



YAWNING: The Unknown



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Objectives

- Description of yawning
 - Neural mechanisms
- Theories of yawning
 - Available evidence
- Contagiousness of yawning
- Disease/Pathology association of yawning

History

- Old English word *Ganien* or *Ginian* – to gape or open wide.
- Hippocrates – exhaustion of fumes preceding fever.
- Darwin – similarity in species. (surprise, surprise!!!)

Superstitions

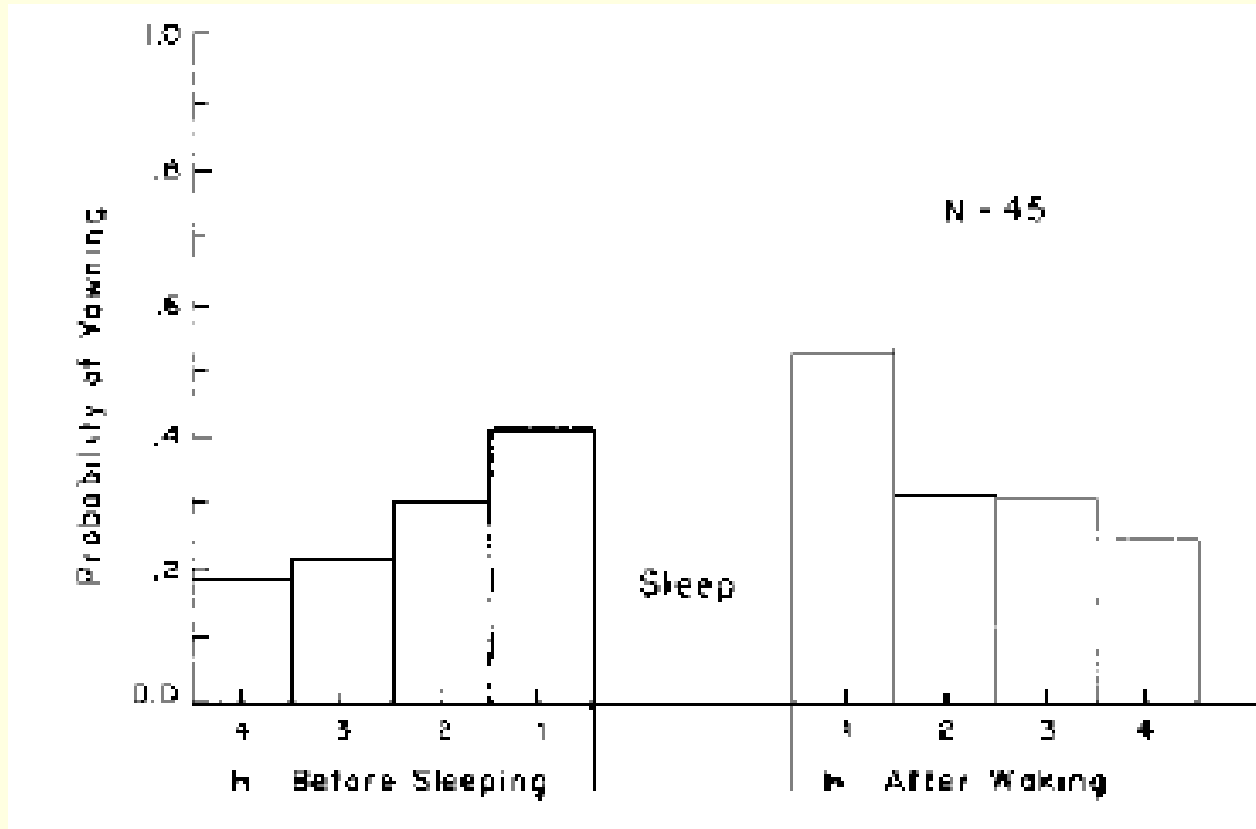
- Ancient Greeks – soul escaping
- Sign of danger
- East Asians – someone talking about you
- Virgil – deadly plague



Description

- Mean duration 5.9 s +/- 1.9 s
- Interyawn interval of 68.3 s
- All or none
- Clenched jaw yawn – not satisfactory
- 1st hour post awakening highest frequency

Probability of yawning



Description ctd.

- Two different types of yawns
 - Rest yawns aka true yawns
 - Tension yawns associated with anxiety, threat
- Similar upon observation.



