Photic Sneeze Reflex

The phenomenon of photic sneeze reflex is the occurrence of reflexive sneezing triggered by exposure to light stimuli. It happens at the moment when one experiences brightness, such as when moving from indoors to the outdoor sunshine or when direct sunlight enters the eyes. The photic sneeze reflex occurs only while perceiving brightness, so the number of sneezes is typically one or two, and it does not happen repeatedly.

The photic sneeze reflex is a physiological (normal) reflex that exists only in some individuals, not everyone. In our survey study conducted with a sample of 749 individuals, it was found that approximately 25% of Japanese people exhibit this reflex (Medicine and Biology, 1992, Vol. 125, No. 6, pp. 215-219). However, within this group, there are individuals who rarely experience the reflex or had it frequently in their youth but not anymore. Therefore, it is estimated that only about half of those with the photic sneeze reflex experience it regularly. The photic sneeze reflex is expressed within families, suggesting that it is likely transmitted to descendants through dominant inheritance. Even among individuals with the photic sneeze reflex, there is a significant individual variation in the light intensity that induces sneezing. Some people only experience the reflex with intense light, such as direct sunlight, while others may sneeze with weak light, like indoor lighting. Regarding the mechanism behind this phenomenon, our research group speculates as follows.

Sneezing can occur not only when foreign substances enter the nasal cavity but also in response to signals from the brain. For some reason, when a group of nerve cells called the salivary nucleus in the medulla oblongata becomes excited, parasympathetic nerve fibers originating from it reach the pterygopalatine ganglion (a group of nerve cells located in the pterygopalatine fossa deep behind the upper jaw) through the facial nerve. Furthermore, nerve excitation is transmitted to the nasal mucosa, leading to nasal mucus secretion and blood vessel dilation. As a result, a tingling sensation occurs in the nasal mucosa, which is the cause of the sneezing reflex.

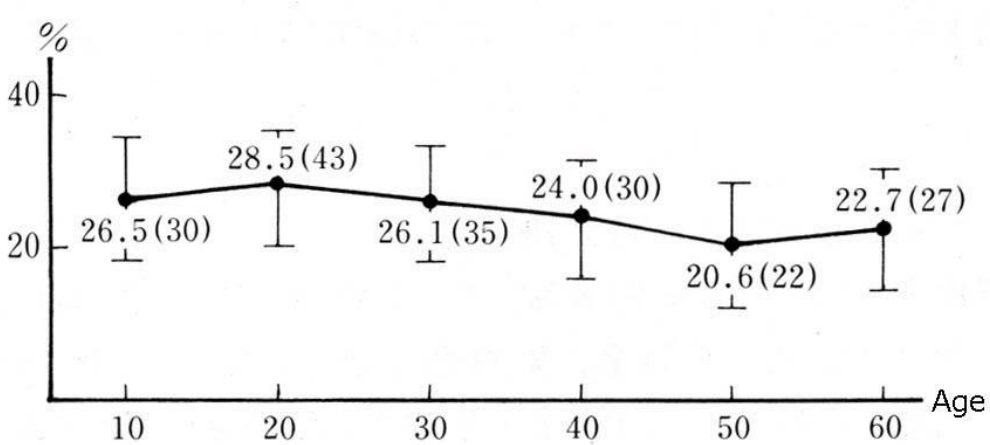
Our research group anatomically demonstrated that the pterygopalatine ganglion is not only controlled by the facial nerve but also by the oculomotor nerve (The Journal of Comparative Neurology, vol. 300: p301-308, 1990). Intense light entering the eyes is transmitted to the pretectal olivary nucleus in the midbrain and further relayed to the Edinger-Westphal nucleus (EW nucleus). The parasympathetic nerves originating from the EW nucleus are conveyed through the ciliary ganglion located behind the eyeball to the pupillary constrictor muscle, causing the pupillary light reflex (contraction of the pupils in response to bright light). We

discovered that a portion of the nerves originating from the EW nucleus reaches the nasal mucosa control cell region of the pterygopalatine ganglion. It can be inferred that the EW nucleus, while inducing the pupillary light reflex, simultaneously stimulates the nasal mucosa control cell group in the pterygopalatine ganglion, leading to vasodilation and nasal mucus secretion.

