

YAWNING

A Homeostatic Reflex and Its Psychological Significance

HEINZ E. LEHMANN, M.D.

Professor of Psychiatry, McGill University, Montreal, Quebec, Canada
Bulletin of the Menninger Clinic, 1979, 43(2), 123-136

Yawning is a common phenomenon that is an expression of certain physiological and psychological states, yet it has received remarkably little attention in the medical literature. Dumpert (1921), Hauptmann (1920), and Lewy (1921) reached some conclusions regarding the nature of yawning in connection with observations of patients with encephalitis lethargica; however, after the 1920s the subject was again disregarded. On the basis of certain clinical and experimental observations which may have some psychiatric significance and which, to my knowledge, have not yet been described, a review of the matter of yawning appeared justified.

Physiological Aspects of Yawning

Physiology textbooks furnish scanty information regarding the nature of yawning. Under a common heading with laughing, crying, sighing, coughing, and sneezing, yawning is usually described as a modified respiratory movement, characterized by a prolonged inspiration with wide open mouth followed by shorter expiration and often associated with stretching movements of the muscles of the trunk and extremities.

Phylogenetically and ontogenetically, yawning is an old phenomenon. Dogs, cats, and even crocodiles yawn; turtles and birds show movements resembling yawning (Vischer 1959). Yawning and stretching seem to be intimately associated in their phylogenetic origins. Although lower mammals stretch without yawning, they almost never yawn without stretching. In man, stretching is also probably an essential part of the yawning act but is often voluntarily suppressed. The early ontogenetic occurrence of yawning is confirmed by the observation that infants yawn when only a few days old (Preyer 1923).

Somatic Causes of Yawning

The physiological conditions that bring about yawning include: fatigue; drowsiness; anemia (particularly acute general anemia, after hemorrhage, when it often indicates impending shock; anemia of the cerebrum, as after ligation of one of the carotid arteries); hunger; hypoglycemic states; intoxication with barbiturates and other cerebral depressants; withdrawal from opiate dependence; certain lesions of the central nervous system, such as postencephalitic conditions, tumors and compression of the cerebrum and cerebellum, and epilepsy (where yawning sometimes constitutes the aura [Oppenheim 1931; Penfield & Erickson 1941]). Among the different somatic conditions that may elicit yawning (other than localized brain lesions, which in most instances do not reflect the condition of the brain as a whole but may effect local irritation), one common

denominator suggests itself quite strongly-impaired oxidative processes in the brain. In barbiturate intoxication, this impairment is due to a direct effect on the nerve cell metabolism, in anemia to insufficient oxygen supply, in hypoglycemia to lack of metabolic substrate. As for physiological fatigue and drowsiness, some evidence points to changes in circulation which result in a diminished cerebral blood supply. After assuming that all the somatic conditions under which yawning occurs, except possibly localized brain lesions, are characterized by reduced brain metabolism, the question arises whether yawning is a somatic defense mechanism to correct the reduction of cerebral oxidative metabolism. Most investigators (Dumpert 1921; Hauptmann 1920; Lewy 1921) arrived at such a conclusion; however, Peiper (1932) regards yawning merely as a functional disintegration of the respiratory center.

What reflexes are at the organism's disposal to improve deficient oxidation of its important parts? The most immediate, effective, systemic compensations for acute oxygen want of the body tissues are hyperventilation and an increase in the volume of circulating blood by direct action on the heart through an effect on the carotid body. It is still a popular belief, even in medical circles, that yawning increases the body's oxygen uptake and that the one deep inspiration is an abortive hyperventilation. However, the deep inspiration of yawning is always followed by a period of apnea, so nothing is gained as far as oxygen metabolism is concerned. Nor is there any reason to assume that yawning directly or significantly stimulates the circulatory system, since yawning without stretching hardly influences pulse rate or blood pressure (Heusner 1946). Thus, hyperventilation and direct stimulation of the circulatory system have to be discarded as measures the organism uses to combat failing brain metabolism in conditions that provoke yawning.

