

# The Brede database and new tools for meta-analysis

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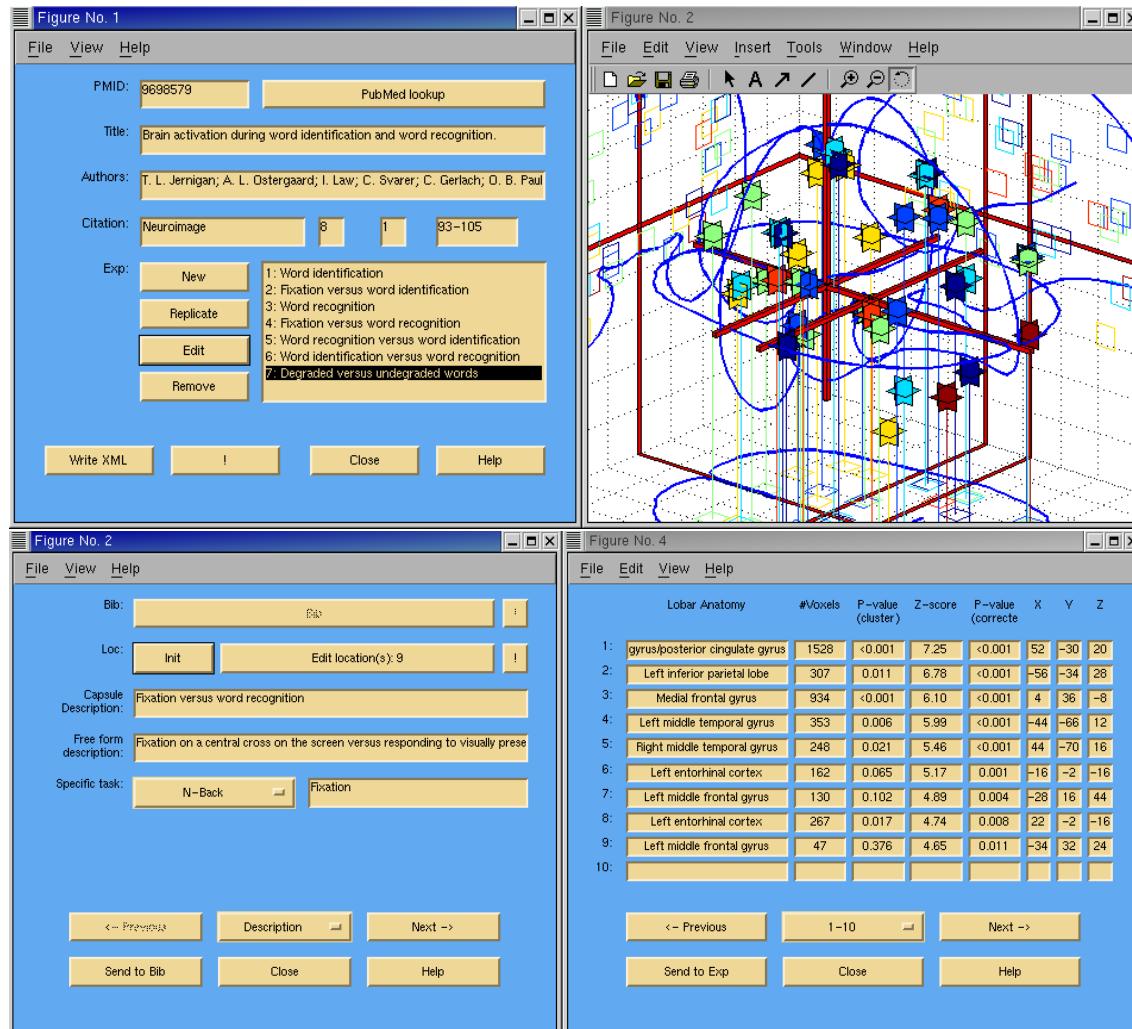
# The 3 Brede tools

**Brede Toolbox:** A program package primarily written in Matlab. Handles visualization, linear modeling, multivariate analysis, locations (Talairach coordinates), volumes, papers, texts.

**Brede Database:** Basically a collection of XML files with data from neuroimaging papers as well as ontologies. Distributed with the Brede Toolbox. “Output” and query services to the Brede Database (generated with the Brede Toolbox) is available on the Internet: <http://neuro.imm.dtu.dk>

**Brede Wiki:** A wiki with data from neuroimaging papers as well as ontologies. Both freeform text and “semantically” organized within MediaWiki templates.

# Brede Toolbox with the Brede Database

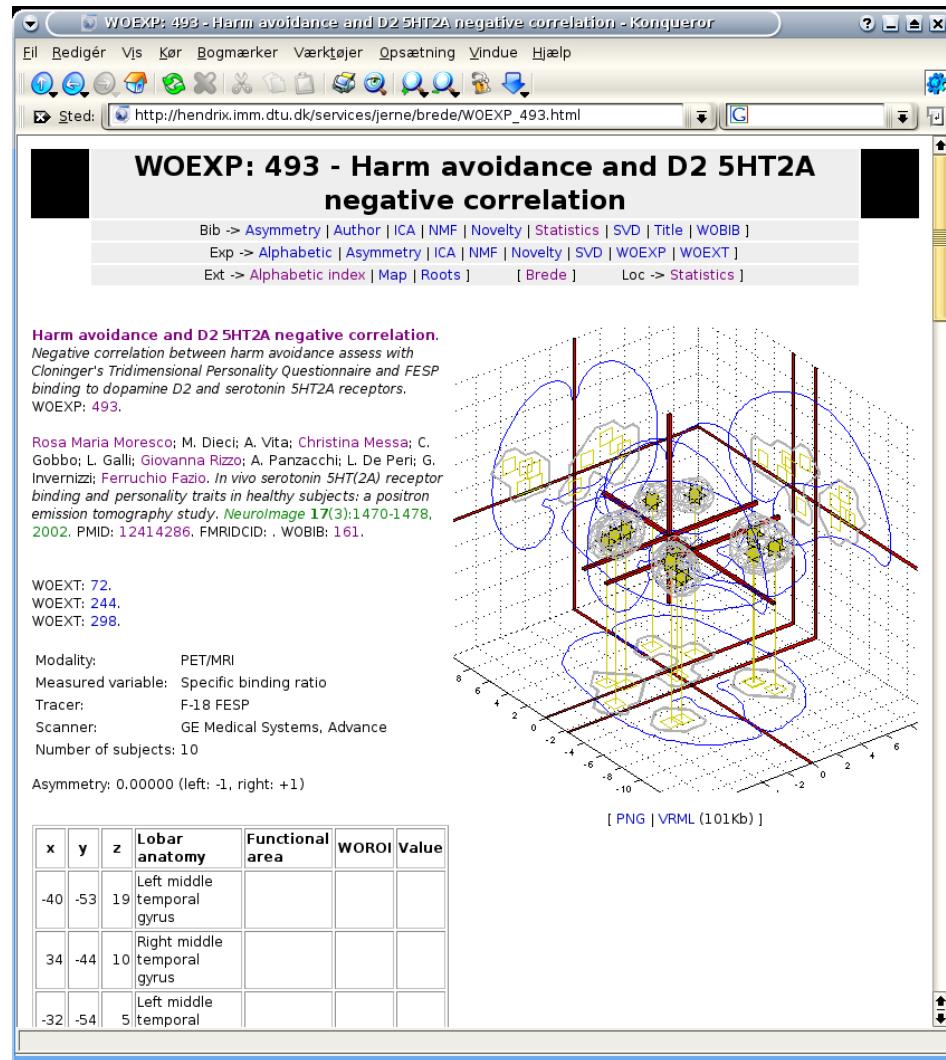


Graphical user interface of Brede Toolbox used to enter data into the Brede Database.

Brede Database: A database with results from published neuroimaging studies as well as ontologies for, e.g., brain regions and brain functions (Nielsen, 2003).

Data stored in XML available on the Web

# The Brede Database on the Web

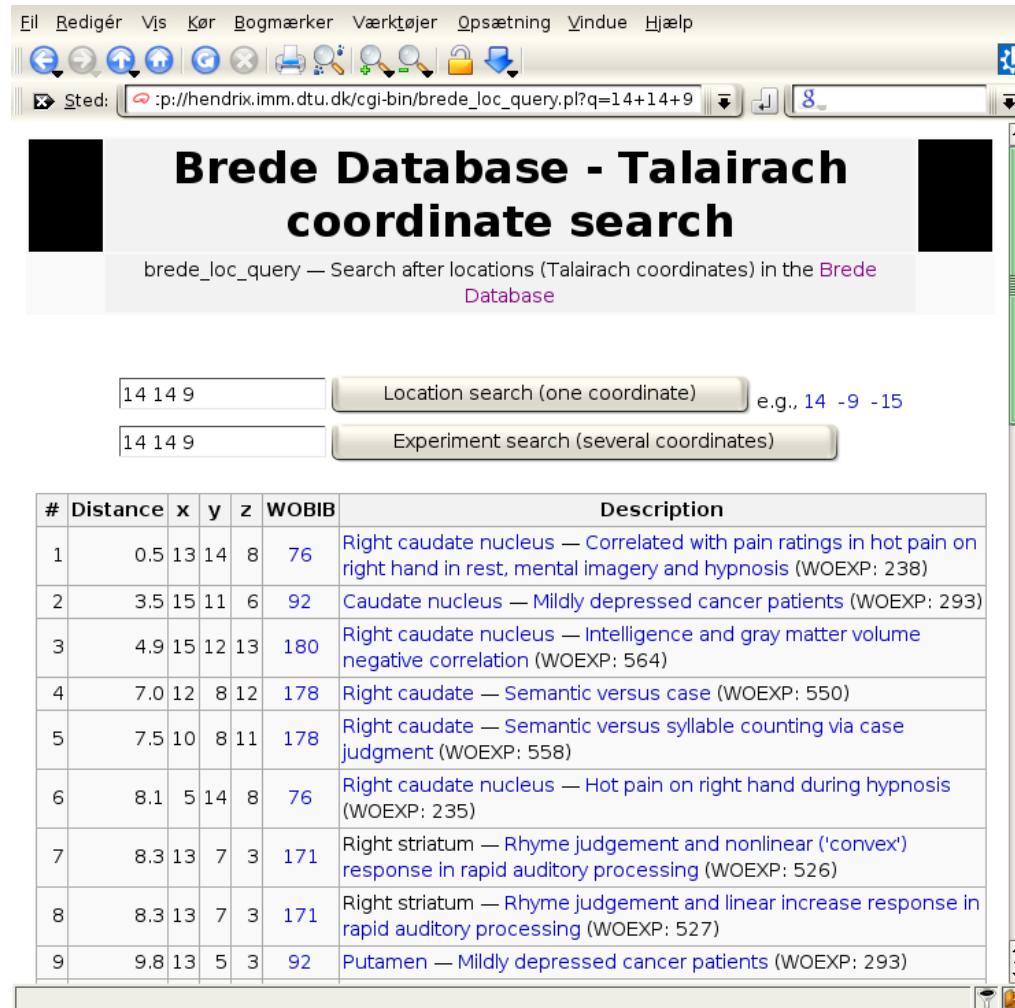


Presentation on the Web

Off-line meta-analysis and generation of indices and visualization in static HTML.

