Interpretation of local abnormalities: Comparison of two fMRI databases - BrainMap versus Neurosynth - with regard to behavioural functional profiles of brain areas in healthy and clinical populations

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FMRI studies contribute to our understanding of brain structure-function relationships and the interpretation of local abnormalities. Imaging neuroscience faces 2 problems:

1. the rapid growth of the fMRI literature and
2. the lack of a interdisciplinary unified up-to-date coding system.

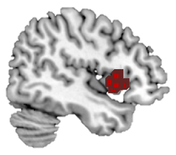
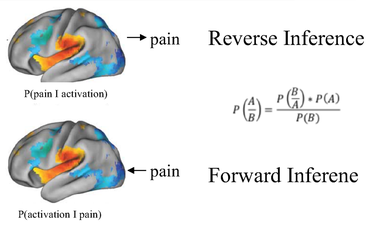
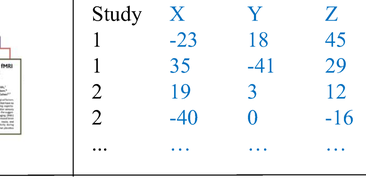
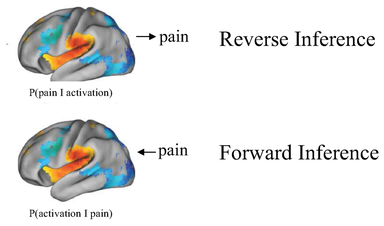
This study investigates if two fMRI databases - reach similar conclusions despite their different approaches when decoding brain areas: BrainMap versus Neurosynth.

Method:

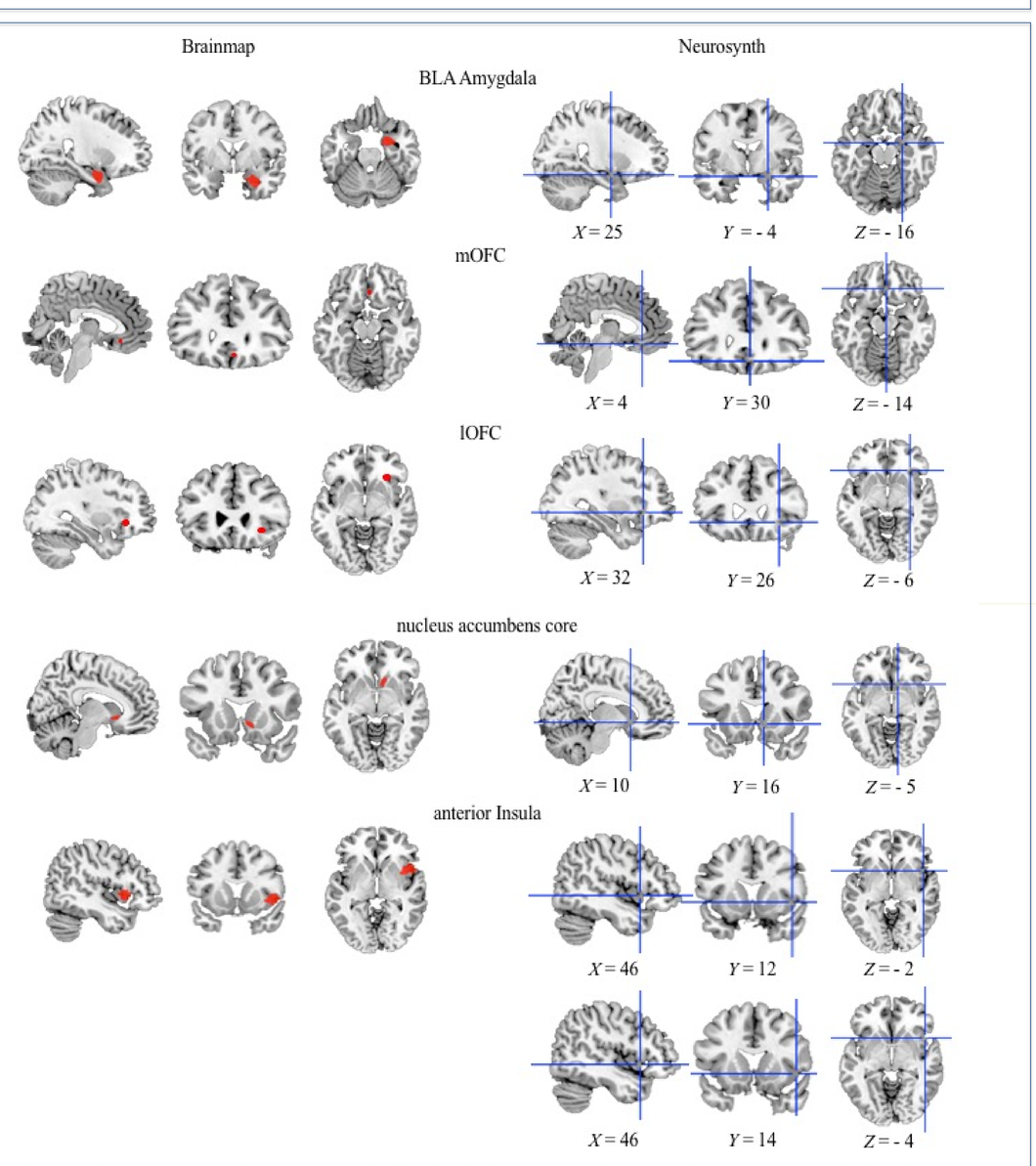
The two databases differ in 4 main aspects:

