparatus, but yawns did not occur when these were present. In Experiment 3 we tried yet another method of eliciting yawns when an observer and recording apparatus were present.

Method

The apparatus, location, and recording methods were the same as in Experiment 2. Thirty undergraduate subjects were assigned to two groups. In the bored group, subjects' baseline skin conductance was recorded for 5 min and they were then asked to read for 10 min from an advanced chemistry text which was selected to be tedious and difficult. In the vigilant group, subjects did not read, but instead wore headphones that played white noise for 10 min. They were asked to press a button whenever there was a pause in the noise. In all other respects the two groups were treated alike. Faked yawns were not requested in this experiment.

Results

Not one of the 30 subjects yawned spontaneously during the 15 min of skin conductance and video recording, despite the conducive surroundings and the unstimulating nature of the two tasks. Close examination of the video records showed no evidence that yawns were being suppressed surreptitiously. Thus, neither boredom nor task demands for vigilant alertness were associated with yawning among subjects with videotaping equipment present.

General Discussion

If yawning is a form of nonverbal communication among humans then its inhibition appears to be under voluntary (or quasi-voluntary) control. The consistent finding in these three studies was that people did not yawn when they believed that they were being observed by laboratory scientists/faculty. In Experiment 1 yawning occurred while subjects were reading about it, but only when the observer appeared to be a student who was not observing them; in Experiments 2 and 3 an apparently relaxing setting was not associated with increased yawning, presumably because subjects did not perceive it as relaxing. It is possible that subjects failed to yawn because they had no desire to communicate nonverbally with anyone, but it seems more likely that subjects were experiencing a certain amount of anxiety in the laboratory, either because they believed that their performance was somehow being observed and evaluated, or because they all subscribed to the social convention that yawning in public is impolite and is an act that should not be performed in the presence of authority figures. Such personal constraints increase the difficulty of performing objective studies of yawning, but we have recently found that self-reports by subjects are in close agreement with videotaped records, when the camera was hidden (Greco & Baenninger, 1989).

In these studies a reliable physiological correlate of spontaneous yawning was found, in the form of a drop in skin conductance immediately following yawns. When students were asked to produce yawns these nonspontaneous "faked" yawns were not reliably accompanied by this change. Changes in skin conductance are commonly used as one measure of sympathetic, or visceral, arousal level; the implication seems clear that yawning may thus affect this form of arousal. The possibility that this effect is a major function of most yawning acts is the working hypothesis of our ongoing research efforts.

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