Vibrotactile threshold and pulse polarity¹

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Abstract

Vibrotactile thresholds on human glabrous skin were determined for short monopolar pulses and for two directions of skin displacement. Positive and negative going pulses showed no threshold differences. No threshold difference was obtained when movement into the skin was compared to outward movement of the contactor. The threshold appears to be independent of the direction of displacement.

Introduction

It can be easily demonstrated that it is difficult for the average S to distinguish a slight push from a slight pull on a von Frey hair glued to the skin. This elementary observation was cited as evidence for the pressure-gradient hypothesis for tactual stimulation (von Frey & Kiesow, 1899). Distortion of the skin, regardless of direction, appears to be adequate to produce the sensation of touch.

Recording from the dorsal cutaneous nerve of frog, Nafe & Kenshalo (1958) demonstrated that both pressure into the skin and the release of that pressure was adequate to elicit a neural response. In an earlier experiment, performed to investigate the role of stimulus movement in tactual sensitivity, Nafe & Wagoner (1941) found that their S reported tactual sensations at both the application and removal of weights from the skin. However, quantitative psychophysical experiments concerning this phenomenon are lacking.

Method

In this report two experiments are described in which tactile thresholds were determined as a function of the polarity of short, monopolar pulses and as a function of the direction of displacement at the onset and termination of long pulses. Four Ss were tested on the fleshy pad over the first metacarpal of the right hand. (The skin covering the Abductor pollicis brevis.) The contactor was an aluminum disk having an area of 2.9 cm^2 . Before testing, the contactor was adjusted so that in its resting position it pressed 1.0 mm into the skin. The vibrator and Ss were located within a sound proofed booth that provided isolation from building vibrations. Each S was tested three times using the method of limits.

Results

In the first experiment absolute thresholds were determined for positive and negative going, 1.0 msec.

monopolar pulses at repetition rates of 1.0 and 32 pulses per sec. The rise time of the pulses was 0.5 msec. The thresholds for positive and negative pulses were obtained alternately during the test sessions.

The results indicate that the Ss could not distinguish between positive and negative going pulses. The median of the threshold differences between the two pulse polarities was zero for all Ss at repetition rates of 1.0 and 32 pulses per sec.

In the second experiment long pulses were produced which were on for 2.0 sec. and off for 2.0 sec. This produced a reverse in the direction of displacement every 2.0 sec. The stimulus was perceived by the Ss only during the dynamic phase of the displacement. Thresholds were determined as a function of displacement as the contactor was advanced into the skin and again as the contactor was released. The results showed, as in the first experiment, that the direction of displacement had no effect on the absolute thresholds.

It is therefore concluded that pulse polarity and the direction of displacement of the skin have no effect on the threshold for touch. It is further suggested that the result of the second experiment is consistent with the position (Nafe & Kenshalo, 1958; Kenshalo & Nafe, 1962) that the response to tactile stimulation is determined by the velocity of tissue displacement rather than by the extent of displacement.

References

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Notes

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2. (Footnote added in proof) Eijkman (1959) determined that Ss could not correctly judge the direction of displacement at values of 2X threshold, but they were able to detect the direction at greater displacements.