SUBJECTIVE LOCALIZATION OF ELECTROCUTANEOUS STIMULI

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Introduction

Studying the perception of spatiotemporal stimulus patterns in various modalities may yield important information on the way in which humans process sensory information. The perception of tactile and nociceptive cutaneous stimulus patterns have been studied by Stolle et al. [1] and Trojan et al. [2][4] respectively. Among other things, both authors studied subjective localization of single stimuli. In Trojan et al. [4], two types of mislocalization patterns were observed for nociceptive single stimuli when comparing the localization reports with the stimulus locations: (1) overall proximal or distal displacement and (2) expansion or contraction of the stimulus area.

It is unknown whether tactile and nociceptive stimuli at the same skin site are *perceived* as being at the same site. Therefore, comparing the spatial perception of tactile and nociceptive cutaneous stimuli may provide new insights into their processing. This comparison can only be successfully made by applying nociceptive and tactile stimuli at the same skin site in the same experiment. This can be done by using a device which has recently been developed at our institute and which we refer to as the bimodal stimulation electrode [3].

Recording the perceived locations of stimuli can be done by letting subjects report these on a scale. The most intuitive scale for this is the stimulated arm itself. However, this would bias the perception of stimulus location by providing visual information of the electrode locations. The goal of the present research was to (1) create and (2) test a setup which allows subjects to report perceived stimulus locations on their own arm without seeing the electrode positions. This was achieved by building a setup consisting of a touch screen (Provision Visboard) which presents a digital image of the subject's own arm (without electrodes) and which is positioned over this arm after the electrodes have been attached. Subjects can report the localizations by pointing at the screen using a pointer.

Methods

In order to assess the accuracy of the system, a test was performed in which a subject pointed at visual markers on his arm.

The setup was tested further in a single-stimulus localization study. Eight subjects (5 males and 3 females, age 21.5±1.6 years) participated in two consecutive experiment parts: a tactile and a nociceptive one. Both employed bimodal electrodes, which were left in place in between the parts. Four bimodal electrodes were placed along the line between the distal end of the ulna and the proximal end of the radius. The distance between the electrodes was 4.6±0.7 cm, with the first distal electrode placed 3 cm from the ulna. In each experiment part, 15 stimuli were given through each electrode, resulting in 60 stimuli per experiment part. Subjects reported the perceived location of each stimulus by using the touch screen setup.

Results and discussion

The reporting error in the accuracy test with the visual pointing task was 0.3 cm, which is much smaller than the inter electrode distance. Graphs were produced which present the subjective localizations in relation to the electrode positions for each subject, following the method introduced by Trojan et al. [4]. A within subject ANOVA showed a significant effect of location, but not of modality. Posthoc analysis showed that the subjective localization of each stimulus position was significantly different from all others. This demonstrates that our setup is sensitive to the difference in stimulus location for both modes of the bimodal electrode, making our setup a useful tool for studying the perception of spatiotemporal stimulus patterns.

References

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