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# HANDEDNESS AND PSYCHOPHYSICS: WEIGHT AND ROUGHNESS

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A sample of 20 men (10 right-handed, 10 left-handed) was selected. Using the method of constant stimuli, the number of correct responses and the differential threshold for weight and roughness for both hands, were studied. The findings were: (1) In the weight test, the number of correct responses was greater and the differential threshold lower in the right-handed than in the left-handed subjects, and the preferred hand was superior to the nonpreferred hand for both groups; (2) In the roughness test, the number of correct responses was greater and the differential threshold lower for the nonpreferred hand. Implications of these findings with regard to our present knowledge of handedness organization are analyzed.

*Keywords: handedness, psychophysics, laterality, somesthesis*

Lateral asymmetry in recognizing different types of sensorial information is considered a fact sufficiently established (Bryden, 1982). Nevertheless, with regard to elementary functions and in particular to somesthesis, the results have not been conclusive. It has been observed that the threshold for pressure is lower in the left half-body, while two-point discrimination is better in the right half-body, though this relation depends on the handedness of the subject (Weinstein, 1962, 1963). It has been proposed that such lateral differences are very small (Weinstein & Sersen, 1961), or they are not found in elementary somatosensory measures, and therefore, they are manifested only in the recognition of more complex aspects of the information, which requires some sort of cortical active processing (Corkin, 1978). Witelson (1974) found better performance in the tactile recognition of meaningless figures with the left hand in children. Benton, Varney and Hamsher (1978) found that the recognition of the direction of lines is superior with the left hand, with this superiority valid in general for all sorts of spatial and tactile tasks (Benton, Levin, & Varney, 1973). Other aspects of somesthesis have been examined both in normal and in brain-damaged patients (see Varney, 1986).

Psychophysics has been used in the study of handedness, generally using the lateralized information methods, particularly in the visual and auditory systems, although on occasion the results have been somehow contradictory (Hannay, 1986). Nevertheless, the application of psychophysic procedures seems justifiable in the study of laterality, which undoubtedly will allow us to widen our comprehension of asymmetry of the nervous system.

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In this research an application of psychophysical methods was carried out for the recognition of weight and roughness first with one hand and then the other in both right-handed and left-handed subjects.

## METHOD

### *Subjects*

Twenty subjects (10 right-handed and 10 left-handed), male university students between 18 and 25 years of age, were chosen. They were given four lateral preference measures: (1) Hand: to write, to draw and to pour water from a jar; (2) Foot: to hop on one foot; (3) to listen closely to the sound of a watch; and (4) Eye: to look through a tube. To be included in the right-handed group, the subject had to do all the three hand tasks and at least two of the other three (foot, ear, and eye) with the right; to be included in the left-handed group, the inverse situation was required. Besides, to participate as right-handed, there could not have been a familial history of left-handedness; to participate as left-handed, the subject had to have a positive familial history of left-handedness (parents and/or brothers).

### *Material*

*Weight test.* A constant weight (200 g) was used and seven comparing weights (170, 180, 190, 200, 210, 220, and 230 g) presented by a myoesthesimeter. The constant weight was put on one of the levers and the variable weight on the other.

*Roughness test.* Seven types of sandpaper were used. They varied progressively in roughness (number of grains per square centimeter) and they corresponded to the numeration commercially used (0, $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, and 3); one of them ($1\frac{1}{2}$) was used as constant stimulus.

### *Procedure*

The weight test was performed initially. The subject was told that on one of the levers there was a constant weight and on the other a variable weight, which would vary through each trial; the subject had to say if the variable weight was greater, equal or less than the constant one. For half the subjects the constant weight was put initially on the right, for the other half on the left. The subject lifted the constant weight and then the variable and gave his answer. Only the forefinger was used. In the roughness test the procedure was similar: with one of the hands (half the subjects began with the right hand, and the other half with the left hand) the subject touched the constant paper and then the comparison paper and gave his answer (greater, equal, or less grain); for this task, the three middle fingers were used. During both tests, the subject was blindfolded.