Yawning and Stretching

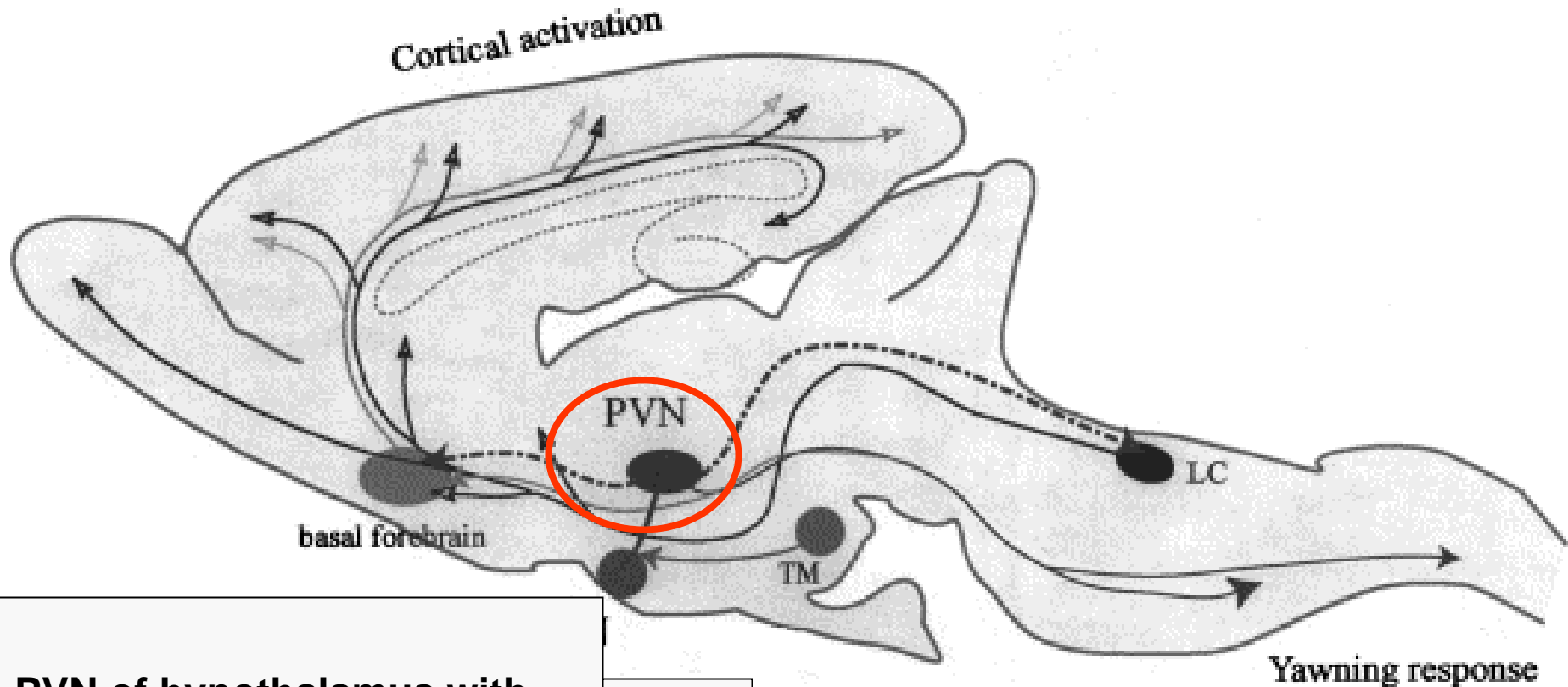
- Yawn when stretching but not always stretch when yawning.
- Provine 1987 -- More post wake yawn-stretch performed than pre sleep.
 - Signal for preparation?
- 1923 Sir Francis Walshe – Observes Hemiplegics yawn.

Physiological Changes

- Increase venous return due to diaphragm contraction and contraction of limbs
- Bronchial musculature stretching – vagal terminals stimulated – cholinergic dilation of arterioles – increased cerebral blood flow
- Exhalation of CO₂ and hyperoxia

THE NEURAL CONNECTION

- Sympathetic versus Parasympathetic
 - Muscle sympathetic nerve activity (MSNA) suppressed during yawning.
- Hypothalamic paraventricular nucleus – site of origination.
 - Projection to cortical and midbrain and other structures.



