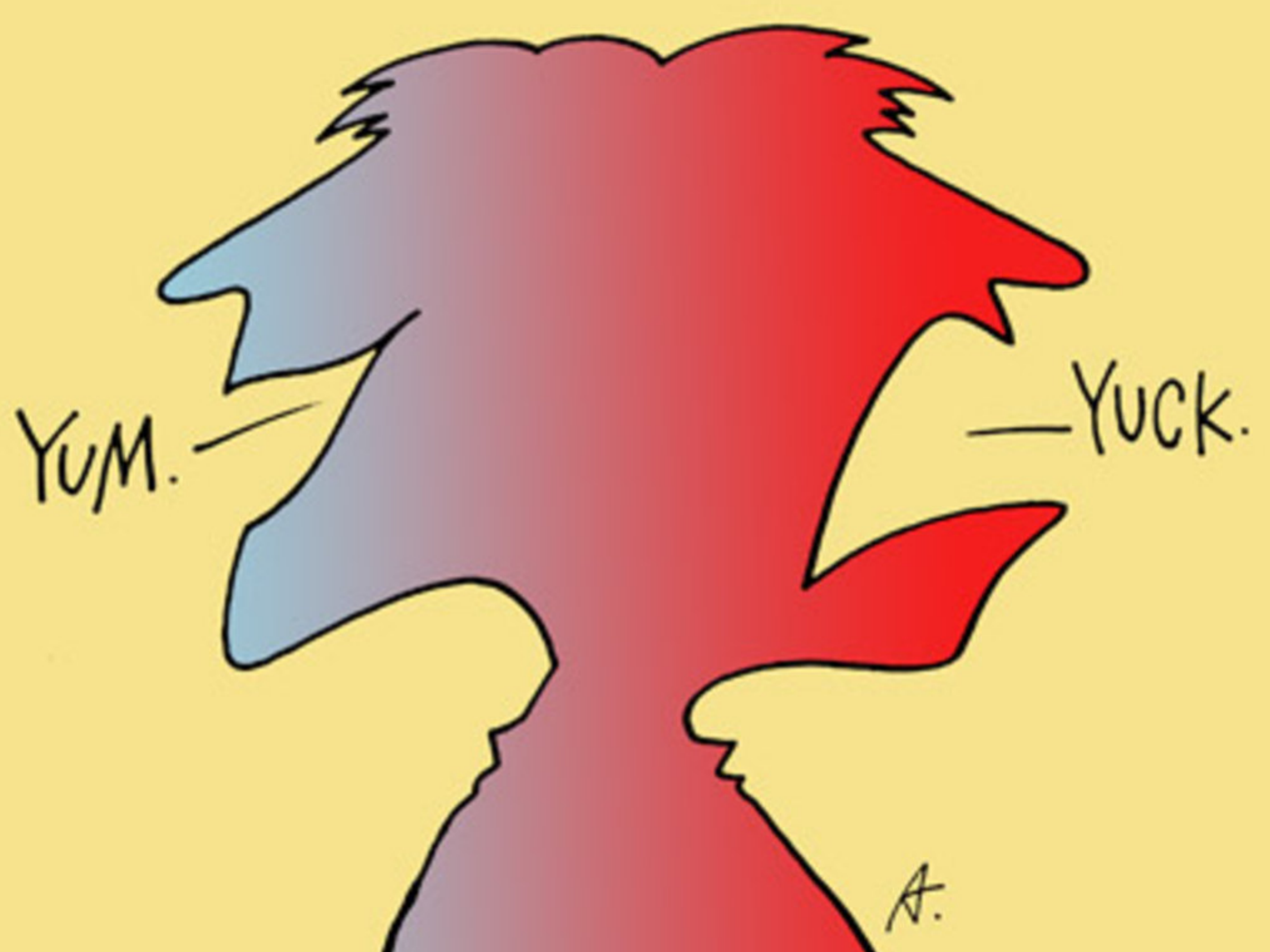

YUM.
—YUCK.
A.