### *Trials*

Each of the seven variable stimuli were presented seven times randomly distributed (49 trials for each hand in each of the tests). One of the stimuli was the same as the comparison stimulus, three were greater, and three were lesser.

*Analysis*

Two different measures were used: (1) number of correct responses (saying greater, equal or less when it really was), and (2) differential threshold. This last one was obtained taking the cutting points with the 50% of the answers for the "greater" curve (superior differential threshold) and for the "less" curve (inferior differential threshold) for each subject. The differential threshold is the difference between these two thresholds divided by two (the "equal" answers were not considered in calculating the differential threshold).

Correct responses and differential thresholds were analyzed for (1) right-handed with preferred hand (PH); (2) right-handed with nonpreferred hand (NPH), (3) left-handed with preferred hand (PH), and (4) left-handed with nonpreferred hand (NPH).

## RESULTS

Figure 1 shows the percentage of correct responses for the different groups considered in the two tasks. It is observed that the number of correct responses in the weight test was greater for the right-handed than for the left-handed group ($t = 5.88$; $df = 38$; $p < .01$) and that the performance was better with PH ($t = 2.16$; $df = 38$; $p = < .05$). The performance with PH is also significantly superior in the right-handed in relation to the left-handed group ($t = 2.82$; $df = 18$; $p < .02$).

For the roughness test, the performance was significantly superior with NPH ($t = 5.65$; $df = 38$; $p < .01$). In the right-handed group, the difference in performance between both hands was small, but in the left-handed group, it was a little greater ($t = 1.81$; $df = 18$; $p < .10$).

Table 1 shows the values of the thresholds found by the constant stimuli method. For the weight test such thresholds were lower for the PH with regard to the NPH ($t = 1.80$; $df = 38$; $p < .10$). The thresholds were lower for the right-handed in relation to the left-handed group ($t = 2.58$; $df = 38$; $p < .10$).

In the roughness test, the differences were opposite; the performance with the NPH was superior ($t = 2.75$; $df = 38$; $p < .01$) and the performance with NPH was significantly superior in the left-handed than in the right-handed group ($t = 2.50$; $df = 18$; $p < .05$).

## DISCUSSION

The results speak in favor of lateral differences in the recognition of weight and roughness. The difficulties in recognition of weights (baragnosia) and of roughness are part of the somatosensory cortical loss syndrome (Verger–Dejerine syndrome) produced by parietal damage. However, in such syndrome, peripheral sensitivity to touch, deep pressure, heat, cold, and pain are only minimally reduced and sometimes clinically normal (Hécaen & Albert, 1978). The studies on recognition of weights and roughness consequent to brain damage have been scarce (Semmes et al., 1960; Weinstein et al., 1958), but being abilities that depend on cortical activity, it seems reasonable to suppose a certain degree of lateralization.

The preferred hand not only is the one that usually is stronger; it is also the hand for which there is better control of fine movements. It would seem justifiable to suppose that the ability to perform fine adjustments in some way participates in

