

Online open neuroimaging mass meta-analysis

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Online: On the Web

Open: “Open Science” = Open Methods + Open Data. Data is made available.

Neuroimaging: Talairach coordinates, text mining, brain regions, . . . Here: Particularly brain volume data

Mass meta-analysis: Google-like large-scale automatic processing across multiple variables.

Research question

How do we construct a simple yet flexible system for computation of published scientific data (meta-analysis) on the Web?

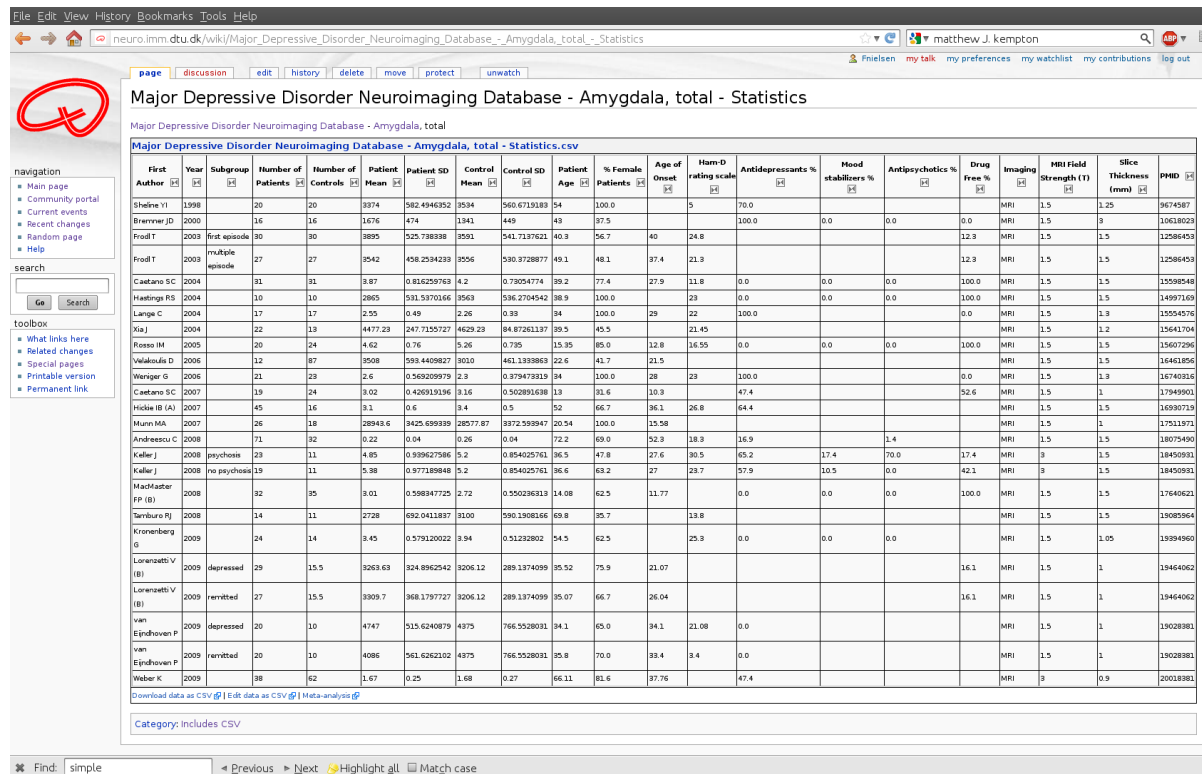
Idea here

- Use MediaWiki to store numerical data from scientific studies
- Keep track of variables and data and interlink with MediaWiki templates
- Use a script to perform numerical analysis (meta-analysis)

Based around “Brede Wiki” <http://neuro.imm.dtu.dk/wiki/>

Data primarily from large meta-analyses by Matthew Kempton and his coworkers (Kempton et al., 2008, 2010, 2011)

