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Investigations of human cortical processing of gentle touch

A study with time-resolved electro-magnetic signal analysis

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademin, Göteborgs universitet kommer att offentligt försvaras i hörsal Arvid Carlsson, Academicum, Medicinaregatan 3, fredagen den 17 maj 2019, klockan 09.00

av Elin Eriksson Hagberg

Fakultetsopponent:

Professor Morten Kringelbach

University of Oxford, UK, and Aarhus University, Denmark

Avhandlingen baseras på följande delarbeten:

I. Ackerley, R., Eriksson, E., & Wessberg, J. Ultra-late EEG potential evoked by preferential activation of unmyelinated tactile afferents in human hairy skin. 2013. Neuroscience Letters, 535, 62-66.

II. Eriksson Hagberg, E., Ackerley, R., Lundqvist, D., Schneiderman, J., Jousmäki, V., & Wessberg, J. Spatio-temporal profile of brain activity during gentle touch investigated with magnetoencephalography. Manuscript, submitted.

III. Eriksson Hagberg, E., Krýsl, D., Ackerley, R., Nilsson, J., Schneiderman, J. Lundqvist, D., Jousmäki, V., Malmgren, K., Rydenhag, B., & Wessberg, J. Induced brain responses to natural touch recorded with intracranial stereo-EEG and MEG. Manuscript.

IV. Eriksson Hagberg, E., Wramner, M., Nyberg, A., Blümel, S., Ackerley, R., Schneiderman, J., & Wessberg, J. Cortical potentials elicited by gentle touch to the hairy skin: A high-resolution EEG study. Manuscript.

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A study with time-resolved electro-magnetic signal analysis

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Abstract

The present work summarizes investigations of the temporal correlates of brain activity elicited by gentle, moving touch on the hairy skin in healthy participants and in epilepsy patients. Light touch to the hairy skin activates two distinct afferent classes: fast conducting, Aβ afferents and slowly conducting C-tactile (CT) afferents. Aβ afferents signal discriminative aspects of touch, whereas CT afferents are proposed to play a role in affective touch. Using complementary neuroimaging methods with high temporal resolution, we aimed to distinguish between brain responses evoked by Aβ and CT afferents. In Papers I and IV, electroencephalography (EEG) showed that brush stroking on the hairy skin evoked an ultra-late potential, presumably driven by CT afference to the brain. Source localization indicated the cingulate cortex, and the precuneus as the underlying sources of this ultra-late potential. In Paper II, using magnetoencephalography (MEG) to spatially track brain activations in response to brush stroking over time, we showed that Aβ afference rapidly activates a well-defined network, including operculo-insular and cingulate regions. In Paper III, time-frequency analyses of MEG recordings from healthy participants were complemented with analyses of stereotactic EEG (SEEG) recordings from epilepsy patients. Here, we showed that naturalistic stroking touch induced spectral changes in alpha, beta, and gamma frequencies in sensorimotor regions and the posterior insula, similar to what has been described previously in studies using less naturalistic stimuli such as electrical median nerve stimulation. The present work contributes new information about the spatiotemporal evolution of the brain's responses to caress-like touch and highlights the importance of considering both Aβ and CT afferents in gentle touch processing.

Keywords: Aβ afferent, C-tactile, touch, EEG, MEG, SEEG

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