

Taste

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According to the narrow scientific definition, taste, or gustation, is defined as the act, or faculty, of tasting. However, in everyday language, the term is used in several different ways. For example, when people say that they like the taste of something, what they really mean is that they like its flavor (i.e., the combination of taste, smell, and chemesthesis). Other uses of the term include referring to someone's aesthetic sensibilities, as when people say that so and so has good taste. Researchers have questioned how many basic taste qualities there are as well as whether it even makes sense to talk of basic tastes in the first place.

History

The four or five taste qualities that most people are familiar with are sweet, sour, salty, bitter, and, increasingly, also umami. Although umami was first identified in the scientific literature in 1909 ([Ikeda, 2002](#)), it has taken a long time to gain widespread acceptance as a basic taste in the West. Over recent decades, a number of researchers have questioned whether taste qualities should be considered as basic at all (e.g., in the way in which we refer to basic, or primary, color categories, the latter referring to those colors from which all others are derived, typically red, green, and blue; [Delwiche, 1996](#); [Erikson, 2008](#)).

It is often suggested that the notion of basic tastes was first formalized by Hans [Henning \(1916\)](#) with his taste tetrahedron (see [Figure 1](#)). Henning suggested that any taste could be described as a mixture of just three primaries. As such, any taste could theoretically be represented as a point on one of the planes of the tetrahedron, meaning that no taste is mapped onto the interior.

