



Introduction to the special issue on functional neuroimaging of the emotional brain



Emotions are central to who we are. They influence our worldviews, decisions, and memories and play a key role in determining which of the myriad events bombarding our senses we see, hear, and feel. Emotions arise in direct proportion to personal meaning—how relevant a stimulus or situation is to our wellbeing. They are thought to be hallmarks of integrative brain processes that bind together perceptions of the world, interoception of our bodily states, conceptions of meaning, and projections about the future. Their integrative nature also makes them complex, and for decades the brain processes that underlie emotions have remained part of a dark unknown space in our understanding of the mind.

However, recent years have witnessed a resurgence of interest in the organization of emotional brain systems. Numerous papers, reviews, and books—academic and popular-press—deconstruct the ‘emotional brain’ and its implications for health, disease, and other kinds of practically important outcomes [1–16].

This Special Issue of *Neuroscience Letters*—*Functional Neuroimaging of the Emotional Brain*—provides a concise survey of recent advances in this burgeoning area of research. Investigators from across North America and Europe contributed 10 original theoretical reviews. This exciting body of work encompasses a broad spectrum of populations—from rodents and monkeys, to children and psychiatric patients—and showcases a wide variety of paradigms, measures, analytic strategies, and conceptual approaches.

Several contributors focused on the nature of emotions, detailing the ways in which they are instantiated in the brain and body, and highlighting the added inferential value of recently developed machine learning approaches (Nummenmaa & Saarikmäki, *this issue*; Barrett & Satpute, *this issue*). Satpute and colleagues describe an integrative model of arousal—a core feature of emotion—and discuss some ways in which cutting-edge neuroimaging techniques promise to accelerate our understanding of the roles performed by the hundreds of identifiable nuclei and sub-nuclei nestled in the small space of the brainstem (Satpute et al., *this issue*). Casey and colleagues tell us how the emotional brain develops, focusing on adolescence, an important and, until very recently, understudied period of mammalian development (Casey et al., *this issue*). Silvers and Moreira describe new insights into the regulation of emotion (Silvers & Moreira, *this issue*). In an extension of existing conceptual models, they highlight emerging evidence that emotion regulation reflects the joint influence of regulatory capacity and trait-like differences in the tendency to use particular regulatory strategies (Silvers & Moreira, *this issue*). Emotion is profoundly intertwined with our social interactions, and several contributors considered ways in which emotions emerge from and, in turn, influence dynamic interactions among individuals and the social milieu. Brooks and Freeman describe a Dynamic Interactive model of emotion perception (Brooks & Freeman, *this issue*). Spunt and Adolphs also focus on the

decoding of emotion, highlighting emerging insights into the neural systems involved in detecting, categorizing (‘labeling’), and drawing inferences about emotional signals in the environment (Spunt & Adolphs, *this issue*). Echoing Barrett and Satpute and Brooks and Silver, they emphasize the complex ways in which ‘top-down’ and ‘bottom-up’ signals dynamically interact to generate internal representations of emotion. Lamm, Rütgen and Wagner extend this line of inquiry from social perception to the experience and expression of prosocial emotions, including empathy and compassion (Lamm et al., *this issue*). Several contributors concentrated on animal models of emotion. Baratta and Maier describe work tracing the distributed circuits underlying coping and its dramatic benefits for stress resilience (Baratta & Maier, *this issue*), while Fox and Shackman put a spotlight on fear and anxiety and argue strongly for the importance of developing cross-species translational models (Fox & Shackman, *this issue*).

Although the future of emotion research looks bright, it is clear that our understanding remains far from complete. In the accompanying review, we delve more deeply into the most important challenges facing the field and highlight some strategies for tackling them (Shackman & Wager, *this volume b*). Understanding how emotions are assembled and how they interact with the brain’s myriad circuits is a vital frontier, and promises to help us how emotional states and traits influence the way we think, feel, and behave.

Author contributions

TDW envisioned the Special Issue. TDW and AJS served as Guest Editors of the Special Issue. AJS drafted the Introduction. Both authors edited the paper and approved the final version. Dr. Stephen Waxman served as action editor for this article.

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