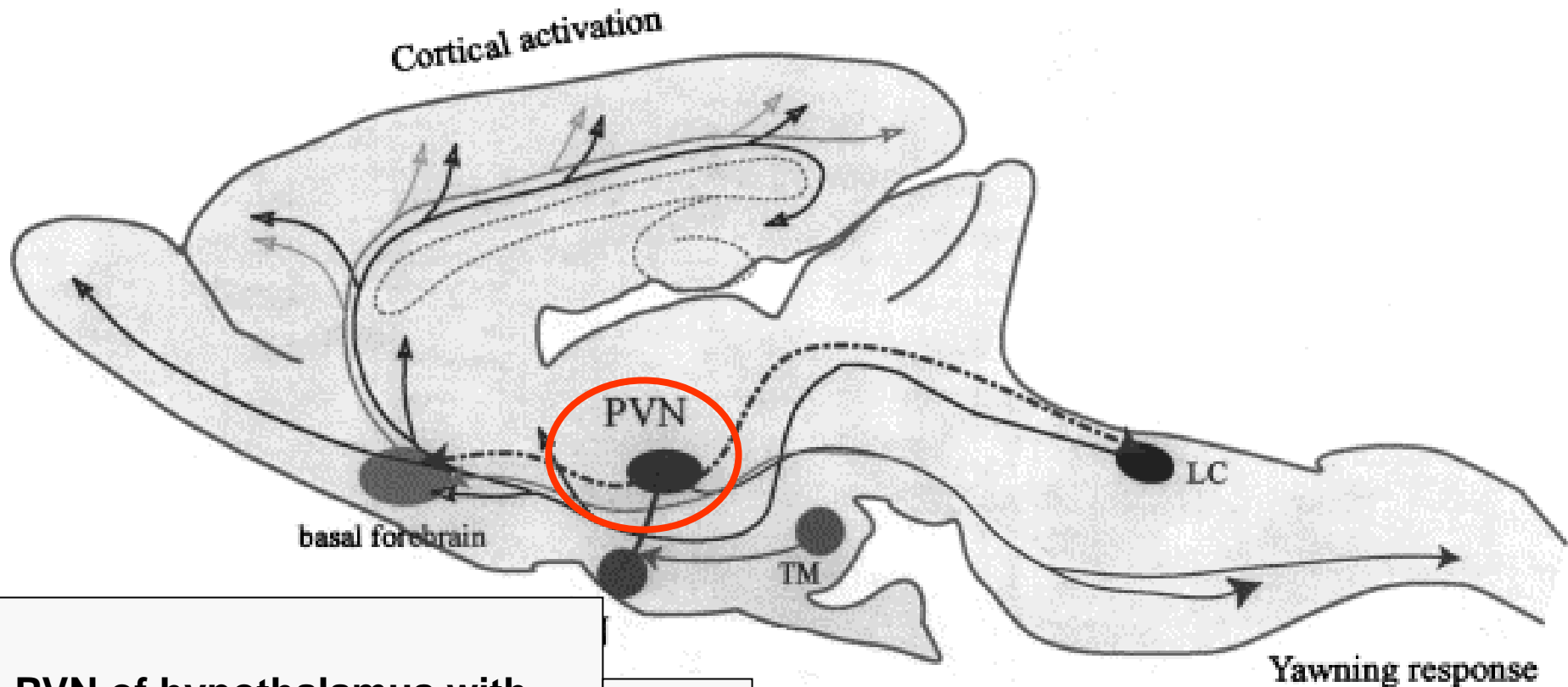
PVN of hypothalamus with Projections to cortical and Other brain structures.

- OXT
- parvocellular neuron
- HA
- NA
- ACh

Neuropeptides involved in the process of yawning.

Neuropeptides	Effect on yawning	Receptor involved	Brain area involved
ACTH/MSH peptides	facilitatory	n.a.	HY
Opioid peptides	inhibitory	μ	PVN, others
Oxytocin	facilitatory	uterine-type	PVN, HI, MO, pons
Neurotensin	inhibitory	n.a.	n.a.
LH-RH	inhibitory	n.a.	n.a.
Prolactin	facilitatory	n.a.	CN

Appropriate references are quoted in the text. ACTH–MSH=adrenocorticotropin–melanocyte stimulating hormone; LH-RH=luteinizing hormone-releasing hormone. PVN=paraventricular nucleus of the hypothalamus, HI=hippocampus, HY=hypothalamus, CN=caudate nucleus, MO=medulla oblongata.



PVN of hypothalamus with Projections to cortical and Other brain structures.

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Imitation or not?

- Functional MRI imaging – activity in posterior cingulate and precuneus regions not in Broca's region.
 - Broca's area needed for 'true imitation' – 'mirror neuron system'
 - Posterior cingulate and precuneus regions—self preoessing, self reference.
 - Associated with primal form of empathy.

Evolutionary Perspective

- Selective pressures
- Study fetal progression.