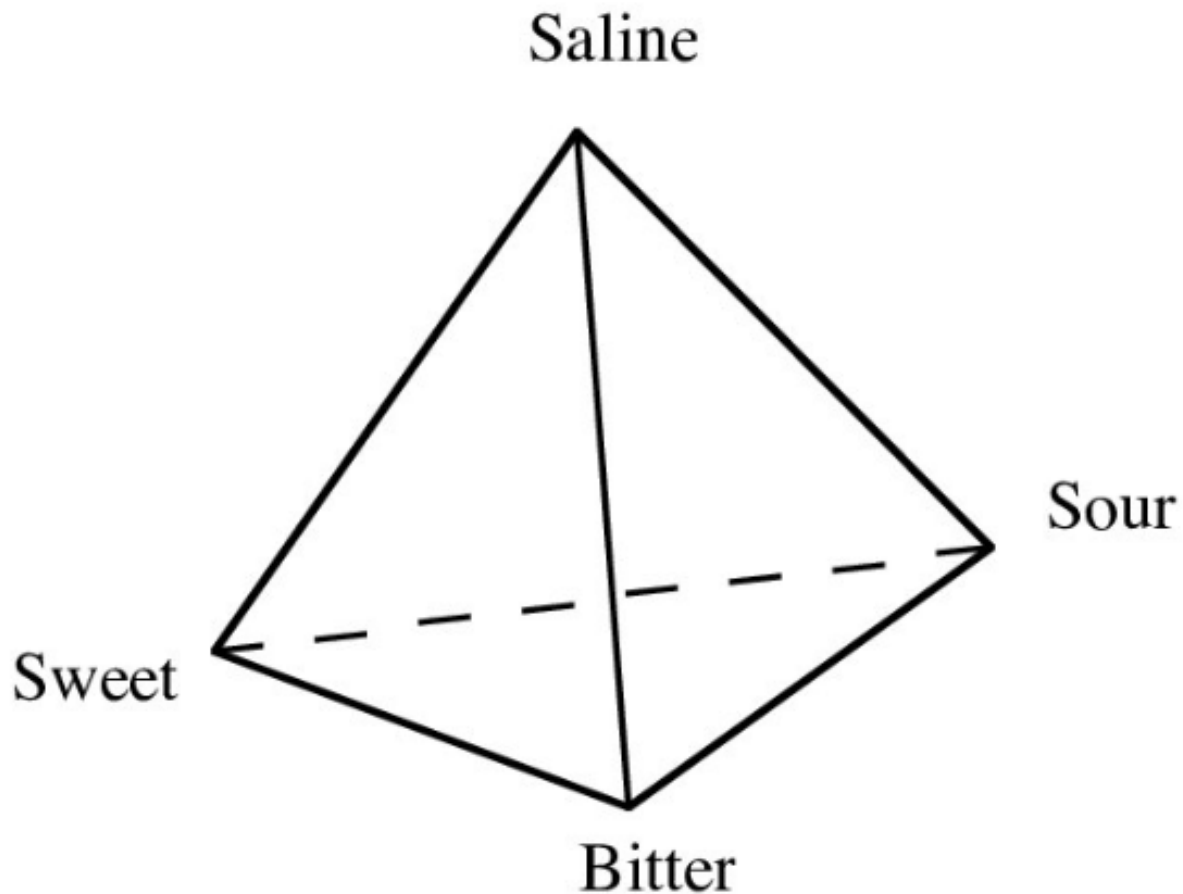


Figure 1

Henning's (1916) taste tetrahedron. As highlighted in the text, researchers disagree as to whether Henning suggested that there were four basic tastes (indicated by the corners of the tetrahedron) or is rather in support of the taste continuum instead (stressing the lines, or surface, connecting each labeled taste quality).

There has also long been disagreement about the existence of a *tongue map* (see [Figure 2](#)). The suggestion, attributed to a mistranslated early German text by the North American experimental psychologist Edwin G. Boring in the 1930s, was that the receptors for different taste qualities are asymmetrically distributed over the tongue: sweet taste receptors are more densely situated on the tip of the tongue, bitter taste receptors are on the posterior tongue, and sour taste receptors are found mostly on the sides of the tongue ([Spence, 2022](#)).

