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Ambient temperature modulates yawning

Comment on: Eldakar OT, et al. Temperature-dependent variation in self-reported contagious yawning. Adap Hum Behav Physiol 2015; 1:460-6; http://dx.doi.org/10.1007/s40750-015-0024-6

In humans yawning can be triggered both physiologically as well as psychologically (i.e., spontaneous and contagious yawns), and it is the distinct manifestation of these 2 yawn types that has led researchers to traditionally study them independently. However, evolution produces adaptations that are constrained by and build upon existing architecture, and since contagious yawning is a derived feature of the more primitive spontaneous form, it stands to reason that at least some fundamental mechanistic pathways should be shared between them. Recent research by Eldakar et al. has taken this perspective by assessing how non-social variables, i.e., those related to thermoregulation, alter the expression of yawn contagion.[1]

The thermoregulatory theory of yawning posits that the motor action pattern of this behavior functions as a brain cooling mechanism,[2] serving to counteract rising brain temperature by altering the rate and temperature of arterial blood flow to the skull. Accordingly, the powerful stretching of the jaw and deep inhalation of air forces hyperthermic blood away from the skull while introducing cooler blood from the lungs and extremities. The deep inspiration also allows for countercurrent heat exchange with the ambient air and subsequent cooling of venous return surrounding arterial blood supply. Since the inception of this theory in 2007, the primary brain/skull cooling predictions derived from this theory have been confirmed and replicated in different species (including humans).[3]

The thermal window hypothesis is a derivative of the thermoregulatory theory, which makes additional predictions regarding the relationship between yawning and ambient temperature (Fig. 1). First, yawns should increase in frequency with initial rises in ambient temperature, as this would trigger cooling mechanisms that function to maintain thermal homeostasis. Second, as air temperature continues to rise toward body temperature, yawning should then decrease since deep inhalations of warm air would heat rather than cool internal tissues. Third, yawning frequency would be expected to diminish as ambient temperature falls below a thermal neutral zone, as cooling mechanisms would no longer be needed. In sum, yawning is predicted to occur within a relatively narrow range of ambient temperatures (i.e., a thermal window). Initial support for this hypothesis has come from studies of birds and rodents, which demonstrated that

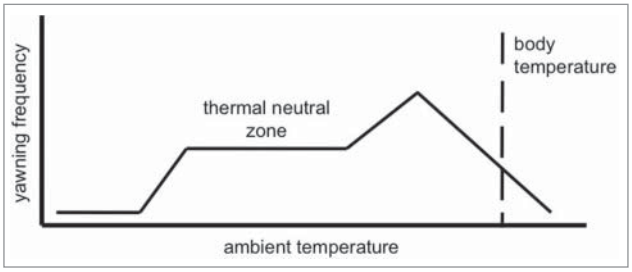

Figure 1. Thermal window hypothesis of yawning.

spontaneous yawning could be modulated in predicted ways through the experimental manipulation of ambient temperature.[4-5]

More recently, a pair of naturalistic experiments has provided further support for these predictions by assessing the influence of ambient temperature on the expression of contagious yawning in humans.[6-7] By sampling pedestrians across divergent seasons and climatic conditions, these studies first demonstrated that contagious yawning (much like the spontaneous form) became less common at temperature extremes. In a follow-up study,[1] which controlled for potential physiological circadian changes that may produce distinct patterns of yawning across different seasons, 142 pedestrians were shown a contagious yawning stimulus while being outside during an 18-day period over the summer in southern Florida, USA. Consistent with the thermal window hypothesis, self-reported contagious yawning was most frequent (60.5%) at moderately warm temperatures, but dropped precipitously (23.8%) as air temperatures approached human body temperature. Ambient temperature was the only significant predictor of contagion in this study, and this was true even when controlling for a host of other variables known to influence yawning frequency.

Before we can fully grasp why it is that we yawn in response to the yawns of others, we first need to understand why we yawn when we are alone. These latest ambient temperature findings provide further evidence indicating that the underlying mechanisms controlling the expression of yawning, both spontaneous and contagious, are embedded in thermoregulatory physiology. Of the numerous hypotheses for why we yawn, only the thermoregulatory theory predicts these combined effects. In sum, the thermoregulatory theory can explain the adaptive value of both isolated and social forms of yawning. Since yawning cools the brain, which in turn should enhance mental processing efficiency, the spreading of this behavior across the group under natural conditions would be expected to heighten collective vigilance and promote the detection and avoidance of threats.

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