The effect of object state-changes on event processing: Do objects compete with themselves?
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INTRODUCTION

Events often entail changes in state of individual objects. How do we maintain distinct representations corresponding to the ‘before’ and ‘after’ of a described event?

On reading “the squirrel will crack the acorn”, we must keep track of multiple representational instantiations of the acorn—before it was cracked, and after. Conversely, reading “the squirrel will sniff the acorn” requires only a single (unchanged) instantiation of the acorn.

The left inferior frontal gyrus (LIFG) has previously been demonstrated to be central in resolving competition amongst incompatible representations of a stimulus, as produced by an ambiguous word or a garden-path sentence (e.g., Hindy et al., 2009; January et al., 2009). To test the hypothesis that multiple object instantiations compete when an object is changed from its original state, we examined fMRI activity within LIFG across three tasks: (i) an event comprehension task; (ii) a Stroop interference functional localizer; and (iii) a sentence comprehension functional localizer.

METHODS

STIMULI

2 (object change) x 2 (temporal order) within-subjects factorial design.

EVENT COMPREHENSION TASK

N = 16 (9 female) 135 trials (30 trials of each condition & 15 catch trials) Each trial lasted 6 sec: first sentence presented for 3 sec, followed by second sentence for 3 sec. Stroop interference sentence was implausible given the first sentence.

FUNCTIONAL LOCALIZERS

Stroop Interference

Task Conflict trials interspersed with neutral trials (e.g., “farmer”). Ss pressed button to indicate font color of each word.

ROI 15 most responsive LIFG voxels for contrast of conflict trials vs. neutral trials

Sentence Comprehension

Task 12 sentence & 12 nonword blocks. Ss responded when consecutive trials had related sentences or identical nonwords.

ROI 15 most responsive LIFG voxels for contrast of sentence blocks vs. nonword blocks

LIFG

MAIN EFFECTS ANALYSIS

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RATED STIMULUS DIMENSIONS

Stroop Interference ROI Sentence Comprehension ROI

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ITEM ANALYSIS

Stroop Interference ROI Sentence Comprehension ROI

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BINNED QUARTILE ANALYSIS

Stroop Interference ROI Sentence Comprehension ROI

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AMPLITUDE MODULATED REGRESSION

Stroop Interference ROI Sentence Comprehension ROI

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DISCUSSION

Tracking objects across events requires maintaining multiple representations of the same object in different states (Allmann & Kamide, 2009). We demonstrate that this component of event cognition elicits a neural response in LIFG that overlaps with increased activation for incongruent trials in a Stroop color naming task, and does not overlap with increased LIFG activation seen during a sentence comprehension localization.

Through analysis of rated stimulus norms, we further observe that activity corresponding to functional localizers is separately modified by variations in distinct stimulus dimensions. The degree to which an object is changed through an event modulates the percent signal change in the Stroop interference ROI, while the rated inageability of an event modulates percent signal change in the sentence comprehension ROI. The inageability effect in the sentence comprehension ROI converges with recent evidence for greater activation in middle LIFG for words with lower inageability or concreteness ratings (e.g., Bedny & Thompson-Schill, 2006). The object-change effect in the Stroop interference ROI is the first neural evidence for interference between multiple representations of the same entity in different states.

LINGERING QUESTIONS

Graded or Probabilistic?
(i) Could be that the more an object is changed, the more semantic dimensions will be in conflict between the instantiations.
(ii) Could be that the more an object is changed, the greater the probability that a new representation of the object will be constructed & will compete for attention with the initial representation.

Object or Action?
(i) Conflict may be between action-independent object representations.
(ii) Conflict may be tied directly to abstract representations of the actions.

REFERENCES


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