Interactive search on coordinates from Web page or within a image analysis program (Wilkowski et al., 2009).

# Searching on Talairach coordinate



| # | Distance | x  | y  | z  | WOBIB               | Description  |
|---|----------|----|----|----|---------------------|--|
| 1 | 0.5      | 13 | 14 | 8  | <a href="#">76</a>  | Right caudate nucleus — Correlated with pain ratings in hot pain on right hand in rest, mental imagery and hypnosis (WOEXP: 238) |
| 2 | 3.5      | 15 | 11 | 6  | <a href="#">92</a>  | Caudate nucleus — Mildly depressed cancer patients (WOEXP: 293)  |
| 3 | 4.9      | 15 | 12 | 13 | <a href="#">180</a> | Right caudate nucleus — Intelligence and gray matter volume negative correlation (WOEXP: 564)                                    |
| 4 | 7.0      | 12 | 8  | 12 | <a href="#">178</a> | Right caudate — Semantic versus case (WOEXP: 550)  |
| 5 | 7.5      | 10 | 8  | 11 | <a href="#">178</a> | Right caudate — Semantic versus syllable counting via case judgment (WOEXP: 558)   |
| 6 | 8.1      | 5  | 14 | 8  | <a href="#">76</a>  | Right caudate nucleus — Hot pain on right hand during hypnosis (WOEXP: 235)  |
| 7 | 8.3      | 13 | 7  | 3  | <a href="#">171</a> | Right striatum — Rhyme judgement and nonlinear ('convex') response in rapid auditory processing (WOEXP: 526)                     |
| 8 | 8.3      | 13 | 7  | 3  | <a href="#">171</a> | Right striatum — Rhyme judgement and linear increase response in rapid auditory processing (WOEXP: 527)                          |
| 9 | 9.8      | 13 | 5  | 3  | <a href="#">92</a>  | Putamen — Mildly depressed cancer patients (WOEXP: 293)  |

Result after search for nearest coordinates to (14, 14, 9) with the Brede Database.

Translation of the data from XML to SQL (Szewczyk, 2008)

Perl + SQLite web-script

Similar searches possible in Antonia Hamilton's AMAT programs, BrainMap, SumsDB and Brede Wiki.

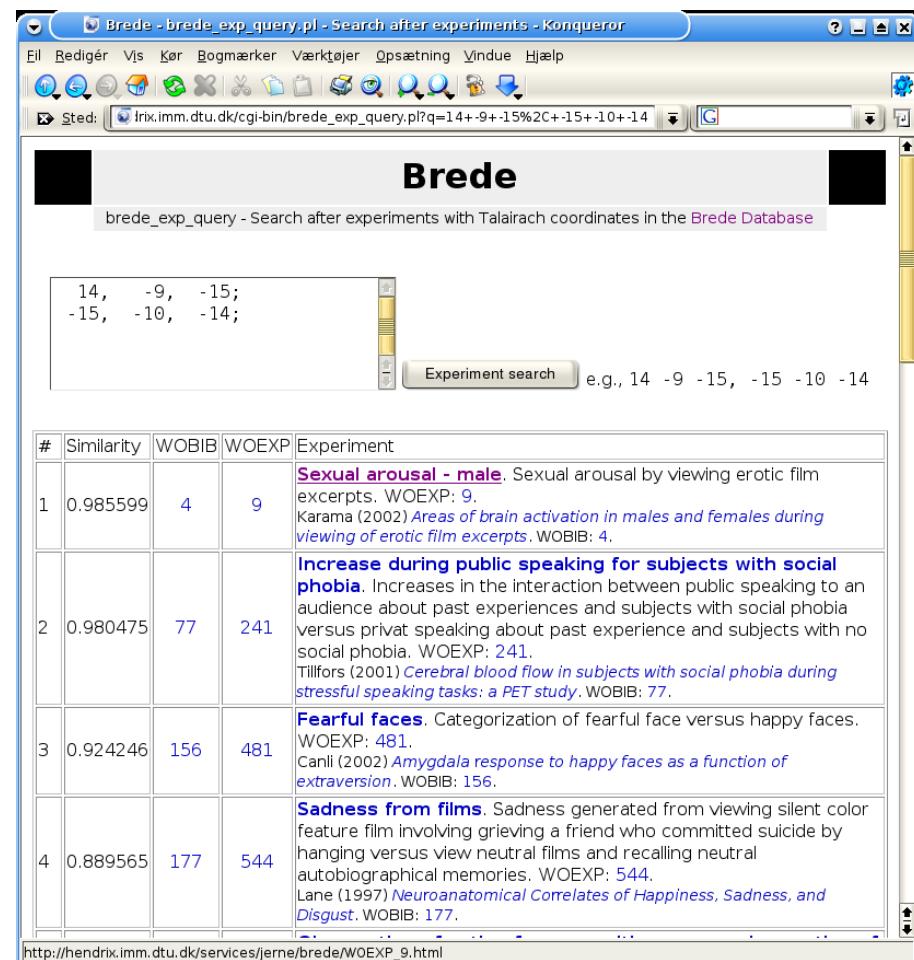
# Online experiment search (multiple coordinates)

Online search on two coordinates in left and right amygdala in the experiments recorded in the Brede Database.

“Related volume” also available from the “original” BrainMap database (Nielsen and Hansen, 2004):

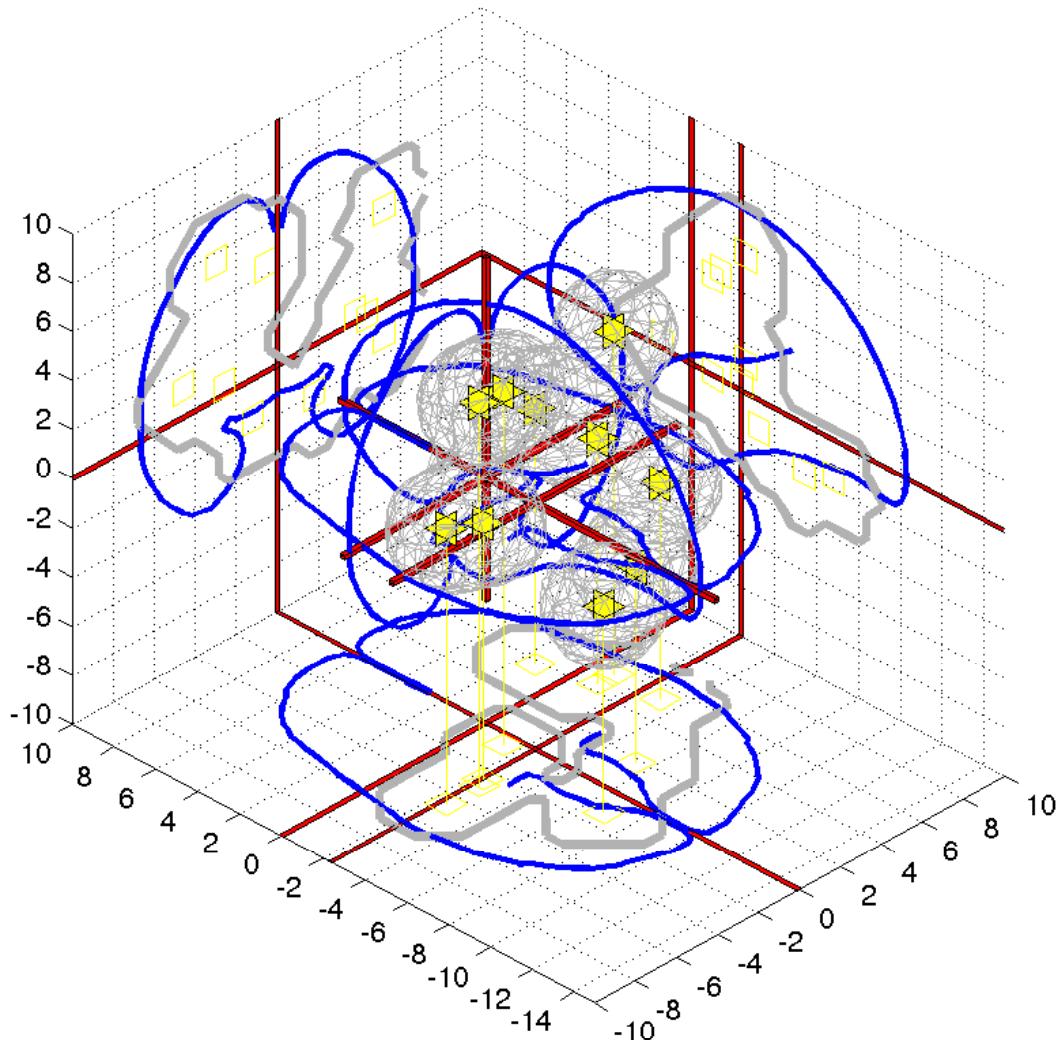
<http://neuro.imm.dtu.dk/services/jerne/ninf/>

Search available to the Brede Database from SPM plugin (Wilkowski et al., 2009).



| # | Similarity | WOBIB | WOEXP | Experiment   |
|---|------------|-------|-------|--|
| 1 | 0.985599   | 4     | 9     | <b>Sexual arousal - male.</b> Sexual arousal by viewing erotic film excerpts. WOEXP: 9.<br>Karama (2002) <i>Areas of brain activation in males and females during viewing of erotic film excerpts.</i> WOBIB: 4.   |
| 2 | 0.980475   | 77    | 241   | <b>Increase during public speaking for subjects with social phobia.</b> Increases in the interaction between public speaking to an audience about past experiences and subjects with social phobia versus privat speaking about past experience and subjects with no social phobia. WOEXP: 241.<br>Tilfors (2001) <i>Cerebral blood flow in subjects with social phobia during stressful speaking tasks: a PET study.</i> WOBIB: 77. |
| 3 | 0.924246   | 156   | 481   | <b>Fearful faces.</b> Categorization of fearful face versus happy faces. WOEXP: 481.<br>Canli (2002) <i>Amygdala response to happy faces as a function of extraversion.</i> WOBIB: 156.  |
| 4 | 0.889565   | 177   | 544   | <b>Sadness from films.</b> Sadness generated from viewing silent color feature film involving grieving a friend who committed suicide by hanging versus view neutral films and recalling neutral autobiographical memories. WOEXP: 544.<br>Lane (1997) <i>Neuroanatomical Correlates of Happiness, Sadness, and Disgust.</i> WOBIB: 177.   |

