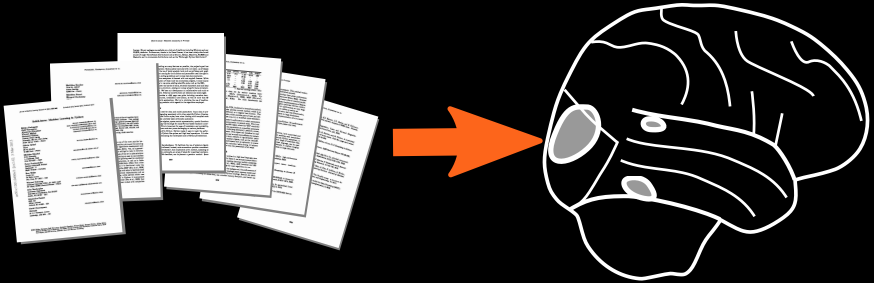
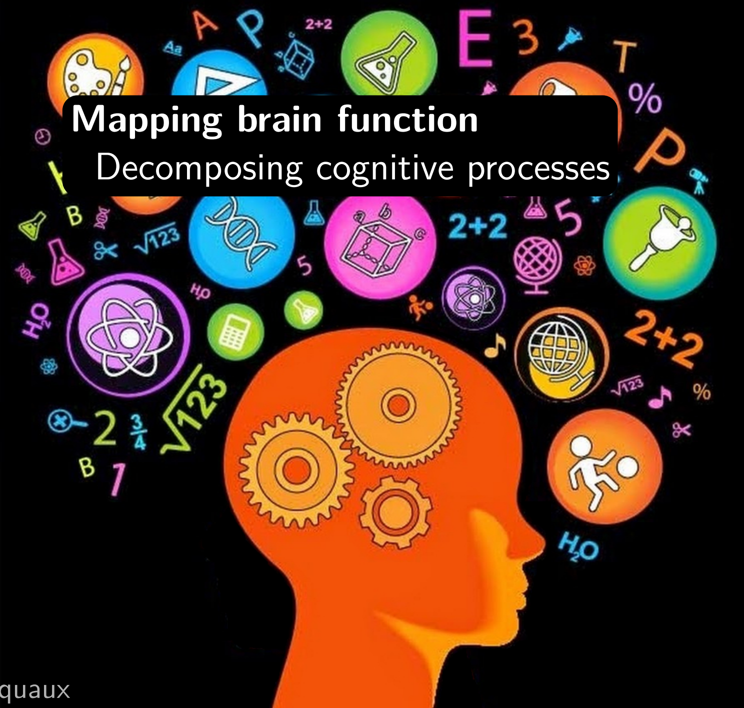
Mapping the brain
thanks to neuroscience publications

Jérome Dockes **Gaël Varoquaux** Inria



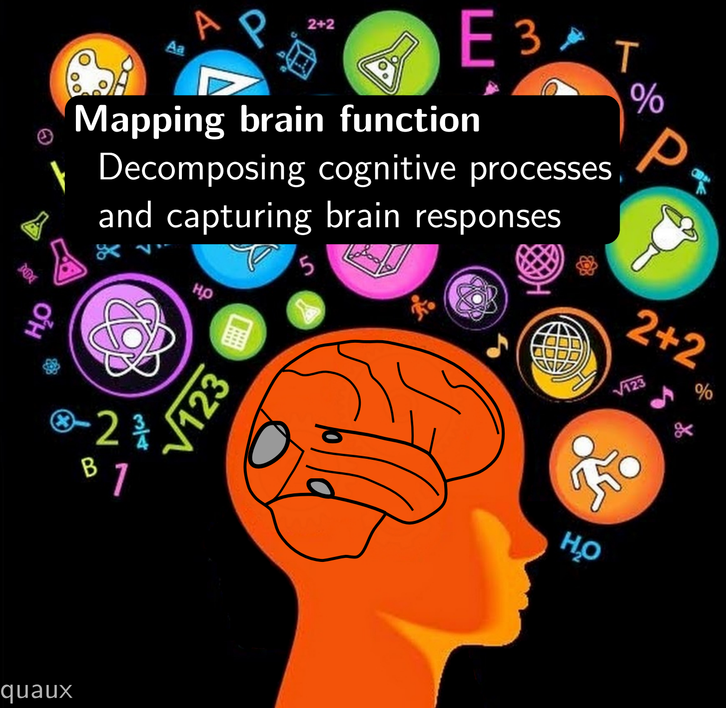
Mapping brain function

Decomposing cognitive processes

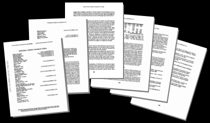


Mapping brain function

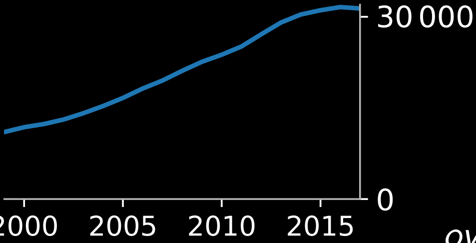
Decomposing cognitive processes and capturing brain responses



