Hum Brain Mapp. 2011 Jan;32(1):51-9. doi: 10.1002/hbm.21002.

Frontal and parietal contributions to arithmetic fact retrieval: a parametric analysis of the problem-size effect.

Jost K, Khader PH, Burke M, Bien S, Rösler F.

Author information

Abstract

The goal of the present study was to investigate the neuroanatomical basis of arithmetic fact retrieval. The rationale was that areas playing a crucial role in arithmetic fact retrieval should show a systematic increase of activation with increasing retrieval effort. To achieve this goal, we utilized the problem-size effect as this is known to be systematically related to retrieval effort. In contrast to many previous studies, we here took a parametric approach to account for the continuous increase of retrieval effort with problem size. BOLD signals were modeled with problem size as parametric regressor and negative slow waves of the EEG were categorized into six levels of problem size. The fMRI data showed that activation in the angular gyrus and ACC/SMA increased parametrically with problem size. The ERP data showed a systematic amplitude increase with increasing problem size, especially at fronto-central electrodes. Consistent with the fMRI data, source modeling localized this effect to the ACC. While these findings support previous notions about the crucial role of the angular gyrus during fact retrieval, they also provide evidence that the medial frontal cortex is involved when single-digit multiplications are solved. Thus, both parietal and frontal structures seem to be integral parts of a system that enables and controls arithmetic fact retrieval.

PMID:
20336690
[PubMed - indexed for MEDLINE]