The human **sense of taste** (or gustation) plays a crucial role in the perception of flavour and the enjoyment of food. Taste is primarily detected by **taste buds**, which are clusters of specialised cells located on the tongue and other parts of the mouth. There are five primary tastes:

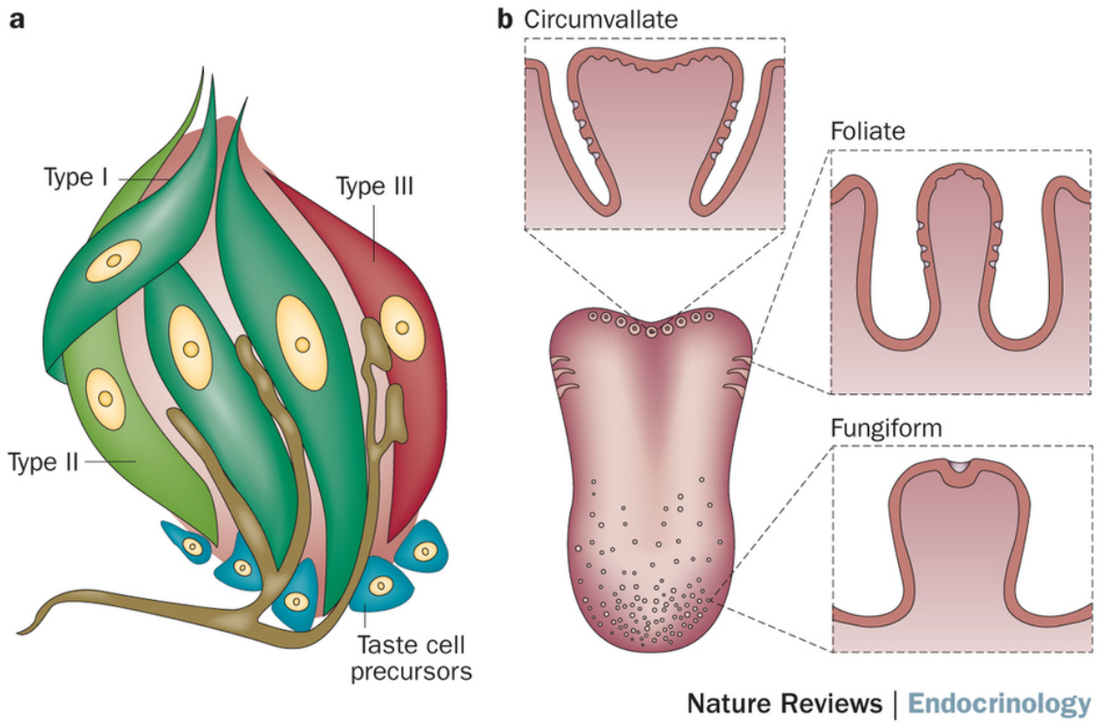
- **Sweet** - Associated with sugar, signalling the presence of energy-rich carbohydrates.
- **Salty** - Detected by the presence of salts, important for maintaining electrolyte balance in the body.
- **Acidic** - Associated with acids, often indicating the presence of potentially harmful or spoiled foods.
- **Bitter** - Evolved to detect potentially toxic substances, many bitter compounds are found in plants.
- **Umami** (savoury) - Describes the savoury taste associated with amino acids, often found in protein-rich foods.

Individual taste preferences and sensitivities can vary widely due to genetic factors, cultural influences and personal experiences. The ability to taste certain compounds, such as the bitter chemical PTC (phenylthiocarbamide), is influenced by specific genes.

Taste perception is a complex process involving the interaction of the taste buds with the brain, where signals are processed and interpreted to create the sensation of flavour. In addition, other sensory factors such as smell and texture contribute significantly to the overall taste experience. Overall, the sense of taste is essential not only for enjoying food, but also for guiding dietary choices and ensuring the intake of essential nutrients.