A vast literature



Papers containing the word “fmri”



overwhelming

A vast literature

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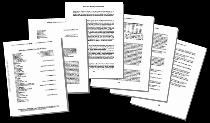

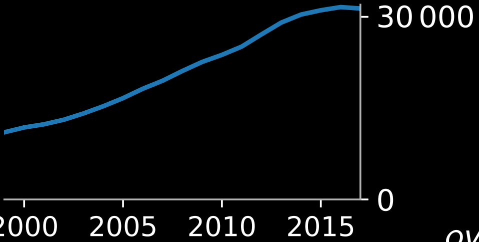

overwhelming

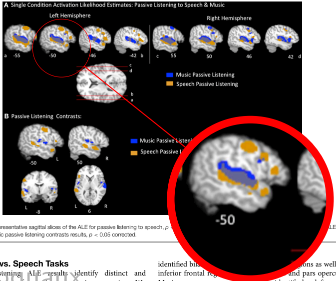

FIGURE 1 | (A) Representative sagittal slices of the ALE for passive listening to speech, p ... LE.
(B) Speech vs. music passive listening contrasts results, $p < 0.05$ corrected.

Music Tasks vs. Speech Tasks

The passive listening ALE results identify distinct and overlapping regions of speech and music processing. We now turn to the question of how do these distinctions change

identified bila... ions as well as left inferior frontal re... and pars opercularis). Music memory > speech memory identified a left posterior superior temporal/inferior parietal region and bilateral medial

TABLE 2 | Locations, peaks and cluster size for significant voxel clusters for each condition's ALE and for each contrast of interest.

Condition	Anatomical locations	Peak coordinates	Voxels
Music passive listening	Left inferior frontal gyrus (pars opercularis)*	–46, 10, 26	32
	Left medial frontal gyrus*, left subcallosal gyrus	–2, 26,–14	65
	Left medial frontal gyrus*	–2, 2, 62	48
	Left postcentral gyrus*, left inferior parietal lobule	–34,–36, 54	27
	Left superior temporal gyrus*, left transverse temporal gyrus, left middle temporal gyrus, left insula	–52,–20, 6	2073
	Right inferior frontal gyrus*	48, 10, 28	43
	Right precentral gyrus*, right postcentral gyrus, right middle frontal gyrus	52,–2, 44	173
	Right superior temporal gyrus*, right transverse temporal gyrus, right middle temporal gyrus, right insula	58,–20, 6	2154
	Right insula*, right inferior frontal gyrus, right precentral gyrus	42, 14, 0	206
	Right lingual gyrus*, right culmen	16,–54,–2	27
Music discrimination	Left medial frontal gyrus*, left middle frontal gyrus	–8,–4, 58	224
	Left precentral gyrus*, left postcentral gyrus, left inferior parietal lobule	–48,–12, 48	259
	Left precentral gyrus*, left inferior frontal gyrus (pars opercularis)	–50, 2, 26	67
	Left superior temporal gyrus*, left transverse temporal gyrus, left precentral gyrus	–54,–16, 8	239
	Left superior temporal gyrus*, left middle temporal gyrus	–58,–34, 8	92
	Left insula*, left inferior frontal gyrus (pars triangularis)	–34, 22, 2	48
	Left cerebellum*	–28,–62,–24	127
	Right inferior frontal gyrus*, right middle frontal gyrus	52, 12, 28	58
	Right precentral gyrus*, right middle frontal gyrus	46,–6, 44	170
	Right superior temporal gyrus*, right middle temporal gyrus	62,–24, 8	310
	Right superior temporal gyrus*, right precentral gyrus, right insula	50, 6,–2	91
Music error detection	Left medial frontal gyrus*	–4,–4, 58	49
	Left superior temporal gyrus*, Let transverse temporal gyrus, Left postcentral gyrus, left insula	–50,–18, 8	1448
	Left inferior parietal lobule*, left supramarginal gyrus, left angular gyrus	–40,–48, 40	41
	Left lentiform nucleus*, left putamen	–22, 6, 10	263

