

Body Pain and Perception Lab

BPP Lab Report - 2020/2021

by Francesca Fardo

At the beginning of 2021, thanks to an ERC Starting Grant, I launched the Body Pain Perception Lab at CFIN. Despite the pandemic and the lockdowns, we were off to a great start by running a very involved multi-center clinical trial on the effects of three known analgesics on functional biomarkers of pain. With the help of two student assistants, Signe Kirk Brødbæk and Thea Rolskov Sloth, as well as collaborators at the Danish Pain Research Center, we spent five weeks by the MRI scanner looking at brains, probing participants, handling drugs and blood samples. It was really hard work, but also a huge pay-off to get this clinical trial completed in a timely manner. It was a real privilege to be able to collect all the data we needed in five continuous weeks during a pandemic, as this was not the case for our collaborators in other research centers in Europe.

Shortly after, Rebecca Astrid Boehme, a psychology student from Potsdam University, joined the lab for an internship. Before enrolling in her psychology degree, she was trained as

an anesthesiology nurse and worked with children suffering from chronic pain. The synergy between her prior training and work experience, and the research we are doing in the BPP lab was a perfect match and led to many fruitful collaborations. She contributed to experimental design and assisted with data collection where anesthetic agents (i.e., lidocaine) were involved (Schaldemose et al, in prep). For her bachelor thesis, she designed an independent project where she applied structural equation modeling to investigate the relationship between mental health and pain sensitivity (Boehme et al, in prep).

In summer 2021, the BPP lab welcomed two other excellent interns, Jesper Fischer Ehmsen and Daniel Elmstrøm Christensen. At the time, both were bachelor students at Cognitive Science. During their internship, they worked on advanced statistical analyses and computational modeling of behavioral data, where around 270 participants completed a "Probabilistic Thermal Learning" task (see Figure 1). The data were collected, as part of a collaboration project with Micah Allen (AU) and Chris Mathys (AU), by several student or

research assistants, including Camilla Eva Andersen, Kristian Severin Mengel-Niemann, and Emma Risgaard Olsen.

Next, Camila Sardeto Deolindo joined the lab as a postdoc. In her first project, she used psychophysics to develop a new procedure to calibrate an illusion of pain, known as the Thermal Grill Illusion. In the future, she will build on this initial work and use magnetoencephalography to investigate brain microstates associated with the perception of illusory and veridical pain.

Finally, in December 2021, Camilla Eva Andersen started her PhD at Health under my supervision. The plan for Camilla's PhD is to use computational modeling, in particular Drift Diffusion Modelling, to investigate spatial summation and lateral inhibition mechanisms in thermosensation.

The first year of the BPP Lab was mostly focused on starting the group, ethics applications, and lots of data collection. We cannot wait to move forward with all our projects and share with you all our exciting results. Stay tuned for updates in the next CFIN Annual Report!