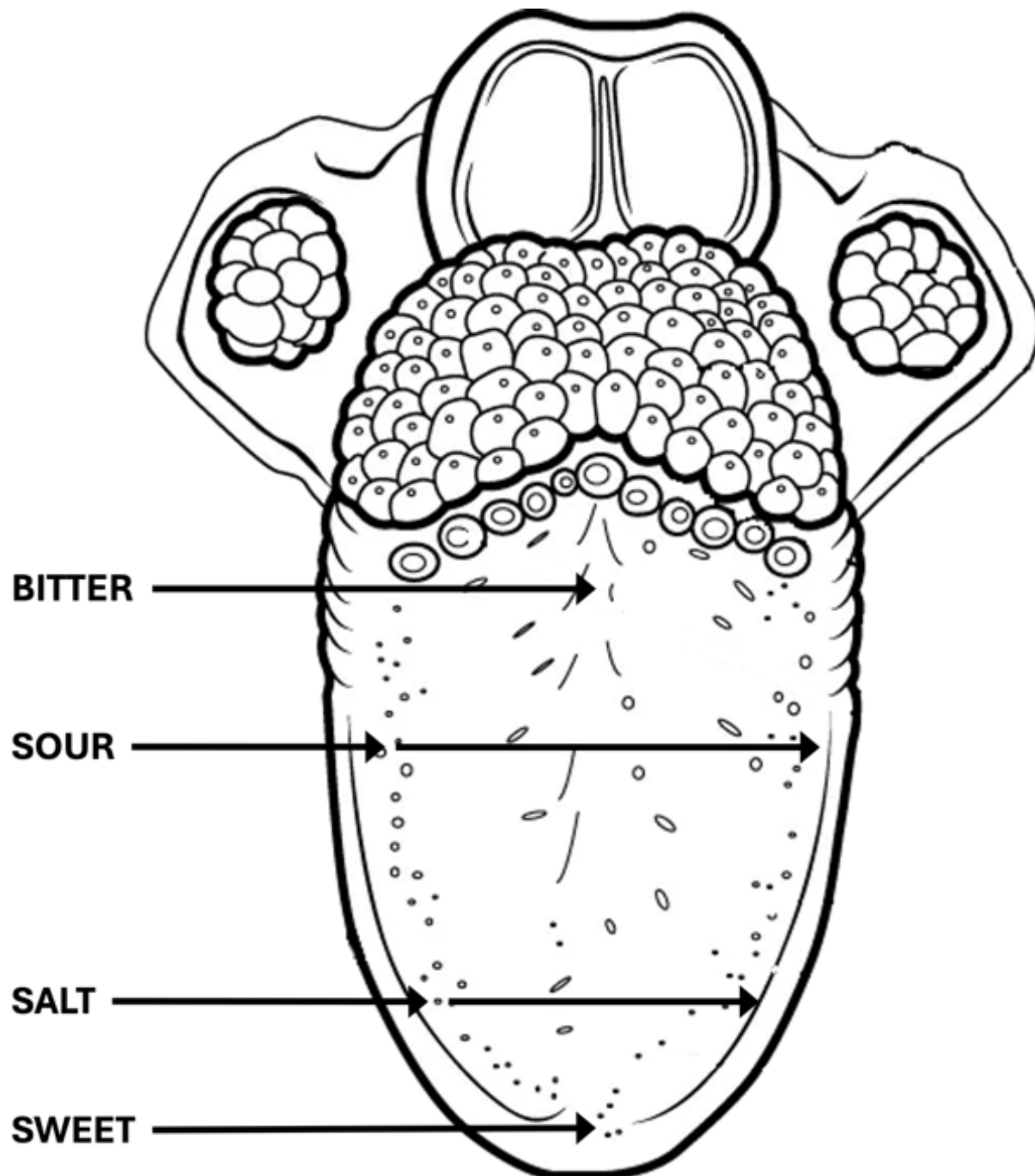


Figure 2

One version of the tongue map (adapted from a figure in [Betts et al., 2013](#)), showing the localization of taste qualities on the human tongue. According to the figure legend in an early paper by [Haagen-Smit \(1952\)](#): “Some areas of the tongue are more sensitive to certain tastes than others; these areas are indicated by the arrows on the top drawing.”

Core concepts

Taste receptors are found throughout the oral cavity (i.e., not just on the tongue but also on the soft palate, the uvula, etc.) as well as elsewhere in the body, although only the former are thought to give rise to conscious taste sensations. Mostly when people say that they like the taste of something, what they really mean is that they like its flavor (i.e., the combination of taste, smell, and chemesthesis; [Rozin, 1982](#); [Spence et al., 2015](#)). In fact, it is often suggested that as much as 70% to 95% of what people think they taste they actually smell (see [Spence, 2015](#)) [see [Smell](#)]. The referral of olfactory stimuli into the oral cavity explains this particular form of chemosensory confusion.

There is widespread agreement that there are a discrete number of basic taste qualities; however, the exact number is disputed, with many neuroscientists unwilling to accept new basic taste categories unless the relevant receptor mechanism (i.e., taste receptors and ligands) has been identified ([Chandrashekar et al., 2006](#)). Thus far, one-to-one mappings between sweet, sour, umami, and salty tastes with specific receptors have been identified.

Responses to the four basic tastes appear to be innate, with the application of tastants eliciting stereotypical facial gestures in newborn humans, chimpanzees, and rodents ([Peciña & Smith, 2010](#)). However, humans come to like initially disliked tastes such as bitter-tasting foods, including coffee and alcohol, or pungent sensations like chili because of conditioning.

People live in very different taste worlds; populations are typically segmented into supertasters, medium tasters, and nontasters depending on their response to bitter-tasting compounds such as PROP (6-n-propylthiouracil) or PTC (phenylthiocarbamide). In Western populations, these three groups each account for roughly a third of the population. Supertasters are likely to find tonic water, coffee, and cruciferous vegetables such as broccoli very bitter. It has been suggested that some individuals may have as many as 14 times more taste buds than others ([Bartoshuk et al., 1994](#)).

Questions, controversies, and new developments

Is there a small set of unitary basic tastes? Although a single receptor is responsible for detecting sweetness, there are as many as 25 different functional bitter receptors (taste 2 receptors encoded by *TAS2R* genes) capable of detecting bitterants ([Lang et al., 2023](#)). Although some of these bitter receptors have very specific agonist sensitivity, others are much more broadly tuned, thus leading some researchers to question whether bitter is really a unitary basic taste.

