I FEEL YOUR PAIN: THE SOCIAL NEUROSCIENCE OF EMPATHY FOR PAIN AND TOUCH

Chair: Loren Martin, PhD, Assistant Professor, University of Toronto Mississauga, Departments of Psychology and Cell Systems Biology

Speakers:
- Robert Bonin, PhD, Assistant Professor, University of Toronto, Leslie Dan Faculty of Pharmacy
- Loren Martin, PhD, Assistant Professor, University of Toronto Mississauga, Departments of Psychology and Cell Systems Biology
- Philip Jackson, PhD, Full Professor, Université Laval, École de Psychologie

Symposium Abstract:

It is well known that social context robustly affects pain levels and outcomes in chronic pain patients. Direct effects of varying social context on laboratory pain sensitivity have also been demonstrated, but prove to be complex. It is of considerable surprise to many that social contexts and social interactions affect pain sensitivity in laboratory animals—but such observations have been made, and interest in the topic is growing. In particular, pain elicits behaviors in humans and nonhuman animals that serve as social cues. Pain behaviors serve a communicative function in humans, and this may be true as well in other animals. Increasingly, data supports the ability of social contact, empathy, social buffering, and social stress to modulate pain sensitivity and pain behavior in mice and rats. However, in order to understand and appreciate the social modulation of pain, studies in laboratory animals as well as humans need to be integrated.

We propose a symposium to discuss the important influence of social interactions and environmental context on pain responses and empathic behaviour in mice and people. In addition to our findings, we will discuss issues related to the feasibility and conduct of animal as well as human studies examining questions pertinent to the social modulation of pain. Our goal is to engage clinicians with pain neuroscientists to address how basic and clinical scientists can best address these complex questions.

Learning Objectives:

1. Upon completion of this session, attendees will be able to discuss the different components of empathy in the context of pain across different species
2. Upon completion of this session, attendees will be able to discuss the physiological underpinnings of physical social contact and their possible contribution to pain sensation
3. Upon completion of this session, attendees will understand the many factors that can modulate brain responses of people facing others in pain

Modulation of pain processing by socially-relevant gentle touch
Robert Bonin, PhD, Assistant Professor, University of Toronto, Leslie Dan Faculty of Pharmacy
Close social interaction incorporates a number of sensory and behavioural factors that interact to create social experiences. Physical contact provides a powerful means of communication that elicit a wide range of responses between individuals, from pleasant to repulsive. In mammals, gentle stroking of hairy skin is generally regarded as pleasant and is thought to serve a unique, physical form of communication between individuals as well as a means of self-stimulation. However, the sensory pathways responsible for this pleasant sensation have not been identified, nor is it known whether these sensory pathways interact with other sensory modalities or directly modulate pain sensation. To explore these questions, we have taken advantage of a recently identified and genetically distinct subset of sensory afferents in mice that respond to gentle stroking of hairy skin. Using a combination of optogenetic and chemogenetic approaches, we explored how the activation of these putative “gentle touch” afferents modulates nociception in mice, and sought to identify a subset of neurons in the dorsal horn of the spinal cord that receives direct input from these afferents. We observe a large proportion of lamina II neurons that receive direct input from optogenetically activated “gentle touch” afferents, suggesting that these afferents can interact with nociceptive processing. The peripheral activation of these afferents produced mild behavioural responses that were not indicative of noxious sensation, while permanent ablation of these neurons only produced subtle changes in self-grooming. Direct activation or ablation of these afferents did not modulate acute nociception. We speculate that the activation of these putative “gentle touch” afferents constitutes a unique non-noxious stimulus that has the potential to broadly modulate noxious sensation.

**Empathy and affective communication in rodents**
Loren Martin, PhD, Assistant Professor, University of Toronto Mississauga, Departments of Psychology and Cell Systems Biology

Empathy has deep evolutionary roots. It is a fundamental process required for social behaviour and allows the understanding of emotions by sharing sensory and affective states with other individuals. Even the most advanced forms of empathy in humans are built on more basic forms and remain connected to core mechanisms. Given the complexity of empathy, investigation of its neurobiological underpinnings would be meaningless without breaking it down into component processes. An increasing amount of evidence suggests that the core components of empathy are shared among rodents and non-human mammals. This talk will give a brief overview of how we study empathy in rodents and discuss molecular targets necessary for its regulation. In particular we find that familiarity between conspecifics is necessary for a form of empathy and that increased stress hormones prevent the expression of empathy between strangers. Recently collected data indicates that the expression of empathy is prevented via an upregulation of the stress-related glucocorticoid receptor in the medial prefrontal cortex. Additionally, we have also developed a novel paradigm for sympathy-like behaviours in mice that is based on prior pain experiences. We find that mice that are pain experienced display more social behaviours towards mice that are currently in pain. Pain experienced mice are more likely to groom, huddle and lick their cage mates when compared with a mouse that has not experienced the same pain stimulus. These models of empathy provide a new means for studying the relationship between social factors, stress and pain. They will also provide insight into the fundamental mechanisms that engage the neural circuits responsible for empathy–like behaviours and will shed light into the molecular mechanisms that are necessary for these behaviours.
The effect of vicarious pain exposure on the behavioural and cerebral responses to the suffering of others
Philip Jackson, PhD, Full Professor, Université Laval, École de Psychologie

In humans, observing pain in others modulates the level of activity in brain regions involved in the processing of nociceptive stimuli. While the extent and specificity of this shared representation of pain is not yet fully understood, evidence suggests that individual differences in the observer and contextual/social factors play important roles. However, whether the vicarious experience of other people’s pain is predictive of one’s subsequent helping behaviour remains unclear. A series of experiments in individuals that are exposed to the pain of others and then asked to detect, evaluate or care for the pain of others will be described. The relationship between pain assessment, prosocial intent and changes in brain activity measured with electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) will be discussed. In these studies, exposition to pain is examined in two different ways: 1) in healthy individuals exposed experimentally by means of repeated presentation of visual stimuli showing people in pain; 2) in individuals that have been regularly exposed to pain such as health professionals and spouses of individuals with chronic pain. Amongst the novel findings, the specificity of previous exposure to pain compared to other negative stimuli, and a link between dampened brain responses and clinical experience in healthcare professionals will be presented. The relationship between expertise, neural response, and evaluation of others’ pain is more complex than suggested by early neuroimaging data, and may vary across healthcare professions, patient populations, and experimental settings. The findings will be discussed in the context of an empathy framework in healthcare, which posits the existence of a fragile balance between healthcare professionals’ care for patients in pain and the regulation of their empathic responses to avoid overwhelming personal distress.