Title
Hemispheric Effects of Concreteness in Pictures and Words

Journal
Proceedings of the Annual Meeting of the Cognitive Science Society, 23(23)

ISSN
1069-7977

Authors
Casasanto, Daniel J.
Kounios, John
Detre, John A.

Publication Date
2001

Peer reviewed

Hemispheric Effects of Concreteness in Pictures and Words

Daniel J. Casasanto[1] (dcasasan@mail.med.upenn.edu)
John Kounios[2] (jkounios@cattell.psych.upenn.edu)
John A. Detre[1] (detre@mail.med.upenn.edu)
Department of Neurology[1] and Psychology[2], University of Pennsylvania
3400 Spruce Street, Philadelphia, PA 19104 USA

Introduction

Functional Magnetic Resonance Imaging (fMRI) studies have demonstrated differently lateralized activation during episodic memory encoding for verbal and pictorial stimuli, as predicted by the material-specific model (1). Results are interpreted as consistent with Dual Coding Theory, which posits parallel verbal and imaginal systems by which a given stimulus may be represented (2), the neural substrates of which have also been shown to be differently lateralized (3). Whereas previous encoding studies have examined variation across material types, the present study investigated hemispheric effects within material types. FMRI was used to determine the laterality of encoding-related activation for verbal stimuli that varied in concreteness, and for pictorial stimuli that varied in verbalizability.

Methods

Task Design

Verbal task. Nine healthy, right-handed native English speakers viewed blocks of serially presented English nouns, alternating with blocks of control strings (2500ms presentation, 500ms ITI). Noun stimuli comprised two sublists: 40 concrete and 40 abstract nouns (mean concreteness ratings 6.31 and 2.61, respectively, on a 1-to-7 point scale (Toglia & Battig, 1978)). Each task block comprised ten nouns: eight from one sublist and two from the other. Subjects classified nouns as concrete or abstract, responding via a left-or-right button press. Control blocks comprised ten strings of Ls or Rs, eliciting the same proportion of left and right button presses as the preceding block of nouns. Subjects were instructed to remember noun stimuli for a post-scan forced-choice recognition memory test.

Pictorial task. For each of two face memory encoding tasks, eleven healthy, right-handed volunteers viewed blocks of unfamiliar face photographs, alternating with blocks of a repeatedly presented pixelated control image (six 40s task/control blocks, 10 stimuli per block, 3500ms presentation, 500ms ITI). For the first task, full-head photographs were shown, including hair, neck, and upper shoulders. In some cases, clothing and jewelry were visible. For the second task, the same set of face photographs was used, but each photograph was cropped so as to include the brow, eyes, nose, and mouth, but exclude ears, hair, and any extraneous objects. Subjects were instructed to remember the faces for a post-scan recognition test, and to attend the control images but not to memorize them. Scanning occurred during the encoding tasks but not during recognition testing.

Image Acquisition and Data Analysis

BOLD functional images were obtained at 1.5Tesla in 20 contiguous 5-mm-thick axial slices. Multisubject SPMs were constructed in Talairach space using the SPM99{t} random effects model. Cognitive subtraction revealed activation associated with encoding during blocks of predominantly concrete and predominantly abstract nouns, and during cropped-face and full-head encoding. For each task, activation exceeding a statistical threshold ($\propto$=.05) was quantified in two *a priori*-defined regions of interest. ROIs comprised the inferior frontal gyrus (IFG) and fusiform gyri (FG), as these structures have demonstrated reliable material-specific effects in previous encoding studies. Hemispheric asymmetry of activation in each ROI was assessed using an asymmetry ratio [AR = (VoxelsR–VoxelsL)/(VoxelsR+VoxelsL)].

Results and Discussion

Differing hemispheric effects shown previously across verbal and pictorial material types were demonstrated in the present study within material types. Average activation in the ROIs was bilateral during encoding of concrete nouns [AR(IFG)=-.06, *ns*; AR(FG)=.13, *ns*], which are amenable to both verbal an imaginal coding, but significantly left-lateralized during encoding of abstract nouns [AR(IFG)=-.22, P=.001; AR(FG)=-.80, P=.009], which are resistant to imaginal coding. Activation during encoding of full-head photographs was left-lateralized in the IFG [AR(IFG)=-.46, P=.001] and bilateral in the FG [AR(FG)=-.25, *ns*], but activation during encoding of cropped-faces, which are resistant to verbal coding, was significantly right-lateralized in both ROIs [AR(IFG)=.12, P=.001; AR(FG)=.71, P=.001]. Replication of these findings within verbal stimuli that vary in imageability and within pictorial stimuli that vary in verbalizability would suggest that hemispheric specialization during memory encoding heretofore described as material-specific might be more accurately described as code-specific.

References

Casasanto, D.J., *et al.* (2000) in *Proceedings of the Cognitive Science Society* **22**, 77-82.

Paivio, A. (1991) *Canadian Journal of Psychology* **45,** 255-287.

Kounios, J. & Holcomb, P.J. (1994) *J. Exp. Psych.: Learning, Memory, & Cognition* **20,** 804-823.