Storing data in MediaWiki



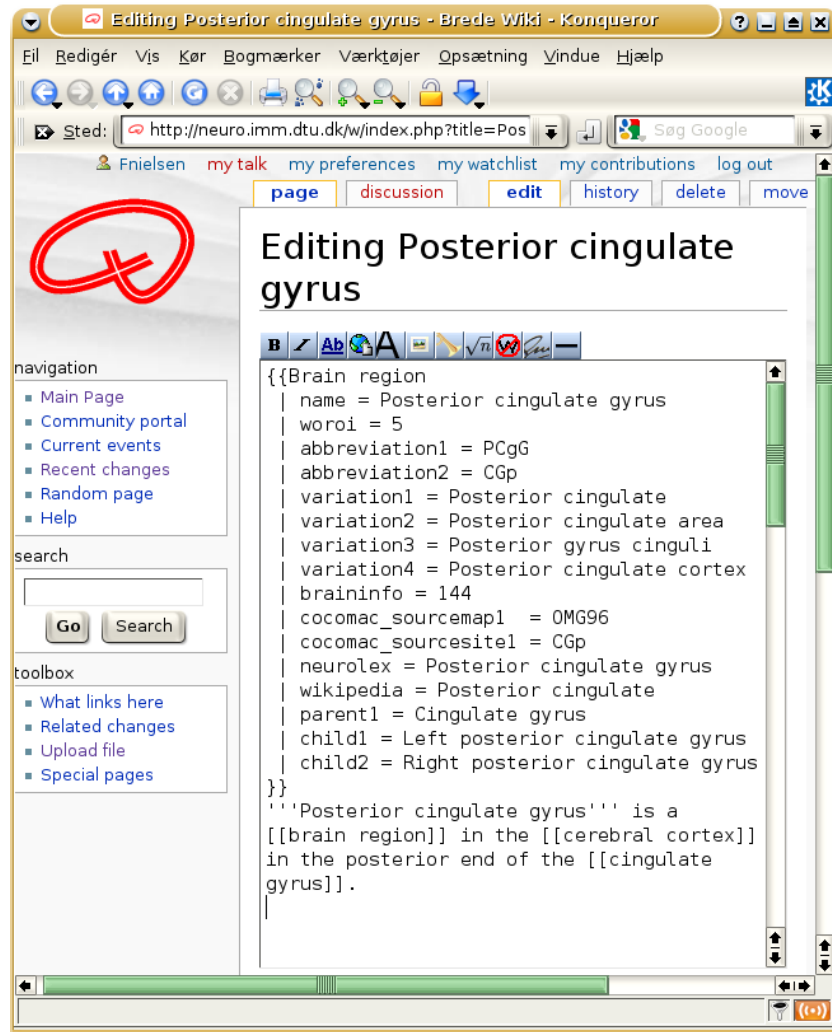
First Author	Year	Subgroup	Number of Patients	Number of Controls	Patient Mean	Patient SD	Control Mean	Control SD	Patient Age	% Female Patients	Age of Onset	Ham-D rating scale	Antidepressants %	Mood stabilizers %	Antipsychotics %	Drug Free %	Imaging	MRI Field Strength (T)	Slice Thickness (mm)	PMID
Sheline YI	1998		20	20	3974	582.4546352	3534	560.6719389	54	100.0		5	70.0				MRI	1.5	1.25	9674587
Bremner JD	2000		16	16	1676	474	1841	449	43	97.5		100.0	0.0	0.0	0.0	0.0	MRI	1.5	9	10618023
Frodl T	2003	first episode	30	30	3895	525.738838	3591	541.7137621	40.9	56.7	40	24.8				12.3	MRI	1.5	1.5	12586453
Frodl T	2003	multiple episode	27	27	3542	458.2334233	3556	530.3728877	49.1	48.1	37.4	21.3				12.3	MRI	1.5	1.5	12586453
Caetano SC	2004		31	31	3.87	0.816259783	4.2	0.73054774	69.2	77.4	27.9	11.8	0.0	0.0	0.0	100.0	MRI	1.5	1.5	15598548
Haefliger RS	2004		10	10	2865	531.5370166	2563	536.2704542	38.9	100.0		23	0.0	0.0	0.0	100.0	MRI	1.5	1.5	14997160
Lange C	2004		17	17	2.55	0.49	2.36	0.39	34	100.0	29	22	100.0			0.0	MRI	1.5	1.8	15554576
Xia J	2004		22	13	4473.23	247.7155727	4629.23	84.87261137	39.5	49.5	12.8	21.45					MRI	1.5	1.2	15641704
Nesse IM	2005		20	24	4.62	0.76	5.36	0.75	15.35	85.0		18.8	16.55	0.0	0.0	0.0	MRI	1.5	1.5	15607296
Velakoulis D	2006		12	87	3508	593.4489827	3010	461.1339863	22.6	41.7	21.5					10.0	MRI	1.5	1.5	16441656
Wurgler G	2006		21	23	2.6	0.569209979	3.3	0.379473313	34	100.0	28	200.0				0.0	MRI	1.5	1.3	16740215