The possibility remains that the blood flow to the brain may be increased, not through action on the heart but through an effect on the peripheral vessels. Most investigators seem to agree that this action does indeed take place and that the active principle of yawning is the intense tonic contraction of large muscle groups-particularly the neck muscles and those of the thoracic girdle as well as the pharynx, the larynx, the diaphragm, and even the tensor tympani (some people hear a cracking sound when yawning). After a painstaking physiological analysis, Mayer (1921) concluded that the deep inspiration is only a side effect of the concerted action of muscles that are ordinarily employed for respiration. The contraction of so many muscles has a momentary influence on circulation by emptying the venous vascular bed in the periphery and increasing blood flow, particularly the flow of blood to the brain. Thus, yawning is a type of indirect muscular and vascular reflex which improves circulation. A reflex that serves a purpose, that adjusts faulty conditions in the organism, a self-righting procedure of the body, is called a -homeostatic reflex."

To summarize: there is considerable evidence that yawning occurs under various somatic conditions, most of which, for different reasons, are associated with diminished oxidative processes in the brain. Furthermore, yawning is a self-adjusting mechanism, a homeostatic reflex; the tonic contraction of large muscle groups improves the circulation in general and brain circulation in particular, thus compensating for defective brain metabolism.

Cerebral Localization of the Yawning Mechanism

Mayer (1921) published the cases of four patients with encephalitis lethargica who showed abnormalities in the frequency and the motor manifestations of yawning. In some of these patients, the yawning was incomplete, the muscle contractions were weak, the inspiration was missing, and the peculiar, "cathartic," pleasant sensation that follows yawning was in abeyance.

Mayer's conclusion was that the impulses which evoke yawning pass from the thalamus through the lenticular nucleus to the respiratory center in the medulla. Lewy (1921) felt that yawning originated somewhere in the corpus striatum or, because of its relationship to expressive movements like laughing and crying, in the thalamus. Peiper (1932), however, mentions an anencephalic monster who showed yawning being only in the possession of the medulla. The cerebrum does not seem to be indispensable for the production of yawning, and apparently there is at least one center for yawning in the neighborhood of the respiratory center. Oppenheim (1931) noted the occurrence of yawning in patients who had tumors of the cerebellum. Oppenheim and many other authors have described forced movements in paralyzed limbs which occurred during yawning and which indicated the involvement of the extrapyramidal system.

Psychological Aspects of Yawning

Man's psychological reasons for yawning are of equal, if not greater, importance than the physiological causes. While real yawning cannot be produced by direct voluntary impulses, it is an ideomotor action: easily elicited by autosuggestion, by mental preoccupation with yawning, and by unconscious imitation.

Boredom

The principal, purely psychological condition evoking yawning, as a kind of reflex, is boredom. Boredom as a mental state is well known, but in spite of its social significance, psychology and psychiatry have almost completely ignored this very human reaction to the environment. However, theologians, philosophers, and writers have repeatedly paid tribute to its importance. For example, during the Middle Ages, a state akin to boredom was known "acedia"; monks feared it as a condition conducive to sin, if not sinful in itself, because it meant that the person who developed acedia had lost his direction in the world and was in grave danger of losing his faith and his values. Pascal pointed out man's continuous need to struggle toward an objective, even if only in play, if he is to avoid aimlessness and boredom. Schopenhauer called pain and boredom the two foes of humanity and said that boredom is the feeling of the burden of one's own existence. Modern phenomenological and existential philosophers (e.g., Heidegger) find a close relationship between boredom and anxiety—both develop when man's existence is in suspense. Dostoevsky's two principal characters in *The Possessed*—Kirilov and Stavrogin—are afflicted with such profound boredom, characterized by their complete loss of values and objectives, that they perform monstrous acts, make selfless and senseless sacrifices, and finally commit suicide.

A brief phenomenological analysis of boredom is necessary to understanding its relationship to yawning. Since it is evidently void of conscious volitional elements, is boredom an idea, an instinct, or an affect? It is apparently an affective state, for not only is it always associated with a definite feeling tone—an unpleasant one of being peculiarly vexed, filled with uncertainty but it also influences the individual's trend of thoughts. Unlike an instinct, boredom is biologically useless and does not follow a definite pattern. Its intrinsic vagueness distinguishes it from an idea. The French word for boredom "ennui" is also used to indicate other emotional states (e.g., loneliness, weariness, annoyance), thus showing that boredom is considered to belong to the same dysphoric category as an emotional quality.

