Errors of mathematical processing: The time course of dorsolateral prefrontal and anterior cingulate cortex activity when solving algebra equations

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Our goal was to assess regions important for successful mathematical problem-solving. Prefrontal regions are more engaged when recognizing incorrect equations (e.g., 2 + 2=5)(Menon, et al., 2002)

However, no study has examined whether prefrontal activity is related to the production of correct solutions.

Question 1: Will activity in prefrontal regions differ between correct and error trials?

ROIs were obtained using a number size x time (2) x time (21) ANOVA or an accuracy x time (21) ANOVA. We were unable to include both accuracy and number size in an omnibus ANOVA because participants made too few errors in the small number condition.

Voxel-wise tests used a threshold of p < .001 and a cluster size of 8 voxels.

Question 2: Will dissociable regions of the ACC be active in the problem-solving and response phases?

This is the first event-related study that examines number size effects.

We predict that regions associated with successful calculation regardless of number size are important for general problem-solving.

Regions that are crucial for solving equations with large but not small numbers may be important for numerical manipulation and/or working memory.

Question 3: What regions are important for general problem-solving vs. regions that are engaged by greater numerical processing or working memory demands?

Subjects: n=9, average age = 23.8

Only subjects who achieved between 25% - 75% correct in pre-testing were included.

Stimuli:

Small: (x - 6)/3 = 7
Large: 5 * (x - 7) = 65

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