A PATHWAY FOR PLEASANT TOUCH
LINKING PERIPHERAL RECEPTORS TO CENTRAL PROCESSING AND HEDONIC EXPERIENCE

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Abstract

This thesis investigates the mechanisms underpinning pleasant touch, describes a pathway from peripheral nerve endings in the skin to the insular cortex, and relates these findings to the subjective hedonic experience of touch.

In Paper I, the relationship between primary afferent encoding and perception of pleasantness was investigated by combining microneurography recordings from human mechanoreceptors with psychophysical measurements during soft brush stroking at 6 different velocities between 0.1–30 cm/s. Results showed that low-threshold unmyelinated fibers (C tactile, CT), but not myelinated afferents, responded most vigorously to intermediate brushing velocities (1–10 cm/s), which were perceived by subjects as being the most pleasant.

In Paper II, a group of patients with reduced C fiber density due to a rare inheritable disorder (hereditary sensory and autonomic neuropathy type V, HSAN-V), provided the opportunity to address how pleasantness is perceived when the number of CT afferents is reduced. In comparison with healthy control subjects the C fiber denervated patients displayed atypical pleasantness ratings for soft brush stroking across different brushing velocities. These results suggest that conventional pleasant touch is dependent on CT fiber density.

CT afferents are lacking in glabrous skin which suggests that pleasant touch is perceived differently in the palm compared to the forearm. In Paper III, three different experiments were performed on three different groups of experimentally naive, healthy subjects. In experiment 1, a series of brush strokes was first applied to the palm followed by a series of brush strokes on the arm; in experiment 2, this order was reversed. In experiment 3, brush strokes were applied to the palm and arm in an alternating fashion. In experiment 1 subjects rated gentle stroking as less pleasant on the palm compared to the arm. In experiments 2 and 3, similar ratings were seen for the palm and arm. These results suggest that the perception of pleasantness on the palm is affected by previous stimulation of the arm, but not vice versa. It was speculated that assessment of pleasant touch may be influenced by affective reactions elicited through activation of the CT afferent pathway.

Paper IV investigated whether CT afferents project to the cortex in a somatotopic fashion. In order to distinguish between cortical activations evoked by myelinated (Aβ) fibers and those specifically related to CT afferents six healthy subjects were compared to a unique patient (GL), who lacks Aβ afferents. Soft brush stimulation was applied to the participants' arm and thigh during functional magnetic resonance imaging (fMRI). CT afferents were shown to project somatotopically to the posterior insular cortex in a similar fashion to those previously identified for signalling temperature and pain.

In conclusion, this thesis provides an improvement to the understanding of the neural substrates governing pleasant touch. Further knowledge on the mechanisms behind affective touch may be useful for understanding certain psychiatric disorders, such as autism, where gentle touch is perceived as unpleasant.

Keywords: CT afferent, unmyelinated, pleasant, touch, human, microneurography
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The thesis is based on the following papers:

I. **Löken L.S**., Wessberg J., Morrison I., McGlone F., Olausson H. Coding of pleasant touch by unmyelinated afferents in humans. *Nature Neuroscience* 2009, May;12(5):547-8.

II. Morrison I., **Löken L.S**., Minde J., Wessberg J., Olausson H. Reduced C afferent fiber density affects perceived pleasantness of touch and empathy for touch. Manuscript.

III. **Löken L.S**., Evert M., Olausson H., Wessberg J. Order effects on affective ratings: pleasantness of touch in hairy and glabrous skin. Manuscript.

IV. Björnsdotter M, **Löken L**, Olausson H, Vallbo Å, Wessberg J. Somatotopic organization of gentle touch processing in the posterior insular cortex. *Journal of Neuroscience* 2009, 29(29): 9314-20.

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