PERCEPTION AND ACTION

What you see is not what you do

Spering, M., Pomplun, M. & Carrasco, M. (2011). Tracking without perceiving: A dissociation between eye movements and motion perception. *Psychological Science*, 22(2), 216–225.

Some of the most interesting scientific discoveries have been stumbled upon while investigators had designs on other goals. Such was the case for Spering, Pomplun and Carrasco who wisely put aside their primary investigation when initial results showed an unexpected divergence between eye movements and reports of motion perception. The team was studying the effects of adaptation to one component of a motion plaid presented dichoptically. Participants adapted to either a vertical, moving grating presented to one eye, or, a horizontal, moving grating presented to the other eye for 1.5 s, before a 500-ms, test presentation of both stimuli. Participants reported most often that they perceived only one component motion in the test, either the horizontal or vertical, replicating previous work on binocular rivalry (Wolfe, JM, 1984, *Vis Research, 24*, 471–478). What Spering and colleagues did differently was they simultaneously tracked eye movements. The surprising result was that on almost all the trials participants' eyes did not follow the perceived direction of motion but instead moved along the diagonal, consistent with the pattern motion that was the sum of the two components. Dissociation of eye movements and motion perception suggested that perception and action use different motion information. There are numerous studies demonstrating dissociations between perception and action in a variety of domains, but motion perception has usually been tightly linked to action, as both seem to stem from responses in the brain's motion center, MT/V5. What makes this result especially interesting is that the dissociation is not one merely from magnitude, such as a difference in speed, which might be expected from a difference in response gain of perceptual and action systems. Rather, the dissociation is from motion-direction, indicating that the two systems may differ in how motion information is integrated. After recognizing the importance of their discovery, Spering and colleagues conducted several experiments to generalize results across stimulus conditions, and to rule out alternative accounts including report bias and intentional eye movements. The results provide a convincing argument that motion information can be used differently by eye movement and perceptual systems, and open the doorway for more discoveries describing the differences between what we see and do.—A. E.S.

OLFACTION

Rethinking the nature of olfactory receptors

Franco, M.I., Turin, L, Mershin, A., & Skoulakis, E.M.C. (2011). Molecular vibration-sensing component in *Drosophila melanogaster* olfaction. *Proceedings of the National Academy of Sciences*, *108*, 3797–3802.

Humans are capable of smelling approximately 100,000 different odors; however, the mechanism by which this vast array of odor molecules is decoded by the olfactory receptor neurons remains a mystery. One popular notion is that olfactory receptor neurons respond to the structure or shape of odor molecules. But this shape-detecting mechanism cannot explain why molecules, that have the same shape, smell different, or why molecules, that have different shapes, smell the same. Over the past decade, an alternative theory, which proposes that olfactory neurons respond not to shape but rather to molecular vibrations, has been gaining support. Molecular vibrations occur when the atoms of a molecule move in a periodic fashion. Although earlier versions of this theory were deemed physically implausible, recent work in physics has validated the possibility. More recently, Franco et al. (2011) provided critical empirical support for the vibration theory of olfaction based on the olfactory abilities of fruit flies. A key innovation in these studies involved creating two molecules with identical shape, but with different vibrations. This was accomplished by selectively replacing the hydrogen atoms of one odorant with deuterium atoms. Deuterium is an isotope of hydrogen and is also called heavy hydrogen, to reflect the extra neutron. Because molecular vibrations can be altered by the density of a particular atom, a "deuterated" molecule can have the same shape as the corresponding hydrogen-only molecule, while also vibrating at a different frequency. If odor quality is determined primarily by shape, then the deuterated and hydrogen-only molecules should be indistinguishable. In contrast, if odor quality is determined by vibration, then the two molecules should be distinguishable. The researchers chose to test these predictions using the fruit fly so as to control the prior odor experiences and abilities of the subjects. With this in mind, the researchers provided a compelling array of behavioral evidence that fruit flies can indeed distinguish between deuterated and hydrogen-only odorants. For instance, when the deuterated molecule was associated with shock, the flies subsequently avoided the deuterated molecule, but not the hydrogen-only molecule (and *vice-versa*). To ensure that the flies were in fact using olfaction to distinguish between the two-odorant molecules (as opposed to some other sense), the researchers repeated this aversive conditioning experiment using fruit flies that were genetically mutated so that they could not smell.