Caetano SC	2007		19	24	3.02	0.420919136	3.16	0.502891638	13	33.6	10.3	47.4			52.6	MRI	1.5	1.1	17949501	
Nickles IB (A)	2007		45	16	3.1	0.6	3.4	0.5	66.7	36.1	26.8	64.4					MRI	1.5	1.5	16930719
Humm MA	2007		26	18	28943.6	3425.699339	28577.87	3372.589347	20.54	100.0	23.58						MRI	1.5	1.1	17313171
Andruscu C	2008		11	32	0.22	0.04	0.26	0.04	72.2	69.0	52.3	18.3	16.9		1.4		MRI	1.5	1.5	18079490
Keller J	2008	psychosis	23	11	4.85	0.939627986	5.2	0.854025761	36.5	47.8	27.6	30.5	65.2	17.4	70.0	17.4	MRI	3	1.5	18450991
Keller J	2008	no psychosis	19	11	5.38	0.97188948	5.2	0.854025761	36.6	63.2	27	23.7	10.5	0.0	42.1	MRI	3	1.5	18450991	
Nachtshost FP (B)	2008		32	35	3.01	0.588347725	2.72	0.550236313	14.08	62.5	11.77		0.0	0.0	100.0	MRI	1.5	1.5	17640623	
Taraborelli R	2008		14	11	2728	692.0411837	3100	590.1308166	69.8	35.7		13.8					MRI	1.5	1.5	19085964
Kronenberg G	2009		24	14	3.45	0.579120022	3.94	0.51232802	54.5	62.5		25.9	0.0	0.0	0.0		MRI	1.5	1.05	19944960
Lorenzetti V (B)	2009	depressed	29	15.5	3263.63	324.8962542	3206.12	289.1374099	35.52	75.9	21.07					16.1	MRI	1.5	1	19464062
Lorenzetti V (B)	2009	erovitted	27	15.5	3399.7	368.1797727	3206.12	289.1374099	35.07	66.7	26.04					16.1	MRI	1.5	1	19464062
van Eijndhoven P	2009	depressed	20	10	4747	515.6240879	4375	766.5028031	34.1	65.0	34.1	21.08	0.0				MRI	1.5	1	19028381
van Eijndhoven P	2009	erovitted	20	10	4086	561.6262102	4375	766.5028031	35.8	70.0	33.4	3.4	0.0				MRI	1.5	1	19028381
Weber K	2009		38	62	1.67	0.25	1.68	0.27	66.11	81.6	37.76	47.4					MRI	3	0.9	20018981

