How to catch a yawn: initial observations of a randomized controlled trial

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Abstract

Background: Yawning continually poses a difficulty for many scientists and clinicians over their agreement about the mechanism, origin, and neuro-chemicals involved. There has previously been no reliable way of profiling a yawn, scientifically, except by observation.

Objective: To represent the yawn episode in terms of jaw-muscle nerve electro-myographical (EMG) data as well as by direct observation. Method. 20 male and female volunteers aged between 18-53 years were exposed to conditions that provoked a yawning response in a randomised controlled trial. This paper is a discussion paper about some of these findings from the larger study. In particular, a profile of the yawn phase is represented to encourage further discussion about the possibilities of using EMG data for early diagnosis of neurological disease.

Conclusions: It is possible to represent yawning with EMG data; however, there is evidence to suggest that the yawning phase is individual and variable and tends to be very small measurements of a millionth of a volt.

Ethics: Bournemouth University Research & Ethics approval granted: BU-PS5/10/11-PS1/3/12. Professional code of conduct, confidentiality, and safety issues have been addressed and approved in the Ethics submission.

TrialsID: ISRCTN61942768. http://www.controlled-trials.com/isrctn/

Introduction

Yawning continually poses a dilemma for many scientists and clinicians because of the uncertainty of its neuroanatomical origin, mechanisms involved, functionality, and neuro-chemicals implicated.

Researchers have suggested that yawning may play an important role in the protection of our immune system, by regulating hormones and other responses, particularly when we are exposed to psychological or physical stress and fatigue (Thompson, & Zisa, 2012).

Walusinksi (2006; 2009) has described the yawning mechanism in light of evidence from brain-stem ischaemic stroke patients where parakinesia brachialis oscitans (the involuntary raising of the paralysed arm upon yawning) is evidenced.

Increasingly, neuroscientists and neurologists believe that the stress hormone, cortisol (Karlson, et al., 2011; McLellan, Lovell, & Gass, 2011) (Figures 1 & 2, Wikipedia, 2013a), may be a part of this complex response because of its involvement in the hypothalamus-pituitary-adrenal (HPA) axis (Thompson, 2011; Wikipedia, 2013b). Cortisol, is known systematically as 11-*beta*-11, 17, 21-trihydroxypregn-4-ene-3, 20-dione, by the Intentional Union of Pure and Applied Chemistry (IUPAC, 2013). It is measured reliably in saliva as well as in the blood. The exact relationship between cortisol and yawning is thought to be either as a precursor to the yawn or as a result of yawning since cortisol is elevated after yawning (Thompson, & Bishop, 2012).

Several reasons for yawning have been proposed in the past such as an indicator of sleep deprivation (Provine, Hamernik, & Curchack, 1987); empathy – in the context of contagious yawning (Campbell, & de Waal, 2011; Norscia, & Palagi, 2011); thermoregulation in people with multiple sclerosis (Gallup, & Gallup, 2008; 2010); and in relation to stress (Grunau, Holsti, & Haley, 2005; Marca, et al., 2011). The similarity across neurological disorders when yawning occurs, has also been discussed (Thompson, 2010; Collins, & Eguibar, 2010; Nahab, 2010), and in recent times, yawning has been proposed as a potential indicator of terrorist ideation (Golgowski, 2012).

However, apart from observing the yawning episode, and from measuring cortisol levels that are highly correlated with the yawn phase (Thompson, & Bishop, 2012), little is known about the exact entity of the yawn. For instance, how powerful is a yawn, neurologically and what electrical activity is produced during the yawn phase? In an attempt to discern these facts and as a part of a study that investigated the potential link between the yawn and cortisol levels, researchers at Bournemouth University, UK, led by Dr Simon Thompson, have produced a profile of the yawn.

The yawn is produced by stretching the mandibular muscles in the jaw but will vary on an individual basis in terms of how much stretch is required and for how long. Generally, the level of electrical activity measured at the muscle site during the yawn phase is in the region of millionths of a volt and may be sustained for several seconds.

Discussion & Conclusions

Initial observations find that of a sample of yawners and non-yawners, induced by presentation of yawning stimuli (video, still photos of humans and animals yawning, reading a boring passage), the people who yawned had elevated nerve activity from 50 (at rest) to 175 (after stimuli presentation and yawning) (Figure 3) compared with those who did not yawn exhibited 10 (at rest) to 80 (after stimuli presentation). This suggests that the yawners generally had higher level of electrical muscular jaw activity both before and after yawning. It is possible that the yawners are more active, in terms of neural activity, and perhaps also are more susceptible to yawning since many of us yawn but under different circumstances and not al of us will yawn on command or by inducement.