# Coordinates-to-volume transformation

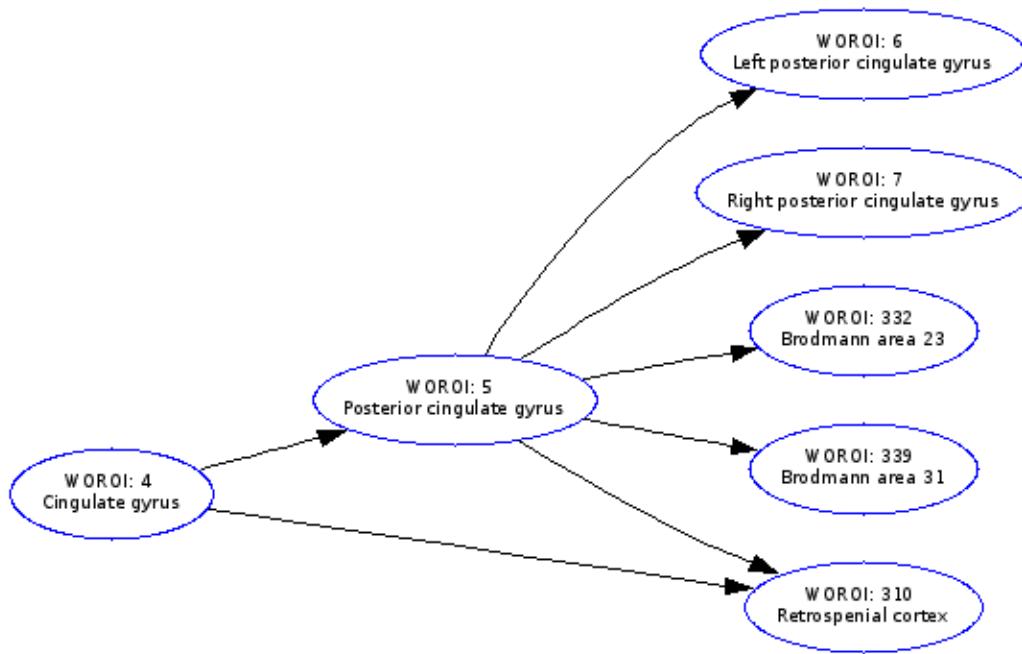


Coordinates in an article converted to volume-data by filtering each point (kernel density estimation) (Nielsen and Hansen, 2002b; Turkeltaub et al., 2002)

One volume for each article or one volume for a set of coordinates in multiple articles.

Yellow coordinates from a study by (Blinkenberg et al., 1996), with grey wireframe indicating the isosurface in the generated volume

# Brede brain region taxonomy/ontology



Taxonomy of neuroanatomical areas with items linked in a hierarchy with “Brain” in the top root and smaller areas in the leafs. WOROI is the ID.

Records parent region, child region, naming variations,

Links to other brain region ontologies

Links to digital brain atlases (AAL, Claus Svarer, Alexander Hammers)

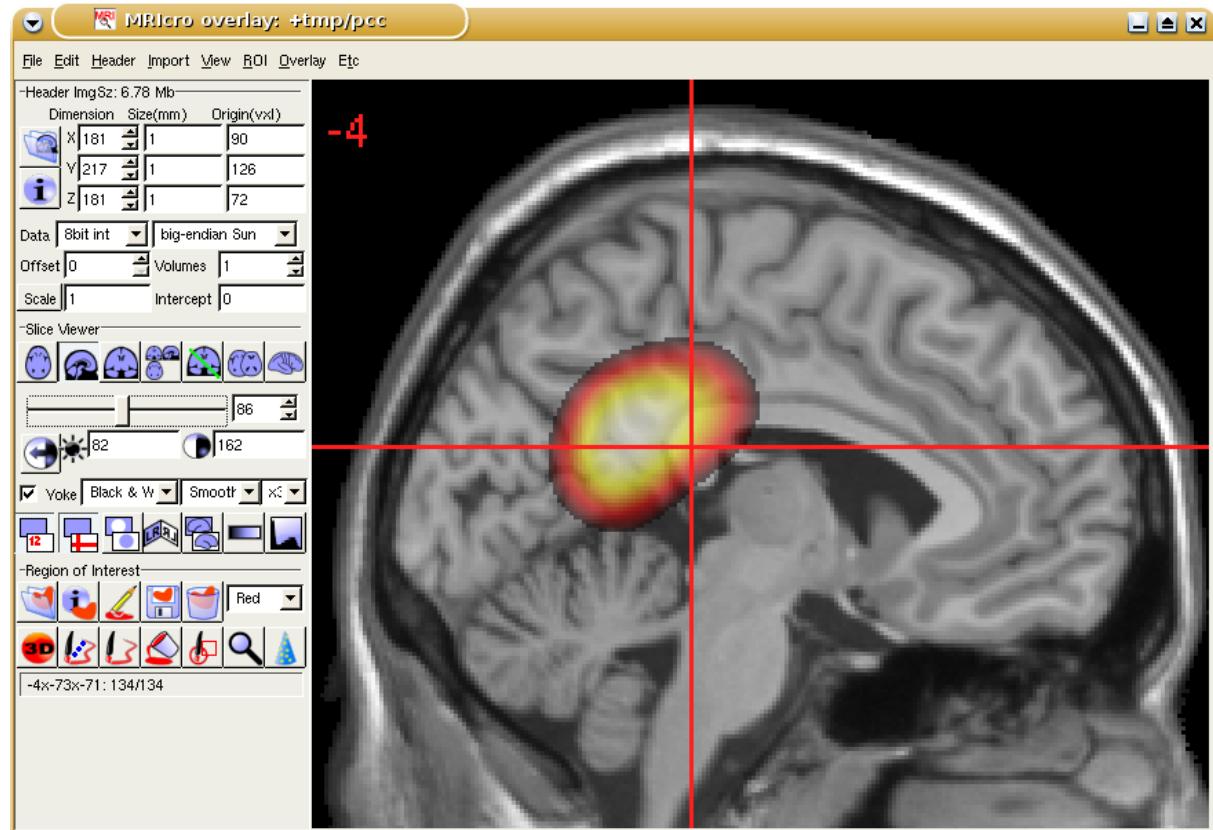
# Example with Brain region ontology

The ontology enables one to get all names for PCC and its subregions.  
Output is (24 names in total):

- 'Posterior cingulate gyrus'
- 'Posterior cingulate'
- 'Posterior cingulate area'
- 'Posterior gyrus cinguli'
- 'Posterior cingulate cortex'
- 'Left posterior cingulate gyrus'
- 'Left posterior cingulate'
- 'Posterior cingulate gyrus, left'
- ... e.g., BA23, retrosplenial, ...

Suitable for text mining where you identify as many occurrences in a corpus that is not using a controlled vocabulary, such as ordinary scientific articles.

# Example: Get PCC locations



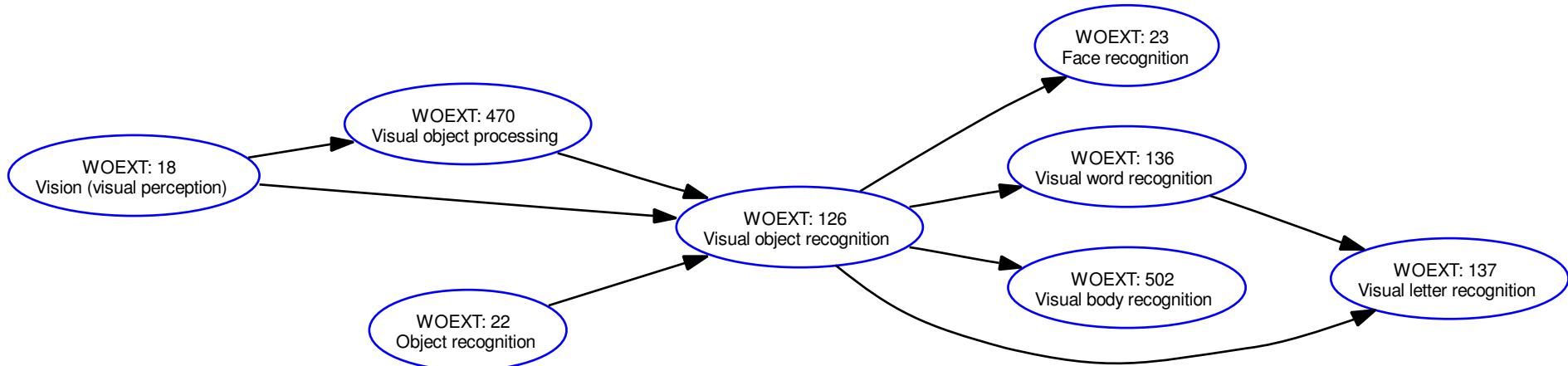
Get all posterior cingulate locations that match on of the naming variation for the regions and its sub-region.

Model the locations with kernel density estimation, and convert the density to a probability.