Review

- Learned that Youtube is the SHIZZLE!
- Starbucks is your friend
- Oxytocin is the prominent neuropeptide
- Paraventricular nucleus is the site of origination
- Yawning cannot be explained by imitation
- Complicated function – involves self processing, self reference

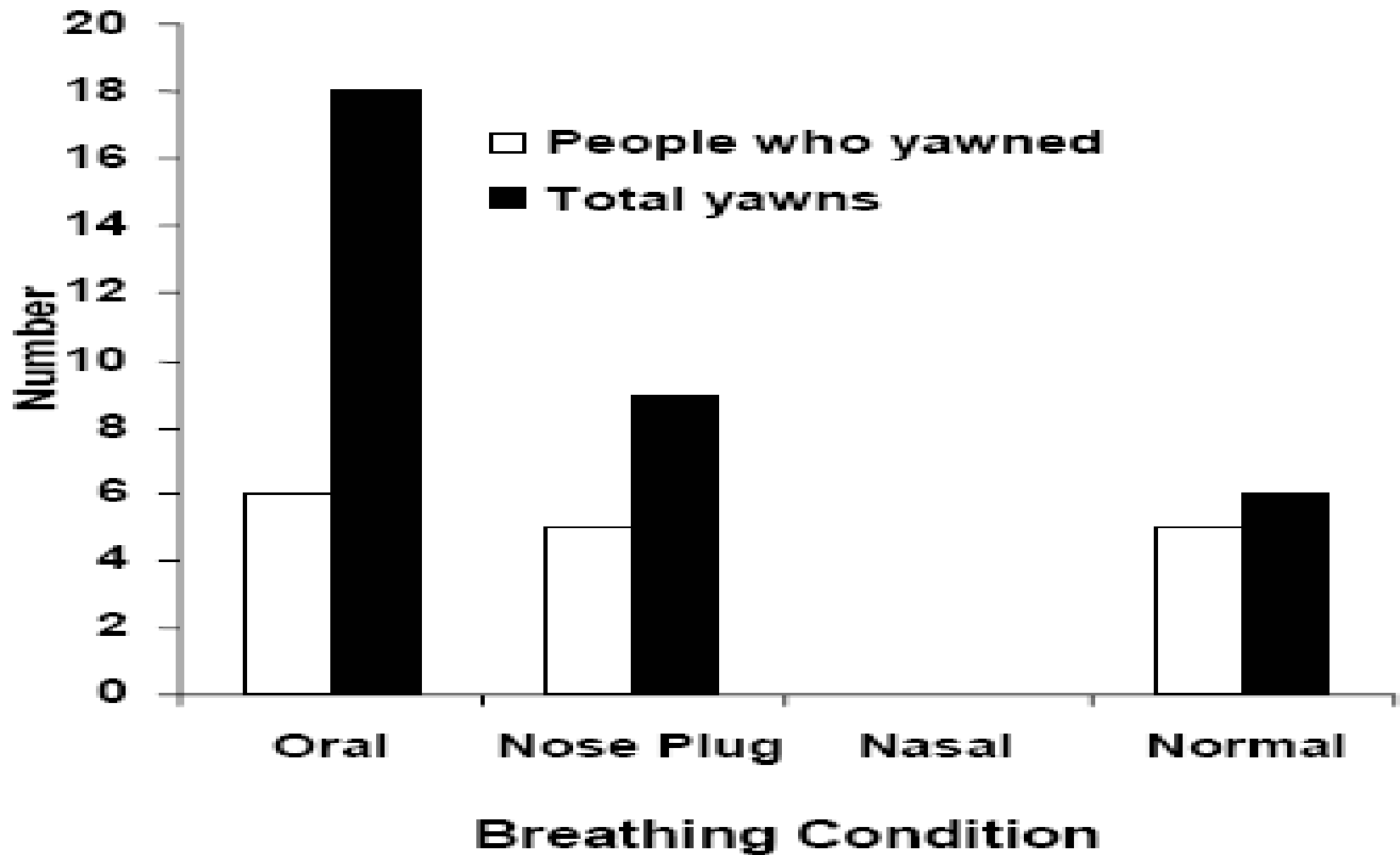
Theories of yawning

- Bored – Music videos or rotating color bars
- Sleepy – Highest during hour after waking
- Communication – Communicate danger in nonverbal form
 - Speaker in danger of losing audience