To feel bored is fundamentally different from being relaxed or indifferent, which are passive states. Boredom is a searching attitude, something active, in fact, a craving for activity. The

bored individual wants to give himself over to definite impressions, experiences, mental or physical tasks; he desires something to be interested in and attentive to. His attitude is markedly extraverted; he longs to contact reality; yet nothing definite, nothing distinctive is available or acceptable; and the bored individual "finds time long." The German and Chinese words for boredom "Langeweile, yim hay" both convey that the individual is painfully aware of time. The person wishes to "kill time." The concept as well as the awareness of time are two essential features of reality. A state that in a general, emotional manner is concerned with time, like boredom, is in a general, emotional manner concerned with reality.

Having now defined boredom as an affective state with an unspecified tendency toward reality, I may approach the question: why does man yawn when he is bored? The situation is similar for the individual who is bored and the fatigued person who is trying to complete a task. In both instances, the individual is aware of being hampered in obtaining a goal. In the case of fatigue, the goal is there, but the mental energy output is inadequate; in the case of boredom, the mental energy is adequate, but the individual has not found a satisfactory goal. The psychological effect of both conditions is the same, and yawning becomes what Darwin (1873) called an "associated habitual movement." Yawning is, then, the expression of an affective state, like laughing or crying.

Indicator of Mental Activity

Yawning is a signal that the individual is struggling to focus his attention on something in the outside world. The "beam of consciousness" is becoming dim or has lost its direction, and the individual is aware that his power to focus attention is not adequate. Even when a person is physiologically fatigued or drowsy, he yawns only as long as he maintains a certain activity. He yawns in the evening while undressing and while reading in bed, but he soon ceases yawning when he turns the light off and settles down to await sleep. He yawns again in the morning, although thoroughly rested, when he finds it difficult to adjust to the requirements of the waking state. Many people yawn when leaving a cinema; after the heightened emotional tension created by the movie, yawning indicates the individual's returning to a more diffuse reality and the ensuing psychic relaxation which he actively resists. If this resistance to the relaxation of attention is not present (for instance, if the individual is entirely absorbed in something else) he does not yawn. A speaker, embarrassed by his yawning audience, must concede that those who yawn are at least making some effort to follow him, while the others may be letting their thoughts wander unchecked or may be asleep with their eyes open.

Indicator of Affect

Yawning may appear as a psychoneurotic symptom. For instance, a neurasthenic patient related that he had troublesome spells of yawning at times of anxious expectation such as while waiting for an important appointment. In other neurotics, frequent yawning may indicate the patients' inability to concentrate, which they struggle to overcome. In hysteria, spasms of yawning may have the same significance as convulsive laughter or crying as an expressive movement. Irresistible yawning spells were known to early clinicians as "oscedo" or "chasmodia." Yawning may be employed in social intercourse as a subtle expression of aggressive tendencies, implying that the partner is a bore.

"Contagiousness"

It is common knowledge that yawning is “contagious.” So many conditions favor the occurrence of yawning that a disposition to yawn is present at most times and its automatism is easily set off. For the individual who often yawns for seemingly no other reason than seeing another person yawn, a certain general disposition to yawn must be present, and usually mild boredom or fatigue serves to facilitate such unconscious imitation. The more specific requirement is that anyone performing an unconscious imitation must have transferred some interest to the individual or object he is imitating. A stranger in the crowd “infects” another person with his yawning only if he had previously aroused the other's interest, possibly for not longer than a moment and for an insignificant reason such as peculiar attire or a conspicuous gesture. In general, any act of unconscious imitation is dependent on a certain amount of cathexis or interest in the environment, and any unconscious imitation of affective expression such as smiling, frowning, and yawning is dependent on a certain capacity for empathy.

