

## Theme: Cognitive Neuroscience

### ACC subregions underlying the neural circuitry of error-monitoring: a 7T fMRI study

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#### Abstract:

The anterior cingulate cortex (ACC) is a key region of error-monitoring, thought to signal the need for enhanced cognitive control to improve performance. However, this region has been linked to a wide range of functions, leading to the hypothesis that it comprises multiple specialized subregions. Despite this, the precise roles of these subregions remain unclear.

This study explored the functional parcellation of the ACC during error-monitoring using 7T functional magnetic resonance imaging (fMRI). Ten participants (mean age  $25.7 \pm 4.5$  years) performed a task with three conditions: in the response condition, participants responded without receiving feedback; in the feedback condition, performance feedback was provided; and in the observation condition, participants evaluated computer-generated responses. To spatially dissociate the effects of error response, error feedback, and error observation, we conducted a linear mixed-effects model to examine how ACC subregions responded to each of these conditions.

Overall, we found that distinct ACC subregions responded differently across conditions. In the response ( $p = 0.017$ ) and feedback ( $p = 3.50 \times 10^{-21}$ ) conditions, error-related activity was predominantly located in the dorsal ACC. In contrast, the observation condition elicited significant activity in the rostral ACC ( $p = 0.03$ ). While the subregions associated with error response and error feedback overlapped, the area activated by error feedback covered a larger region than that for error response. Interestingly, in the observation condition, rostral ACC activity diminished following errors compared to correct events. In contrast, as expected, dorsal ACC activity increased for errors in the remaining conditions.

In conclusion, ACC responses to errors are context-dependent, with spatial dissociation between subregions processing error response/feedback and error observation. Nevertheless, overlapping activity was observed for error response and feedback processing.

**Keywords:** Anterior cingulate cortex (ACC), error-monitoring, 7T fMRI.