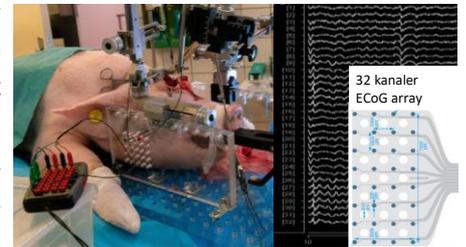


ANNUAL HIGHLIGHTS IN CNAP

CNAP has the ambition of being one of the world's best research centres within areas related to neuroplasticity and pain. Our concept is to "Provoke, Probe and Modulate" pain neuroplasticity, combined with a focus on interdisciplinarity, internationalisation, and training.

Research Highlights: Peripheral mechanisms play a critical role for understanding pain neuroplasticity as the origin for neural information traveling to the brain. Here, insight into specific ion channels in the sensory nerve fibres mediating pain is vital. CNAP studies this in humans by developing probing techniques based on electrophysiology and linking this to sophisticated computer models for relevant ion channels.

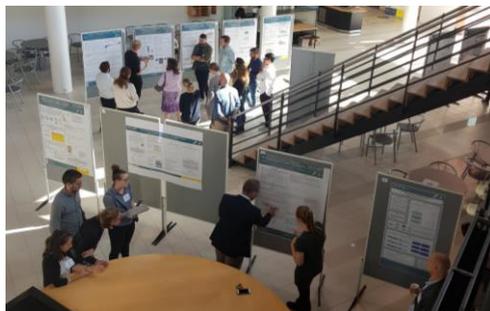
Much pain research is done in human or rodent models, but many findings in rodent models have later failed in clinical trials. To overcome these species-specific issues, an innovative pig model was developed at CNAP to study cortical pain neuroplasticity. Simultaneous recordings are done from electrodes inserted directly into brain areas and around the peripheral nerve. This allows tracking of the development of pain-related responses before, during and after a trauma.



Many chronic pain conditions, e.g. fibromyalgia, exhibit unexplained neuroplasticity with pronounced hypersensitivity. In the past year, we have discovered that environmentally induced epigenetic modification (DNA methylation) may be important for pain neuroplasticity. In a family cohort, the epigenetic fingerprint was compared in female pain patients and their sisters. In the pain patients we found a specific modification of the GRM2 region, which can contribute to higher levels of synaptic glutamate known as an excitatory mediator for pain neuroplasticity.

Based on a large meta-analysis of neuroplastic manifestations in chronic pain patients it was found that neuroplastic characteristics were present. Whether this illustrates a trait in pain neuroplasticity or more a state characteristic was further studied by investigating how episodes of pain impact measures of pain neuroplasticity, in comparison to pain-free periods within the same individuals. Pro-nociceptive mechanisms were facilitated by pain episodes in patients whereas the anti-nociceptive mechanism was impaired also in pain-free episodes, illustrating that the neuroplastic manifestations were both state and trait dependent.

Extension of CNAP: A proportion of 2019 was devoted to the application process for four more years of funding from the Danish National Research Foundation. The process culminated with a site visit by an international evaluation panel in September; also including an enriching poster session at which most CNAP projects were presented. After the visit, the panel gave CNAP a very positive evaluation. Their report mentioned, among other things, "New ambitious and innovative research plans are being launched, representing real innovation with the potential of groundbreaking results in the pain field but also in other areas in neuroscience and medicine", and "High level of enthusiasm and satisfaction expressed by students in relation to their work and activity at CNAP". Based on dedicated work by all CNAP members we can now appreciate that CNAP will continue at least until 2025.



Publications and Public Outreach: CNAP published widely in 2019 and papers by early career researchers received special attention as Editor's Choice paper with video summary (*McPhee*, Pain) and Featured Journal Club Article (*De Martino*, Journal of Pain). Moreover, several researchers gave popular science presentations e.g. as part of the Danish Science Festival (Forskningens Døgn) and Girls' Day in Science.

Congresses and Events: At the largest pain conference in 2019, the Congress of the European Pain Federation EFIC, CNAP was highly visible with more than 20 participants and more than 40 presentations. The annual CNAP research seminar had a special focus on the use of bibliometry and Social Media in academia. The purpose of this was to train our researchers in discussing and reflecting on the way they might use these instruments to gain more visibility in research.

Internationalisation, Interdisciplinarity, and Training: In 2019 in total, the gender composition of CNAP scientific staff was 50% male - 50% female. The researchers came from 17 different countries and had many different backgrounds within both Technical Science/Engineering, Health Science, and Natural Science, e.g. Biomedical Engineering, Physiotherapy, Medicine, Psychology, and Biophysics. Finally, several PhD defences witnessed the success of CNAP's research training.