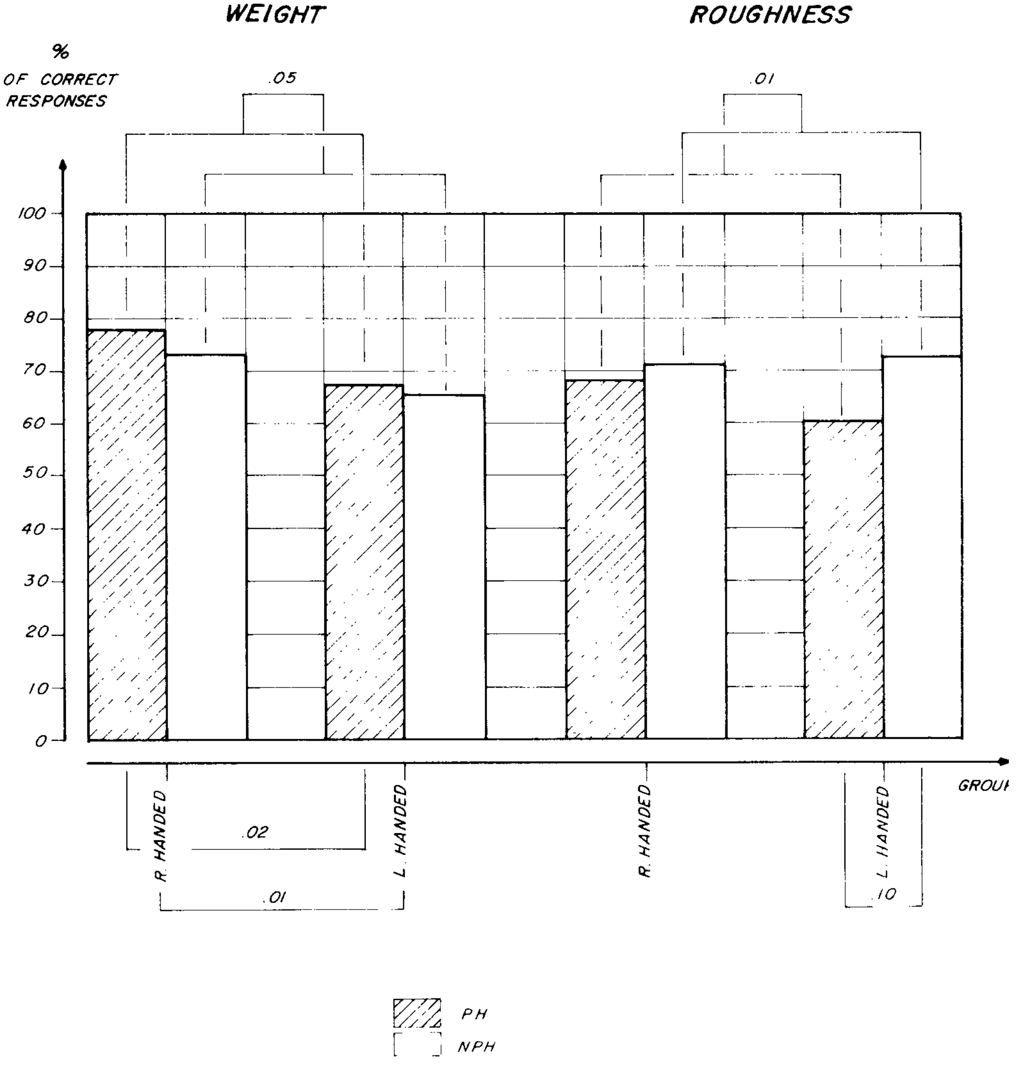


FIGURE 1 Percentage of correct responses in the weight and roughness tests for righ-handed and left-handed subjects using their preferred hand (PH) and nonpreferred-hand (NPH). The statistically significant differences are shown.



weight judgments. On the other hand, we know that right hemisphere damage not only produces more bilateral deficits in recognition of tactile stimulus direction (Fontenot & Benton, 1971) but also in tactile perception in general (Boll, 1974), which indicates some right hemisphere dominance in this type of tasks.

In conclusion, the results obtained seem to agree with our present knowledge about cortical organization of somesthesis. We could add that apparently simple tasks as the recognition of weight and roughness, could imply an asymmetric brain organization, and as a result, the performance in a normal subject could show lateral differences depending on the hand used and handedness.

Table 1
Differential thresholds obtained by the method of constant stimuli in the weight test the values indicate grams; in the roughness test, they are referred to conditional units

| | Right hand | Left hand |
|---|---|---|
| Weight | | |
| Right-handed | 5.61 | 7.67 |
| Left-handed | 8.85 | 8.20 |
| Roughness | | |
| Right-handed | 0.95 | 0.90 |
| Left-handed | 0.75 | 1.15 |



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