PopGen ▷ Yum & Yuck

Taste is triggered by chemicals when they come into contact with **taste receptor cells** (TRCs) on the tongue. The TRCs are grouped into taste buds, which are located on different papillae of the tongue. Each taste bud contains approximately 50-100 TRCs. TRCs are divided into four different cell types and all taste buds contain cells of all four subtypes.



Type I: perception of salt

Type II: expresses receptors for sweet, umami and bitter taste

Type III: perception of sour (acid) taste

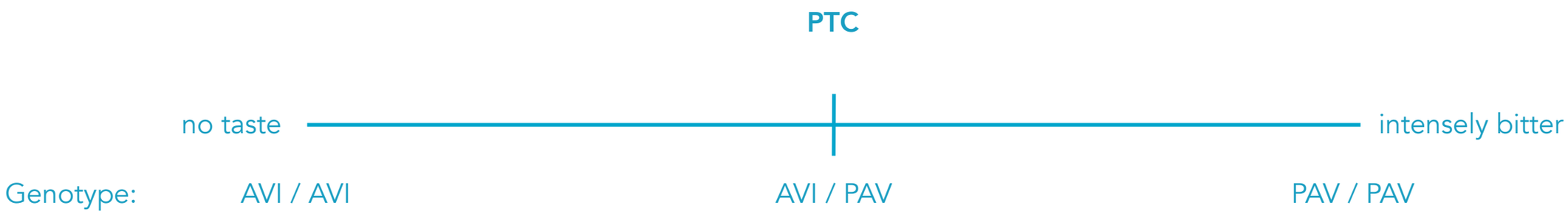
Type IV: taste cell precursors

Source: Santa-Cruz Calvo and Egan (2015) The endocrinology of taste receptors. Nature Reviews Endocrinology 11, 213–227

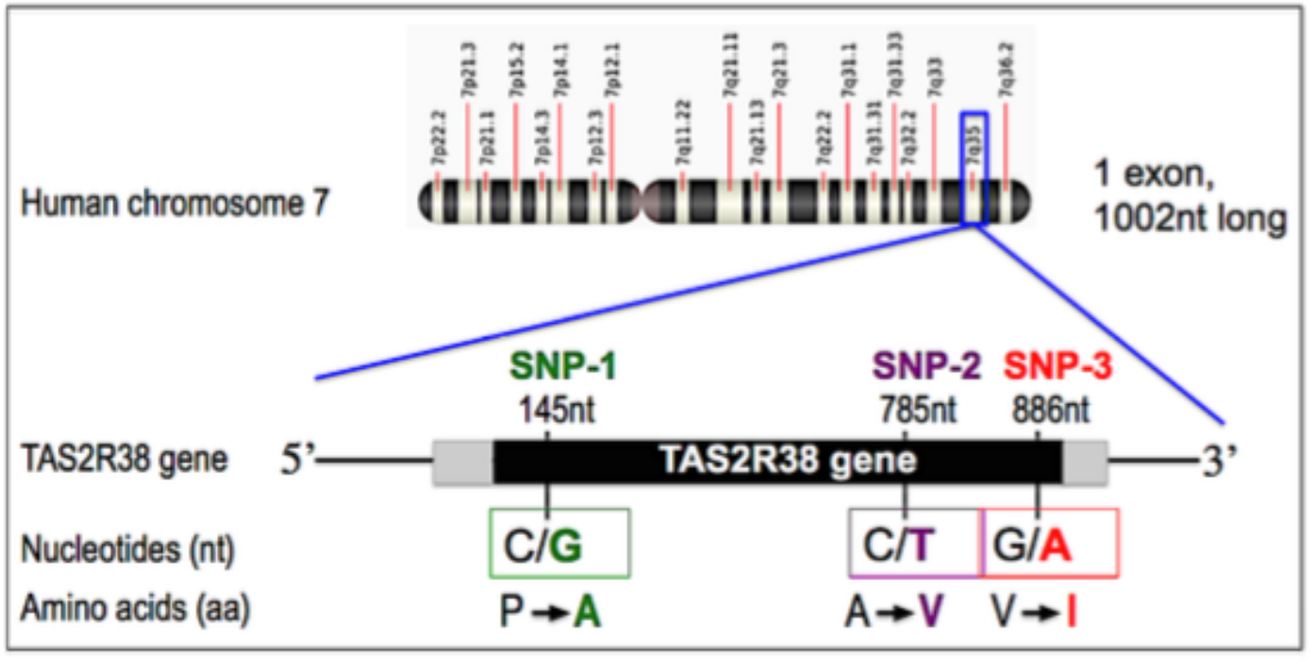
PTC (phenylthiocarbamide) is a chemical compound that some people can taste and others cannot. The ability to taste PTC is determined by genetic factors, specifically a gene known as **TAS2R38**.

