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Review

'Emotional Intelligence': Lessons from Lesions

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'Emotional intelligence' (EI) is one of the most highly used psychological terms in popular nomenclature, yet its construct, divergent, and predictive validities are contentiously debated. Despite this debate, the EI construct is composed of a set of emotional abilities – recognizing emotional states in the self and others, using emotions to guide thought and behavior, understanding how emotions shape behavior, and emotion regulation – that undoubtedly influence important social and personal outcomes. In this review, evidence from human lesion studies is reviewed in order to provide insight into the necessary brain regions for each of these core emotional abilities. Critically, we consider how this neuropsychological evidence might help to guide efforts to define and measure EI.

Emotional Intelligence

A long-standing goal in psychology and neuroscience has been to elucidate the mechanisms that enable individuals to interpret and respond to their environment in an adaptive manner. Traditionally, this pursuit has focused on critical cognitive abilities – verbal comprehension, perceptual organization, reasoning, problem solving, etc. – and their integration into a latent underlying construct, often referred to as 'general intelligence' or 'g' [1,2]. However, the degree to which general intelligence alone can predict important personal and social outcomes has been called into question, with research suggesting that it is an insufficient predictor of upward social mobility, career success, and creative achievement [3–5]. Accordingly, applied research has recently shifted its focus to the study of '**emotional intelligence**' (EI; see Glossary), referring to a set of emotional abilities purported to predict success in the real world above and beyond general intelligence. Evidence suggests that high EI is associated with improved mental health [6], better social problem solving [7], superior relationship quality [8], and enhanced academic and job performance [9,10]. As such, educators and consultants have devoted significant efforts to the development of tools to promote EI [11].

EI has been widely adopted in both basic research and applied fields, yet there is a lack of clarity in the field with respect to how EI should be defined and measured. Two of the most influential EI theories are Bar-On's mixed model and Mayer and Salovey's integrative model. According to Bar-On's mixed model, EI is defined as an array of 'noncognitive abilities', which influence an individual's adaptive success by shaping his/her interpretation and response to environmental demands and pressures [12]. However, the use of the term 'noncognitive' to define EI is problematic for several reasons, including the fact that emotional abilities must rely upon 'cold' cognitive systems (e.g., metacognition in **emotional awareness**, stimulus-driven attention in emotion recognition). Additionally, many of the noncognitive abilities incorporated into the mixed model are tangential to the established research literature on emotion and intelligence, resulting in a heterogeneous set of dimensions that are difficult to integrate into a cohesive EI construct [13]. Perhaps most concerning, the mixed model's divergent validity is weak, with 62% of the variance on its companion **Emotional Quotient Inventory** (EQ-i) being accounted for by

Trends

The validity of 'emotional intelligence' (EI) has been contentiously debated.

Despite this debate, human lesion studies suggest that several of the emotional abilities that make up EI are critical to human personal and social functioning.

Human lesion evidence suggests a core network of brain regions including the amygdala, ventromedial prefrontal cortex, insula, and anterior cingulate cortex is critical to a range of emotional abilities.

This evidence should be taken into consideration when attempting to define the factor structure of EI and develop empirically validated test materials.

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general intelligence and the big five personality traits [14]. In the integrative model, Salovey and Mayer [15] define EI as the confluence of a set of emotional abilities that enable individuals to 'carry out accurate reasoning about emotions and the ability to use emotions and emotional knowledge to enhance thought' [13]. Data from the integrative model's companion measurement tool – **The Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT)** [16] – correlate with general intelligence, but variance explained by other measures is reduced relative to the EQ-i (14%), suggesting that the integrative model has preferable divergent validity [14]. Additionally, the MSCEIT is a performance-based measure, whereas mixed models of EI often deploy self-report measures (e.g., EQ-i). In performance-based methods, the goal is to measure how well participants perform tasks and solve problems related to emotions, whereas in self-report methods individuals rate their level of agreement with descriptive statements about their own emotional abilities [17]. The performance-based approach is typically preferred in the domain of intelligence research, as it attempts to objectively isolate maximum performance (i.e., 'ability') in a way that is compatible with the intelligence construct [17]. Thus, for several reasons, empirical research on EI has typically favored Mayer and Salovey's integrative or 'ability-based' model of EI, whereas Bar-On's mixed model and related approaches are more often found in applied fields.

Akin to a lack of consistency in behavioral research on EI, neuroimaging studies have revealed similarly unclear results. There are six studies that have directly investigated EI on the Neurosynth[i] online neuroimaging archive [18], and we conducted a miniature meta-analysis using these studies to determine whether any particular brain regions have been 'reliably' associated with EI. Regions-of-interest were manually constructed based on the relevant neuroimaging tables reported in each paper, and these regions-of-interest were placed on a glass brain to visualize the degree of overlap between the six papers. The resulting figure revealed a striking level of inconsistency in brain regions that have been implicated using traditional measures of EI (Figure 1A, Key Figure). Therefore, inconsistencies in both the behavioral and functional neuroimaging data make it difficult to establish the neurocognitive factor structure of EI.

Goals and Structure of the Present Review

The field is in need of a clearer delineation of EI's constituent emotional abilities and some evidence that these abilities rely on a common network of brain regions, which would provide support for the assertion that they can be integrated into an overarching EI construct. The present review aims to accomplish these two goals. First, the review is organized according to the four domains of emotional ability that are included in all models of EI: (i) recognizing emotional states in the self and in others, (ii) using emotions to facilitate thought and behavior, (iii) understanding how emotions shape one's own behavior and the behavior of others, and (iv) regulating one's own emotions and the emotions of others [19]. By clearly outlining the component emotional abilities that are common to all EI theories, we aim to provide a clear definition of EI that represents a consensus across the various working models of this construct. Second, the review aims to summarize human lesion studies that provide insight into the network of brain regions that are reliably implicated across these component emotional abilities. In the domain of general intelligence, human lesion studies have provided critical evidence that damage to a fronto-parietal network leads to disruptions across a range of higher-order cognitive abilities, providing support for the presence of a core underlying 'g' factor [20,21]. Similarly, over the past few decades, research into the impairments and psychosocial consequences of focal brain injuries has helped to elucidate a network of brain regions that appear to be critical across a range of emotional abilities. The first section of this review outlines the key findings from this literature. Then, the next section considers existing methods used to measure EI, and how human lesion studies might inform future research on how to conceptualize and measure EI.