

Weber on sensory asymmetry

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Ernst Heinrich Weber's Latin monograph of 1834 (Fig. 10-1), widely celebrated but seldom read, contains many diverse and interesting observations besides the statement of Weber's law. The passages translated here correspond to pages 84-85, 92-94, and 119-122 of *De pulsu, resorptione, auditu et tactu*.

**On the difference between the right and left sides of the body
in the ability to judge weight by touch**

We should not omit to mention that there is often a difference between the right and left sides in the sense of touch. Just as the two sides are unequal in muscular strength, so too, according to my experiments, they differ in cutaneous sensitivity. Whereas, however, in most men the right side exceeds the left in muscular strength, we find the contrary if we measure tactual sensitivity [*subtilitatem tactus*] on the right and left sides of the body by placing weights on various parts and keeping these parts passive and motionless. For the same weight seems heavier to most subjects when it is placed on the left and lighter when it is placed on the right; and different weights often appear equal if the heavier is placed on the right and the lighter on the left, whereas they appear unequal if the heavier is placed on the left and the lighter on the right. This phenomenon seems to arise from the fact that the sensitivity of the left side is, in most subjects, finer [*subtilior*] than that of the right.¹

I was myself the subject when this observation was first made by my colleague Seyffarth,² Professor at Leipzig. Seyffarth once before gave me helpful advice when I was investigating wave theory, and now in this enquiry he likewise drew my attention to the

Fig. 10-1. Title page of Weber's monograph.

DE
PULSU, RESORPTIONE, AUDITU
ET TACTU.

ANNOTATIONES ANATOMICAE
ET PHYSIOLOGICAE

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1834.

discrepancy between left and right. So considerable is this difference in my own body that it shows itself not only on my hands but also on the soles of my feet and other places; and it significantly hinders the accurate comparison of weights that are placed one on each side of the body.

I am certainly not claiming that in all subjects the left side enjoys a keener weight perception [*ad percipienda pondera subtilior sensu praeditum esse*]. I have placed weights on the hands of many subjects and examined their sense of touch. I found only that in the majority of subjects the left hand has the more delicate sense of touch; in some the right is more sensitive, and in a few no difference is observed between right and left hands.

Out of 14 subjects, varying in sex and age and engaged in various studies and occupations, 11 perceived the same weight as heavier when it lay on the left hand rather than on the right; in 2 subjects the contrary held; and in just 1 there was no clear difference between right and left.

On the cause of the difference between the right and left sides of the human body in the perception of weight

Why, in the case of most subjects, does the same weight appear to press less hard on the right hand than on the left? Many, perhaps, would seek the answer to this question in the hardness and thickness of the skin, which have been increased by work and repeated pressure.³ For most people use their right hand more often than their left and we may suspect that the sense of touch is thereby blunted in the right hand.

Others perhaps will think that the cause is to be sought in muscular differences between the right and left. They believe that a weight lifted by hand seems heavier on that side on which the muscles, being weaker, require a greater effort of will for the contraction necessary to raise the imposed weight.

However, both explanations are wrong. The first is wrong because thickness of the cuticle does not impair the perception of weight. On the heel and on the sole of the foot the skin is thicker than anywhere else and all thermal sensation and two-point discrimination [*perceptio distantiae crurum circini has corporis partes tangentium*] are remarkably impaired; yet the comparison of two weights is there performed readily and precisely. The other expla-

nation, which is based on the muscular weakness of the left side, is not able to explain what we wish to explain. For there would then be a difference in weight perception only if weights were lifted and not if they were placed on the passive hand.

So, since we lack any other explanation, it is likely that the difference lies in the structure of the sensory nerves. Just as the muscles of the right side are thicker than those of the left and thus more powerful, so it is not impossible that the sensory nerves on the left should be more sensitive than those on the right.

In this way one can readily explain why the perception of weight by touch is more delicate on the left than on the right, not only on the hand but also on the foot and shoulder. For these latter parts are not practiced in the perception and judgment of weights and yet they show the same difference as is found in the hands.

Some time ago I explored the question of whether the right-left difference that has been recorded in muscular strength is also found in the nervous system and in the perceptual faculty [*sentiendi facultatem*]. At the time I thought the eye to be an organ singularly suited for experiments on this problem and I commended such a research project to Holke.⁴ For I had at some time examined the journals of Tauber,⁵ a spectacle-maker who was a Master of Liberal Arts and had formerly been secretary to Hindenburg, Professor of Physics at Leipzig. I discovered that over a number of years Tauber had examined the eyes of many people who were buying spectacles from him: He had measured their visual acuity and optimal reading distance and he had made quantitative records of the difference between the eyes. I hoped it would be worth the work involved if a thorough analysis of these observations were to show whether both eyes usually enjoy the same acuity at a given distance or whether one has better acuity than the other.

