Prediction bias in perceptual experience and decision making

Tuesday, Jun 19: 8:00 AM - 9:15 AM
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Symposium
Tuesday - Symposia AM

Although psychological and cognitive research has established the role of bias in perception for several years, recently several neuroimaging studies have the emphasis on top-down processes and knowledge of how priors are used in learning and decision making. A persuasive adaptation of priors in research approaches are generative models such as predictive coding, Bayesian and computational models that offer a principled, model-driven and deductive approach for studying brain function. The central focus of this approach is to identify a multi-purpose model for understanding heuristic brain functions such as aversive and reward based learning. However an exposition of how predictions can bias our mental experiences away from sense data is a viable source of insights on perceptual processes in both health and disease. The objective and deductive evidence directs new epistemological challenges to how we view sense perception in general and it may lead to new demarcations of boundaries and limits of perception. Studies in prediction bias also serve an important function of isolating lacunae in brain function that contribute to mental health and social issues. Overall, we argue that understanding the neural underpinning of prediction bias is useful because it has a wide range of social and clinical implications.

Objective

-To understand that predictions - based on prior knowledge, have an influence on sensory, cognitive and social decisions.
-To learn about new models of brain function that offer key insights on maladaptive perceptual processes that lead to mental health issues.

Target Audience

Scientists, clinicians, knowledge users, stake holders, patients and lay audience.

Organizer

Javeria Hashmi, Dalhousie University

Presentations

Hallucinations as top-down effects on perception (index.cfm?do=ev.viewEv&ev=1646)

The problem of whether and how information is integrated across hierarchical brain networks embodies a fundamental tension in contemporary cognitive neuroscience, and by extension, cognitive neuropsychiatry. Indeed, the penetrability of perceptual processes in a ‘top-down’ manner by higher-level cognition—a natural extension of hierarchical models of perception—may contradict a strictly modular view of mental organization. Furthermore, some in the cognitive science community have challenged cognitive penetration as an unlikely, if not impossible, process. I will review the evidence for and against top-down influences in perception, informed by a predictive coding model of perception and drawing heavily upon the literature of computational neuroimaging. I extend these findings to propose a way in which these processes may be altered in mental illness. I propose that hallucinations - perceptions without stimulus - can be understood as top-down effects on perception, mediated by inappropriate perceptual priors. I will show empirical data from behavioural, computational and functional imaging studies that suggest hallucinations are indeed an example, from psychiatry, of the penetration of prior beliefs into perception. That people without a history of serious mental illness can also evince hallucinations underlines the relevance of this phenomenon for understanding conscious perception.

Presenter

Philip Corlett, Assistant Professor, Yale University

Predictive states exert strong biases in pain perception (index.cfm?do=ev.viewEv&ev=1647)

Pain research has shown that our perceptual reality will match stimulus reality only insofar as the stimulus properties matches the expectation. The brain endogenously adjusts peripheral pain signals to ensure that our response to threats is appropriate to the circumstance. Context based pain processing is necessary for generating appropriate physical and mental responses to threats and thus plays a key role in the survival of the species. The fact that the perceptual experience of pain is modified by context is clinically useful since it explains underpinnings of phenomenon such as placebo response. However, context and prior predictive states can also result in amplification of pain and interfere with the process of generating positive response to treatments. This talk will discuss brain imaging studies that have shown how the process of treatment mobilizes top-down states of expectation, attention, memory and motivation; these states are the main substrates through which context shapes and modulates pain perception. In addition, cognitive models of pain expectation are yielding new information about the nature and extent of bias that expectations induce on pain perception. The large extent to which prior states and expectation alters pain intensity maps to underlying cortical and sub-cortical circuitry related to reward and aversion. Since pain must be tolerated in several contexts for future rewards, the experience of pain is adaptively modulated through underlying generative mechanisms that weigh the potential risks against the rewards. Thus sensory modulation of pain is an important example for understanding how our perceptual reality is controlled by our motivations and prior predictive states. The role of context in pain perception is important because it explain why pain self-reports are so variable and helps to explain aberrant pain states such as chronic pains.

Presenter

Javeria Hashmi, Dalhousie University

Predicting threat: structure, dynamics, and individual differences (index.cfm?do=ev.viewEv&ev=1648)

Efficient prediction of potential threats enhances an organism’s chances of survival. One must be ready to quickly identify and react to clear, imminent danger, while also accurately and more deliberately assessing ambiguous threat situations. While many models of affective perception posit that all negative stimuli are threatening and aversive, our studies show that human observers are in fact keenly sensitive to different types of negative stimuli, exhibiting distinct response patterns to clear or ambiguous threats, and to merely-negative, non-threatening stimuli. We have shown that humans rapidly extract the spatial and temporal qualities of threat from scene images to decide whether imminent danger is present, and whether it is directed at us or someone else. We are able to efficiently integrate compound threat cues in human faces, such as facial expression, group identity, and eye gaze to decipher quickly the source and level of threat. I will describe the functional response patterns, neural substrates, and the neural dynamics in the visual, affective and prediction regions implicated in these processes, drawing on psychophysical, fMRI and MEG studies in our lab. I will discuss the role of expectations and how they are subserved by the major visual pathways and contribute to threat perception in visual scenes, faces, and crowds. Lastly, I will talk about how individual characteristics such as anxiety, sex, and age affect behavioral and neural responses in predicting threat.

Presenter

Kestutis Kveraga, Harvard Medical School, Mass General Hospital