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Letter

Cultural Factors Shape Olfactory Language

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Compared to the other senses, smell is linguistically challenged. Colors and shapes; tastes and textures, each have their armory. A tomato is 'red' and 'round'. A lemon is 'smooth' to touch and has a 'sour' taste. Each sensory domain has its own lexical field: a set of words codifying the distinctions in that modality. Smell stands apart. When asked to name familiar, everyday scents English speakers are stumped.

Olfaction does not have dedicated lexical apparatus (or so it is claimed: see references in [1]). Instead, when English speakers name smells they typically refer to sources (e.g., 'it smells like banana'). Worse still, when they use source-descriptions they usually incorrectly identify the odor [2]. Olofsson and Gottfried [3] argue that olfactory naming is difficult because of the way the brain is organized. But, does the neural anatomical organization they describe cause olfactory naming problems or does it merely reflect the learning history of a particular cultural group? To answer this question a cross-cultural approach is essential.

In a recent study, my colleagues and I compared how often speakers of 13 diverse languages around the globe talked about sight, hearing, touch, taste, and smell in everyday conversation [4]. In all communities (including English) vision was the most talked about perceptual modality, followed by hearing – except for Semai (a language from the Malay Peninsula) – where smell leapt to second-place. Maniq [1] and Jahai [2], languages related to Semai, exhibit a similar preoccupation with smell. Unlike English, these languages have a dedicated lexical field for smell. Just as you would describe a tomato as *red*, a Jahai speaker would describe the smell of bearcat as *ltpɨt*.

There are 12–15 words used by the Jahai and Maniq to describe different categories of smells. A bearcat is *ltpɨt*, but so are flowers, durian, soap, etc. (in the same way as both a fire-engine and blood are *red* like a tomato). Terms such as *ltpɨt* do not refer to general qualities (like 'edibility' or 'stingingness', *contra* Olofsson and Gottfried). Their meaning is not general over tastes, textures, pain, or any other state; their business is smell. To develop and use such a lexicon, speakers must pay attention to odors all the time. A smell experienced now might not be talked about until much later, so when encountered it must be appropriately linguistically tagged and coded in memory. The Maniq and Jahai are not alone; a dedicated lexical field for smell has been attested in numerous languages in Asia-Pacific, the Americas, and Africa [5]. The problem with odor naming is not universal.

Olofsson and Gottfried ask whether olfactory-naming could ever be as good as visual object naming. However, this is not the best comparison. Odors are properties, and therefore should be compared to another property (e.g., color). This analogy has much potential. Like smell, the basic lexicon for color naming varies cross-linguistically [6]. Some languages have only three basic color words (e.g., Umpila, Australia [7]), while others have as many as 15. Similarly, English speakers appear to have only two or three dedicated smell words in their active vocabulary ('stinky', 'fragrant', 'musty'), in contrast to the 15 smell terms in Maniq. When a language has a small set of color words, speakers rely on *ad-hoc* source-descriptions (e.g., 'it is banana-colored') [7]; just as English speakers turn to source-descriptions when their smell lexicon fails them. Color lexicons evolve in a predictable manner [8]; it is an open question at present whether the same holds for smell lexicons.

Language is, of course, coupled to perceptual and cognitive systems and to their underlying neural foundations. But, there is considerable plasticity, reflecting individual learning histories, which in turn reflect linguistic and cultural experience. English speakers are literate (unlike the Maniq or Jahai). Literacy – a recent technological invention in human history – changes the neural organization for spoken language [9]. English is an outlier from a cross-linguistic perspective [10]. Typologically different languages have distinct neural signatures: Chinese listeners show more bilateral hemispheric activation for speech than English speakers, whereas processing of Finnish recruits different neural circuits again [11]. To describe smells English speakers usually use nouns, whereas Maniq and Jahai speakers use verbs. Referring to entities recruits different neural circuits than predicating something about them [12], another potential point of difference.