There are two common variations of the TAS2R38 gene and individuals can inherit one of three possible genotypes: two dominant alleles (tasters), two recessive alleles (non-tasters) or one of each (intermediate tasters). Tasters can perceive a bitter taste when consuming PTC, while non-tasters do not taste anything or perceive a much milder taste.

This genetic variation in the ability to taste PTC has been widely studied in the field of genetics and is often used as an example in discussions of genetic inheritance and taste perception.



The sense of bitter taste is mediated by a group of bitter taste receptor proteins. There are ca. 30 genes for different bitter taste receptors in mammals. The gene for the phenylthiocarbamide (PTC) taste receptor, **TAS2R38** (taste receptor type 2, member 38), was identified in 2003 (Kim et al. 2003). It resides on chromosome 7, position q35. Within this gene, several single nucleotide polymorphism (SNPs) have been identified, all of which result in amino acid changes in the protein (nonsynonymous SNPs). Three of these SNPs are the most common in the human population; they reside on nucleotide position 145 (SNP-1: C → G), nucleotide position 785 (SNP-2: C → T) and nucleotide position 886 (SNP-3: G → A), and alter the amino acid sequence.



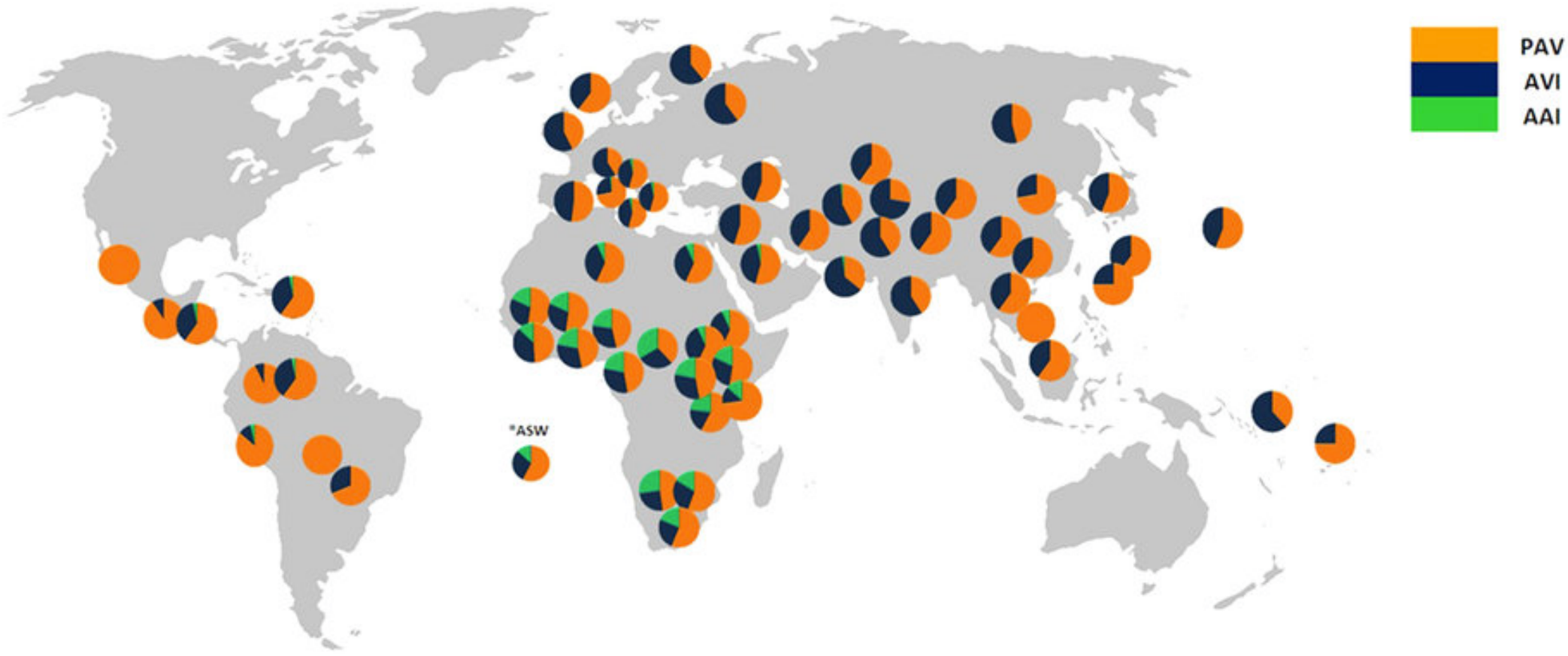
Kim U. et al (2003). Positional Cloning of the Human Quantitative Trait Locus Underlying Taste Sensitivity to Phenylthiocarbamide. SCIENCE VOL 299

