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Mining Posterior Cingulate

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Modeling & Analysis

Abstract

Introduction

One of the goals in human brain mapping is to relate brain areas to psychological functions. Meta-analyses can confirm presumed links and further suggest new directions for hypothesis-testing research [1]. The mounting functional imaging literature calls for new innovative computer assisted meta-analysis schemes. Here we describe a semi-automated data mining method combining text analysis of PubMed abstracts and analysis of the spatial distribution of Talairach activation foci. The method is applied to extract main functions associated with the posterior cingulate and describe their spatial distribution within this area.

Method

We queried PubMed for articles about posterior cingulate including the retrosplenial area and further restricting the query to functional neuroimaging. The articles retrieved by the query were downloaded and converted to a vectorial bag-of-words representation by counting the number of occurrences of each word in each article. An extensive stop word list was applied to focus on words pertaining to brain function. The set of abstracts were represented in an abstract-times-words matrix and this matrix was subjected to non-negative matrix factorization (NMF) [2]. The number of components in the NMF was varied between K=1-12. Talairach coordinates were extracted from articles that had a high load on the NMF components and grouped according to their component. Multivariate statistical tests were performed to investigate whether the centroids of the sets of Talairach coordinates overlapped.

Results

The text analysis with NMF showed that the most dominating theme related to the posterior cingulate was memory: "memory", "retrieval", and "episodic" were the words that had the highest load on the component and, e.g., an article with the title *Remembering the past: two facets of episodic memory explored with positron emission tomography* was found to be a prototypical article for this component. "Alzheimer" ('s disease) was found as another prominent theme (figure 1). As the number of NMF components increased these two themes would typically be modeled with several components. Pain and emotion were also found as major themes. Spatial analysis of extracted Talairach coordinates revealed that memory and pain showed a difference in focus (Figure 2; Hotelling's T^2 test: P=0.0022; permutation test: P=0.002) where the memory coordinates showed an affinity toward the caudal aspect of posterior cingulate while pain was mostly confined to the rostral part.

Discussion

The finding that episodic memory retrieval and Alzheimer's disease were highly associated with posterior cingulate is in accordance with "manual" reviews [1, 3]. The involvement of the posterior cingulate cortex in pain was unexpected (e.g.[4]). Our analysis of the spatial distribution of Talairach coordinates showed functional heterogeneity along the rostrocaudal axis. This is "orthogonal" to the ventrodorsal cytoarchictonic division [5].

References

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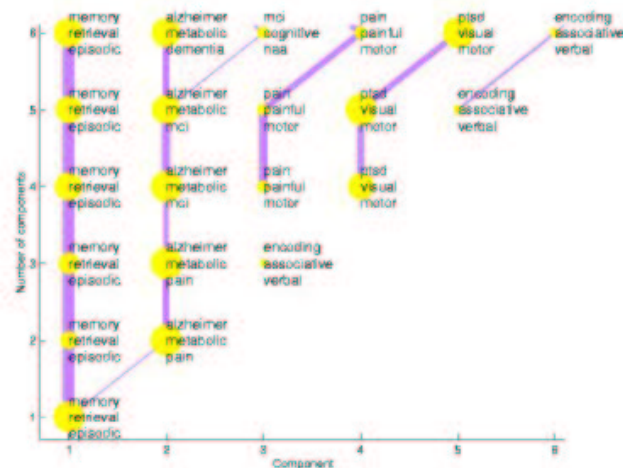
Overview of the NMF components. The *y*-axis represents the number of components *K*=1-6 in the NMF while the *x*-axis is the individual components. The words on each component are those with the highest load on the component.
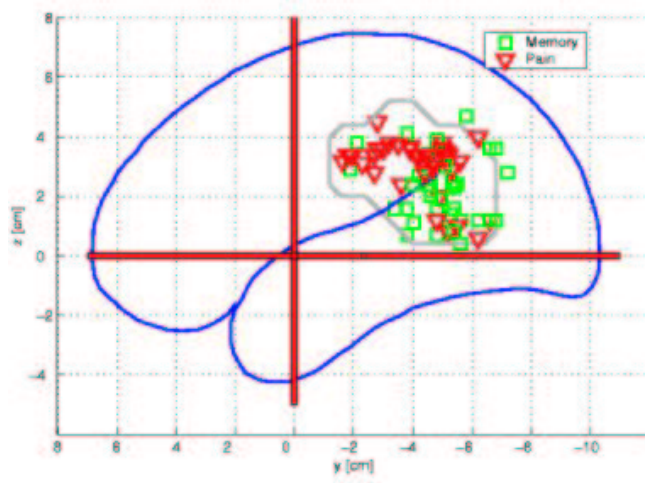
Sagittal view of memory and pain Talairach locations in posterior cingulate.

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