Choose as simple representation as possible: comma-separated values (CSV) with one row column header containing free-form description and no formatting.

Add the CSV data on a page on its own on a MediaWiki with extension .csv (so recognizable)

Include the data on another page via a template, — and here the use of a table rendering MediaWiki extension. The template may also make links for download and editing.

Keep track with MediaWiki templates



Structured information is stored in MediaWiki templates.

Template use simple so it is easy to convert data all template instantiations to an SQL representation: No wiki formatting in field values, non-nested templates, lower case field names (a one-to-one mapping of MediaWiki templates and ontology classes). (Nielsen, 2009)

Link as much as possible in the template values.

Link to external sites whenever possible.

Markup for CSV information:

```
{{Metaanalysis csv begin}}
{{Metaanalysis csv
  | title = Major Depressive Disorder Neuroimaging Database - Amygdala, total - Statistics
  | topic1 = Amygdala
  | topic2 = Major depressive disorder
  | topic3 = MaND
}}
{{Metaanalysis csv
  | title = Bipolar Disorder Neuroimaging Database - Amygdala
  | topic1 = Amygdala
  | topic2 = Bipolar disorder
  | topic3 = BiND
  | cn_ne = Number of Bipolars
  | cn_me = Bipolar Mean
  | cn_sde = Controls SD
}}
{{Metaanalysis csv
  | title = Obsessive-compulsive disorder Neuroimaging Database - Amygdala
  | topic1 = Amygdala
  | topic2 = Obsessive-compulsive disorder
  | topic3 = ObND
}}
{{Metaanalysis csv end}}
```

Keep track of data with MediaWiki templates

Major depressive disorder

Major depressive disorder

See also:

- Major Depressive Disorder
- Neuroimaging Database

Papers [edit]

Neuroimaging [edit]

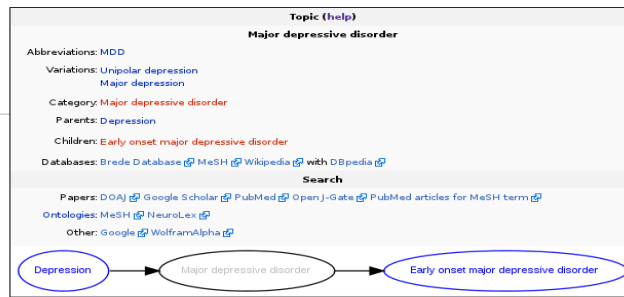
- Brain volume abnormalities in major depressive disorder: a meta-analysis of magnetic resonance imaging studies
- Structural neuroimaging studies in major depressive disorder: meta-analysis and comparison with bipolar disorder

- Hippocampal volume in primary unipolar major depression: a magnetic resonance imaging study
- Reduced caudate and nucleus accumbens response to rewards in unmedicated individuals with major depressive disorder
- Regional cerebral blood flow abnormalities in depressed patients with cognitive impairment

Treatment response and genetics [edit]

- 5-HT1A, 5-HT2A, 5-HT6, TPH1 and TPH2 polymorphisms and major depression
- Genetic association analysis of serotonin 2A receptor gene (HTR2A) with bipolar disorder and major depressive disorder in the Japanese population

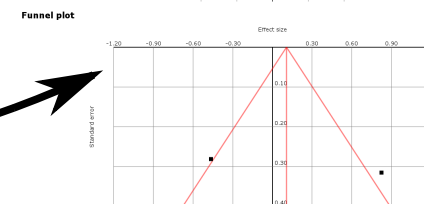
Categories: Topics | Topics in Brede Database | Topics in MeSH | Topics in Wikipedia



Meta-analyses

Topic	Data	Raw data	Meta-analysis
Amygdala — Major depressive disorder — MaND	Data	CSV	Meta-analysis
Amygdala — Bipolar disorder — BiND	Data	CSV	Meta-analysis
Amygdala — Obsessive-compulsive disorder — ObND	Data	CSV	Meta-analysis

