NOCICEPTIVE DETECTION PROBABILITY DEPENDS ON THE TEMPORAL PROPERTIES OF ELECTROCUTANEOUS STIMULI

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ABSTRACT

Electrical stimulation of the skin using a needle-electrode specifically activates nociceptive nerve fibres. The detection of such stimuli by subjects depends on the activation of subsequent nociceptive mechanisms. Activation of these mechanisms depends on the temporal stimulus properties, such as the pulse-width, number of pulses, and inter-pulse interval. This different activation of nociceptive mechanisms is reflected in nociceptive (detection) thresholds [1]. The threshold is a commonly used measure to detect nociceptive malfunctioning and is defined as the stimulus amplitude resulting in a 50% detection probability in the psychophysical curve [2]. In addition to the threshold, the psychophysical curve is also described by a slope parameter, indicating the steepness of the curve. While the effect of stimulus parameters on the threshold was studied before, the effect on the slope was not studied before. The slope could be dependent on the processing of the stimulus by the underlying mechanisms, and thus on the temporal stimulus properties. Moreover, the combination of threshold and slope estimates could possibly be used to detect malfunctioning of nociceptive mechanisms. Here, we study whether different temporal stimulus properties do not only affect the detection threshold, but also the slope of the psychophysical curve.

30 healthy human subjects were included in a 10-minute psychophysical experiment. All experimental procedures were approved by the local ethics committee. Subjects were presented with electrocutaneous stimuli with various temporal properties and were to indicate detected ones. The pulse-width (either 480 or 820 μs), number of pulses (either 1 or 2 pulses), and the inter-pulse interval (10, 50, or 100 ms) were varied in this experiment. Generalized linear mixed models with a logit link function were used to obtain estimates of the detection probability given the stimulus amplitude.

The results showed that the psychophysical function, and thus the detection probability, depends on stimulus properties. Not only the threshold, but also the slope can change when different temporal properties are chosen. Moreover, habituation of the detection probability was present for all stimulus parameters, but the effect was strongest for 1-pulse stimuli. All this suggest that additional estimation of the psychophysical curve could be useful for improved observation of (several) nociceptive mechanisms.

REFERENCES

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