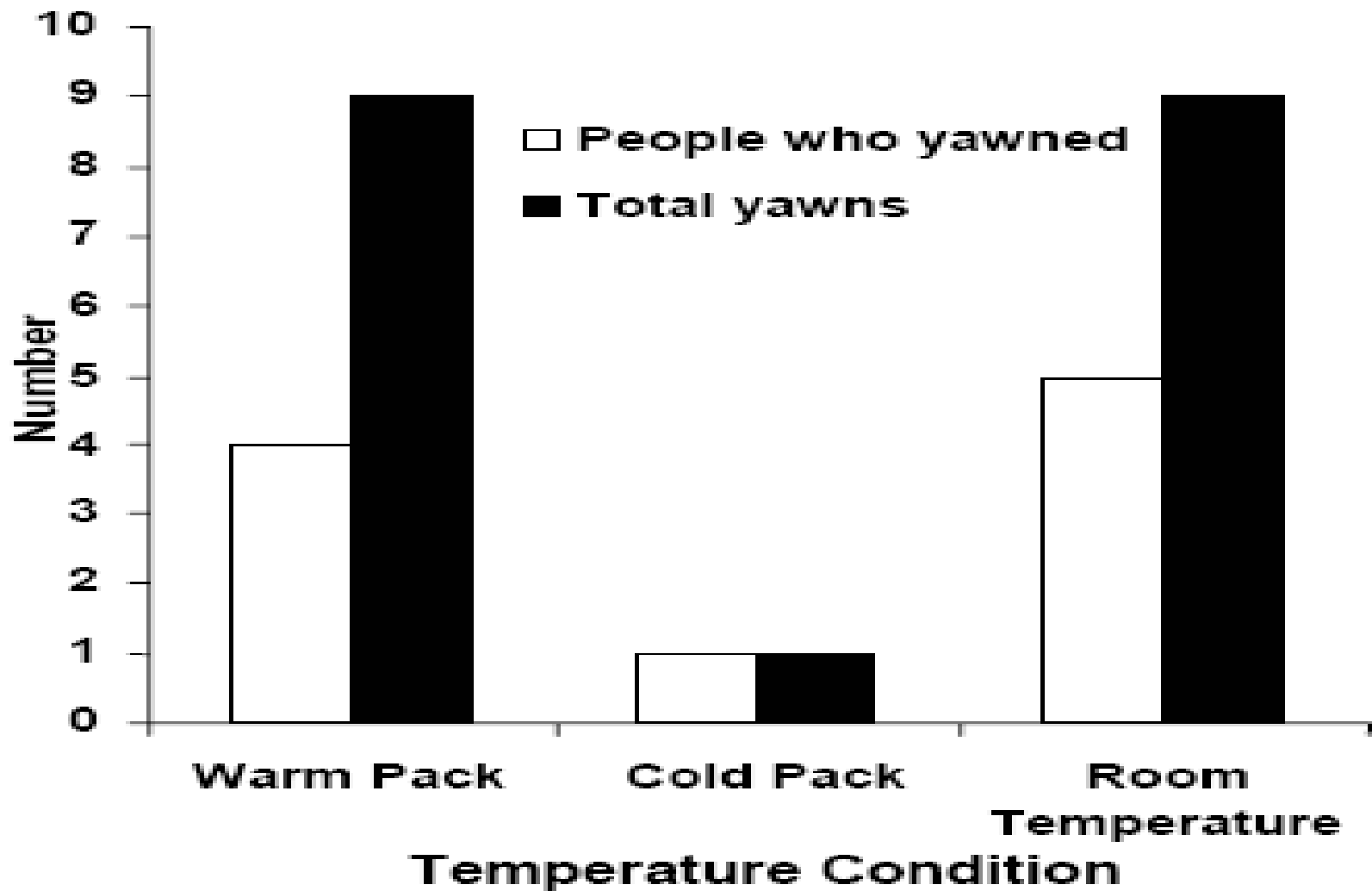
Theories of yawning

- Thermoregulatory Mechanism
 - Hypothesis – Increased brain temperature leads to more yawns. Causes cooler ambient air exchange and decreases brain temperature
 - Background – Nasal breathing → brain cooling.
 - Frontal cortex and brainstem are cooled