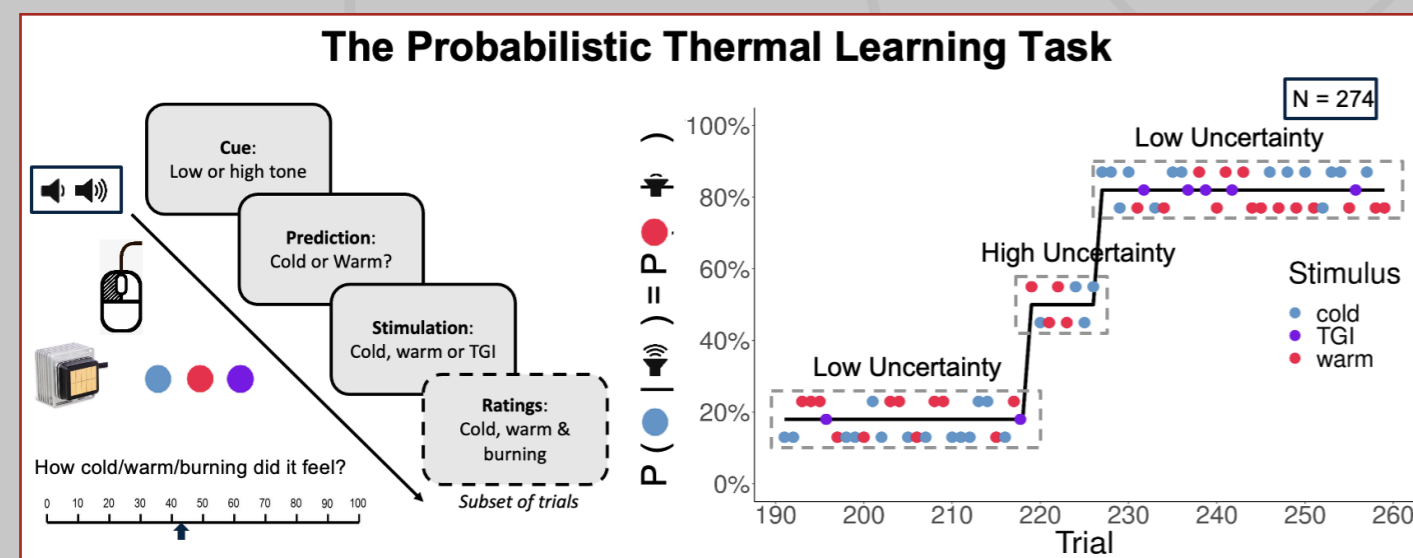


Figure 1 We quantified the relationship between learned expectations and thermosensation using a probabilistic associative learning task. In each trial, participants heard an auditory cue that was highly, weakly or not predictive of the subsequent quality of thermosensation (i.e., whether the stimulus would be cold or warm). Participants provided a binary response based on whether they expected a cold, or a warm stimulus given the cue. Participants had to dynamically learn new cue-stimulus contingencies throughout the task, as the association between the cue and the quality of the stimulation varied after either shorter or longer predefined intervals. Valid and invalid cue-stimulus contingencies were intermixed with a third type of stimulus that was simultaneously cold and warm. This stimulus was introduced to assess the effect of learned expectations on ambiguous thermal stimuli. The peculiarity of this third type of stimulus is that even if the cold and warm temperatures are objectively innocuous, most participants may perceive a distinct sensation of either freezing cold or burning hot – a phenomenon known as the Thermal Grill Illusion. An equal number of valid trials (expect and receive cold, expect and receive warm), invalid (expect cold but receive warm or vice versa), and ambiguous trials (expect cold or warm, receive both temperatures) was followed by VAS ratings, probing the participants to rate the cold, warm and burning qualities of their sensation.

FACTS

Group members:

- Francesca Fardo
- Camila Sardeto Deolindo
- Camilla Eva Andersen

Student assistants (2021)

- Signe Kirk Brødbæk
- Thea Rolskov Sloth
- Kristian Severin Mengel-Niemann
- Emma Risgaard Olsen

Interns (2021)

- Rebecca Astrid Boehme
- Daniel Elmstrøm Christensen
- Jesper Fischer Ehmsen

Active and ongoing collaborations:

- Chris Mathys (AU) and Micah Allen (AU): Computational modeling of thermal perception using the Hierarchical Gaussian Filter
- Diego Vidaurre (AU): Temporal decoding of pain processing
- Ellen Lund Schaldemose (AU) & Nanna Brix Finnerup (AU): Paradoxical heat sensations
- Jan Vollert (Imperial College London, UK): Paradoxical heat sensations & neuropathic pain
- Jonathan Brooks (University of East Anglia, UK) & Nanna Brix Finnerup (AU): Spinal cord imaging in amputees
- Harry Hebert (University of Dundee, UK) and the DOLORisk consortium: Predicting risk factors of chronic neuropathic pain
- IMI-PainCare-BioPain: Functional pain biomarkers of pain processing and analgesia in healthy subjects

References

Ongoing work

1. Boehme et al, in prep. "No Evidence for a Link Between Individual Mental Health Factors to Thermal Pain Thresholds"
2. Ehmsen/Christensen et al, in prep. "Expectation Uncertainty Modulates Veridical Thermosensation and Illusory Pain"

BPP collaborations

1. Hébert HL, Veluchamy A, Baskozos F, Fardo F, Van Ryckeghem DML, Pascal MMV, Jones C, Milburn K, Pearson ER, Crombez G, Bennett DLH, Meng W, Palmer CNA, Smith BH (2021). Cohort profile: DOLORisk Dundee: a longitudinal study of chronic neuropathic pain. *BMJ open*. 11:e042887
2. Legrand N, Engen SS, Correa CMC, Mathiasen NK, Nikolova NE, Fardo F, Allen A (2021). Emotional Metacognition: Stimulus Valence Modulates Cardiac Arousal and Metamemory. *Cognition and Emotion*, 11-17.
3. Schaldemose EL, Andersen NT, Finnerup NB, Fardo F. When cooling of the skin is perceived as warmth: Enhanced paradoxical heat sensation by cooling of the skin in healthy individuals. In preparation
4. Schaldemose EL, Raaschou-Nielsen L, Rebecca Astrid Böhme RA, Finnerup NB, Fardo F. It is one or the other: No overlap between healthy individuals perceiving thermal grill illusion or paradoxical heat sensation. In preparation

NEW FACE at CFIN



Camilla Eva Andersen joined CFIN in December 2021 as a PhD student, supervised by Francesca Fardo (Body, Pain, and Perception Lab).

Although she has recently started her PhD, her face may already be familiar to you, as she worked in several behavioral and neuroimaging projects

at CFIN & MIB since 2016. Camilla and Francesca actually met for the first time in 2016, when Camilla was a student assistant in a project about language and pain, in collaboration with Nikola Vukovic and Yury Shtyrov ([link](#)). More recently, Camilla worked on the Caregiving project (Hedonia Group) and the Visceral Mind Project (Embodied Computation Group). Among all these projects, she collected data of several hundreds participants using behavioral techniques, EEG, MEG and/or MRI. Camilla completed her master's degree in Cognitive Science at Aarhus University in July 2021. In her thesis, she analyzed MEG and resting state fMRI to assess cognitive differences in parents and non-parents in collaboration with MIB's longitudinal Caregiving Project. For her PhD, she has now switched topic to pain perception, and she is particularly interested in computational modeling of behavioral and MEG data to better understand how thermal pain is perceived in both healthy volunteers and patients with diabetic neuropathy.

NEW FACE at CFIN



Camila Sardeto Deolindo, joined CFIN in August 2021 as a postdoctoral researcher, supervised by Francesca Fardo at the Body Pain and Perception Lab.

She is an electronics engineer and received her PhD in Health Sciences from the Albert

Einstein Israelite Hospital in São Paulo, Brazil, where she studied the physiology of decision making in critical environments. These measurements can be used in other realistic experiments to assess cognitive functions.

Her postdoctoral project's long-term goal is to evaluate how innocuous thermal stimuli presented simultaneously give rise to the perception of pain (Thermal Grill Illusion). By assessing this illusion, we can study pain without noxious stimulation, which can contribute to further insights on how pain perception occurs.