A vast literature

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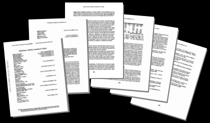
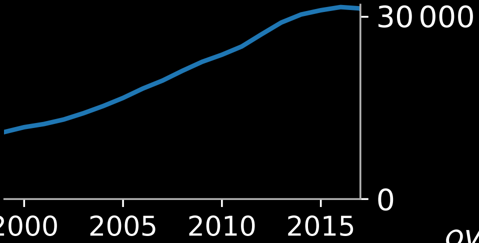
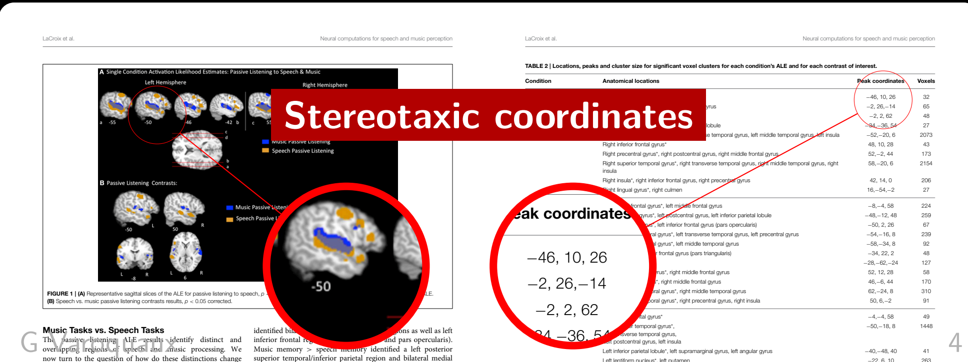




overwhelming



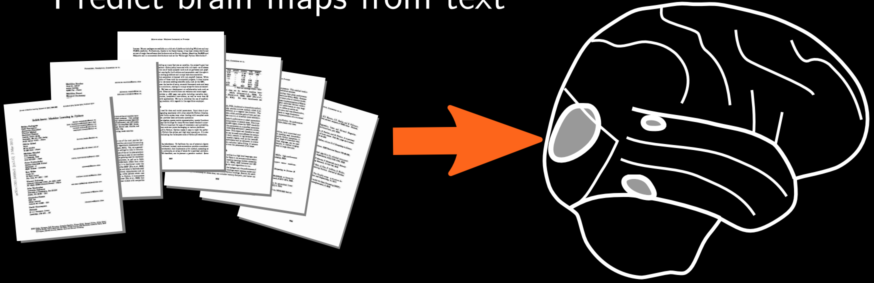
Brain mapping from the literature

- We downloaded 140K scientific publications (as XML)
- Extracted brain coordinates from 14K

Text2brain

text analysis + supervised learning

Predict brain maps from text



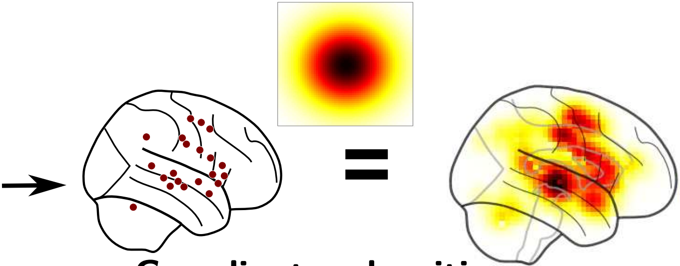
Text2brain

Recognized neuroscience terms

Syntactic priming and the lexical boost effect during sentence production and sentence comprehension

Fit a regression

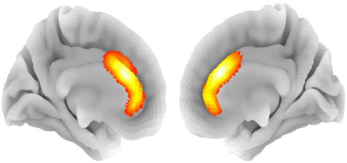
-31.0	-78.0	-9.0
-17.0	-68.0	2.0
-33.0	13.0	15.0
25.0	-53.0	-9.0
24.0	-73.0	-9.0
5.0	19.0	37.0
37.0	19.0	4.0
27.0	41.0	32.0
-56.0	-43.0	26.0
-51.0	-56.0	17.0
-41.0	-72.0	14.0
-58.0	-23.0	22.0
-12.0	-88.0	17.0
-43.0	-56.0	6.0
-50.0	-67.0	2.0
52.0	-31.0	22.0
48.0	-67.0	2.0
47.0	-38.0	44.0