Volume written to an Analyze file

Viewed in the external MRICro program

# Topics ontology



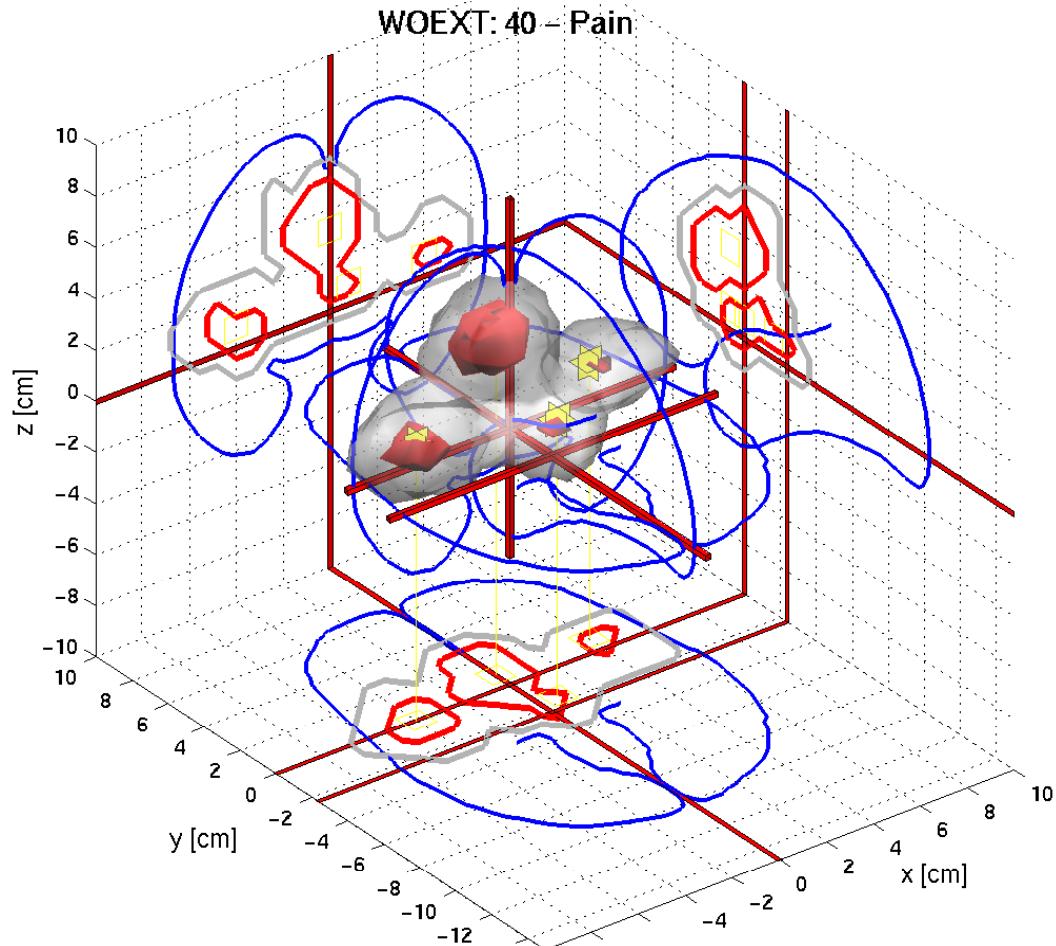
Topics, such as brain functions and mental disorders, organized in a hierarchy. Example: episodic memory retrieval, OCD, 5-HT2A receptor.

Used to label each neuroimaging experiment

Other efforts: MeSH (too coarse), BrainMap, Cognitive Atlas (Poldrack), Cognitive Paradigm Ontology (Turner and Laird, 2011)

Cognitive components are “open to interpretation”

# Supervised data mining



Volume for a specific taxonomic component: “Pain” Volume threshold at statistical values determined by resampling statistics (Nielsen, 2005). Red areas are the most significant areas: Anterior cingulate, anterior insula, thalamus. In agreement with “human” reviewer (Ingvar, 1999).

Implementations of supervised datamining in the Brede Toolbox and in GingerALE.

# Text representation: a “bag-of-words”

|          | ‘memory’ | ‘visual’ | ‘motor’ | ‘time’ | ‘retrieval’ | ... |
|----------|----------|----------|---------|--------|-------------|-----|
| Fujii    | 6        | 0        | 1       | 0      | 4           | ... |
| Maddock  | 5        | 0        | 0       | 0      | 0           | ... |
| Tsukiura | 0        | 0        | 4       | 0      | 0           | ... |
| Belin    | 0        | 0        | 0       | 0      | 0           | ... |
| Ellerman | 0        | 0        | 0       | 5      | 0           | ... |
| :        | :        | :        | :       | :      | :           | ... |

Representation of the abstract of the articles in “bag-of-word”. Table counts how often a word occurs

Exclusion of “stop words”: common words (the, a, of, ...), words for brain anatomy, and a large number of common words that appear in abstracts. Mostly words for brain function are left. More advanced extraction: Match to ontologies

# Grouping of words from articles

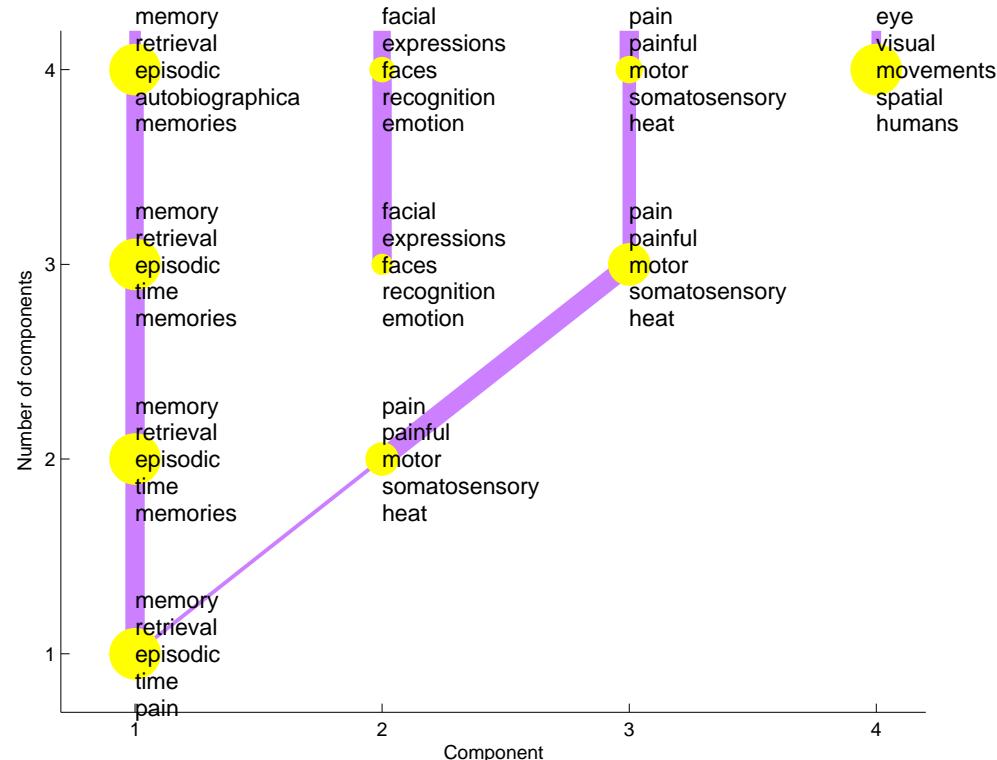


Figure 1: Grouped words.

Multivariate analysis (NMF) of the text in *posterior cingulate* articles to find “themes”, which can be represented with weights over words and articles (Nielsen et al., 2005).

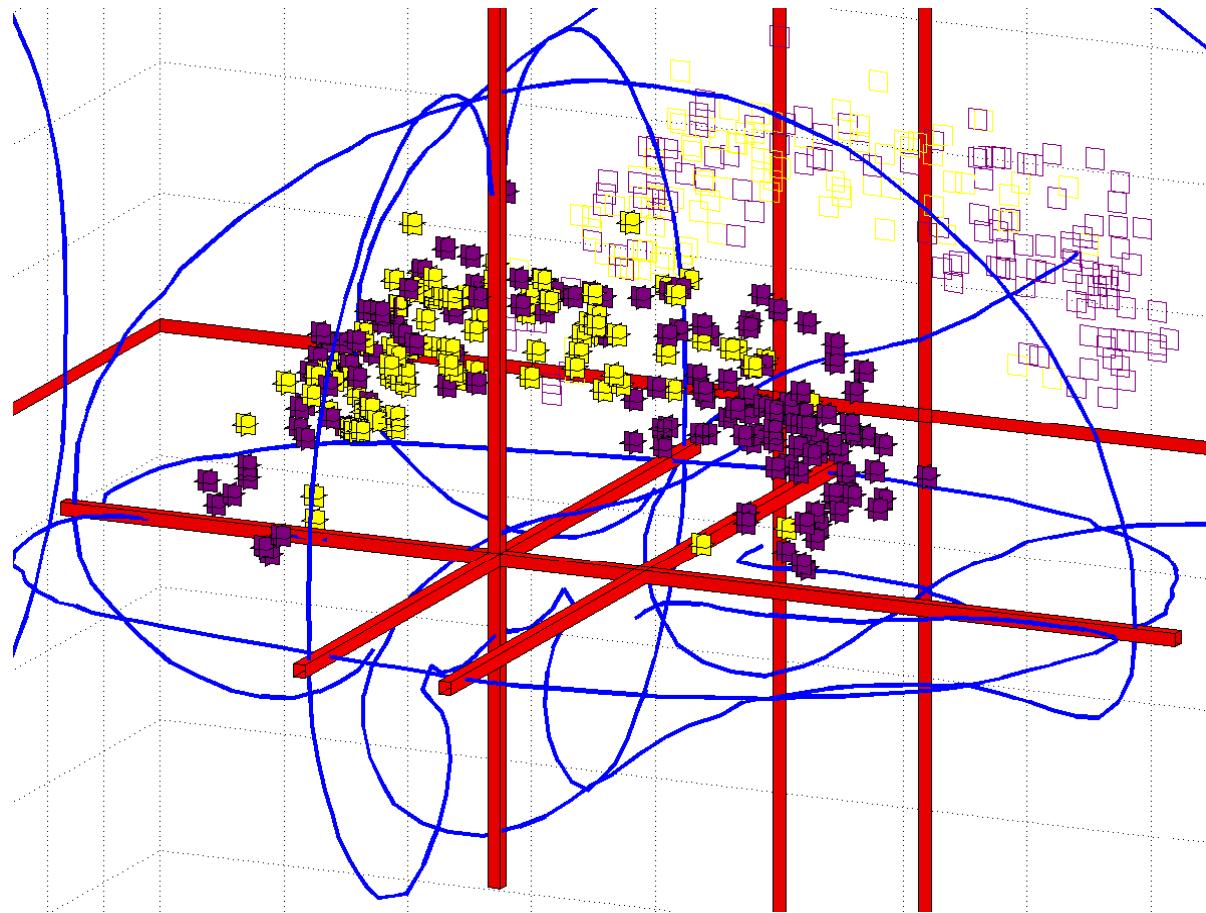
Most dominating words: memory, retrieval, episodic

pain, painful, motor, somatosensory

facial, expressions, faces,

eye, visual, movements

# Combining text analysis and coordinates



Is there a difference in how brain functions distribute in the cingulate gyrus?