Clinical Observations

It is an old clinical observation (Russell 1891; Geigel 1908) that persons suffering from an acute physical illness never yawn as long as their condition is serious. Nurses have learned to recognize the return of yawning as a sign of patients' convalescence, particularly in those patients who have infectious diseases. The literature, however, reports few observations regarding yawning in psychotic patients, although Hauptmann (1920) made mention of its possible significance.

Some time ago I was struck by the conspicuous scarcity of yawning among mental patients. I informally recorded the incidence of people yawning in public gatherings, on buses, in restaurants, at scientific meetings, and on mental hospital wards. These observations confirmed my impression that yawning among the mentally ill is unusually rare. There were two exceptions: patients receiving large doses of sedatives and those diagnosed as suffering from organic brain syndrome. Of course, the absence of yawning in patients with psychoses associated with constant psychomotor excitement or increased nervous tension was not surprising since excitement or emotional tension usually excludes the occurrence of yawning in normal individuals. However, the majority of patients I observed were quiet, inactive, indifferent persons suffering from schizophrenia. Their failure to yawn requires an explanation.

One of the most consistent physiological findings about patients with schizophrenia is defective homeostasis. The schizophrenic patient's ability to adjust to changes in the internal milieu is impaired. Slight reductions of the schizophrenic subject's brain metabolism would, therefore, provoke a homeostatic response less easily than in a normal person. Yawning might not be elicited unless the yawning provoking stimulus assumes an unusual strength such as that provided by hypoglycemia or by barbiturates.

As I have mentioned, the principal psychological agent to produce yawning-boredom-is an affect characterized by an extraverted attitude, a searching tendency toward reality. The schizophrenic subject's typical withdrawal from reality and his affective blunting make it almost impossible for him to be truly bored; his passivity, indifference, and daydreaming must not be confused with boredom. In addition, the schizophrenic individual can hardly be expected to imitate unconsciously the yawning of another person since he is not likely to transfer sufficient interest to other persons in his surroundings. Therefore, when a schizophrenic patient yawns as a result of boredom or unconscious imitation, it shows that the patient's contact with reality is not entirely lost and that he is making an effort to maintain it. In fact, when any psychiatric patient yawns, it is a

signal that he is in an accessible mood, regardless of his general mental state or diagnosis.

Of course, yawning is by no means completely absent in schizophrenic patients. Its incidence, however, appears to be much lower in schizophrenia than in normal mental conditions or in other mental diseases. The occurrence of yawning in early schizophrenia may be evaluated as a favorable sign; however, it seems to be of ominous significance in chronic schizophrenia. One may theorize that yawning in the acute schizophrenic patient is the reflection of a fairly intact homeostatic system and possibly the expression of the patient's efforts to retain his contact with reality. In the chronic stages of the disease, yawning may be indicative of structural brain changes and the formation of a new, permanent, and pathological relationship to the outside world, characterized by complacency and the complete loss of the inner stress and tension that should accompany even partial insight.

Experimental Induction of Yawning

Yawning is an elusive phenomenon and lends itself poorly to experimental investigation. It is usually difficult, if not impossible, to determine which psychic or somatic cause or combination of causes is actually responsible for spontaneous yawning.

In an attempt to elicit yawning under fairly uniform and observable conditions, 180 mental patients were administered a standardized cerebral depressant that would bring into action the homeostatic function of yawning. Psychological factors, such as an intention to remain awake and in contact with the environment, could have been present but were certainly in the background as yawning-producing agents in these cases. The subjects selected to participate in the experiment were divided into three groups of sixty patients each. Group I consisted of only those patients who, beyond any doubt, had been recognized by several staff members as schizophrenic and who presented no atypical features. Group II included only those patients suffering from a variety of psychoses caused by and associated with neurological brain lesions. Group III was made up of persons with miscellaneous functional mental disorders that did not belong in either the schizophrenic or in the "organic" group.

These 180 patients were intravenously administered a 3 percent solution of pentobarbital, a barbiturate, usually at a rate of not more than 1 cc per 30 seconds. The investigator carried on a running conversation with the patient during the injection, telling him that the injection would not hurt or incommode him in any way but would make him feel sleepy. When yawning occurred, the reaction was counted as positive and the injection was discontinued, unless a more profound narcosis was desired for reasons other than the experiment. When no yawning occurred after a maximum of 0.3 g of pentobarbital (10 cc of the 3 percent solution) had been administered, the injection was terminated and the reaction was counted as negative.

