Autistic and non-autistic brain differences isolated for first time

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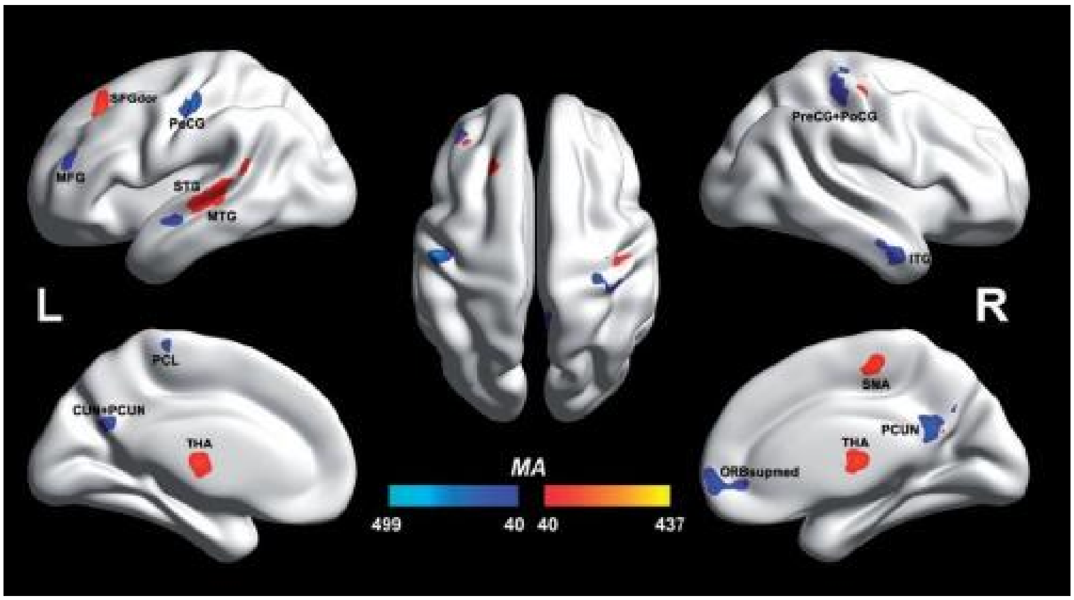


Brain model with regions of interest highlighted. Credit: University of Warwick

The functional differences between autistic and non-autistic brains have been isolated for the first time, following the development of a new methodology for analysing MRI scans.

Developed by researchers at the University of Warwick, the methodology, called Brain-Wide Association Analysis (BWAS), is the first capable of creating panoramic views of the whole brain and provides scientists with an accurate 3D model to study.

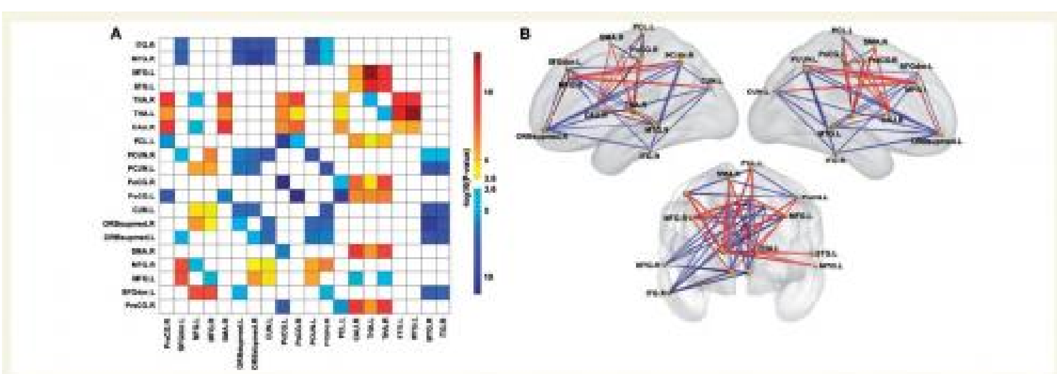
The researchers used BWAS to identify regions of the brain that may make a major contribution to the symptoms of autism.

BWAS does so by analysing 1,134,570,430 individual pieces of data; covering the 47,636 different areas of the brain, called voxels, which comprise a functional MRI (fMRI) scan and the connections between them.