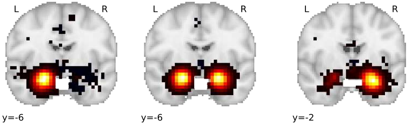
Coordinates densities

[Dockès... 2018]

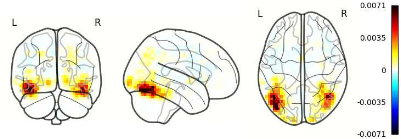
Regression coefficients



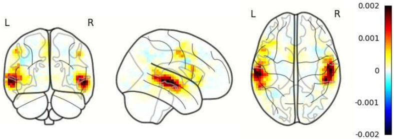
"anterior cingulate"



"left amygdala", "amygdala", "right amygdala"



"object recognition"

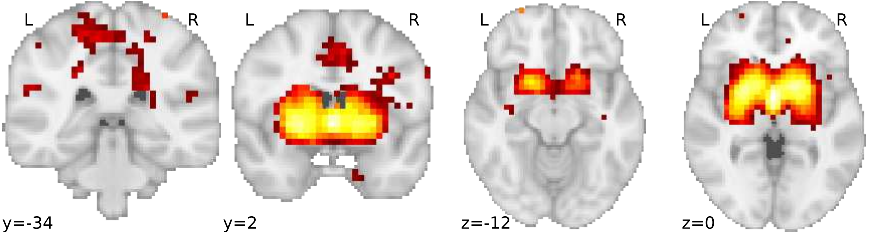


"speech"

Semantic: using related words

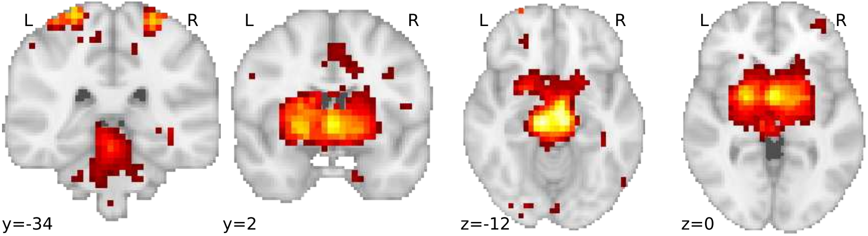
- “Hungtington” only appears in 21 articles with coordinates
- Articles without coordinates capture word relationships
- Encode “Hungtington” using other related words

“Hungtington”

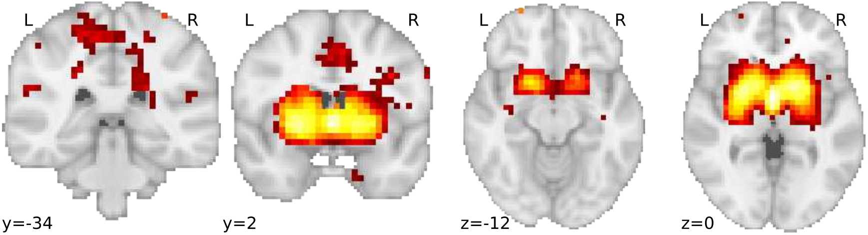


Semantic: using related words

“Parkinson”



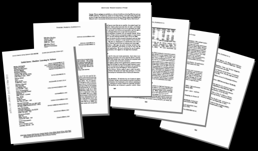
“Hungtington”



Mapping the brain thanks to neuroscience publications

a.k.a. having the computer read the publications

Text2brain



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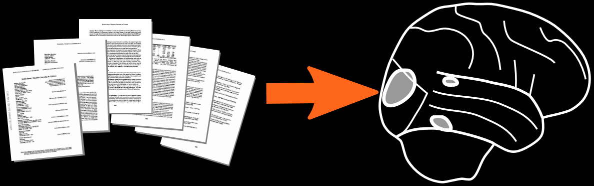

Open access: publications

Preferably structured (XML, not PDF)

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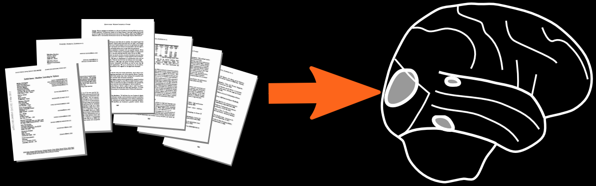

Open access: publications

Preferably structured (XML, not PDF)

Open source: software

Python scipy scikit-learn nilearn

@GaelVaroquaux

References I

J. Dockès, D. Wassermann, R. Poldrack, F. Suchanek, B. Thirion, and G. Varoquaux. Text to brain: predicting the spatial distribution of neuroimaging observations from text reports. *MICCAI*, 2018.

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