In some cases, yawning occurred frequently after about 0.15 g of pentobarbital had been injected. At the same time, the patient's speech became slurred and he stated that he felt dizzy, lightheaded, or drowsy. His respiration then became shallow and infrequent; yawning occurred frequently at this stage, too. As a rule, respiration became regular again within a minute or two, and the patient then slept for several hours if left undisturbed. In other cases, yawning was delayed and appeared after the patient had passed from the somnolent stage into profound sleep. Therefore, a reaction was counted as negative only when yawning was not observed during the injection or within 90 seconds following it. Patients who did not yawn often sighed deeply when they began to

feel drowsy; however, yawning was defined as an inspiration accompanied by tonic contraction of the facial muscles and by opening of the mouth.

Results are summarized in Table 1. These findings are statistically significant, although their reliability may be questioned as they depend to a certain extent on the speed of the injection and some accidental factors in the patient's condition (e.g., mood, bodily state). However, from the data on hand, I could show that moderate variations of these factors did not alter a patient's yawning response. For example, instead of using the quantity of the drug injected as a standard, the yawning responses during similar states of consciousness (e.g., drowsiness, sleep) could be compared.

TABLE 1

Diagnosis	<i>Yawning Reaction</i>			
	Present		Absent	
	N	%	N	%
I Schizophrenia	16	26.7	44	73.3
II Organic Psychoses				
General Paresis	16	76.2	5	23.8
Senile Dementia	7	63.6	4	36.4
Cerebral Arteriosclerosis with psychosis	6	75.0	2	25.0
Huntington's Chorea	2	66.7	1	33.3
Parkinsonism with psychosis	2	66.7	1	33.3
Hemiplegia with psychosis	3	100.0	0	0.0
Little's Disease with psychosis	2	100.0	0	0.0
Tuberous Sclerosis	1	50.0	1	50.0
Surgical Brain Scar	2	100.0	0	0.0
Contusio Cerebri	1	100.0	0	0.0
Subdural Hematoma	0	0.0	1	100.0
Cerebral Aplasia	0	0.0	1	100.0
Frontal Lobe Tumor	1	100.0	0	0.0
Pick's Disease	1	100.0	0	0.0
Total	43	71.7	17	28.3
M. Other Mental Disorders				
Manic-Depressive	8	34.8	15	65.2
Psychoneurosis	3	17.6	14	82.4
Involutional Depression	5	55.6	4	44.4
Mental Deficiency	5	55.6	4	44.4
Toxic Confusional State	2	100.0	0	0.0
Total	23	38.3	37	61.7

The difference in the incidence of induced yawning in schizophrenic subjects as compared with those suffering from a psychosis with structural brain changes is evident and of statistical significance ($\chi^2 = 26.38$; $df = 2$; $p < 0.001$): 26.7 percent positive responses in schizophrenic patients against 71.7 percent positive responses in patients with organic brain syndrome. The positive responses for the miscellaneous group hold a middle position. As with spontaneous yawning, induced yawning was less likely to occur in tense, excited, or acutely ill individuals than in quiet, cooperative patients. Very resistive or excited patients showed little response to the pentobarbital injection. Other patients who expressed marked euphoria or depression usually did not yawn. A general rule seems to be that, *ceteris paribus* yawning is favored by the absence of psychomotor excitement, emotional tension, and acute, active illness. Thus a depressed patient in a depressive stupor or a patient in a manic delirium would probably fail to show this response.

Within Group III, a distinct majority of psychoneurotic patients showed negative yawning reactions. The psychoneurotic individual behaves like the schizophrenic patient in responding to the sudden reduction of cerebral function, especially when anxiety and obsessive symptoms are prominent. Among those with affective psychoses, there were more negative responses in the manic-depressive group and positive responses in the involuntal melancholia group.

