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Is Yawning A Warning, Neurologically?

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Abstract

Yawning has fascinated scientists for centuries. Hippocrates included it I his list of “useful natures” and Hindus used to regard yawning as a religious “offence”. Some ancient superstitions saw yawning as the escaping of the soul. However, scientists today are still amazed with the extent to yawning tells us about many other neurological conditions (e.g. Thompson, 2010). The importance of yawning in helping us understand other neurological mechanisms has led to La Société Française de Neurologie et La Société des Neurosciences convening the first international conference on yawning at l’Hôpital de la Pitié-Salpêtrière, Paris, France in June 2010 to which the author was invited as one of the Invited Speakers.

Introduction

It has been commonly thought that yawning replaces important oxygen in the blood by expanding the lungs and stretching the muscles. Indeed, stretching the lungs potentially increases their capacity and also increases wakefulness (Provine, 1986).

The curious nature of yawning has led researchers to question these beliefs especially since yawning has been evidenced in so many animals as well as in humans (Illustrations 1). Yawning has been seen even in rodents, and in the order of reptiles known as the Testudines (which is the crown group of the super order of Chelonia) such as turtles, and in pigs.

A possible reason for yawing is that muscle movements and compressions stiumulate the carotid body, receiving shunted blood, giving rise to an increase in pressure and hormones release (Matikainen & Elo, 2008). Stretching the muscles involved in yawning implicates the locus coeruleus, paraventricular nucleus of the hypothalamus, and reticular activating system (Provine, 1986). However, others believe that neural mechanisms are responsible for the mechanical action as well as the aetiology (Thompson, 2010).

Discussion

In pre-term and near term infants (Illustration 2), the incidence of yawning and also the frequency, decreases during the day and with age (Giganti, et al., 2007). This is probably due to circadian and homeostatic control of sleep and wakefulness.

In non-primates, the incidence of yawning is higher before than after sleep (Walusinski & Deputte, 2004). In particular, in rats, cholinesterase inhibitors such as E2030, can induce yawning. Scopolamine, (a centrally acting anti-muscarinic drug), has been seen to block E2030-induced yawning but not E2020-induced yawning. This suggests that central cholinergic and dopinergic mechanisms may be involved in E2020-induced yawning (Ogura, et al., 2001).

Drug-induced yawning may serve as a compensatory brain cooling mechanism when natural regulation fails (Prasad, 2008). Gallup and Gallup (2007) have suggested that yawning may regulate brain temperature in Multiple Sclerosis (MS). Although patients often experience disturbed sleep patterns with MS, there is evidence of irregular thermoregulation (Fleming & Pollak, 2005).

The yawn may be a physiological trait emerging from a vestigial reflex that coordinates aggressive social behaviour (Prasad, 2008). However, Walusinki and colleagues (2010) have shown that the onset of yawning can coincide with involuntary rising of the paralysed arm in stroke, leading the authors to coin the term “parakinesia brachialis oscitans”.

Patients with depression have elevated brain temperature levels; with mania, brain temperature tends to fall (Salerian, et al., 2008). This has led researchers to investigate whether reducing the dose of antidepressant lowers brain temperature and reduces the incidence of yawning (Gutiérrez-Álvarez, 2007).

The link between brain-stem ischaemia and excessive yawning is also well documented (Wimalaratna & Capildeo, 1988) and suggests that neural mechanisms are involved.

Contagious yawning

Fifty per cent of us yawn within 5 minutes of seeing another person yawn. It is suggested that yawning is an innate action that recognises a particular behavioural state. Indeed, Mental Attribution Theory provides an explanation along the lines that we simulate another’s behaviour if we empathy with their perceived emotional state. Hence, if we are aligned with them at some emotional level, then we might actually yawn after they yawn.

This attribution of empathy is being explored by the author in other contexts, such as with artistic and film

appreciation, fashion choice, and the level of cortisol in the blood (correlated with fatigue and cold). It will be interesting to see if yawning is correlated with any of these factors and if so, if it is because of the attribution of perceived (and shared) levels of emotional status.

Some authors have suggested that there are “mirror neurons” present that may be responsible for contagious yawning (Cooper, et al., 2008). Others support the theory that yawning shares the neural networks with empathy (Walusinki, 2006; Thompson, 2010). Higher representational states may engage neurophysiological structures to produce the yawn (Sarnecki, 2008).

Linking neurological disorders

There is an historical lack of clarity of the neurotransmitters implicated in Parkinson’s disease – namely, dopamine was thought to be the only one implicated and later on, also serotonin. Likewise, in Alzheimer’s disease, E2020 (acetylcholine esterase inhibitor) is known to have an affect on memory functioning and has been introduced as an “anti-dementia” drug but E2020-induced yawning is not blocked by Scopolamine, as stated earlier.

Serotonin is implicated in depression because of its depletion. Monoamine oxidase inhibitor-A, is active for serotonin (Jansen Steur, 1997). Dopamine is thought to be implicated in contagious yawning by activating oxytocin in the hypothalamus and hippocampus. Yawning is now thought to be influenced by the neurotransmitters acetylcholine (active in memory functioning); gamma amino butyric acid (GABA); Adreno-Cortico-Trophic Stimulating Hormone (ACTH); and may be others.

Yawning may also increase arousal and self-awareness and connects consciousness as well as unconscious interoception to higher mental functions (Walusinski, 2006).

Yawning and trauma

Olivier Walusinski (2006b; 2007) and Walusinski and colleagues (2010) have been influential in re-writing our knowledge of the “yawn”, particularly with his descriptions of parakinesia brachialis oscitans. Furthermore, he has proposed that mapping of the neural network for yawning may be possible from knowledge of stroke localisation. This invites an exciting new area of research potentially linking together several neurological disorders.

Conclusion(s)

Yawning research is interesting because it offers scientists and neurologists that yawning may represent a warning of underlying neurological problems. With the advent of modern technology and understanding, we still do not have a clear picture of why yawning happens in some neurological cases. On the other hand, we do know that yawning can indicate neurological trauma which makes it an important area of further in-depth investigation.

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Royalty free yawning illustrations courtesy of Fotosearch (2011).

Illustrations

Illustration 1

Yawning animals

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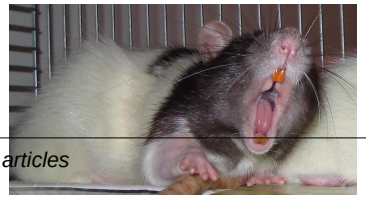
Fox Hippopotamus Monkey

Osterich Tiger Lion



Pig

Illustration 2

Newborn

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