Study	Experimentals			Controls			Effects				
	Mean	SD	Event/ N	Mean	SD	Event/ N	MD/mean	SE	CI	Weight	Weight%
Stavitskiy 1993	3.84	0.0000	576/ 1000000	3.84	0.0000	877/ 1000000	0.0000	0.0000	0.0000	12.00	95.45%
Kwon 2003	1.50	0.3115	22/ 22	1.25	0.2831	22/ 22	0.2475	0.0287	0.1902, 0.3048	44.33%	49.33%
Meta-analysis (fixed, I ²)			598			904	0.1237	0.0130	0.1007, 0.1467	100%	
Meta-analysis (random, I ²)							0.1721	0.0445	0.0831, 0.2611	100%	



Obsessive-compulsive disorder Neuroimaging Database - Amygdala

ObND for amygdala

Obsessive-compulsive disorder Neuroimaging Database - Amygdala.csv

Author	Year	Region	Patient mean	Patient SD	Number of patients	Controls mean	Controls SD	Number of controls	Controls YBOCS mean	Controls YBOCS SD	Patient mean age	Patient SD age	Controls mean age	Controls SD age	Notes	PMID	Title
Szavitskiy	1993	Amygdala	3.84	0.0000	576	3.84	0.0000	877	22.4	6.9	32.2	8	29.8	6.8		10530638	Cerebral frontal and amygdala volume reductions in obsessive-compulsive disorder
Kwon	2003	Amygdala	1.50	0.3115	22	1.25	0.2831	22			26.7	7.2	26.2	6.1	Values computed from left/right	12817792	Similarity and disparity of obsessive-compulsive disorder and schizophrenia in MR volumetric abnormalities of the hippocampus-amygdala complex

Download data as CSV | Edit data as CSV | Meta-analysis

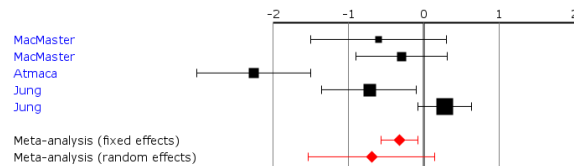
Meta-analysis with a MediaWiki-based wiki

Interpreted data and analysis

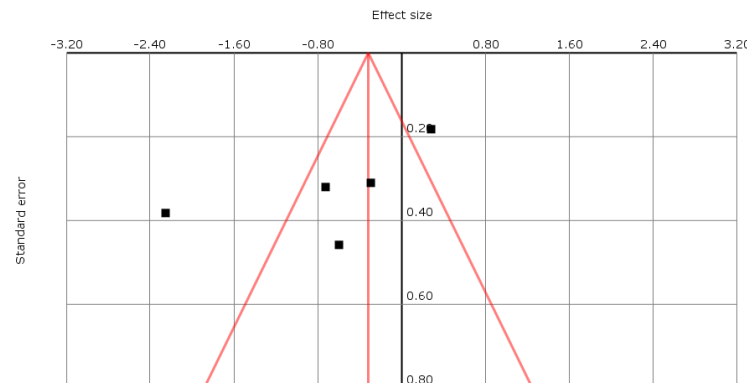
Study	Experimentals				Controls				Effects							
	Mean	SD	Events	N	Mean	SD	Events	N	SD _{pooled}	Effect	SE	CI	Weight	Weight _{post}		
MacMaster 2006	0.434000	0.130230	nan	10	0.542000	0.209860	nan	10	0.174644	-0.592	0.459	-1.492 0.308	4.741110	7.674%	0.986339	18.096%
MacMaster 2006	0.623300	0.179700	nan	21	0.677600	0.186680	nan	21	0.183223	-0.291	0.310	-0.899 0.318	10.378958	16.798%	1.112003	20.401%
Atmaca 2009	691.000000	62.000000	nan	23	846.000000	73.000000	nan	23	67.723703	-2.249	0.384	-3.001 -1.498	6.797617	11.002%	1.052587	19.311%
Jung 2009	465.000000	55.800000	nan	12	543.000000	113.700000	nan	62	106.903327	-0.722	0.321	-1.352 -0.092	9.691549	15.686%	1.103616	20.248%
Jung 2009	577.800000	129.100000	nan	60	543.000000	113.700000	nan	62	121.515804	0.285	0.182	-0.072 0.641	30.176193	48.840%	1.196075	21.944%
Meta-analysis (fixed effect)				126				178		-0.316	0.127	-0.565 -0.067		100%		
Meta-analysis (random effects, DSL)										-0.685	0.428	-1.524 0.155				100%