Aside from the quantitative differences among the three groups, there were also qualitative differences. If yawning occurred in schizophrenic patients, it usually appeared in a peculiar, short, superficial manner and was not repeated, while the yawning of a patient with structural brain lesion tended to be frequent, deep, and prolonged. One patient, suffering from involuntal melancholia without evident cerebral lesion, yawned so forcefully after awakening from the pentobarbital narcosis that he dislocated his jaw and required manual reduction. As with spontaneous yawning, the induced yawning occurring in early schizophrenia seemed to have favorable significance, whereas in chronic cases it seemed to be evidence of marked deterioration.

In one particular case, the yawning response to the pentobarbital injection gave a diagnostic hint. A Chinese man was admitted to the hospital because of peculiar behavior and general inertia. Language difficulties prevented the taking of an adequate history from the relatives and made the psychiatric examination of the patient difficult. The physical examination yielded no definite results, and a provisional diagnosis of simple schizophrenia was made. However, the patient showed such a frequent and intensive yawning response to pentobarbital that the staff doubted that they were dealing with a schizophrenic individual. The spinal fluid findings then revealed that the patient was suffering from general paresis.

Conclusions

(1) Yawning is a phylogenetically and ontogenetically old reflex that occurs under somatic conditions which seem to be characterized by a reduction of brain metabolism.

(2) There is reasonable support for the view that yawning originated as a self-adjusting mechanism of the organism, a homeostatic reflex which operates through the tonic contraction of large muscle groups and temporarily improves circulation in general and blood flow to the brain in particular.

- (3) The principal psychological reasons for yawning are boredom and unconscious imitation.
- (4) Boredom is an affect characterized by an extraverted attitude.
- (5) Unconscious imitation requires transferring interest to something in the outside world.
- (6) Yawning is a signal that the person is making an effort to maintain contact with the outside world.
- (7) Psychotic persons yawn rarely, except when suffering from organic brain syndrome.
- (8) Spontaneous yawning in a psychotic, particularly a schizophrenic, individual may be a signal that he is in an accessible mood.
- (9) When yawning is induced experimentally by pharmacosedation, the responses of schizophrenic subjects differ significantly from those of psychotic subjects with structural brain lesions.
- (10) In persons with psychiatric conditions, yawning may assume the value of a clinical symptom with diagnostic and prognostic implications.

References

- DARWIN, C. R.: The Expression of the Emotions in Man and Animals. New York: Appleton & Co., 1873,
- DUMPERT, V.: Zur Kenntniss des Wesens und der Physiologischen Bedeutung des Gähnens. J. Psychol. Neurol. (Lpz) 27:82-95, 1921.
- GEIGEL, R.: Das Gähnen. Münch. Med. Wschr, 55:223-24, 1908.
- HAUPTMANN, A.: Wie, Wann und Wozu Gähnen Wir? Neurol. Zbl. 39:781-82, 1920.
- HEUSNER, A. P.: Yawning and Associated Phenomena. Physiol. Rev. 26:156-68, 1946.
- LEWY, E.: Über das Gähnen. Z. Ges Neurol. Psychiat, 72:161-74, 1921.
- MAYER, C.: Physiologisches und Pathologisches Über das Gähnen. Z. fur Biol. 73:10114, 1921.
- OPPENHEIM, H.: Lehrbuch der Nervenkrankheiten. Berlin: Karger, 1931.
- PEIPER, A.: Das Gähnen. Dtsch. Med. Wschr. ~8:693-94, 1932.
- PENFIELD, WILDER & ERICKSON, T. C.: Epilepsy und Cerebral Localization. Springfield, IL: Thomas, 1941.
- PREYER, W.: Die Seele des Kindes. Leipzig: Th. Grieben, 1923.

RUSSELL, H.: Yawning (Delsarte Series, No. 1). New York: U.S. Book Co., 1891.

VISCHER, A. L.: Über das Gähnen und Seine Spontanen Mitbewegungen. Schweiz. Med. Wschr. 89:1356-59, 1959.

WEINBERGER, J. L. & MULLER, J. J.: The American Icarus Revisited: Phallic Narcissism and Boredom. Int. J. Psychoanal. 55(4):581-86, 1974.