Breathing Experiment



Temperature Experiment



Thermoregulatory Mechanism

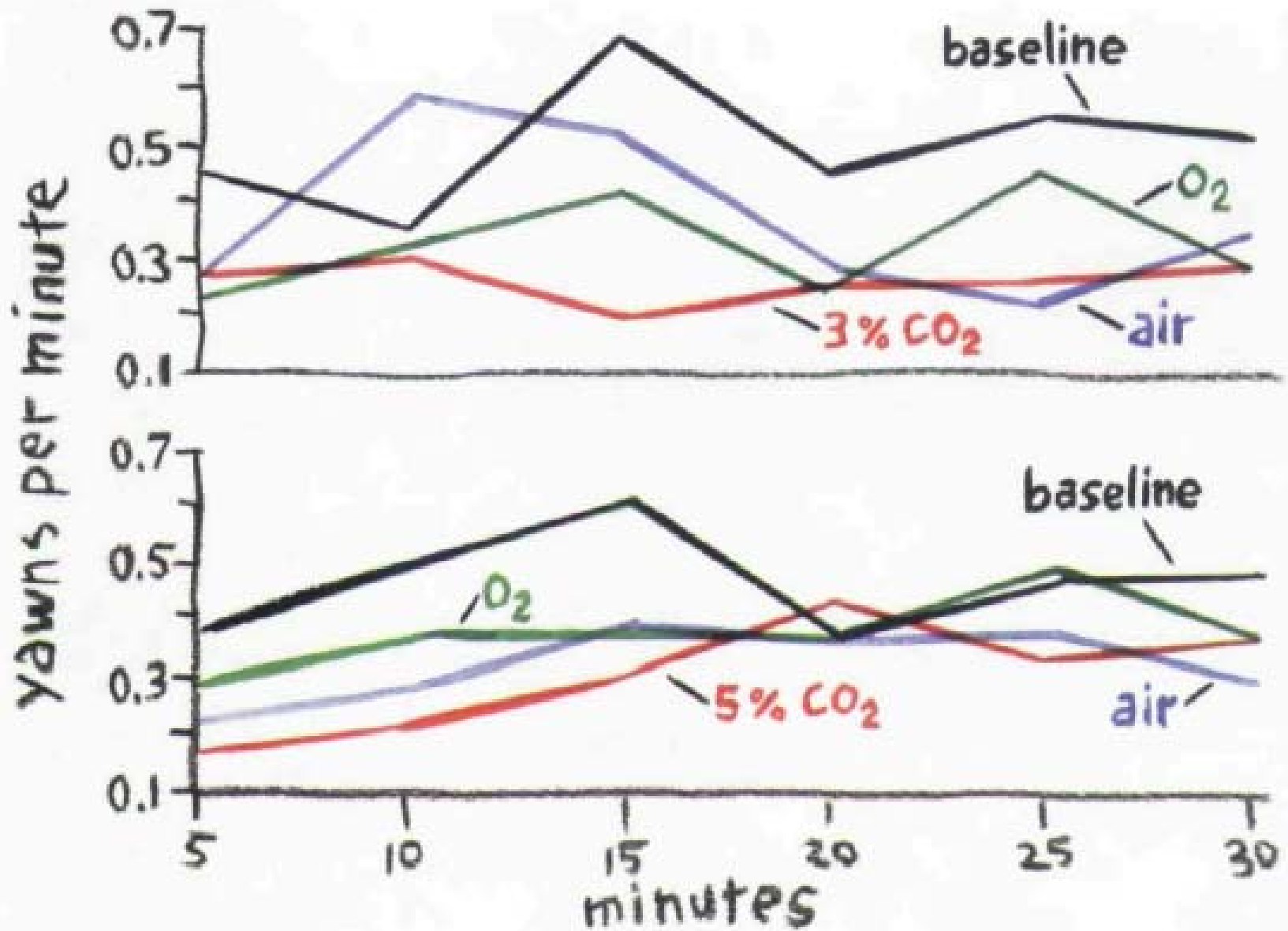
- Yawning – a radiator

Arousal hypothesis

- Hypothesis – Is yawning an arousal mechanism?
 - Guggisberg et al 2007. 16 subjects in a darkened room with continuous EEG recording.
 - Theta and Delta waves – progressive drowsiness.
 - Alpha waves – arousal
 - Pre Yawning – Theta and Delta waves.
 - Post Yawning – No correlation with Alpha waves.

