Flanker and task switching conflict produce separable dorsal anterior cingulate cortex activations: A high resolution fMRI investigation

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Introduction
Cognitive conflict is often discussed as a single phenomenon. We sought to differentiate the stimulus selection conflict generated by a flanker task from the response selection conflict generated by a pro/anti-response task. We have addressed this distinction using behavioral, fMRI, and, preliminarily, high-resolution fMRI.

We have found systematic differences in performance between flanker and pro/anti-response tasks, with pro-response trials showing effects of task history, but with anti-response and flanker trials showing no such effects. Neural activation signatures for the tasks also differed, especially in the dorsal ACC.

Behavioral Experiment:
Stimuli
Pro response: Indicate direction of center arrow
Anti-response: Indicate direction opposite the center arrow’s direction
Congruent
Incongruent
Pro
Anti

Behavioral Methods
Thirty-nine subjects (mean age 20.6) participated for pay or course credit. Participants completed 17 blocks of 85 trials each and had error rates of 15% or less overall. Errors and trials with RTs <200 ms or >1200 ms were excluded from further analysis. Inter-trial intervals ranged from 1800 ms to 2200 ms in 50 ms increments.

Scanning Methods
Stimulus presentation was identical to behavioral experiment except that 60% of the ITIs were 2200 ms, 30% were 4400 ms, and 10% were 6600 ms. Analysis was collapsed across ITI. Images were collected using a Varian INOVA 4 Tesla MRI and analyzed with SPM2.

Standard Resolution: 14 healthy adult subjects (mean age 24.6 years); 30 3.5 mm slices, 0.5 mm slice gap, in-plane resolution was 3.5 x 3.5 mm.
High Resolution: 2 healthy adult subjects (ages 20 and 24 years); 20 2.5 mm slices, 0.25 mm slice gap, in-plane resolution was 1.75 x 1.75 mm.

This volume was positioned to cover dorsomedial frontal cortex as fully as possible.

Future Directions
In order to refine our understanding of the role of dACC in cognitive conflict resolution, we are using high-resolution fMRI to examine whether distinct subregions subserve the different types of conflict.

Discussion
We found distinct patterns of activity between stimulus selection conflict and response selection conflict. Flanker activity was left lateralized in the dACC and was paired with left DLPFC and bilateral frontal pole activity. The pro/anteresponse task produced right DACC activity without corresponding DLPFC activity. Interestingly, both tasks activated the right inferior frontal junction.

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