Possible to find the corresponding articles for the coordinates — and text mine these articles for clustering and label the coordinate according to cluster.

Sagittal plot of memory (magenta) and pain (yellow).

# Text and volume: Functional atlas

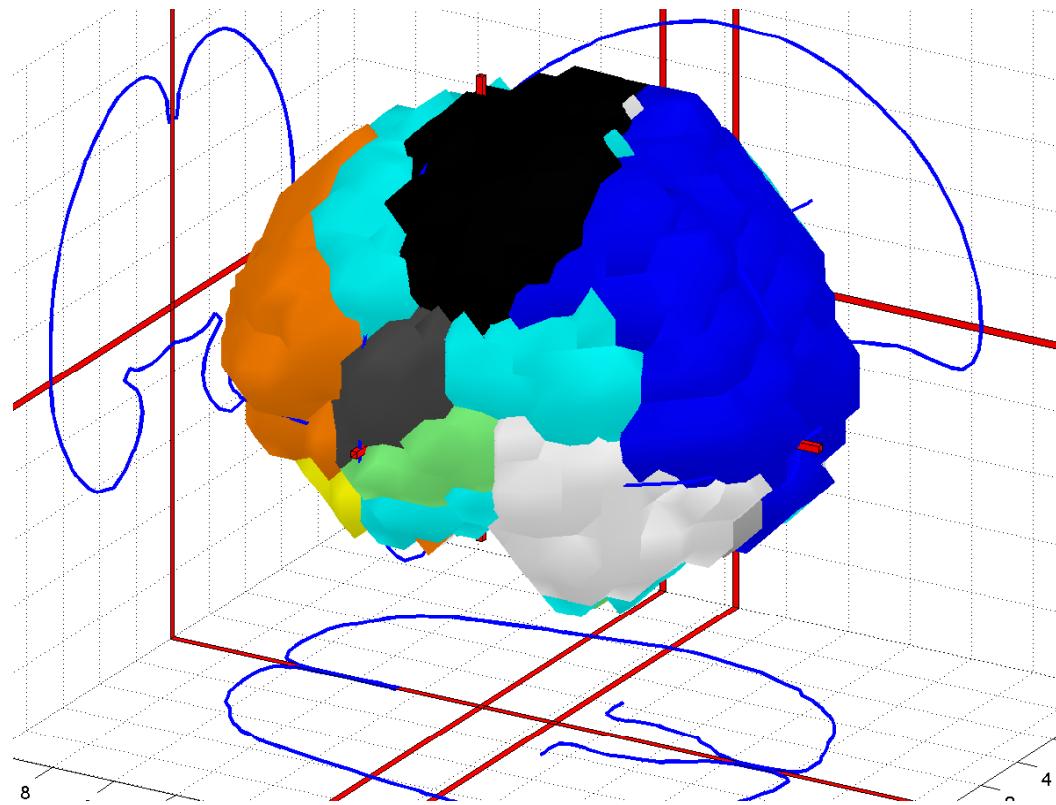


Figure 2: Functional atlas in 3D visualization.

Automatic construction of functional atlas, where words for function become associated with brain areas

Two matrices: Bag-of-words matrix, matrix from voxelization of coordinates. NMF on the product matrix.

Example components: Blue area: visual, eye, time. Black: motor, movements, hand. White: faces, perceptual, face.

# Problems

Difficult to add new information to the Brede Database

Difficult to do incremental additions.

# Problems

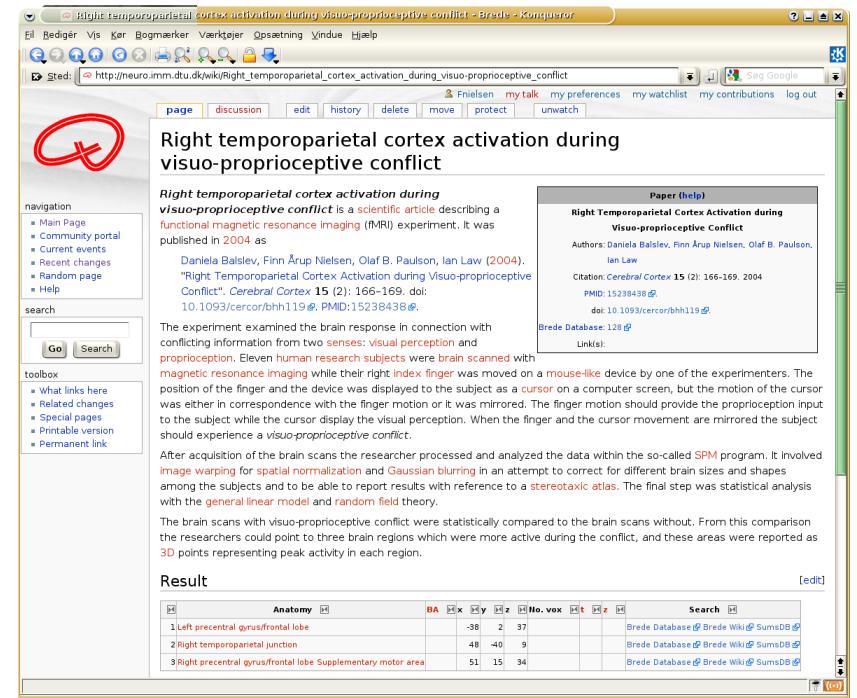
Difficult to add new information to the Brede Database

Difficult to do incremental additions.

# Solution?

Wiki with structured data

Brede Wiki = MediaWiki templates +  
Extraction + SQL + Neuroscience



The screenshot shows a MediaWiki page with the following content:

**Right tempoparietal cortex activation during visuo-proprioceptive conflict**

**Paper (help)**

**Right Tempoparietal Cortex Activation during Visuo-proprioceptive Conflict**

Authors: Daniela Balšev, Finn Årup Nielsen, Olaf B. Paulson, Ian Law

Citation: Cerebral Cortex 15 (2): 166-169. doi: 10.1093/cercor/bhh119. PMID:15238438.

The experiment examined the brain response in connection with conflicting information from two senses: visual perception and proprioception. Eleven human research subjects were brain scanned with magnetic resonance imaging while their right index finger was moved on a mouse-like device by one of the experimenters. The position of the finger and the device was displayed to the subject as a cursor on a computer screen, but the motion of the cursor was either in correspondence with the finger motion or it was mirrored. The finger motion should provide the proprioception input to the subject while the cursor display the visual perception. When the finger and the cursor movement are mirrored the subject should experience a visuo-proprioceptive conflict.

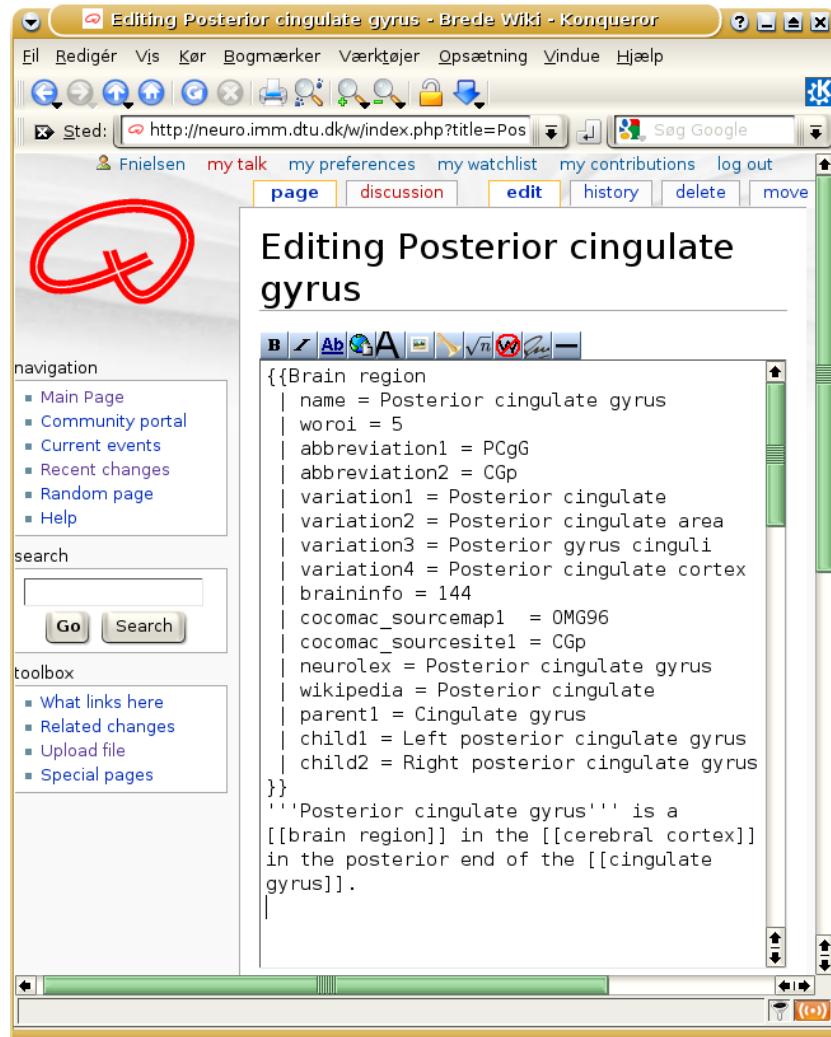
After acquisition of the brain scan the researcher processed and analyzed the data within the so-called SPM program. It involved image warping for spatial normalization and Gaussian blurring in an attempt to correct for different brain sizes and shapes among the subjects and to be able to report results with reference to a stereotaxic atlas. The final step was statistical analysis with the general linear model and random field theory.

The brain scans with visuo-proprioceptive conflict were statistically compared to the brain scans without. From this comparison the researchers could point to three brain regions which were more active during the conflict, and these areas were reported as 3D points representing peak activity in each region.

**Result**

| Anatomy  | BA  | x   | y  | z | No. vox | t | p | Search         |
|--|-----|-----|----|---|---------|---|---|----------------|
| 1 Left precentral gyrus/frontal lobe                           | -38 | 2   | 37 |   |         |   |   | Brede Database |
| 2 Right tempoparietal junction                                 | 48  | -40 | 9  |   |         |   |   | Brede Database |
| 3 Right precentral gyrus/frontal lobe Supplementary motor area | 51  | 15  | 34 |   |         |   |   | Brede Database |

# Principles of the Brede Wiki



Structured information is stored in the so-called “templates” of Mediawiki.

