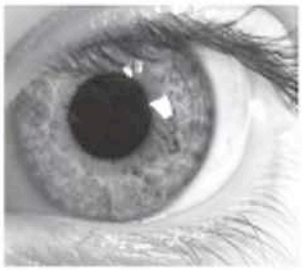
The Senses:

did you know...?

By Amrita Goyal and Lucie Guo

sight



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...that it might be possible for us to see more colors via genetic engineering?

Mice are normally only able to see the world in a bland mixture of blues, greys, and yellow. However, when scientists at UC Santa Barbara inserted a gene for a human photopigment into their genome, transgenic mice developed the ability to see a rainbow of colors that they previously could not. Even though normal mice are not able to see these new colors, the genetically engineered ones had no trouble processing the new visual information. This demonstrates the incredible adaptive flexibility of the mammalian brain. Endowing humans with the ability to see infrared or ultraviolet light may be as simple as inserting the gene for the correct photopigment into our genome.

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Source: Jacobs, Gerald, et al. "Emergence of novel color vision in mice engineered to express a human cone photopigment." Science 315(5819): 1723-25 (2007).

smell

...that electroshock therapy can improve a person's sense of smell?

(Via classical conditioning that is.) Scientists recently found that a person's sense of smell really does become more acute when painful stimuli are involved. After being conditioned via small electric shocks, humans are able to tell the difference between two previously indistinguishable isomers of the same compound. Wen Li *et al.* at Northwestern University presented volunteers in the study with each of the compounds to smell. Along with one of the isomers, the participants were also given a shock. The researchers found that this actually resulted in changes in the primary olfactory cortex, the area of the brain that processes smell.

Source: Li, Wen, et al. "Aversive learning enhances perceptual and cortical discrimination of indiscriminable odor cues." Science 319 (5871): 1842-5 (2008).

touch

...that force, not geometry, determines our perception of shape?

As we slide our fingers across an object to explore its surface, we experience both geometric cues and the force exerted on us by that surface. In an experiment from 2001, when blindfolded subjects rolled objects across a bump, as expected, they perceived a bump; however, when these subjects rolled an object across a flat surface while a virtual force was applied by a robot, subjects still perceived a bump. Thus, subjects perceived shapes on the basis of force cues alone, regardless of surface geometry.

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Source: Robles-De-La-Torre, et al. "Force can overcome object geometry in the perception of shape through active touch." Nature 412: 445-448 (2001).

taste

...that food tastes different depending on mood, which might help identify chemical causes of depression?

Doctors have found that anxiety can dull your ability to detect bitter and salty tastes, indicating a link between brain chemistry and taste. When healthy volunteers were given a drug that raised serotonin levels, they became more sensitive to bitter and sweet tastes. Increasing norepinephrine levels improved subjects' abilities to detect bitter and sour flavors. This finding may give doctors a way to determine what neurotransmitter a patient is lacking via a simple taste test, and thus a give them a hint as to which anti-depressant drug to prescribe (4).

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Source: Heath T., et al. "Human taste thresholds are modulated by serotonin and noradrenaline." J. of Neuroscience 49: 12664-71 (2006).

pain

...that some spider toxins can induce inflammation via the same pathway activated by chili peppers?

Transient receptor potential vanilloid (TRPV) ion channels sense heat and pain. Capsaicin, the active component in chili peppers, is a strong irritant for mammals because it binds to TRPV channels, which sit on the membranes of neurons that sense pain and heat.. Activated TRPV channels have recently been shown to be strongly associated with inflammation. Venom from tarantulas from the West Indies can also activate TRPV channels to induce inflammation, as a part of the animal's defense against predators.

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Source: Siemens J, et al. "Spider toxins activate the capsaicin receptor to produce inflammatory pain." Nature 444(7116): 208-12 (2006).

hearing

...that our ability to hear comes from sound waves vibrating bundles of cilia?

Mechanoreceptive organelles, known as "hair bundles," are found in hair cells in the inner ear. Each hair bundle contains tens to thousands of stereocilia, cross-linked by actin microfilaments (1). Bending of the hair bundle by sound waves causes the stereocilia to brush past one another, allowing the tips to separate and the tip links, recently found to be made of cadherin 23 and protocadherin 15, to tighten, pulling open transduction channels, thus resulting in the generation of nerve impulses which are then sent to the brain (2).

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Sources: 1. Pickles, J.O., et al. "Mechanoelectrical transduction by hair cells." Trends in Neurosciences 15(7): 254-9 (1992)
2. Corey, DP. "Stringing the fiddle: the inner ear's two-part invention." Nat Neurosci 10(10): 1232-3 (2007).

proprioception

...that motor output from the brain has a key role in determining limb position, not just sensory input?

It was long accepted that the brain determines the relative positions of our extremities from information sent to it by nerve endings in skin, muscles, and joints. However, there is now evidence that our preception of where our limbs are is largely based on the expected results from motor signals sent *by* the brain, not just sensory information sent to it by the body. This may help explain mysterious physiological phenomena like phantom limb syndrome.

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Source: Gandevia S. C. et al. "Motor commands contribute to human sense position." J Physiol 571(3): 703-710 (2006).

—Amrita Goyal '09-'10 is an OEB concentrator in Kirkland House. Lucie Guo '09 is a Biochemistry concentrator in Lowell House. H

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