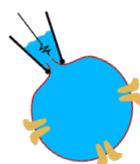
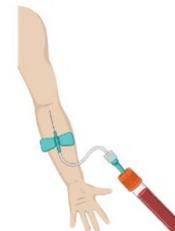


## ANNUAL HIGHLIGHTS IN CNAP

The CNAP approach to provoke, probe and modulate pain neuroplasticity, seeking fundamental mechanisms of neuroplasticity in human prolonged pain conditions, constitutes a strong impact on the research field. The below highlights illustrate the role of CNAP as an essential translational component bridging basic and human understanding of the pain system.

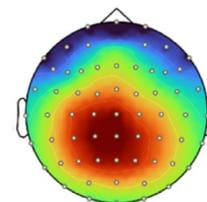
### Research Highlights

Epigenetics are heritable and perpetuate alternative functional states, which may confer vulnerability to pain neuroplasticity in long-term pain conditions. In 2022, CNAP researchers performed the first human study world-wide to evaluate the circulating markers for epigenetic changes after an experimental muscle pain provocation in healthy subjects. In the time-window up to 24 hours after the pain provocation, several epigenetic markers were altered. Interestingly, many of these markers have been related with the pain system and found upregulated in chronic pain patients.



Nociceptors signal to the central nervous system when the body is potentially harmed. Their responsiveness is governed by proteins in the cell membrane. Variations in genes coding for these proteins alter the responsiveness of nociceptors which is therefore a complex interplay between gene variants and expression. This year, CNAP studies showed that a newly developed perception threshold tracking protocol can quantify the responsiveness of single cultured cells.

Following a series of studies demonstrating that brain activity and sensitivity to painful stimuli were enhanced when exposed to prolonged pain in individuals with life-long extensive repetitive training (musicians) compared with non-trained subjects, CNAP studies extended this in 2022 by exploring the brain motor response in musicians compared with non-musicians as a function of prolonged experimental pain. After several days of experiencing experimental muscle pain, the brain motor response in musicians was not affected in contrast to non-musicians, who displayed a classical brain motor impairment associated with pain. These findings indicate that extensive repetitive training may facilitate pain perception and modulate the consequences of pain in the brain's motor pathways.



CNAP researchers have established a preclinical pig model to probe manifestations of pain neuroplasticity over time. Modulation of brain activity were demonstrated in both acute (one day) and chronic (weeks) pain conditions. Following these findings, invasive recordings from neurons in the spinal cord were added in 2022. This work proved unique as this was the first time to demonstrate simultaneous peripheral, spinal and brain recordings from the same pig during a pain provocation.

### Publications and Public Outreach

The scientific and societal impact of CNAP's research is essential. In 2022, CNAP researchers published more peer-reviewed papers than ever before, many in high-impact journals. In parallel, CNAP researchers engaged in the public dissemination for instance at Ungdommens Videnskabelige Forening and Forskningens Døgn as well as teaching activities at Aalborg University and at high schools.

### Congresses and Events

CNAP researchers attended the most important conferences within the field, e.g., the European Pain Federation and the World Congress on Pain by the International Association for the Study of Pain. CNAP presented more than 20 posters and 5 workshops at the two conferences and Graven-Nielsen gave a keynote lecture at the World Congress on Pain. Seven CNAP PhD students successfully defended their PhDs. The new CNAP Advisory Board was inaugurated in May and the CNAP seminar took place in December.



### Internationalisation, Interdisciplinarity, and Training

CNAP research environment is international, accommodating 32 researchers with 12 different nationalities and diverse backgrounds within e.g., biomedical engineering, medicine, biology, psychology and physiotherapy. Creating a diverse and creative research environment is a key CNAP objective. In 2022 CNAP comprised 47% female researchers and approx. 63% were in training positions.