The researchers intend to conduct more in-depth work looking at the “yawning envelope” – ie the lowest and highest levels of electrical activity exhibited during the yawn phase – to see if this is generalizable across people and across different experimental situations. It is hoped this new an important information will also be part of a potential new diagnostic tool that identifies untoward early neurological sequelae that are indicative of neurological disease.

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Illustrations

Illustration 1

Schematic of Cortisol Molecule

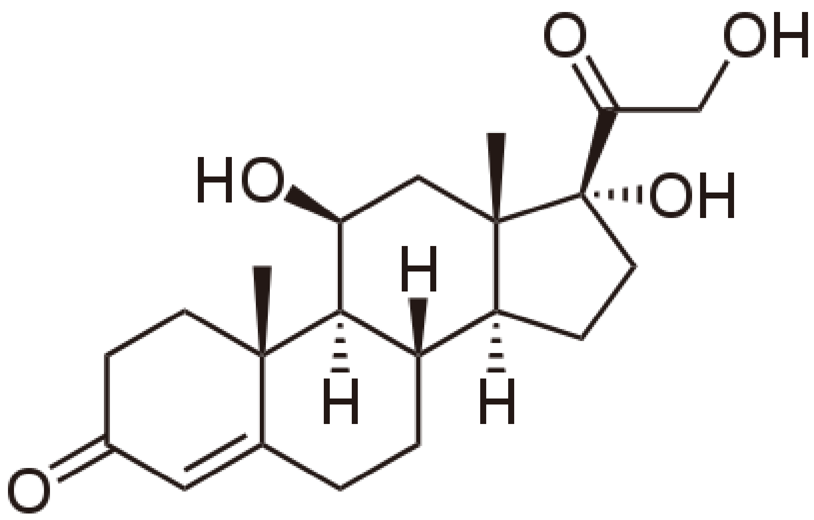

Illustration 2

Schematic of Cortisol Molecule highlighting bonds

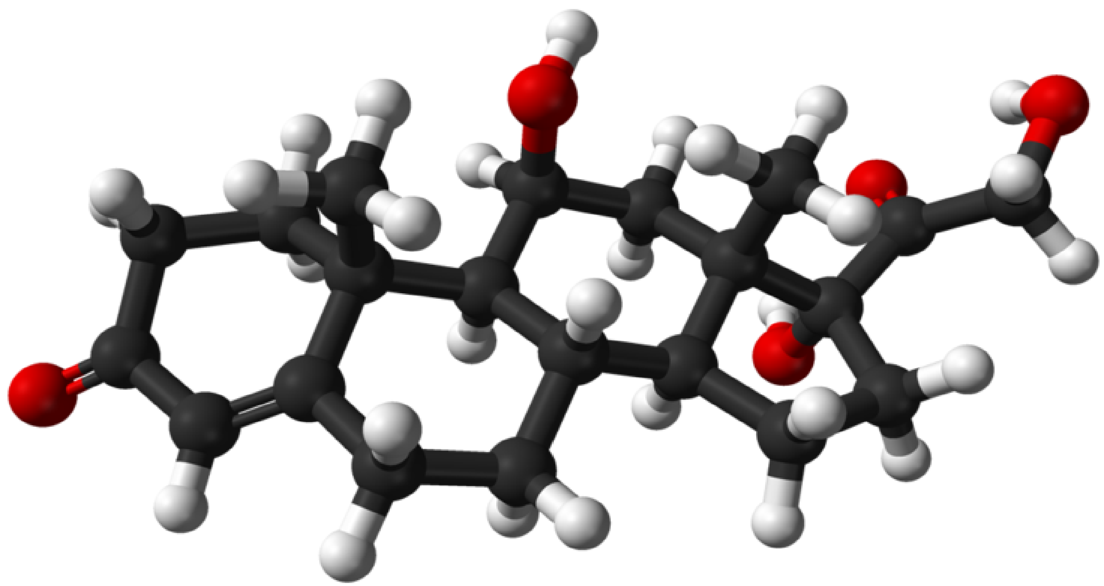

Illustration 3

EMG of Yawn Episode