I^2 : 0.896063 | Q : 38.262526 | df : 4.0 | P -value: 0.000

Forest plot



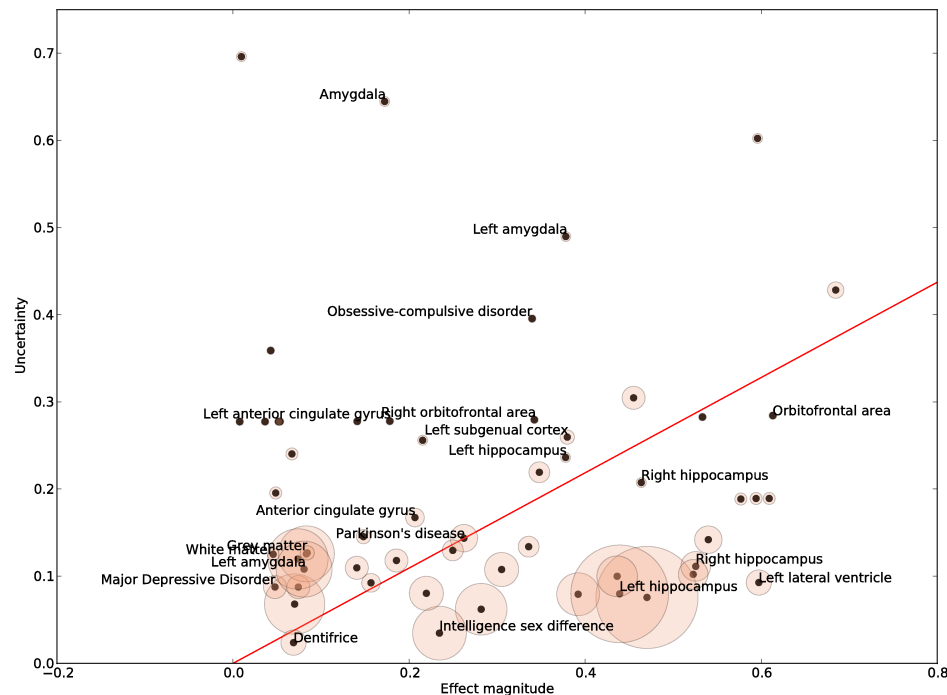
Funnel plot



The template generates a link to the Web service that downloads and makes meta-analytic computations on the data (Hartung et al., 2008), presenting the effects in so-called forest and funnel plots.

Here the difference in the volume of the pituitary gland between obsessive-compulsive disorder patients and normal control subjects.