Ultimately, any explanation of olfactory language will not be satisfactory if it only accounts for the behavior of one linguistic community. Even if we found naming odors recruited disparate neural circuitry in Maniq, Jahai, and English, this would not tell us why this was the case. Mapping the neural processes for odor-naming cannot explain why speakers of different languages talk about and think about odors in such different ways. Instead we need an account that reflects the variability of odor lexicons and odor-naming abilities in the human population as a whole. And that requires we take culture seriously.

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Letter

Response to Majid: Neurocognitive and Cultural Approaches to Odor Naming are Complementary

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Over the past few years, several studies have investigated the neural pathways and mechanisms underlying olfactory lexical processing. In a recent review, we provided a synthesis of behavioral and neuroimaging work pertaining to odor-source naming and identification, primarily in English speakers [1]. In a separate line of research, Dr Majid and colleagues have documented how odors are described among Maniq and Jahai speakers from the Malay peninsula. An important topic concerns whether the neural organization of language is causing the observed limitation in odor-source naming, or whether this phenomenon merely reflects a lack of priority to odors in our western culture. Thus, we welcome Dr Majid's commentary on this issue [2].

Three arguments run in parallel in Dr Majid's commentary. First, she assumes that odors are essential properties of objects (i.e., similar to colors) rather than objects per se (e.g., 'popcorn' is an object identifiable through sight, sound, or smell). However, the literature supports our object-based approach to odor-source naming. Objects (e.g., the smell of 'popcorn') constitute building blocks of perception and provide the input to lexical systems for source naming. The striking mechanistic similarities between human and rodent data [3] and between vision, audition, and olfaction [4] lead us to believe that odors are universally encoded as objects. Odor properties, such as pleasantness or edibility, are likely secondary features, and need to be derived from the odor object representation [5]. Furthermore, the object-centered approach is promising because it fits with our understanding of odor identification deficits in patients with neurological disorders [6,7].

Second, Dr Majid states that a cross-cultural perspective is necessary to enable an understanding of the nature of olfactory language, whereas other approaches will be insufficient. In fact, universal odor object mechanisms are fully compatible with evidence of cultural flexibility in their interactions with language. For example, cultures that prioritize olfaction might retain object-based perception, but might additionally develop mechanisms that allow for linguistic generalization across objects. Thus, results emanating from odor object source identification and naming should not be conflated with, or refuted by, results emanating from other methods of perceptual or semantic analysis [2]. There is evidence that perfumers and enologists in western countries learn designated odor terms and categories well beyond those present in everyday language [8]. Neuroimaging evidence indicates a corresponding increased thickness of the orbitofrontal gyrus, a key region for odor object identification [1,9]. Might similar effects be shown in speakers of Jahai and Maniq? We hypothesize that the hunter-gatherer populations described by Dr Majid would excel in utilizing source descriptors to name and identify odors, although more research is needed.

Third, Dr Majid suggests that neuroscientific studies have limited relevance for understanding olfactory language, writing that 'Mapping the neural processes for odor naming cannot explain why speakers of different languages talk about and think about odors in such different ways' [2]. This position discounts the wealth of neuroscience insights regarding perception, cognition, and language. The recent emergence of fluorescent magnetic resonance imaging (fMRI) multivariate pattern-based techniques [10] to characterize how, rather than where, information content is encoded in the human brain, could offer powerful ways to test some of the assumptions put forward by Dr Majid; for example, whether the apparent cultural distinctions in odor naming are reflected in qualitatively distinct pattern representations in the odor-language network.

In sum, we believe that neurocognitive and cross-cultural approaches offer complementary insights into olfactory language interactions. Research on odor-source naming in western populations has accumulated a critical mass of data allowing for a mechanistic synthesis of perceptual, cognitive, and neural processes. To date, methodological variations and scarcity of replicated experimental results from hunter-gatherer populations prevent us from drawing firm conclusions regarding cultural universality or biological causality. We welcome further explorations that might bring clarity to these outstanding issues.

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