The CORSINI ENCYCLOPEDIA *of* PSYCHOLOGY

FOURTH EDITION

VOLUME 4

R–Z

BRIEF BIOGRAPHIES

INDEX

Edited by

IRVING B. WEINER

W. EDWARD CRAIGHEAD

T

TACTILE SENSATION

When you drive a car, you can sense pressure, vibrations, and warmth in your hands as you grip the steering wheel. You experience such events because contact with the steering wheel triggers activity in sensory receptors in your skin wherever contact occurs. These receptors respond to mechanical and/or thermal energy, leading to sensory experiences that are collectively described as tactile sensations. Other sensations you may have from your skin, including pain and itch, are not generally included in this definition. Tactile sensations are passively elicited as a result of stimulation by some external source. This is in contrast with haptic perception, which typically involves contact with the external environment through active manual exploration. These two modes of tactile experience result in an interesting distinction. When your skin is passively stimulated, you typically focus your attention on your internal subjective tactile sensations (although it is often possible to perceive external objects and their properties). In contrast, when you haptically explore, you tend instead to focus your attention on the external world.

Mechanical Sensation

Our hands and faces are arguably the most important of our touch organs. It is in these body regions that we are able to detect the smallest spatial details and the lightest of pressures. For example, on the fingertip, the traditional two-point discrimination test shows that you can discriminate two separate contact points that are about 2–4 mm apart, or ~1 mm with more precise methods (Johnson, Yoshioka, & Vega-Bermudez, 2000). Compare this to your back, where the two points must be separated by ~40 mm. The traditional test for pressure sensitivity also shows that you can detect a contact force of ~0.02–0.06 g on the fingertips, compared with 0.2 g (up to about 10 times that amount) on the thigh. We should also consider how well the skin can resolve fine temporal details. It is known that you can feel two successive taps to the fingertip when they are separated by as little as ~5 ms. This value for touch seems to be better than that for vision (~25 ms) but worse than that for audition (~0.01 ms).

Hairless Skin

Tactile scientists believe that mechanical sensations in the hairless skin on the human hand are mediated by four different types of tactile nerve fibers (Johansson & Vallbo, 1983). Each fiber type possesses its own kind of receiving unit, which filters and then transforms mechanical stimulation into electrical pulses in the fibers. The mechanically sensitive fibers are characterized by how long they respond during the stimulus and by the size of the skin area that, when stimulated, evokes a response in that fiber. Two of the four types of fibers adapt slowly (i.e., continue to respond) during the steady application of force and are accordingly called slow-adapting (SA) units. The other two afferents respond only to changes in stimulation and are thus called fast-adapting receptors or FA units. The second division is into type I and type II fibers: SA I and FA I fibers can transmit mechanical deformation patterns on the skin with relatively high spatial fidelity; in contrast, SA II and FA II fibers can only transmit relatively less precise spatial details about the mechanical stimulus.

Mechanical vibratory sensations are an extremely important aspect of human tactile sensing. Current scientific thinking suggests that they may be the result of processing by three different tactile channels, each one maximally sensitive to a specific range of vibration frequencies (e.g., Löfvenberg & Johansson, 1984) and mediated by a specific type of tactile nerve fiber. The channel that responds best to very low-frequency vibrations (less than ~3 Hz) is believed to be mediated by SA I nerve fibers. A second channel that maximally responds to somewhat higher frequencies (~3–40 Hz) is possibly mediated by FA I fibers. The third channel that is maximally sensitive to still higher frequencies (from ~40 up to 700 Hz, the highest level that has been tested to date) is mediated by FA II fibers. The fourth type of tactile nerve fiber, which is found in hairless skin and known as an SA II fiber, is responsive to slow mechanical displacement, such as local pressure and skin stretch, as opposed to a selected range of vibratory frequencies.

Hairy Skin

There are five different types of mechanoreceptors in hairy skin, two of which are slow adapting and three that are rapid adapting. It has been suggested that sensations of mechanical vibration in hairy skin are also mediated by three different channels possibly involving these receptors. In addition, recent research has discovered a class of narrow fibers in hairy skin that specifically respond when lightly brushed at low speed. Some researchers think that this type of fiber may contribute to our experiences of pleasant touch (Wessberg, Olausson, Fernström, & Vallbo, 2003).