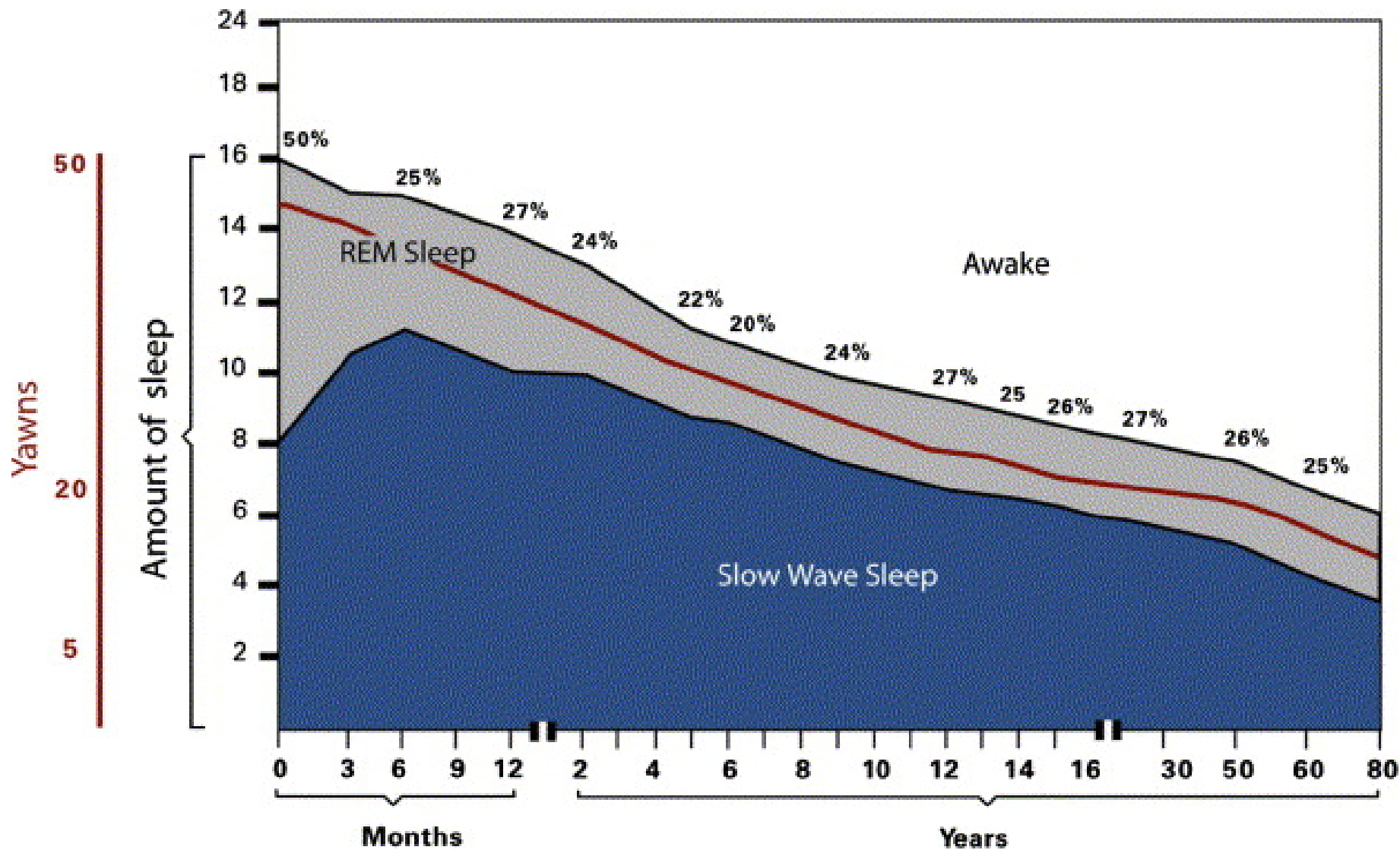
Lack of O₂ or excess of CO₂

- Hypothesis – yawn to increase oxygen concentration or to decrease carbon dioxide concentration
 - Provine 1987: Subjects breathed
 - A. 100% oxygen
 - B. 3% Co₂, 21% O₂, balance N₂
 - C. 5% CO₂, 21% O₂, balance N₂
 - D. normal compressed air 20.95% O₂, 0.03% Co₂, 79.02% N₂, and inert gases.
 - Asked to think about yawning



Reversal of Hypotonia

- Hypothesis – Yawning and stretching lead to reversal of hypotonia.
 - REM sleep – muscular hypotonia and microatelectasis.
 - Yawning and stretching – reverses hypotonia, reverses lung compliance