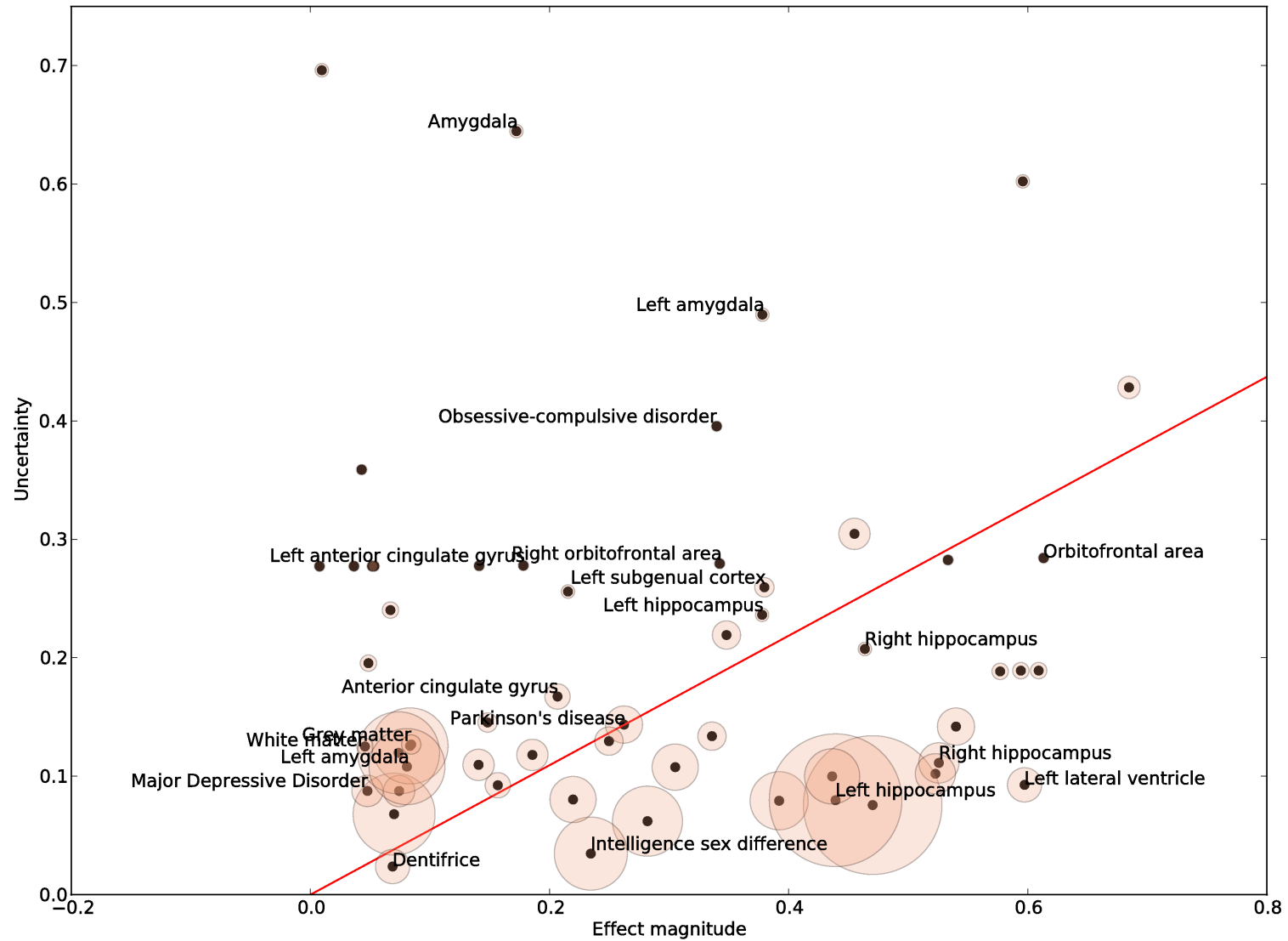
Mass meta-analysis



With numerical data from CSV pages and information about them in templates it is possible to download and analyze all meta-analysis together.

A Python scripts download multiple pages from the wiki via the MediaWiki API, extracts the template information, fetch JSON from the meta-analysis script and plot the data.

Here a L'Abbé-like plot of many of the meta-analyses in the Brede Wiki with effect magnitude on the x-axis and its uncertainty on the y-axis.



Issues

We are using “vanilla” MediaWiki, only a slightly modified table rendering extension used.

Is Semantic Web functionality necessary? E.g., SCOVO might be interesting, but not crucial for the numerical analysis.

What would Semantic MediaWiki add? Computations are difficult/impossible Semantic MediaWiki.

Closer integration of the meta-analysis with MediaWiki through an extension?

Can newer developments Wikidata and Lua help?

The Brede Wiki available from

<http://neuro.imm.dtu.dk/wiki/>

Thanks!

References

- Hartung, J., Knapp, G., and Sinha, B. K. (2008). *Statistical Meta-Analysis with Applications*. Wiley Series in Probability and Statistics. Wiley, Hoboken, New Jersey.
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