

Processing of Factually Correct and Incorrect Sentences Involves Different Processes

Submission No:

3304

Authors:

Tao Yu¹, Simone Lang², Alexandra Markl³, Dominik Vogel³, Friedemann Mueller³, Ranganatha Sitaram⁴, Boris Kotchoubey¹

Institutions:

¹Institute of Medical Psychology and Behavioral Neurobiology, University of Tuebingen, Tuebingen, Germany, ²Institute of Psychology, University of Heidelberg, Heidelberg, Germany, ³Clinic of Neurology, Bad Aibling, Bad Aibling, Germany, ⁴Institute of Medical Psychology and Behavioral Neurobiology, University of Tuebingen, Tuebingen, Germany

Introduction:

Neurophysiological underpinnings of the integration of information during sentence comprehension have been studied since 1980. However, little is known about integrative processes in sentences containing word which is not semantically incongruent, but factually incompatible with the context (e.g., New York is the largest city of England). In the present study, we aimed at investigating the differences between the brain regions involved in responses to factually correct and incorrect sentences, using an event-related fMRI design.

Methods:

18 healthy right-handed native German speakers listened passively to 40 true and 40 false sentences while BOLD signal was recorded using a 3T Siemens scanner. Functional images were obtained using a multi-slice echo planar imaging sequence (TR = 2380 ms, TE = 25 ms, FoV = 210 mm, flip angle = 90°, 64 x 64 matrix, 40 slices, slice thickness = 3 mm, voxel size 3.3 x 3.3 x 3.0 mm). The fMRI data were preprocessed and analysed using SPM8.

Results:

A direct comparison of the activation for factually correct versus incorrect sentence endings revealed significant bilateral activation in the thalamus and the left premotor cortex (BA6) ($p < 0.05$, Family-Wise-Error corrected for multiple comparisons). Moreover, when clusters with a voxel-wise intensity threshold of $p < 0.001$ (uncorrected) were considered to be significant, we found additional differences in the bilateral superior temporal cortex and the left inferior parietal lobule associated to the processing of these two classes of statements.

Conclusions:

Factually incorrect sentence endings differentially activated the thalamus and the premotor cortex (BA6). Both areas have been previously related to language processing in clinical investigations. Some studies have demonstrated that the processing of semantic incongruence may occur even in the absence of conscious awareness. However, there is no such evidence regarding the processing of factual incongruence. Therefore, we argue that the present paradigm may be suited to for examinations of patients with disorders of consciousness, because a finding of a consistent brain response to factually incorrect sentences would be a stronger argument for the presence of conscious awareness than the response to semantically incongruent sentences.

Language

Language Comprehension and Semantics

Abstract Information

References

- Friederici, A.D. (2006). Broca's area and the ventral premotor cortex in language: Functional differentiation and specificity. *Cortex*, 42, 472-475.
- Just, M. A. (1996). Brain activation modulated by sentence comprehension. *Science* 274:114-116.
- Kotchoubey, B. (2002). Can humans perceive their brain states? *Consciousness and cognition*, 11, 98 - 113.
- Kotchoubey, B. (2005). Pragmatics, prosody, and evolution: Language is more than a symbolic system. *Behavioral and Brain Sciences*, 28(2), 136-137.
- Kotchoubey, B. (2005). Semantic processing in a coma patient. *Grand Rounds: A Journal for Case Studies*, 5, 37-41.
- Owen AM. (2002). Detecting residual cognitive function in persistent vegetative state. *Neurocase* 8(5):394-403
- Wahl M. (2008). The human thalamus processes syntactic and semantic language violations. *Neuron*. 59(5): 695-707.