Thermal Sensation

Thermal sensations appear to be more complex than mechanical sensations because they are involved in both perceiving the external world and in maintaining a stable condition (homeostasis) for our bodily functions (Stevens, 1991). With thermal sensations, we tend to pick up intensity information (i.e., how warm or cold the skin feels) rather than the exact spatial and temporal patterns of stimulation. There are two kinds of thermoreceptors located in the skin. When the skin at the base of the palm is 33°C, people can detect a difference in warming of about 0.2°C and a difference in cooling of about 0.1°C. Sensitivity varies approximately 100-fold over the body surface, with the face being exquisitely sensitive and the extremities relatively insensitive.

Application

To date, the use of tactile sensations, particularly vibration, is most familiar on the simple but ubiquitous level of mobile phones and other alerting devices. However, more complex applications are in the offing, from rumble motors in game consoles that simulate the galloping of hooves or shots of gunfire, to devices that effectively help the blind and visually impaired interact with the environment.

REFERENCES

Johansson, R. S., & Vallbo, A. B. (1983). Tactile sensory coding in the glabrous skin of the human hand. *Trends in Neurosciences, 6*, 27–32.

Johnson, K. O., Yoshioka, T., & Vega-Bermudez, F. (2000). Tactile functions of mechanoreceptive afferents innervating the hand. *Journal of Clinical Neurophysiology, 17*, 539–558.

Löfvenberg, J., & Johansson, R. S. (1984). Regional differences and interindividual variability in sensitivity to vibration in the glabrous skin of the human hand. *Brain Research, 301*, 65–72.

Stevens, J. C. (1991). Thermal sensibility. In M. Heller & W. Schiff (Eds.), *The psychology of touch* (pp. 61–90). Hillsdale, NJ: Lawrence Erlbaum.

Wessberg, J., Olausson, H., Fernström, K. W., & Vallbo, A. B. (2003). Receptive field properties of unmyelinated tactile afferents in the human skin. *Journal of Neurophysiology, 89*, 1567–1575.

SUGGESTED READINGS

Jones, L. A., & Lederman, S. J. (2006). *Human hand function.* New York: Oxford University Press.

Kandel, E. R., Schwartz, J. H., & Jessell, T. M. (Eds.). (2000). *Principles of neural science* (4th ed.). New York: Elsevier.

Lederman, S. J., & Klatzky, R. L. (Eds.). (2007). New directions in touch [Special issue]. *Canadian Journal of Experimental Psychology, 62*(3).

Ryo Kitada
Queen's University, Canada

Dianne T. V. Pawluk
Virginia Commonwealth University

See also: Haptic Perception

TASK DESIGN

Early writings on task design advocated the simplification and standardization of tasks comprising a job as means of enhancing productivity in organizations. Indeed, these strategies led to simplified production scheduling, lowered training costs, and reduced expenditures for labor through the employment of lower-skilled, more interchangeable, and cheaper workers. However, simplification also produced monotonous work, which presumably led to boredom and dissatisfaction that cost employers in terms of increased absenteeism and turnover and reduced production output.

To counteract these costs, job enlargement and job enrichment were advocated as alternative task design strategies. Conceptually, the two strategies are quite similar and can be thought of as entailing the design of jobs to include a wider variety of tasks and to increase workers' freedom of pace, responsibility for checking quality, and discretion over method. For the most part, the research addressing the two strategies has taken the form of testimonial evidence; thus, one is unable to assert generalizations regarding their efficacy. As an alternative to task enlargement, knowledge enlargement, which involves adding requirements to the job for understanding procedures or rules related to the organization's products, was advanced. This form of enlargement has been shown to be associated with more satisfaction, as well as less overload and fewer errors.

Hackman and Oldham (1975) suggested that five task dimensions influence employees' attitudinal and behavioral reactions to their jobs: (1) skill variety, the degree to which a job requires a variety of different activities; (2) task identity, the degree to which a job requires the completion of a whole and identifiable piece of work; (3) task significance, the degree to which a job has a substantial impact on the lives or work of other people; (4) autonomy, the degree to which a job provides substantial freedom and discretion to an employee in scheduling work