Effects of Intellectual Ability on Cortical Thickness in Autistic Children with and without Intellectual Disability

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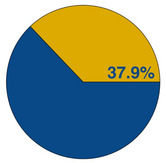
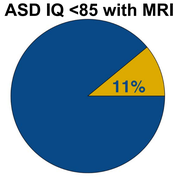
Introduction

Among autistic individuals intellectual disability (ID) is a common co-occurring condition defined by significant limitations in both intellectual functioning and adaptive behavior.

ASD Population with ID[1]

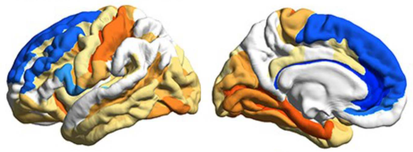


National Database for Autism Research ASD IQ <85 with MRI[2]



In adults, thicker cortex = higher IQ[3], while in younger children thinner cortex = higher IQ[4-6]. The transition from a negative to positive association between cortical thickness and IQ occurs sometime in middle childhood (7-10 years)[4,6].

Associations of Cortical Thickness with IQ in 9-11 Year Old Children[5]



Regions where **Thicker** and **Thinner** Cortex = Higher IQ

Hypotheses

1. Autistic and non-autistic children have associations between cortical thickness and IQ that differ regionally and by degree.
2. Autistic children with ID have thicker cortex in regions associated with intelligence compared to autistic children with ID.
3. Autistic children with and without ID have different associations between cortical thickness and IQ.
4. Spatial patterns of cortical thickness associated with both autism symptom severity and IQ will be similar.

Sample & Methods

Table 1: Autism Phenome Project Sample

	ASD (total)	ASD noID	ASD ID	TD
n	88	55	33	53
male / female	60 / 28	37 / 18	23 / 10	27 / 26
age (months)	64.5 (5.3)	64.4 (5.0)	64.7 (5.7)	63.5 (6.4)
DQ	79.8 (32.4)	102.2 (15.4)	42.4 (12.1)	114.2 (10.6)
ADOS CSS	7.2 (1.7)	6.8 (1.7)	8.2 (1.3)	-
VABS ABC	77.0 (64.4)	84.4 (12.6)	64.1 (13.5)	-

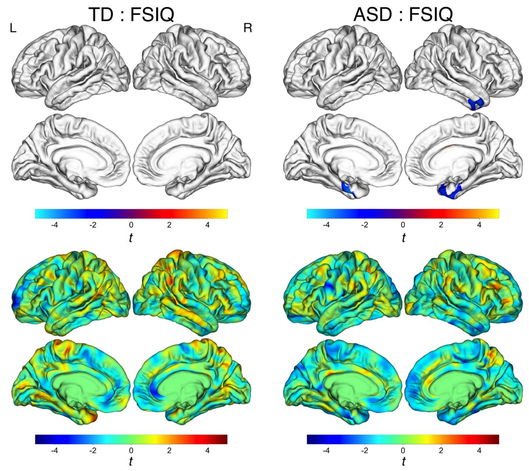
T1 weighted MPRAGE MRIs acquired during natural nocturnal sleep

Cortical thickness estimated using *Freesurfer* v7.1.1, visualizations using the *fsbrain* R package[7]

General linear mixed effects models estimated using the *Surfstat* package, SPIN tests of spatial similarity[8] both implemented in MATLAB v9.12.0 2022a

Results

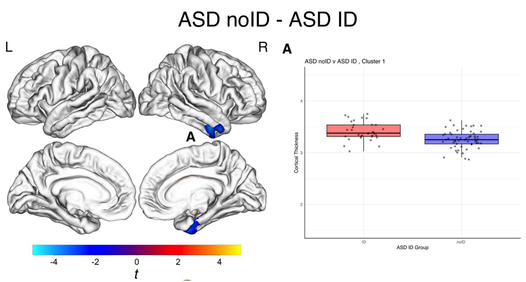
Fig 1. Cortical Regions Associated with IQ in TD and ASD



Autistic children had more significant negative associations between cortical thickness and IQ in temporal regions.

These included: bilateral entorhinal cortex, and the right fusiform gyrus, superior temporal gyrus, middle temporal gyrus, inferior temporal gyrus, and temporal pole

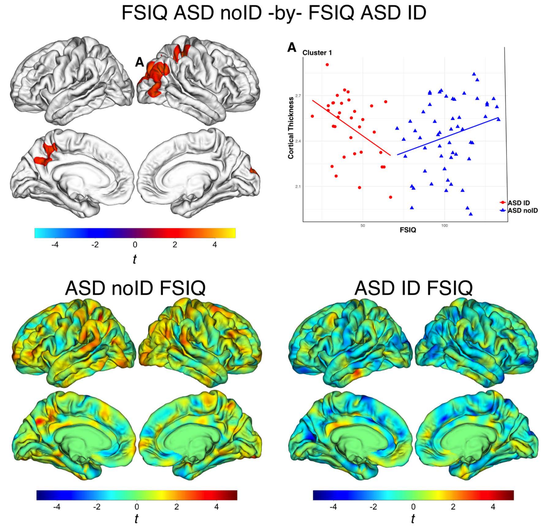
Fig 2. Differences in Cortical Thickness between ASD with and without ID



Compared to autistic children with ID, those without ID had thinner cortex.

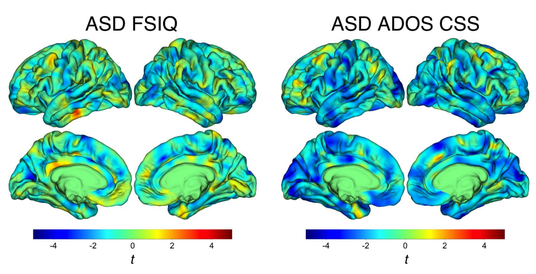
These regions largely overlapped with those that showed significant associations with IQ across all autistic children and included the right entorhinal cortex, fusiform gyrus, inferior temporal gyrus, middle temporal gyrus and temporal pole.

Fig 3. Differences in the Association of Cortical Thickness and IQ between ASD with and without ID



Top) Different associations between IQ and cortical thickness were found for autistic children with ID (thinner cortex = higher IQ) and without ID (thicker cortex = higher IQ) within the right inferior parietal cortex, superior parietal cortex, lateral occipital cortex, postcentral gyrus, and left precuneus. **Bottom)** Little spatial correspondence was found for cortical regions associated with intellectual ability between autistic children with and without ID (p=0.24).

Fig 4. Spatial Similarity of Effects of IQ and Autism Symptom Severity in ASD



Effects of autism symptoms and IQ on cortical thickness had a high degree of spatially correspondence, more so than would be expected by chance (p<0.001)

Conclusions

Despite comprising nearly 40% of the autism population, until now no neuroimaging study has directly investigated differences in brain structure between autistic individuals with and without ID.

Large differences in intellectual ability across the autism spectrum contribute to significant heterogeneity in autistic brain phenotypes.

Different associations between cortical thickness and IQ between autistic children with and without ID may be reflective of delayed or compensatory cortical development.

Processes that contribute to autism symptoms and intellectual ability significantly overlap, making disentangling to two challenging.

Further studies that take longitudinal, individual centered, approaches will be helpful in resolving the complexities of how cortical development contributes to intellectual ability in autism.

Acknowledgements & Key References

We would like to thank all our participants and families, study coordinators and staff!

Funding: USA National Institute of Health; P50 HD103526, P50 HD093079, R01 MH128814, R01 MH127046, R01 MH103284, UL1 TR000002

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