Memories of touch: The role of higher order cortical areas in processing and remembering tactile textures.

Supervisory team:
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Project description:

Humans mainly use the visual system to understand and interpret the world, making it difficult for us to imagine the world of touch in any detail or understand its importance. Yet if we were unable to recognise objects from the way they feel, we would then most likely realise the wealth of information yielded up by this vital sense. This studentship project is aimed at understanding how texture information is processed in the brain and how the brain adapts and learns to attribute meaning to particular textures. To do this we will study texture processing in the rodent brain. Rodents are nocturnal animals and are therefore highly reliant on tactile information for identifying objects in their environment. Rodents are experts at touch. In laboratory tasks, we have found that they preferentially use their whiskers to identify different textures. Remarkably, they are able to distinguish between surfaces that differ in particle size by just 18um, a distance that is orders of magnitude smaller than the spacing between whiskers on the face.

Building on the findings of an earlier BBSRC PhD studentship (Pacchiarin et al. 2017; 2020), we propose to extend our investigation of how higher order somatosensory processing occurs in the cerebral cortex. We have established that primary somatosensory cortex (SI) is necessary for texture discrimination in freely moving mice by using chemo-genetic methods to inactivate temporarily SI during a whisker-dependent discrimination. Furthermore, using in vivo 2-photon microscopy of dendritic spines, we have found that SI neurones undergo structural synaptic plasticity during texture discrimination, if and only if the mice learn the discrimination. The next step is to determine how texture information processing proceeds from SI to the hippocampus via the hypothesised ventral stream pathway. We will initially study SII, which is strongly connected to SI, projects ventrally to Perirhinal cortex, and responds to tactile textures. We will inactivate SII during the learning task using DREADDs and measure whether the mice still learn the texture discrimination. These studies will lead to an understanding of how tactile sensory experience can be stored as memories that are used to direct future choices.

Pacchiarin et al (2017) Perceptual learning with tactile stimuli in rodents: Shaping the somatosensory system. Learning & Behaviour 45 (2), 107-114 Pacciarini et al (2020) Whisker-mediated texture discrimination learning in freely moving mice. J. Exp. Psych.: Animal Learning and Cognition 46 (1), 40.