

The Role of the Right Hemisphere in Successful Comprehension of Homonyms

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Purpose

Identify the neural regions activated in comprehending homonyms using two event-related fMRI experiments.

Behavioral Task

- Participants read sentences that ended in homonyms.
- A test word appeared after each sentence at a short (100 ms) or a long (3100 ms) test interval.
- Participants manually indicated whether the test word was related to the meaning of the sentence.

Experimental Stimuli

Experiment I

INAPPROPRIATELY RELATED: Test word related to the inappropriate meaning of the sentence-final homonym.

He won the match. FIRE

UNRELATED: Test word unrelated to the sentence meaning.

He won the game. FIRE

(Correct answer is “no” to both sentences.)

Filler stimuli were those used as experimental stimuli in Experiment II.

Experimental Stimuli

Experiment II

STRONGLY RELATED: Test word related to the appropriate meaning of the sentence-final homonym.

He lit the match. FIRE

NON-SPECIFICALLY RELATED:

Test word related to more than one meaning of the sentence-final homonym.

He saw the match. FIRE

(Correct answer is “yes” to both sentences.)

Filler stimuli were those used as experimental stimuli in Experiment I.

Previous Behavioral Findings

- Behaviorally, interference is observed at short test intervals when the test word is inappropriately related to the meaning of the homonym compared to when the test word is unrelated to the homonym. With longer test intervals, this interference dissipates, suggesting suppression of the inappropriate meanings (Gernsbacher, 1997).
- Behaviorally, comprehenders benefit more from strongly biased sentences that imply one specific meaning of the homonym compared to non-specific sentence contexts. This benefit is achieved initially and remains even over long test intervals (Gernsbacher et al., 2001).

Experimental Design

- 240 sentences, divided equally between 2 types of “no” & “yes” items.
- Experimental items counter-balanced so that across participants each test word served as an immediate-inappropriate, immediate-unrelated, delayed-inappropriate, delayed-unrelated in the first experiment and as an immediate-strongly related, immediate-non-specifically related, delayed-strongly related, and as a delayed-non-specifically related in the second experiment.
- Sentences were presented word-by-word at a rate based on each word’s length.
- 16 right-handed graduate or post-doctoral fellows; 2 males and 2 females assigned to each of the four material sets (one subject removed from analysis in Exp. II due to extraneous noise in fMRI signal).
- “Yes” and “no” responses were counter-balanced between the right and left hands.

Scanning Parameters

- GE 1.5T functional EPI images.
- 23 coronal slices, interleaved acquisition, slice/gap = 7/1 mm, TR = 3 sec, TE = 50 ms, 90° flip, matrix: 64 x 64, FOV 24 cm.
- 196 images for each of 5 scans, first 4 images removed.
- T1-weighted 3D SPR GR (256 x 256 x 124).

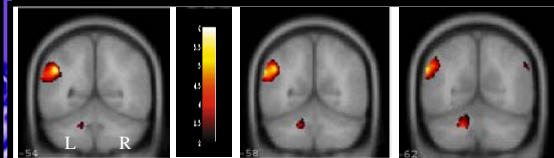
fMRI Data Analysis

- Post-processing and statistical analysis done with SPM99.
- Data sets slice-timed, motion corrected, coregistered, normalized, and smoothed (FW HM= 8 x 16 x 8 mm).
- Fixed-effect statistical analysis ($T = 3.11$, $p = .001$ uncorrected, $k = 0$) for each subject used in random-effect group analysis ($T = 3.73$, $p = .001$ uncorrected, $k = 0$).
- fMRI analysis based on cognitive subtraction at each test interval.

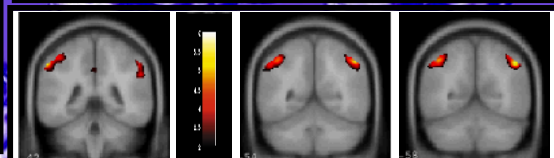
Behavioral Data

	Short Interval	Long Interval
Inappropriately Related	1048 ms - 8% error	1004 ms - 6% error
Unrelated	963 ms - 2% error 85 ms interference ($p < .001$)	980 ms - 3% error interference not sig ($F \sim 1.0$)
Strongly Related	925 ms - 7% error	915 ms - 4% error
Non-specifically Related	1062 ms - 18% error 137 ms advantage ($p < .0001$)	1064 ms - 17% error 149 ms advantage ($P < .0001$)

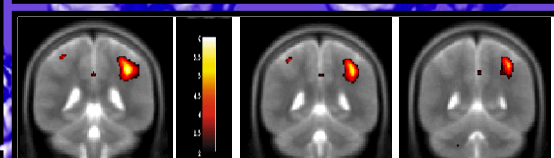
Inappropriately Related minus Unrelated at Short Test Interval



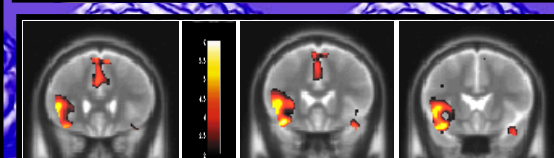
Inappropriately Related minus Unrelated at Long Test Interval



Strongly minus Non-specifically Related at Long Test Interval



Non-specifically minus Strongly Related at Long Test Interval



Thresholds greater than $T = 3.73$ are significant at the p -uncorrected cluster level .001