SNP Position	145	785	886
Genotype	C/G	C/T	G/A
Aminoacid change	P > A	A > V	V > I
wt - dominant taster haplotype	P	A	V
recessive non-taster haplotype	A	V	I

In addition to the high frequency PAV and AVI haplotypes, two rare (AAV and AAI) and four extremely rare (PVI, PAI, AVV, PVV) haplotypes are also found in the human population (Risso et al, 2016).

It should be noted that **PTC taste sensitivity is not an all or nothing trait**. However, people homozygous for the PAV/PAV genotype have the highest PTC scores (most find PTC intensely bitter), PAV heterozygotes (PAV/AVI genotype) generally have an intermediate PTC score (find PTC somewhat bitter), and AVI/AVI homozygotes have the lowest PTC scores (for most of them, the PTC compound has no taste at all).

Risso, E.S. et al. (2016). Global diversity in the TAS2R38 bitter taste receptor: revisiting a classic evolutionary PROPosal. Scientific Reports 6



Population	PAV	AVI	AAV	AVV	PAI	PVI	AAI	PVV
All	50.76%	42.70%	2.48%	0.32%	0.18%	0.07%	3.39%	0.10%
Africans	50.76%	35.18%	0.61%	0.08%	0.00%	0.15%	13.22%	0.00%
Asians	64.51%	35.31%	0.00%	0.17%	0.00%	0.00%	0.00%	0.00%
Europeans	45.66%	49.22%	3.56%	0.49%	0.32%	0.03%	0.55%	0.17%
Americans	68.61%	26.69%	2.26%	0.00%	0.00%	0.19%	2.26%	0.00%

Risso, E.S. et al. (2016). Global diversity in the TAS2R38 bitter taste receptor: revisiting a classic evolutionary PROPosal. Scientific Reports 6

