New Animal Data on Osmotic and Hypovolemic Thirst

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Keywords

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Abstract

Introduction: The group of Yuki Oka, working at Caltech, recently discovered unique populations of neurons in the mouse brain that separately drive osmotic thirst and hypovolemic thirst [1]. After eating salty chips, the concentration of salts and minerals in blood becomes elevated which induces a state called osmotic thirst. On the other hand, after exercising and losing water and some electrolytes, a different thirst called hypovolemic thirst occurs since extracellular fluid volume is reduced. Two brain regions have already been defined to be important in drinking behaviors in animals, the subfornical organ and the organum vasculosum of the lamina terminalis. **Methods:** With a technique called single-cell RNA-seq, single cells were found to be involved in specific behavior states, that is, either drinking pure water and avoiding salty water, osmotic thirst, or, appetite for mineral-rich liquids for hypovolemic thirst (Fig. 1). **Discussion/Conclusion:** Thirst is therefore a multimodal, many ways, 2 or more, of doing things, sensation, activated by 2 different stimuli, osmotic and hypovolemic. Multimodal means having, or using, a variety of modes, or methods to do some-

thing. Multimodal teaching is a style in which students learn material through a number of different sensory modalities. For example, a teacher will create a lesson in which students learn through auditory and visual methods. For thirst, the 2 circumventricular sensory group of neurons, that is, the subfornical organ and organum vasculosum of the lamina terminalis, are able to perceive 2 modes of thirst. Other peripheral sensory systems are also characterized by multimodal sensations like taste and olfaction. The fungiform papilla of the anterior tongue involved in water and salt tasting is also described as a complex multimodal sensory organ for taste, tactile, and temperature modalities [2]. The instantaneous and simultaneous sensations of taste, touch, and temperature when solid or liquid stimuli contact the tongue tip are necessary for eating and drinking. Oka and his team [3] also found that the tongue has a taste for water: applying deionized water to mouse tongues caused specific taste nerves to fire owing to a change in the pH of the saliva as it was diluted by the water. Water is detected only by acid-sensing taste receptor cells (type III cells). The appetitive sodium responses are mediated through the sodium-selective ENaC pathway (type III cells), whereas the rejection of high salt results from the recruitment of the sour- and bitter-taste-sensing pathways (type II cells) [4]. It is therefore inferred that our brain senses internal states by using similar strategies.

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Fig. 1. Optogenetic activation of RXFP1 (relaxin/insulin-like family peptide receptor 1) neurons drive selective drinking of pure water (left). Conversely, stimulation of prodynorphin neurons drives consumption of both water and hyperosmotic salt solution (right). Modified and redrawn from [1].

Statement of Ethics

This work is based on previously published data and therefore does not require ethical approval.

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Conflict of Interest Statement

The author has no conflicts of interest to declare.

Data Availability Statement

The data referred to in this abstract can be found in reference [1].

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