1. the organization of behavioural functional terms
2. the database input
3. the different analysis approaches
4. the total amount of stored studies

We developed a correspondence scheme assigning appropriate Neurosynth terms to terms in the BrainMap taxonomy. This correspondence scheme enabled the comparison of decoding results across databases. The database output were behavioural functional profiles of brain areas showing consistent and selective associations derived by the Forward and Reverse Inference analyses.

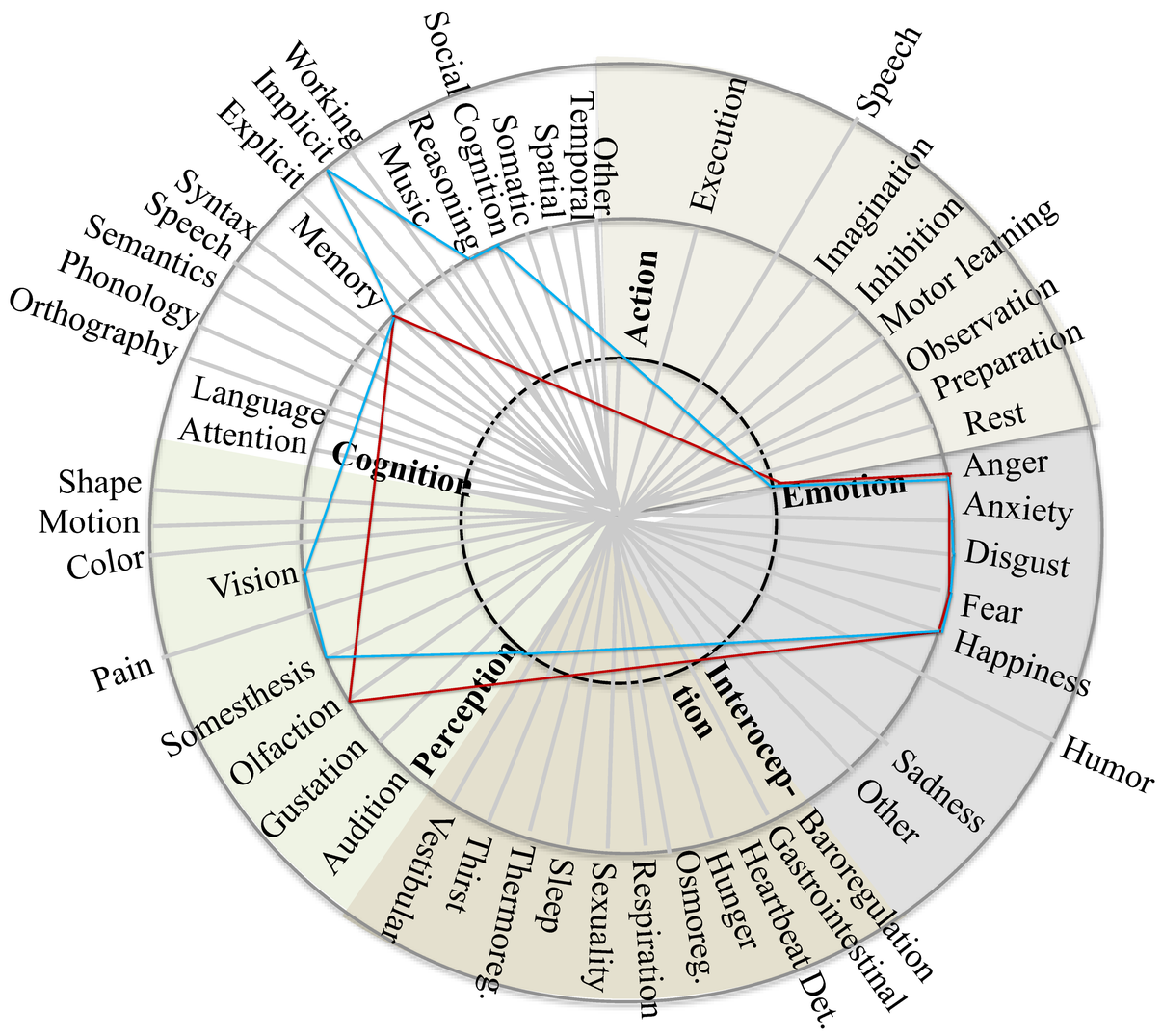
	Behavioural functional term extraction	Brain structure extraction	Structure-Function Meta-analyses / Behavioural functional decoding
BrainMap	Manually-curated extraction through experts and with the aid of many criteria 	Creating volume of interest (VOI) 	
Neurosynth	Automated-curated Text-mining technique 	Automated coordinate extraction 	