Template use simple so it is easy to convert data all template instantiations to an SQL representation: No wiki formating 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.

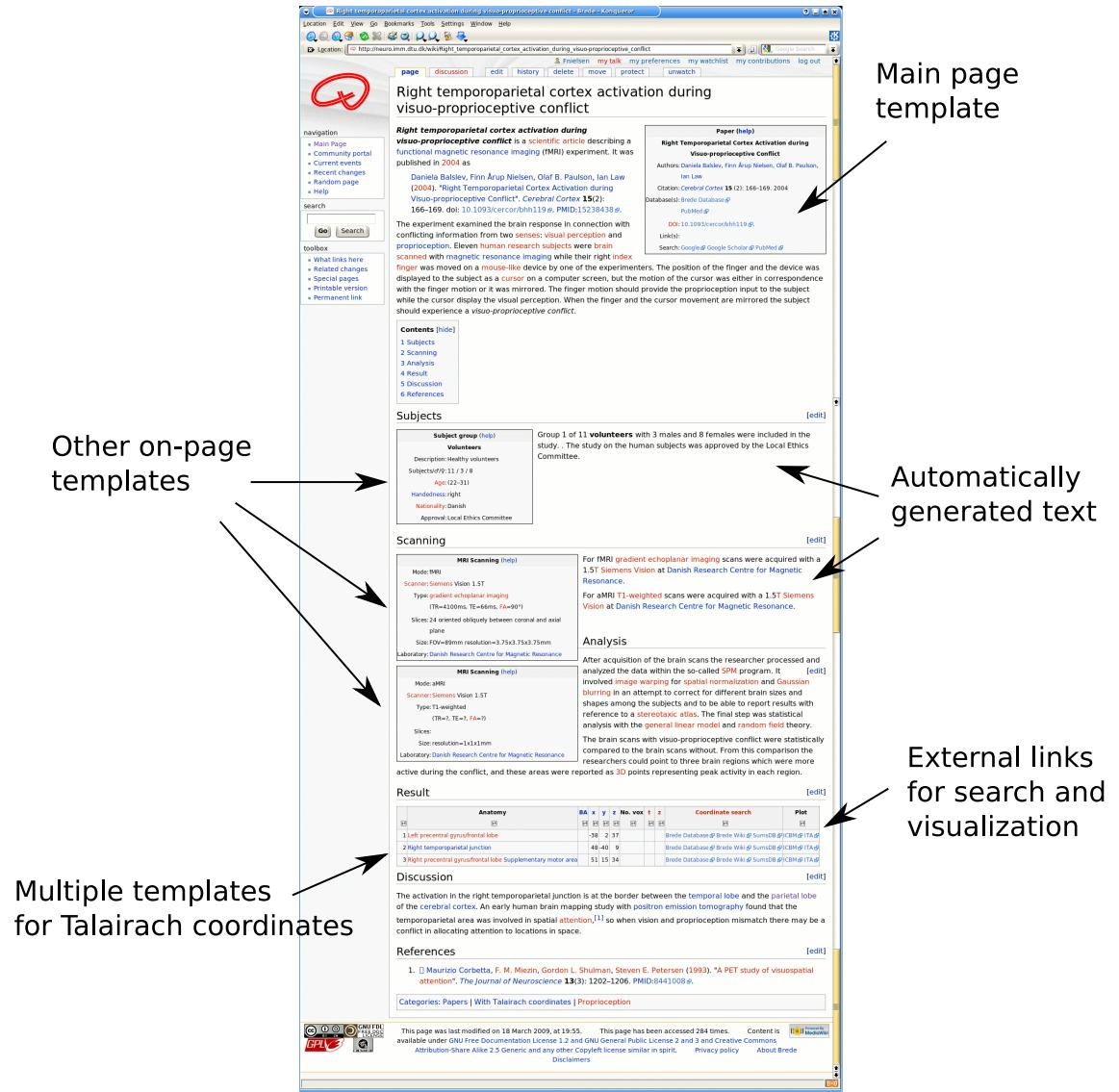
Link to external sites whenever possible.

# Brede Wiki templates

Templates may describe a paper with bibliographic information or a researcher or journal.

Hierarchical templates: Brain regions, Topics, Organizations, Software.

Multiple templates on each page, e.g., to describe subject group, brain scan, experimental condition, Talairach coordinate, brain volume, gene personality association.



# Storing of volumes

## Scanning

**MRI Scanning (help)**

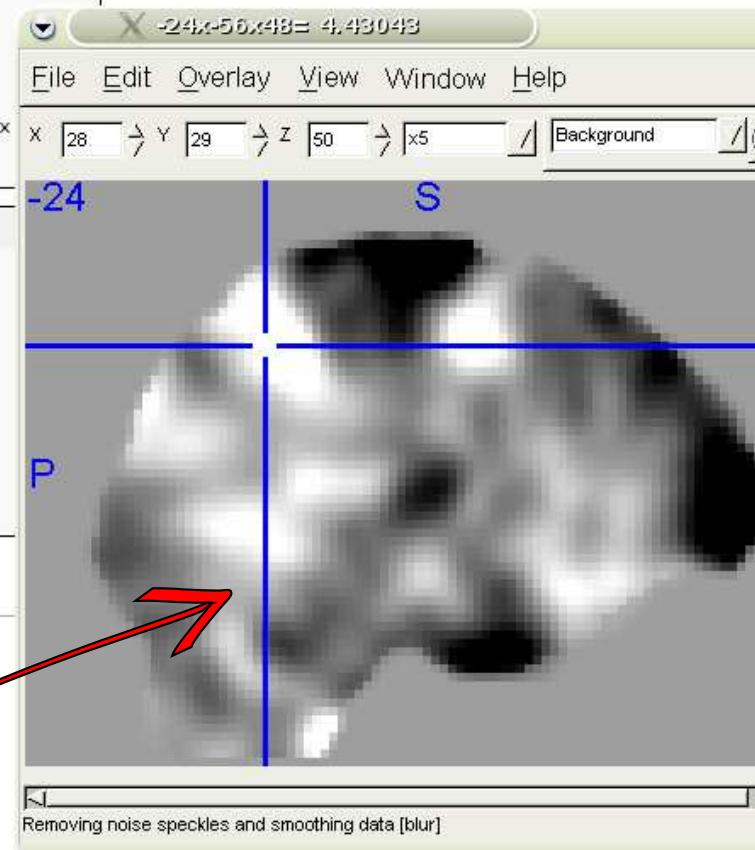
Mode: fMRI  
Scanner: Philips Achieva 3T  
Type: Gradient-echo echo-planar  
(TR=3000ms, TE=35ms, FA=?)  
Slices: 49 (thickness=3mm) oriented Horizontal  
Size: FOV=240 x 147 x 240mm resolution=2.5 x 2.5 x 3mm  
Laboratory: missing laboratory

**MRI Scanning (help)**

Mode: aMRI  
Scanner:  
Type: T1-weighted  
(TR=?, TE=?, FA=?)  
Slices:  
Size: resolution=1 x 1 x 2mm  
Laboratory: missing laboratory

For fMRI Gradient-echo echo-planar scans were acquired with a 3T Philips Achieva.

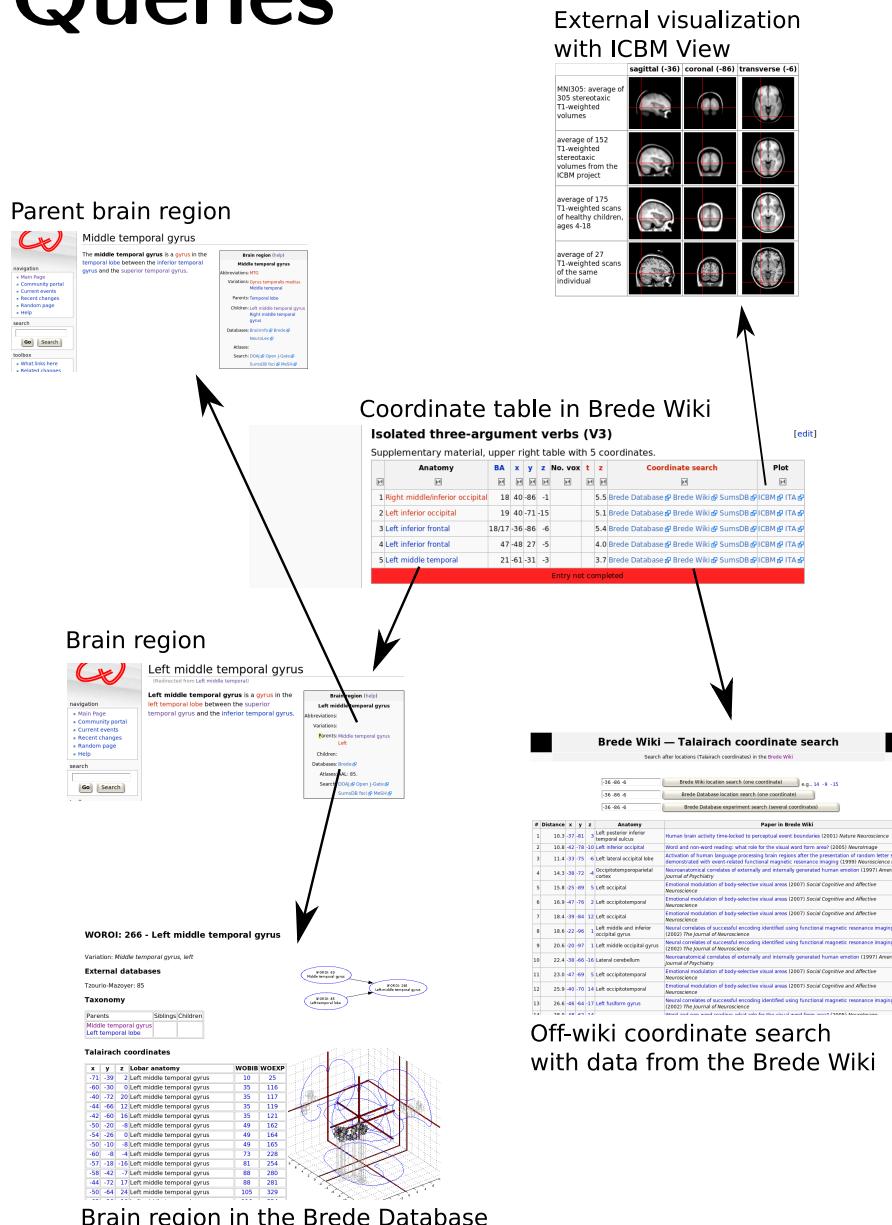
For aMRI T1-weighted scans were acquired with a .