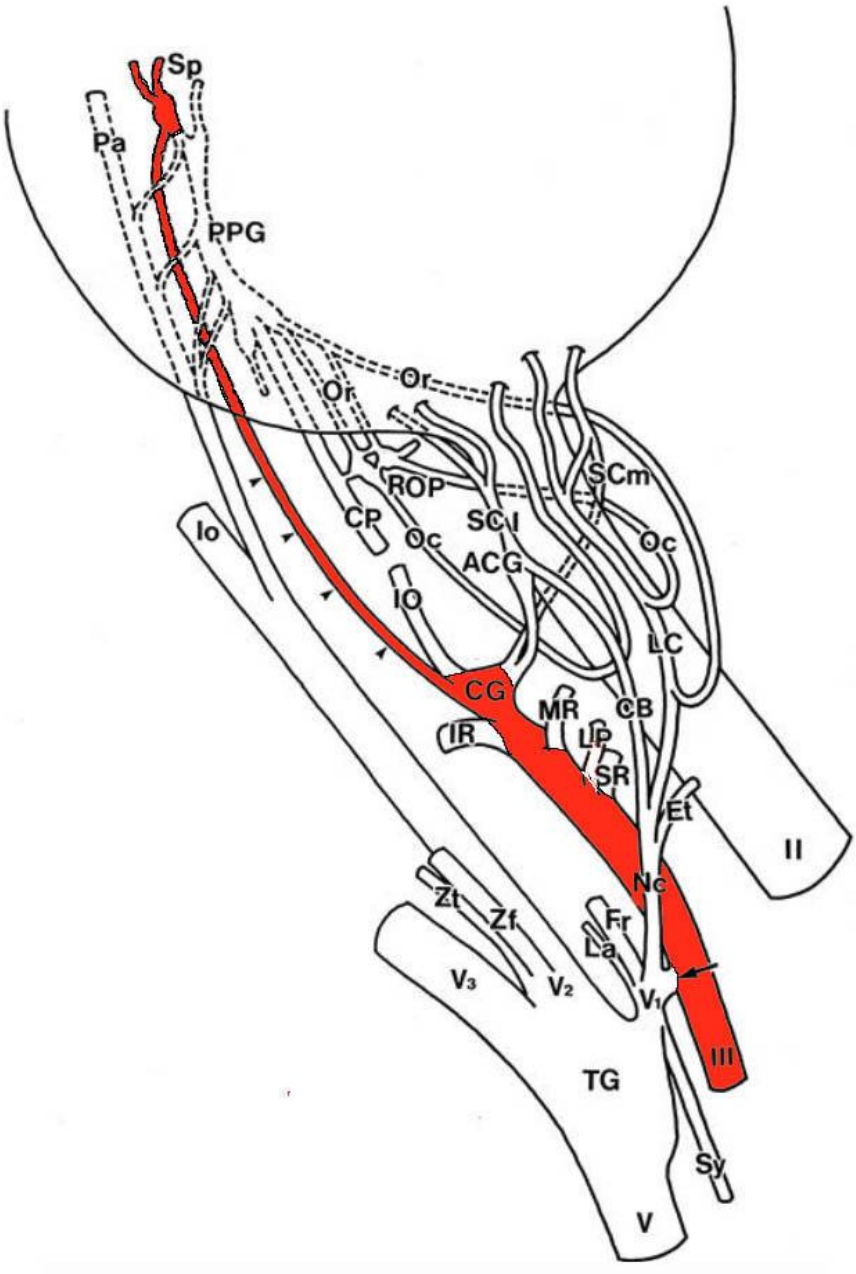
Incidentally, the facial nerve is part of the neural system associated with emotions. The facial nerve is responsible for creating facial expressions, shedding tears, and causing facial flushing in response to emotional movements. Intense emotional states can also lead to nasal mucus secretion and vasodilation, so although rare, some individuals may experience sneezing when indulging in sexual fantasies. (Bhutta and Maxwell, 2008)

Photic Sneeze Reflex Ownership Rate by Gender

Gender	Number of survey participants	Number of Owner	Number of Non-owner	Ownership rate (%)
Female	358	88	270	24.6
Male	391	99	292	25.3
Total	749	187	562	25.0