Different database approaches of BrainMap and Neurosynth



Database input: Brain areas definded by voxels (BrainMap) and brain areas defined by coordinates (Neurosynth)

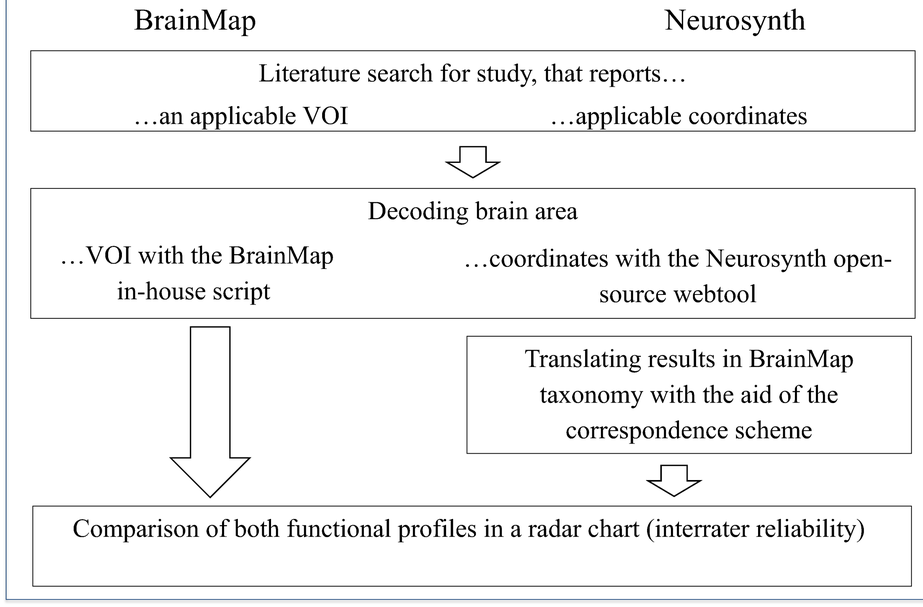
Functional profiles of the BLA amygdala derived by BrainMap (red) and Neurosynth (blue)



Results:

Overall agreement on functional profiles between databases was good (κ = .51): interrater reliabilities were excellent for BLA amygdala (κ = 1) and nucleus accumbens core (κ = 1) and poor for lOFC (κ = .29), mOFC (κ = .17) and anterior insula (κ = 0).

Analysis workflow



Discussion:

- BrainMap offered less error-prone and misleading results than Neurosynth.
- BrainMap often was inferior to Neurosynth in the total amount of studies, which found the same structure-function association.
- A future database could integrate a manual and automated coding system at the same time, but keep the BrainMap taxonomy. Thereby the future database could address both issues,
  1. the rapid growth of the fMRI literature and
  2. the semantic confusion on behavioural functional terms.
- A future study might circumvent the differences in database input by making a voxel-wise comparison for the whole brain.