Previous methodologies were process this level of data and were restricted to modelling only limited areas.

The ability to analyse the entire data set from an fMRI scan provided the Warwick researchers the opportunity to compile, compare and contrast accurate computer models for both autistic and non-autistic brains.

Led by BWAS developer Professor Jianfeng Feng, from the University of Warwick's Department of Computer Science, the researchers collected the data from hundreds of fMRI scans of autistic and non-autistic brains.



Connections between regions of interest. Credit: University of Warwick

By comparing the two subsequent models the researchers isolated twenty examples of difference, where the connections between voxels of the autistic brain were stronger or weaker than the non-autistic .

The identified differences include key systems involved with brain functions relating to autism. Professor Feng explained the findings:

"We identified in the autistic model a key system in the temporal lobe visual cortex with reduced cortical functional connectivity. This region is involved with the face expression processing involved in social behaviour. This key system has reduced functional connectivity with the ventromedial prefrontal cortex, which is implicated in emotion and social communication".

The researchers also identified in autism a second key system relating to reduced cortical functional connectivity, a part of the parietal lobe implicated in spatial functions.

They propose that these two types of functionality, face expression-related, and of one's self and the environment, are important components of the computations involved in theory of mind, whether of oneself or of others, and that reduced connectivity within and between these regions may make a major contribution to the symptoms of autism.

Significant regions of interest in the voxel-based whole brain analysis

No.	Areas	# Voxels in ROI	Peak *MA* value	MNI coordinates (Peak)
ROI 1	Right precentral gyrus	49	117	36 −21 54
ROI 2	Left superior frontal gyrus, dorsolateral	37	340	−21 27 45
ROI 3	Left MTG	69	182	−39 45 24
ROI 4	Right MTG	23	−371	51 48 3
ROI 5	Right supplementary motor area	34	135	9 −21 54
ROI 6	Left superior frontal gyrus, medial orbital	20	−155	0 63 −6
ROI 7	Right superior frontal gyrus, medial orbital	68	−250	3 63 −6
ROI 8	Left cuneus	22	−114	−6 −63 27
ROI 9	Left postcentral gyrus	110	−449	−51 −15 48
ROI 10	Right postcentral gyrus	145	−152	33 −27 54
ROI 11	Left precuneus	44	−95	−3 −66 30
ROI 12	Right precuneus	47	−210	6 −51 24
ROI 13	Left paracentral lobule	30	−112	−12 −36 72
ROI 14	Right caudate nucleus	32	424	15 −6 18
ROI 15	Left thalamus	145	352	−9 −15 12
ROI 16	Right thalamus	146	437	15 −9 18
ROI 17	Left STG	29	133	−57 −45 18
ROI 18	Left MTG	178	160	−57 −24 0
ROI 19	Right MTG	25	−308	60 0 −30
ROI 20	Right ITG	33	−294	57 0 −30

A region of interest (ROI) was defined as an area in an AAL region with ≥20 significant voxels after Bonferroni correction. The measure of association (*MA*) is shown as positive if overall the voxel has stronger functional connectivity links in subjects with autism, and as negative if they are weaker.

A list of 20 regions of interest indentified by BWAS. Credit: University of Warwick

The researchers argue that the methodology can potentially isolate the areas of the brain involved with other cognitive problems, including Obsessive Compulsive Disorder, ADHD and schizophrenia.

By using meta-analysis and a rigorous statistics approach the Warwick researchers were able to collect and use a big data set to obtain significant results, the likes of which have not been seen in autistic literature before. Professor Feng explains:

"We used BWAS to analyse resting state fMRI data collected from 523 autistic people and 452 controls. The amount of data analysed helped to achieve the sufficient statistical power necessary for this first voxel-based, comparison of whole autistic and non-autistic brains. Until the development of BWAS this had not been possible.

"BWAS tests for differences between patients and controls in the connectivity of every pair of voxels at a whole brain level. Unlike previous seed-based or independent components-based approaches, this method has the great advantage of being fully unbiased in that the connectivity of all brain voxels can be compared, not just selected brain regions."

Provided by University of Warwick

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