The fact that the same four basic taste categories (sweet, bitter, salt, sour) appear across a wide range of different languages, over the course of human history, supports their cognitive meaningfulness as categories of taste ([Majid & Levinson, 2008](#)). That said, one of the ongoing debates in the literature concerns how many basic tastes humans are sensitive to. Taste qualities that have, in recent years, been vying for a place on the list of basic tastes include fatty acid (or *oleogustus*; [Running et al., 2015](#)), kokumi (a

Japanese term referring to a “rich taste” sensation that imparts no taste itself but which enhances the perception of other tastes), and metallic ([Skinner et al., 2017](#)).

Another controversy concerns whether fatty acid and kokumi should be considered as basic tastes. Although people can distinguish solutions that do or do not contain these tastants, there is seemingly no associated phenomenology—suggesting a kind of blind taste. Although kokumi compounds (γ -glutamyl peptides) impart no taste of their own, they do seem to enhance the taste of those foods to which they are added, resulting in their tasting both rounder and more satisfying. This had led some researchers to describe kokumi compounds as “flavor potentiators” ([Maga & Yamaguchi, 1983](#)), although the terminology has not been widely adopted. Several of the new, and putative, taste qualities, including umami and fat, appear to be more important in terms of the postingestive consequences of nutrients that are detected not only in the oral cavity but throughout the alimentary canal. This observation led [Hartley et al. \(2019\)](#) to suggest that umami and fat should be classified as *alimentary* rather than basic tastes. According to the latter researchers, the latter term would then be restricted to sweet, sour, bitter, and salty because of their critical function during preingestive taste detection.

Metallic is an interesting descriptor inasmuch as healthy individuals associate the term with a range of metal salts, some smelled orthonasally (i.e., by sniffing) and others tasted or else experienced retronasally (i.e., when volatile-rich air is pushed out from the back of the mouth through the nose when chewing and swallowing; [Skinner et al., 2017](#)). At the same time, however, complaints about foods having a *metallic taste* are often reported by patients undergoing chemotherapy. It is, though, currently unclear whether the transduction mechanism (i.e., the process of converting the chemical into a neural signal) is the same in the two cases.

There continues to be widespread controversy surrounding the tongue map. A growing body of evidence suggests that people do sometimes experience different taste qualities as localized to different parts of the tongue. As such, there may be some truth to the tongue map in terms of the phenomenology of taste (gustation), thus perhaps explaining why the notion has not disappeared ([Spence, 2022](#)).

There is currently debate amongst cognitive neuroscientists concerning the existence of a gustotopic map, with neural activation associated with the different taste qualities segregated spatially of basic tastes in the primary gustatory cortex in the anterior insula and frontal operculum in various rodent and mammalian species ([Avery, 2021](#)). At the same time, however, the fact that the pungent burning chemesthetic sensation associated with the consumption of capsaicin in chili activates the primary taste cortex has led other researchers to question whether such evidence qualifies it as a basic taste ([Kawakami et al., 2016](#)).

Broader connections

There is much excitement around the possibility of digitizing the chemical senses, that is, representing or inducing taste qualities digitally, although little success has been achieved thus far. Taste sensitivity to

bitter compounds such as PROP or PTC is related to visceral but not moral disgust ([Herz, 2011](#)), hinting perhaps at the broader links between taste and cognitive science. Philosophers have, in recent years, become increasingly interested in the multisensory nature of flavor perception ([Spence et al., 2015](#)), for example, in questions such as whether flavor perception should be considered as a sensory modality or whether it should be considered as a kind of multisensory Gestalt instead. Other cognitive science researchers, meanwhile, are more interested in connections between the categorization and perceptual aspects of taste ([Rozin, 1982](#)). Finally, and more controversially, biologists have recently questioned whether it even makes sense to individuate taste and smell as separate senses ([Mollo et al., 2022](#)).

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