## Results

Volume: Contrast image

# Queries



Structured content can be extracted (like DBpedia on Wikipedia)

Queries are possible, but not within  
the wiki

Query on nearby coordinates with an off-wiki script.

So-called “SKOS file” (Miles and Bechhofer, 2009) generated for brain region and topic hierarchies from the structured content.

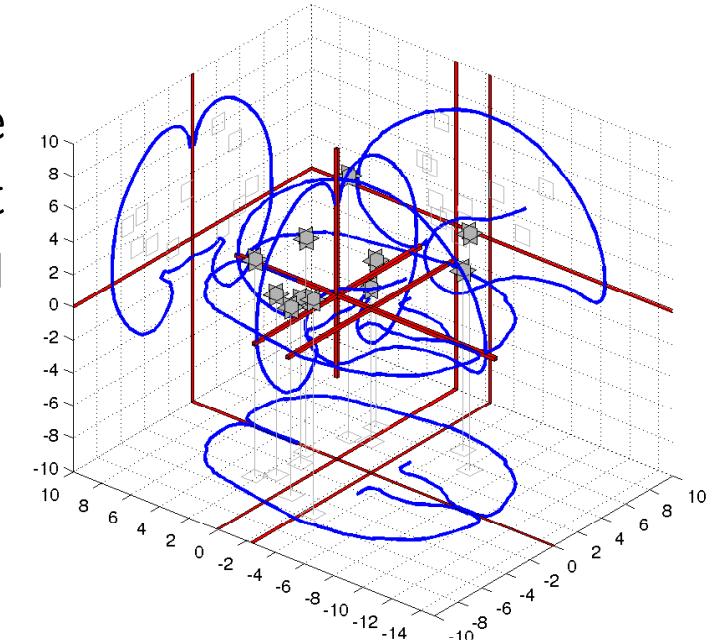
# Brede Wiki and Toolbox integration

You can get data from the Brede Wiki into Matlab, e.g., paper in the Brede Wiki (Lin et al., 2008):

```
>> title = 'Brain maps of Iowa gambling task';
>> Ls = brede_web_bw2loc(title);
>> figure, brede_ta3_frame, brede_ta3_loc(Ls)
```

Get the page from the Web site and extract the information within the templates and convert to a structure that fits the Brede Toolbox and Database.

Finally, plot the locations.



## Issues

Contribution is difficult: Presently “raw” data entry ☹

Online interactive meta-analysis is not immediately available ☹

# Brede Wiki for personality genetics

| Table 1. TOI Scores grouped by genotype |                |                   |                   | 139         |   |
|---|----------------|-------------------|-------------------|-------------|---|
| Genotype (N=6)                          | Harm avoidance | TOI factor scores |                   |             | P |
|   |                | Novelty seeking   | Reward dependence | Persistence |   |
| "s" (86/60.1)                           | 17.14 ± 7.11   | 20.36 ± 6.15      | 15.50 ± 3.48      | 4.81 ± 2.13 |   |
| "d" (54/4.9)                            | 16.59 ± 7.71   | 20.35 ± 6.02      | 15.27 ± 4.31      | 4.69 ± 2.36 |   |
| "I" (95.7)                              | 17.55 ± 4.02   | 20.67 ± 7.58      | 15.55 ± 3.48      | 4.22 ± 2.05 |   |
| "s+d" (10/1.6)                          | 17.14 ± 7.11   | 20.36 ± 6.15      | 15.40 ± 3.48      | 4.81 ± 2.13 |   |
| "s+I" (63/39.9)                         | 16.90 ± 7.31   | 20.33 ± 6.23      | 15.65 ± 4.05      | 4.76 ± 2.31 |   |
| F                                       | 1.53           | 0.91              | 0.56              | 0.67        |   |
| p                                       | 0.98           | 0.89              | 0.79              | 0.97        |   |

In the study, they were from Hong-kong University, located in Hong Kong. There were 60 males and 40 females, aged of 23.8 ± 3.1 years (SD). All subjects were healthy and participated in the study after giving informed consent. The study protocol was approved by the Institutional Review Board at Chinese Medical Center.

A total of 160 subjects were recruited. A total of 10 male healthy subjects were eliminated due to incomplete DNA analysis. DNA was isolated from peripheral blood leukocytes according to standard procedures. DNA fragments were analyzed by polymerase chain reaction using 5'-GGCGTTCGGCGGT-  
CCTG-3' (forward) and 5'-TTTCTTCCATGAC-  
CTGCTGAACTTAC-3' (reverse) primers (39). The PCR reaction mixture contained a total volume of 20  $\mu$ L with the following composition: 12 ng genomic DNA, 4  $\mu$ M of each primers, 2.5 mM dNTPs, 5 mM of deox dGTP, and 1 U Taq polymerase (Takara, Japan). The PCR cycle was 5 min denaturation at 95 °C, 3 cycles were performed consisting of 40 sec at 95 °C, 40 sec at 58 °C, and 90 sec at 72 °C, followed by an additional 35 cycles of 40 sec at 95 °C, 40 sec at 58 °C, and 90 sec at 72 °C. The reaction was ended by incubation at 72 °C for 7 min. PCR products were separated for the Nov (7 kb) and short (3 kb) by their variants on

Ninety-five subjects (60.1%) were "s" genotype, and subjected with "d" (54.0%), "s+d" (10.1%), and 9 (5.7%), respectively. There were no gender differences in frequencies according to sex. There were no significant differences in the scores of harm avoidance ( $F=3.8$ ,  $p=0.09$ ), novelty seeking ( $F=0.07$ ,  $p=0.93$ ), reward dependence ( $F=0.16$ ,  $p=0.86$ ) and persistence ( $F=0.24$ ,  $p=0.87$ ) between sex and sex independent. When we included the subjects in the same two groups of "s" (60.1%) and "s+d" (9.9%), we could not find associations between the two genotype group and persistence, either (Table 1).

The scores of 5-HTTLPR alleles frequencies ( $F=11.04$ ,  $p<0.001$ ) and allele allelles ( $F=7.11$ ,  $p=0.001$ ) in our samples are significantly different from those of Ieshi et al. (2), these scores are quite similar to other studies of Korean (20), Japanese (6, 12, 23), and Chinese (22).

## DISCUSSION

In the present study, we could not find evidence for an association between 5-HTTLPR and harm avoidance measured by STCI in healthy Chinese subjects. It is common to miss

No association between 5-HTTLPR and harm avoidance in Korean college students

**Subjects**

Subject group #1 (help)  
Healthy Korean students  
Subjects: 69 / 158 (49.89%  
Age: 23.8 ± 3.1 (-)  
Nationality: Korean  
Approval: Institutional Review Board of Asan Medical Center  
Databases:

Group 1 of 158 healthy Korean students with 69 males and 89 females were included in the study. The Korean group had a mean age of 23.8. The study on the human subjects was approved by the Institutional Review Board of Asan Medical Center.

**Results**

Categories: Papers | Papers in PubMed Central

Paper (help)  
No association between 5-HTTLPR and harm avoidance in Korean college students  
Authors: Yeon Hee Jo, Heung Bum Oh, Byengsu Kim, Suk Hoan Jung, Jun Kyu Chung, Jin Pyo Hong, Chang Yoon Kim  
Citation: Journal of Korean Medical Science 22 (1): 138-131, 2007 February  
Database(s): PubMed (edit)  
DOI: 10.3346/jkms.2007.22.1.138 (edit)  
PMCID: 2693551 (edit)  
Link(s):  
Search  
Web | Bing | Google | Yahoo! | Jams | Google PDF (edit)  
Article: Google Scholar | PubMed (edit)  
Services  
Format: BibTeX | Template from PMID (edit)  
Extract:

Data entry in the wiki in a table-like interface: Gene, polymorphism, genotype, inventory, trait, personality scores, subject group, PMID.

“Normal” Brede Wiki keeps track of data entry.

Data can also be exported to the Brede Wiki.

So far typed in data from 87 studies with 2815 personality scores.

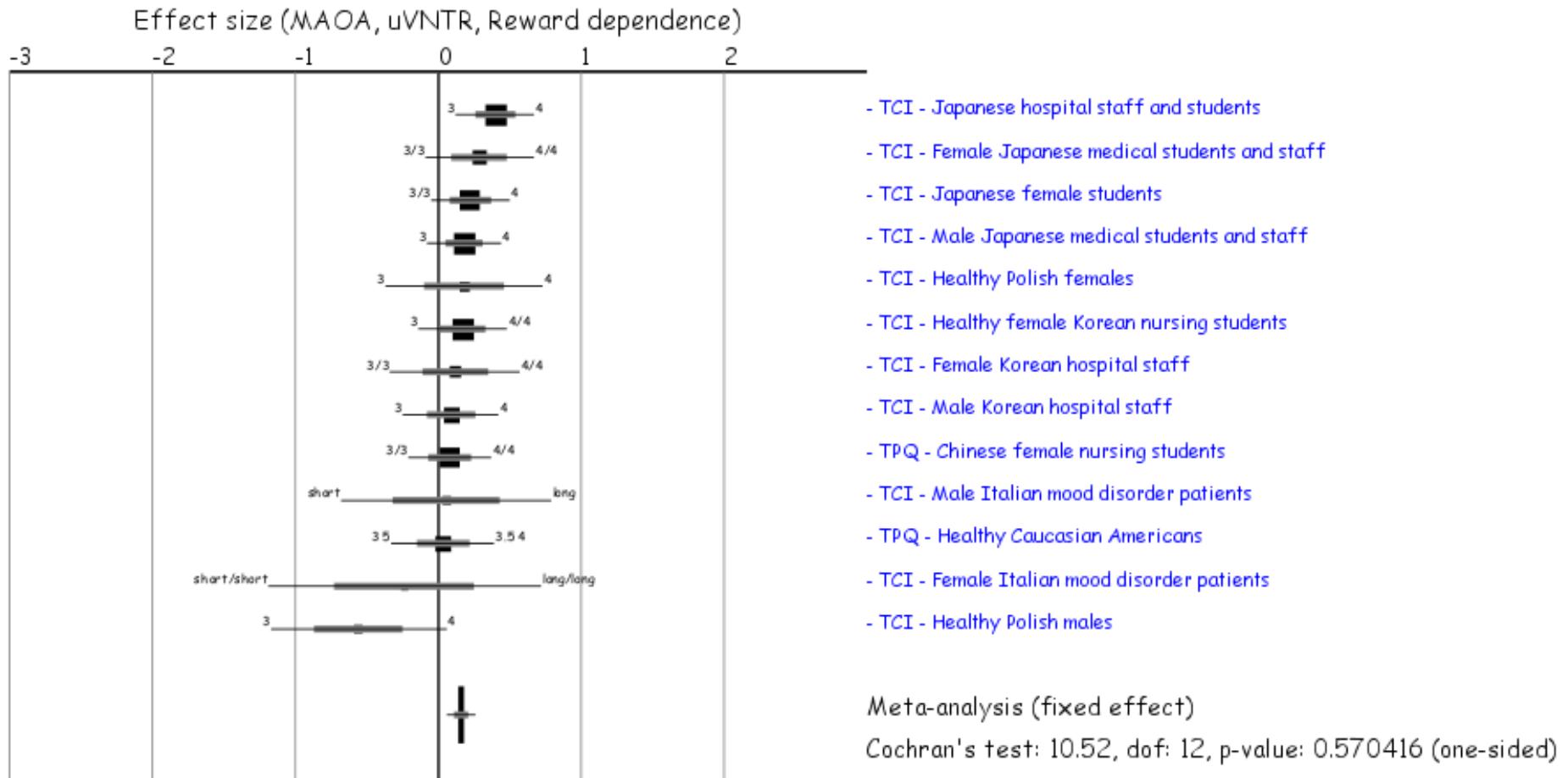
# Meta-analysis across traits and polymorphisms