Photic Sneeze Reflex Ownership Rate by Age Group



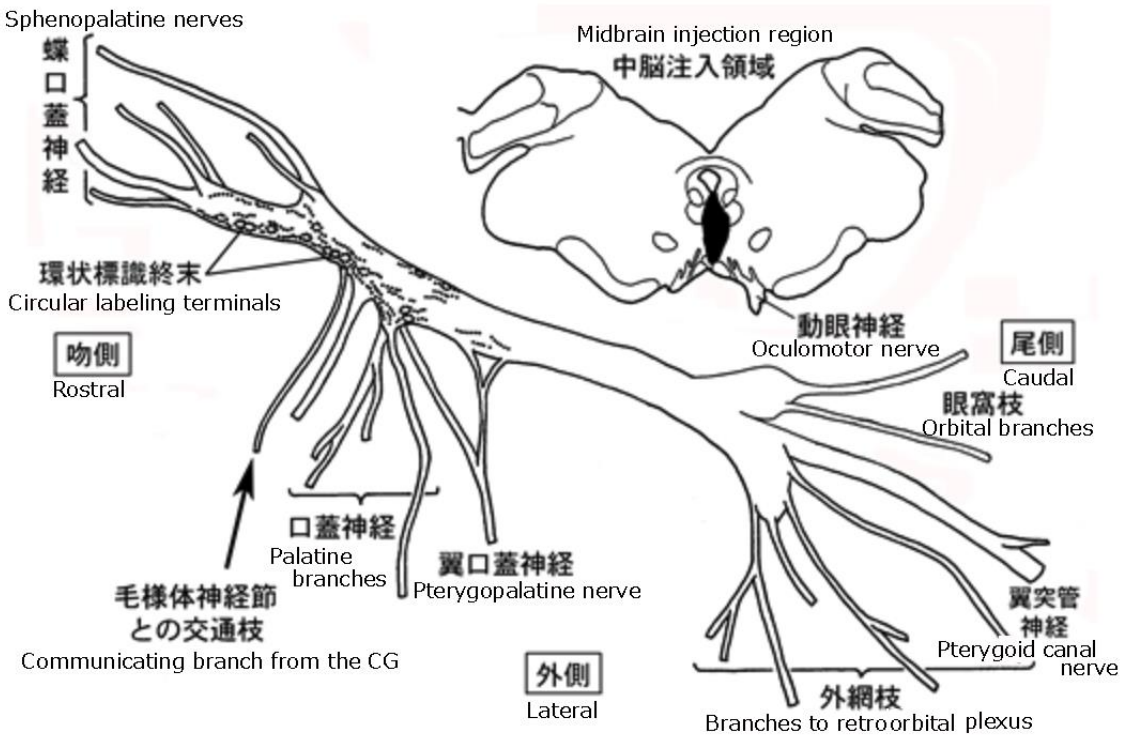
Neural Network between the cranial base and the orbit
(Indicating the connection of the oculomotor nerve and the pterygopalatine ganglion)

The parasympathetic preganglionic fibers originating from the Edinger-Westphal nucleus (EW nucleus) enter the orbit along the oculomotor nerve (III) and reach the ciliary ganglion (CG). A nerve that pass through the ciliary ganglion (indicated by four arrowheads) then travel to reach

the rostral part of the pterygopalatine ganglion (PPG). From this region of the ganglion, the sphenopalatine nerve (Sp) emerges, distributing to the nasal mucosa and palate. II, optic nerve; V, trigeminal nerve; ACG, accessory ciliary ganglion; ROP, posterior orbital nerve and ganglion. Or and Oc represent vasomotor nerves projecting to the eyeball from the pterygopalatine ganglion or posterior orbital ganglion. Arrow indicate communicating branches between the trigeminal nerve and the ciliary nerve (including parasympathetic preganglionic fibers reaching the ciliary ganglion via the trigeminal nerve); CB represents the trigeminal root entering the ciliary ganglion.

Microscopic photographs of acetylcholinesterase staining (AChE staining) specimens of the oculomotor nerve. In the nerves traveling from the ciliary ganglion to the pterygopalatine ganglion (4b), both AChE-positive and AChE-negative fibers are present. The preganglionic fibers of the parasympathetic nervous system are AChE-negative, while the postganglionic fibers are AChE-positive. Therefore, AChE-negative fibers traveling from the ciliary ganglion (CG) to the pterygopalatine ganglion (PPG) may originate from the Edinger-Westphal (EW) nucleus, serving parasympathetic preganglionic fibers to nasal mucosa control cells located in the rostral part of

the PPG. On the other hand, AChE-positive fibers are postganglionic fibers of the CG cells, and they may pass through the PPG, distributing to the nasal mucosa via the sphenopalatine nerve (Sp). These findings strongly suggest the potential involvement of the EW nucleus in the regulation of blood flow and nasal secretion in nasal mucosa.



Midbrain sections and pterygopalatine ganglion sections in an experiment involving microinjections of a tracer substance into the region containing the Edinger-Westphal (EW) nucleus in cats: illustrating the injection site of the tracer substance and showing the distribution of anterograde labeling.

The injection site covers the Edinger-Westphal nucleus (EW nucleus). Anterograde labeling, arranged in a circular pattern around large postganglionic neurons in the rostral part of the pterygopalatine ganglion (PPG), was prominently observed. This suggests the presence of anterograde projections from the EW nucleus to the rostral part of the PPG, where labeling appeared is known to autonomically control the nasal mucosa through the sphenopalatine nerve (Sp). Large cells of the PPG are known to control exocrine glands (quoted from "Why do we sneeze when we see the light?" Clinical Neuroscience, Vol. 33, 2015).