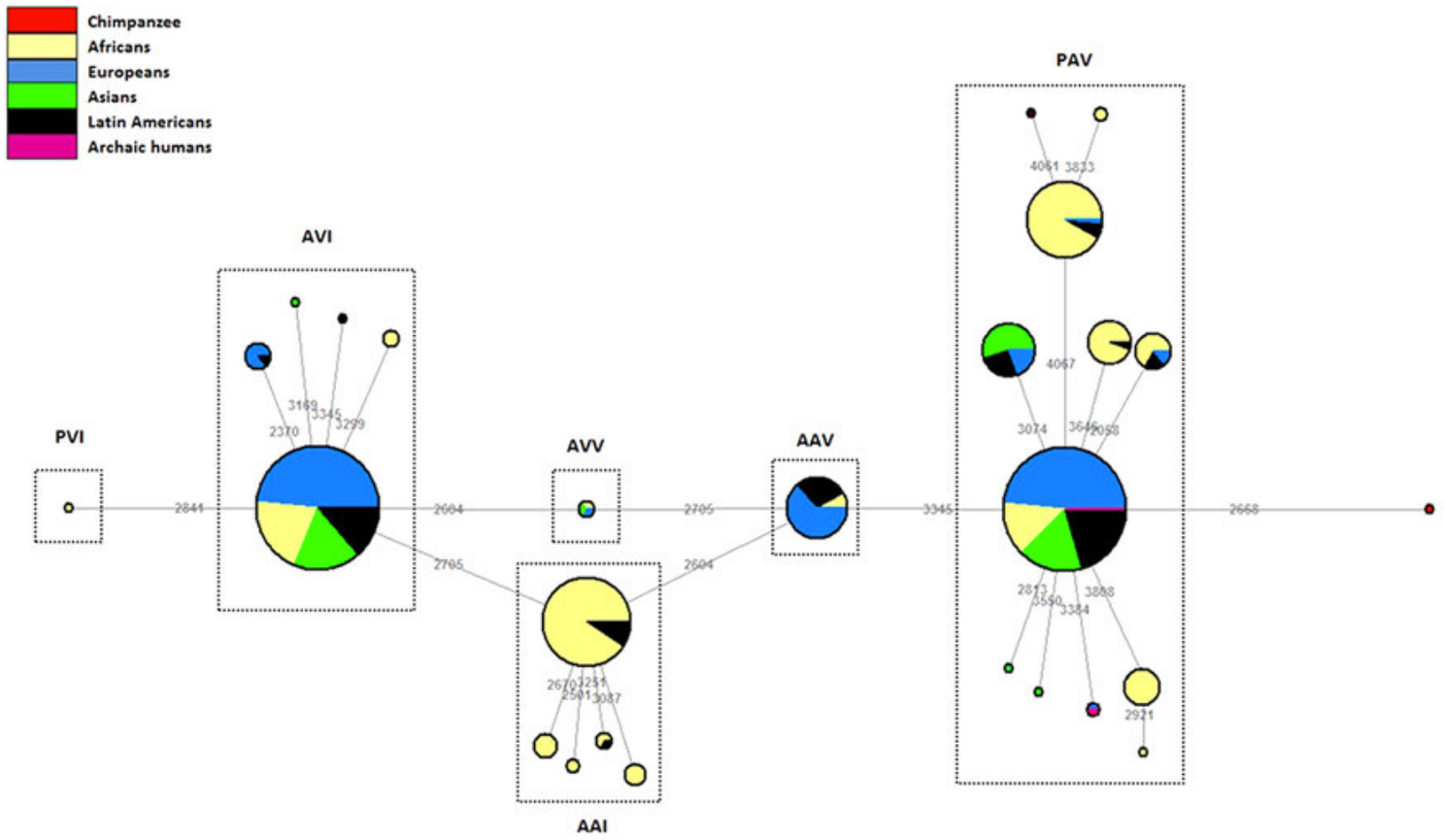


Figure 2: Neighbor-joining **haplotype network** illustrating the genealogical relationships between TAS2R38 haplotypes in archaic hominids and modern African, European, Asian and Latin American populations.

Source: Risso, E.S. et al. (2016). Global diversity in the TAS2R38 bitter taste receptor: revisiting a classic evolutionary PROPosal. Scientific Reports 6