|    | <b>Effect</b> | <b>Std</b> | <b>P</b> | <b>Studies</b> | <b>Subjects</b> | <b>Gene</b> | <b>Polymorphism</b> | <b>Trait</b>      |
|----|---------------|------------|----------|----------------|-----------------|-------------|---------------------|-------------------|
| 1  | 0.854         | 0.223      | 0.00013  | 2              | 107             | ESR1        | TA repeat           | Harm avoidance    |
| 2  | -1.102        | 0.289      | 0.00014  | 2              | 245             | HTR3A       | C178T               | Harm avoidance    |
| 3  | -0.779        | 0.220      | 0.00039  | 1              | 90              | ESR1        | TA repeat           | Anxiety           |
| 4  | -0.445        | 0.135      | 0.00098  | 1              | 247             | TH          | TCAT repeat         | Extraversion      |
| 5  | -0.401        | 0.123      | 0.00108  | 1              | 315             | DRD4        | Exon 3 VNTR         | Positive emotions |
| 6  | 0.165         | 0.051      | 0.00118  | 13             | 1747            | MAOA        | uVNTR               | Reward dependence |
| 7  | -0.393        | 0.123      | 0.00135  | 1              | 315             | DRD4        | Exon 3 VNTR         | Extraversion      |
| 8  | -1.355        | 0.427      | 0.00152  | 1              | 125             | HTR3A       | C178T               | Nonconformity     |
| 9  | -0.758        | 0.240      | 0.00161  | 1              | 122             | SLC6A4      | 5-HTTLPR            | Activity          |
| 10 | -0.174        | 0.055      | 0.00163  | 16             | 1791            | SLC6A4      | 5-HTTLPR            | Agreeableness     |

Large-scale data mining across all recorded personality traits and polymorphisms and present the result on the wiki.

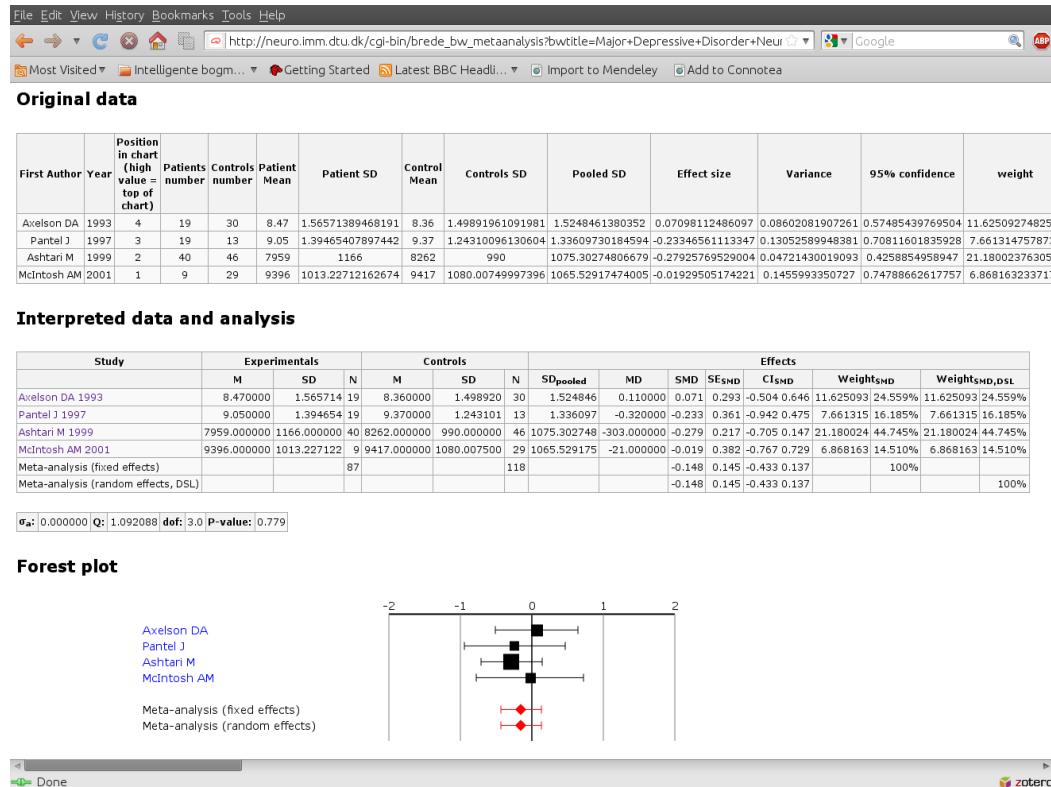
Order meta-analytic results, e.g., with respect to *P*-value

# MAOA uVNTR/reward dependence



Forest plot generated by the wiki for the “warrior gene” and Cloninger’s reward dependence with meta-analysis and Cochrane’s test.

# Meta-analysis with a MediaWiki-based wiki



Data sets from structural neuroimaging meta-analyses across multiple brain regions by Kemp-ton et al. (2008, 2011)

Represent the data as comma-separated values on a separate page.

Web script extracts the data and present a meta-analysis on a Web page.

Online forest plot and funnel plots.

# Data quality

Spamming is a serious problem on smaller open wikis.

On an open wiki you need daily surveillance and block vandals and delete pages

MediaWiki has numerous methods deal with spamming

MediaWiki can also restrict who is able to edit and signup

On the Brede Wiki incomplete data entry is indicated with a prominent red color

What data is incomplete is not apparent for users during search

# Data quality: Outlier detection

| #  | Value     | x   | y   | z   | term      | Lobar anatomy                                     | WOBIB | WOEXP |
|----|-----------|-----|-----|-----|-----------|---|-------|-------|
| 1  | -111.6671 | -11 | -76 | -53 | parietal  | Left superior parietal lobe                       | 176   | 539   |
| 2  | -86.8558  | -50 | -52 | 17  | right     | Right occipitotemporal cortex                     | 4     | 9     |
| 3  | -71.9572  | 57  | -22 | 13  | left      | Left Heschl's gyrus                               | 164   | 499   |
| 4  | -59.8896  | -46 | -25 | 13  | right     | Right superior temporal gyrus                     | 164   | 499   |
| 5  | -56.9524  | 46  | 40  | -4  | left      | Left middle frontal gyrus                         | 88    | 283   |
| 6  | -56.4492  | -11 | -76 | -53 | superior  | Left superior parietal lobe                       | 176   | 539   |
| 7  | -56.1964  | -30 | 59  | 3   | lobule    | Left middle frontal lobule                        | 88    | 283   |
| 8  | -55.4707  | -39 | -33 | 46  | right     | Right intraparietal sulcus                        | 24    | 77    |
| 9  | -53.914   | -44 | -62 | 4   | anterior  | Left anterior middle temporal gyrus               | 104   | 324   |
| 10 | -53.3065  | 40  | 10  | 0   | left      | Left frontal insula                               | 17    | 50    |
| 11 | -52.9443  | -8  | -32 | -4  | frontal   | Mesolimbic, right inferior frontal gyrus          | 111   | 343   |
| 12 | -51.4662  | 52  | -30 | 20  | cingulate | Right postcentral gyrus/posterior cingulate gyrus | 35    | 119   |
| 13 | -44.1041  | -34 | -48 | -18 | right     | Right fusiform gyrus                              | 145   | 443   |
| 14 | -42.5693  | 8   | -68 | -35 | precuneus | Right precuneus                                   | 23    | 73    |
| 15 | -40.5044  | -37 | 35  | 36  | right     | Right middle frontal gyrus                        | 178   | 561   |
| 16 | -39.5277  | -44 | 32  | 9   | lobule    | Left inferior frontal lobule                      | 88    | 283   |
| 17 | -37.978   | -15 | -53 | -2  | anterior  | Left lingual gyrus/anterior calcarine sulcus      | 3     | 7     |
| 18 | -36.8332  | -34 | 3   | 15  | right     | Right inferior frontal cortex                     | 161   | 493   |
| 19 | -34.993   | -30 | -40 | -25 | anterior  | Left anterior cerebellum                          | 180   | 563   |
| 20 | -33.018   | 38  | 18  | -26 | fusiform  | Fusiform gyrus                                    | 31    | 104   |

What about data entry errors and other peculiarities?

Data mining for outliers using an automated algorithm that looks at the redundancy between the anatomical label and the 3D coordinate (Nielsen and Hansen, 2002a).

Here “parietal” in “left superior parietal lobe” does not “fit” with  $z = -53$  and “right” in “Right occipitotemporal cortex” does not fit with  $x = -50$ .

# Data sharing

Data from the Brede Database distributed as XML, comma-separated values file, JSON, SKOS.

Brede Database aggregated into Antonia Hamilton's AMAT, — an thereby also SumsDB.

Federated into *Neuroscience Information Framework*

AcaWiki, <http://acawiki.org/>, academic summaries.

Issue with license: CC-by or CC-by-sa.

The Brede Wiki available from

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

Brede Database

<http://neuro.imm.dtu.dk/services/brededatabase>

Brede Toolbox

<http://neuro.imm.dtu.dk/software/brede>

Thanks!

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