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A Breath of New Life into Human Social Cognition

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Abstract

Sniffing has historically been considered an olfactory behavior because inhalation is a necessary step in odor perception. Growing evidence, however, has demonstrated that the display of sniffing surpasses the bounds of those contexts that are olfactory in nature. In this issue of Chemical Senses, Arzi, Shedlesky, Secundo, and Sobel demonstrate that humans mimic visually and auditory-observed sniffing, independent of experimentally applied olfactory sensory input. These findings raise important and exciting questions about the possible roles of sniffing in the social context and highlight the need for chemosensory researchers to reconsider the significance of sniffing.

Key words: cognition, communication, imitation, olfaction, respiration, sniffing

When you greet people, you consciously direct your visual gaze, speak, and perhaps touch for exchanging social information. A friendly embrace communicates comfort and acceptance, whereas a glaring sharp stare signals hostility. It is well established that information can be emitted and conveyed in a variety of species-specific manners, including facial gestures, physical contact, odor cues, and colorations (Bradbury and Vehrencamp 2011). This transmission of information is essential to the normal orchestration of social behavior. But what happens when someone you are near sniffs? Is the act of sniffing communicated from person-to-person? In this issue of Chemical Senses, Arzi and colleagues test this question and uncover evidence that humans mimic sniffing behavior (Arzi et al. 2014). These new findings suggest that sniffing itself may play a role in human social communication and possibly hint towards specific shared neural substrates between olfactory and social brain centers.

To examine the possible social transmission of sniffing behavior, Arzi and colleagues cleverly staged subjects to watch the movie Perfume under the guise that they were going to assist in calibrating physiological equipment. Perfume tells a story of a young man who was born with a uniquely powerful sense of smell and whom sought to be a perfumer. The smell of women was especially intoxicating to him. The young man sought to preserve the feminine scent so he would never lose access to its beauty. That motivation, together with the protagonist’s position in society as an ill-fitting loner, led him towards becoming a murderer of women he had an affinity for and extracting their unique scents from their remains. Arzi and colleagues’ use of Perfume as a stimulus was perfect for an initial test of social sniffing behavior in humans. Not only are movies strongly capable of engendering heightened emotional states (Gross and Levenson 1995), but also, at some point while watching Perfume, what you experience seems strongly dependent upon smell. You pay attention to the audio and visual details of the movie not only with your eyes and ears but also with your nose.

Arzi and colleagues recorded respiratory data from subjects by means of a nasal cannula along with other physiological signals while the subjects were watching Perfume. The subjects were unaware that their sniffing patterns were the focus of the study. The authors report that sniffing by characters in Perfume elicited sniffing consisting of long-duration inhalations in the experimental subjects. Further, all 24 subjects adjusted the timing of their sniffing upon observing a sniffing event in the movie. The authors conclude that humans mirror the sniffing behavior of other humans as they observe them. Mirroring behaviors are commonly observed among close
companions, including copying verbal tone, body language, and other precise communication behaviors such as eye contact. It is considered that imitation is highly specific (Brass and Heyes 2005), in that we mimic with our hands when we see what others do with their hands, for instance, but not with their feet. The finding, that observers mirror the sniffing in Perfume, suggests, at its most simple level, that respiratory imitation is mediated by shared respiratory motor mechanisms simultaneously during action generation and action observation. This would be analogous to how observed motor movements are somatotopically mapped in motor areas, including premotor cortex (Wheaton et al. 2004). Understanding the mechanisms of mirror sniffing in the brain will be important in unraveling the basis for this behavior and its potential significance for olfactory function—this especially because the motor act of sniffing alone modulates primary olfactory cortex activity (Sobel et al. 1998a, 1998b).

Regardless of whether the observers saw or heard the sniffs in the movie, they modulated their sniffing. Interestingly, the authors found that changes in sniffing among observers were most dramatic when they heard but did not see the object that was being sniffed in Perfume. The authors note that this sensory-specific magnification of mirror sniffing is parallel to sensory-specific aspects observed in other imitation behaviors and that this suggests mirror sniffing in the present context may be a form of an orienting response. Additionally though, it is interesting to consider how sniffing may be driven by possible olfactory perception even independent of odors—but due solely to visual or auditory stimuli. Both the visual (Gottfried and Dolan 2003; Jadauji et al. 2012) and auditory systems (Budinger et al. 2006; Wesson and Wilson 2010; Varga and Wesson 2013) converge with the olfactory system in manners whereby either can modulate activity of the olfactory cortex. Thus a possible mechanism of visual- and auditory-evoked sniffing is that the sniffs, heard or seen, stimulated the olfactory system to create a possible olfactory percept in the subjects, thereby driving or even just adding to the tendency to sniff.

A perhaps underemphasized aspect of this study is the finding that sniffing behavior occurred “independent” of experimentally applied odors while the subjects were watching the movie. This finding is in agreement with numerous reports of respiratory modulation in both humans and rodents to a wide variety of nonolfactory stimuli (Harrison 1979; Wiemtjes 1992; Wesson et al. 2008; Kosck and Anderson 2013), including the nonolfactory display of sniffing by rodents during face-to-face social interactions (Wesson 2013). Sniffing behavior is also highly state dependent, with increases in sniffing frequency being pronounced during the execution of motivated behaviors (Clarke and Trowill 1971; Whishaw and Tomie 1989; Uchida and Mainen 2003; Kepc et al. 2007; Wesson et al. 2008). The present work by the authors further implicates sniffing as a behavior with far greater reach than simply in the stimulus-acquisition realm.

Although the authors’ study was elegant, in that the stimulus was highly controlled, a real-life test for mirror sniffing in humans ultimately needs to be performed between two living and sniffing people. Perhaps a confederate could be instructed to sniff in the presence of others whom he or she knows to see if they in turn change their sniffing duration as predicted by the work of Arzi and colleagues. These data would support the authors’ hypothesis that the reported mirror sniffing may be a behavioral response orchestrated to optimize odor acquisition in the social context. Alternatively, anosmic subjects could be included to test if the outcome is independent of odor sampling. In this design, one could also address other outstanding questions, including how the degree of social relationship and/or arousal levels impact the sniffing response of the observer. These later possibilities stated, the study by Arzi and colleagues lays a solid foundation for future research into social roles for sniffing behavior and additional studies will undoubtedly highlight the growing hidden relationships between this odor sampling behavior and human social cognition and communication.

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References