Holke collated and analyzed Tauber's records, but they show that there is no clear difference between right and left eyes in this respect.

Having in vain sought this difference in the visual organ, I was the more surprised when I unexpectedly observed it in the tactual modality on the left side.⁶

I did hope that I might observe the same difference between right and left hands by another method, if, that is, I were to place two different weights simultaneously on the flexor surface of the fingers and were to record the least difference in the weights that

tioned above, that in the case of most people the two hands are not of the same temperature, the left being commonly found to be warmer.

However, the falsity of this explanation is shown by the fact that the same result is observed in both cold and warm water. If the left hand were more sensitive to cold water because of its own greater warmth, then it should necessarily be less sensitive to warm water than the right; for the intrinsic temperature of the water would be less different from the temperature of the left hand than it would be from that of the colder right hand. But this is not so, since the left hand is affected more keenly than the right, whether one immerses one's hand in warmer water or colder. So we must have recourse to another explanation. The palm of the right hand is covered with thicker skin than that of the left. Since the thicker skin is less easily penetrated by heat or cold, it presumably has two effects. First, if the bulb of a thermometer is enclosed in the right hand, a given quantity of heat does not flow so quickly into the thermometer as it does from the left hand. Second, if the hands are immersed, a given quantity of heat or cold does not pass so quickly from warm or cold water into the right hand as it does into the left. This explanation is supported by another phenomenon that I have observed on the palm and the dorsum of the hands. A moderately large wooden vessel is filled with water at a temperature of $+9.5^{\circ}$ and the two hands are spread out and immersed. The ulnar surface is turned downward and the radial surface upward and the two hands are held a little way from each other. At the same time I attend to whether the dorsum or the palm is more strongly stimulated by the cold. I always find that at first the water

Table 10-2.

Part of body immersed in water	Temperature of this water ($^{\circ}$ R)	Part of the body immersed in water	Temperature of this water ($^{\circ}$ R)	Parts in which sensation indicated a greater coldness
Thumb and left index finger	10.5	Thumb and right index finger	10.5	Left fingers
Same fingers	11.75	Same fingers	10.66	Right fingers
Same fingers	12	Same fingers	12	Left fingers
Same fingers	12	Same fingers	11.8	Left fingers

touching the dorsum of my hand seems colder than the water between my two hands; but when 10, or 15, or 24 seconds⁸ have passed, the sensation of cold gradually lessens in the dorsum of the hand and increases in the palm, so that finally the water between the two hands seems to be colder than the water touching the backs of the hands. I observe the same if the water is less cold. If indeed I use warm water, I find that at first the water touching the dorsum of my hand feels hotter but after some seconds have passed the palm seems more strongly stimulated by the heat. I have observed this in the case of a colleague as well as in my own case when the water had a temperature of 38.5°.

ACKNOWLEDGMENTS

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NOTES

- 1 Cf. J. Semmes, S. Weinstein, L. Ghent, and H.-L. Teuber, *Somatosensory Changes After Penetrating Brain Wounds in Man* (Cambridge: Harvard University Press, 1960), and A. Carmon, D. E. Bilstrom, and A. L. Benton, *Cortex* 5:27-35, 1969.
- 2 Probably Gustav Seyffarth (1796-1885), the Egyptologist.
- 3 Cf. S. Weinstein and E. A. Sersen, *J. Comp. Physiol. Psychol.* 54:665-669, 1961, and S. Weinstein, *Am. J. Psychol.* 76:475-497, 1963.
- 4 See Ferd. Aug. Holke. *Disquisitio de acie oculi dextri et sinistri in mille ducentis hominibus sexu, aetate et vitae ratione examinata*. Diss. inaug. Lipsiae 1830 apud. Leop. Voss. 4. (Weber's note)
- 5 Gottfried Tauber (1766-1825).
- 6 The experiment on weight discrimination that Weber is about to discuss would have offered a rather closer analogy. In these passages he does not clearly distinguish sensitivity and resolution: The left hand is simply "*subtilior*."
- 7 1° Réaumur equals 1.25° Centigrade. The zero point is the same.
- 8 *Sexagesimis*: See *Corrigenda* at end of 1834 edition.