Differential fMRI Activation in a Priming Paradigm using Two Different Word Relatedness Types in Schizophrenia

Laurel H. Bobrow, Marek Kubicki, Martha E. Shenton, Robert W. McCarley, and Margaret A. Niznikiewicz

Psychiatry Neuroimaging Laboratory, Brigham and Women’s Hospital, Harvard Medical School, Boston, MA;
Clinical Neuroscience Division, Laboratory of Neuroscience, Boston VA Healthcare System - Brockton Division, Department of Psychiatry, Brockton, MA and Harvard Medical School, Boston, MA;
Surgical Planning Laboratory, Magnetic Resonance Imaging Division, Department of Radiology, Brigham and Women’s Hospital, Harvard Medical School, Boston, MA.

Background

Several fMRI studies of semantic priming in normal controls (NCs) indicate the involvement of specific brain regions in processing semantic information, typically with significantly less activation found to primed words. Relatively few studies of semantic priming that examine the extent and engagement of specific brain areas in semantic processing exist in schizophrenia (SZ) (e.g., Han et al., 2007; Kubicki et al., 2003). Our specific interest was in contrasting two types of semantic relationships: categorical and associative.

Exploring these two types of relationships allows insights about brain regions supporting two types of semantic networks: those organized according to feature overlap and words belonging to a category, e.g., couch and desk and those organized according to co-occurrence in language and culture, e.g., bee and honey. Relatively few studies asked questions regarding the possible differences and overlap in brain regions supporting these two types of relationships. Furthermore, there are no published fMRI studies in schizophrenia that compare activation patterns both as a function of priming at both short and long SOAs and as a function of type of relationships between words.

As expected, normal controls (NC) showed significantly more activation than schizophrenia subjects (SZ) in nearly all conditions testing the two types of semantic relations. NCs had more frontal activation in the associative conditions and more temporal activation for the categorical condition than SZ. There was more activation at the shorter SOA for NCs, these two lobes depending on condition and suggesting that different cognitive processes/brain areas are involved in these group differences. This suggests that semantic system is compromised in schizophrenia at multiple points.

Methods

• Stimuli: prime-target; 72 words of each target type:
  - Words related by category only: couch-desk
  - by association only: bee-honey
  - Unrelated words: branch-cake
  - Non-words: slope-meask
  - Words matched on frequency, length, syllables and imageability
  - Two SOAs: short SOA: 100 msec (2 runs)
  - long SOA: 750 msec (2 runs)
  - Primes and targets were displayed for 250ms each, and viewed on a mirror reflecting a back projection screen; time between the onset of one prime and the next was jittered between 7s and 9s.
  - Task: lexical decision.

• Scan parameters: 3T GE scanner, EPIBOLD sequence, 43 slices, 3.75mm x 3.75mm x 3.5mm, 2.5s TR
  - Subject: 16 normal controls (14 included per group)
  - categorical and associative 14 chronic schizophrenia patients were group matched (see below). All participants spoke English as their first language.

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• Age
• PSES
• Handedness
• Verbal IQ

Discussion

As expected, normal controls (NC) showed significantly more activation than schizophrenia subjects (SZ) in nearly all conditions testing the two types of semantic relations. NCs had more frontal activation in the associative conditions and more temporal activation for the categorical condition than SZ. There was more activation at the shorter SOA for NCs, especially for the categorical condition, whereas SZ subjects had more activation at short SOA for the associative condition and more at long SOA for the categorical condition. These results paint a complex picture of brain activation that depends on the type of semantic relationship and on temporal distance between prime and target in both subject groups. While the group differences were localized to aspects of frontal and temporal lobes, they were observed in different regions within these two lobes depending on condition and suggesting that different cognitive processes/break areas are involved in these group differences. This suggests that semantic system is compromised in schizophrenia at multiple points.

References

Han, SD, Spencer MH, Kubicki, M, Niznikiewicz MA, Jolesz, FA, McCarley RW, Nestor PG. Connectivity among semantic associates: an fMRI study of semantic priming. Brain Lang 2006;97:294-305