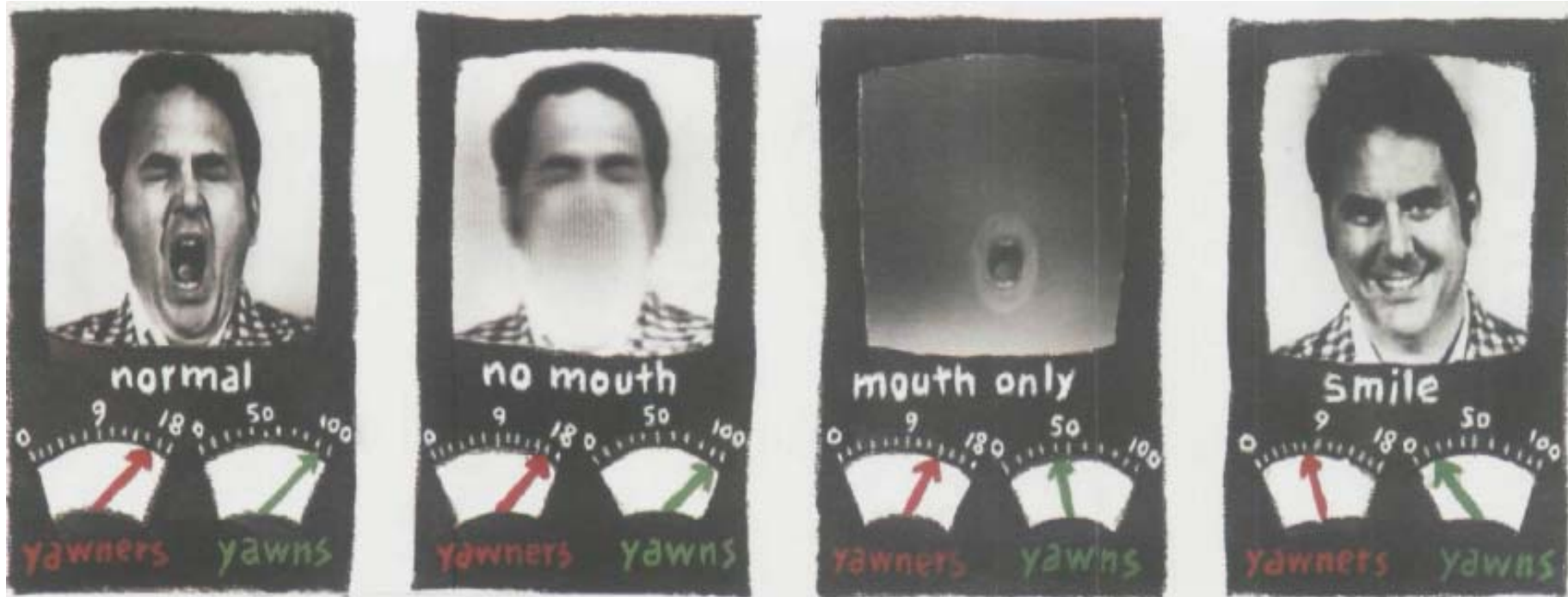


Review

- You tube is still the SHIZZLE!
- Being bored and sleepy causes yawning
- Yawning not 2/2 decreased O₂ or increased CO₂.
- Does not cause Arousal by EEG criteria.
- Brain cooling methods – nasal breathing and cold rag causes minimal yawning.
 - Thermoregulatory hypothesis – Significant evidence

Contagiousness

- Yawning occurs in almost all vertebrates
- Contagious yawning
 - Only noted in humans, chimpanzees and certain monkey species
 - Children do not yawn contagiously until a few years after birth
 - Contagious yawning with recent evolutionary origin
 - Associated with sociality



Contagiousness Ctd.

- PVN of hypothalamus and other cortical areas – involved in self processing, theory of mind.
- Platek 2005 – Schizotypal Personality questionnaire.
 - High score – lower number of contagious yawns.
 - Self introspection, self processing, empathy decreased in schizotypal personality disorder



- a. Yawn after watching other monkeys yawning.**
- b. Facial movements associated with agitation.**

Review

- Contagious yawning seen in humans, chimpanzees and a few species of monkeys.
 - Need self processing, self awareness, self recognition.
 - Decreased contagious yawning in pts with Schizotypal personality disorder.

Drugs and Yawning

- Review of French pharmacologic database for 11 years.
 - SSRIs 12 cases
 - Decrease in dosage – cessation of yawning
 - Dopaminergic agents 7 cases
 - Opioids 4 cases
 - Benzodiazopines 4 cases

Yawning and Tamponade

- 59 yo w/ NSCLC and a malignant pericardial effusion leading to tamponade and 24 hours of repeated yawning. 2L drained. Cessation of yawning.
 - Yawning reversing microatelectasis
 - Phrenic nerve irritation
 - Increasing venous return with diaphragmatic contraction.

Yawning and Neurological Pathology

- Case report of yawning as a presenting symptom for pontine ischemia.
 - Denervation hypersensitivity mechanism
- Yawning during migraine
 - Dopaminergic hypersensitivity
- Yawning, hemiparesis and facial paresis as a relapse symptom of multiple sclerosis

Conclusion

- Association with PVN and other cortical areas – not an imitative mechanism
- Thermoregulatory mechanism has the most evidence.
- Contagious yawning seen in humans and a few other species – able to have self awareness, self processing

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