

AIMS

To test if mothers of children with autism are more likely to have studied:

- a **Narrow STEM** (science, technology, engineering, or mathematics) degree, and/or
- a **Broad STEM** (e.g., linguistics, economics, and other systems-centred) degree, compared to mothers of typically developing children.



INTRODUCTION

- Fathers and grandfathers of children with autism are more likely to work in the field of engineering, compared to fathers and grandfathers of typically developing children (Baron-Cohen et al, 1997).
- There are higher rates of autism in geographical regions that have higher rates of people working in fields such as information technology, like Eindhoven in the Netherlands (Roelfsema et al, 2012).
- Such results are also consistent with the hyper-systemizing genetic theory of autism, which suggests that the genetics of autism overlaps with the genetics of strong systemizing talent.
- Mothers of children with autism in the San Francisco Bay Area are more likely to work in STEM occupations (Windham et al, 2009).
- Mothers of children with autism also have elevated Systemizing Quotient scores (Grove et al, 2015)
- And have faster/more accurate scores on the Embedded Figures Test of attention to detail (Baron-Cohen and Hammer, 1997).
- To date, no study has investigated the degrees that mothers of children with autism have studied, prior to having their child.

METHODS

- Group 1: 749 mothers of a child with autism, age 18-75 years old, registered at the online Cambridge Autism Research Database (CARD), and who had provided information about their degree type;
- Group 2: A control group of 1,212 age-matched mothers of a typically developing child who had registered at the online cambridgepsychology database, who had no family history of autism.
- All 1,961 women selected their degree type from a drop-down menu of 180 degrees, and these were coded into Narrow STEM, Broad STEM, or Non-STEM, by two independent judges, with 100% agreement.

RESULTS

Of those women who had also completed the Autism Spectrum Quotient (AQ):

- Mothers of children with autism scored higher than controls ($p=0.0045$), replicating earlier findings.
- A Chi Square test of Narrow STEM, Broad STEM, and Non-STEM degrees revealed that:
- Mothers of children with autism were more likely to have studied a STEM degree than mothers of typically developing children
- Mothers of children with autism: 83%
- Mothers of typically developing children: 77.5%
- Chi Square (1) = 8.84, $p=0.003$.



RESULTS (continued)

Table 1: Sample

	N	Mean Age (years)	UK Resident (%)	Postgrad Degree (%)	AQ Completed (%)
Control Mothers	1,212	45.8	421 (34.7%)	181 (14.9%)	978 (80.1%)
Mothers of a child with autism	749	45.2	393 (52.5)	41 (5.5%)	633 (84.5%)
Total	1,961	45.4	841 (42.9%)	222 (11.3%)	1,611 (82.2%)

T-test of age of mothers: $p = 0.947$
 T-test of AQ for mothers: $p = 0.0045$

Table 2: Degree Type and AQ in mothers

	Degree Type	N	Mean AQ	AQ Range
Control Mothers	Narrow STEM	328	17.7	3-39
	Broad STEM	432	16.0	2-45
	Other	219	15.7	1-40
Mothers of a child with autism	Narrow STEM	220	19.2	2-47
	Broad STEM	309	16.8	2-50
	Other	105	17.0	5-48
	All	634	17.7	2-50

Mean AQ's from Ruzich et al (2015):
 Control females: 14.88 (10.4-17.4)

Table 3: Mothers x All Degree Types

	Narrow STEM	Broad STEM	Other	Total
Child with autism	257 (34.3%)	365 (48.7%)	127 (17.0%)	749 (100%)
Child without autism	385 (31.8%)	554 (45.7%)	273 (22.5%)	1,212 (100%)
Total	642 (32.7%)	919 (46.9%)	400 (20.4%)	1,961

Chi Square (2) = 8.8573, $p = 0.012$

Table 4: Mothers x Any STEM Degree

	Narrow and Broad STEM	Other	Total
Child with autism	622 (83.0%)	127 (17.0%)	749 (100%)
Child without autism	939 (77.5%)	273 (22.5%)	1,212 (100%)
Total	1,561 (79.6%)	400 (20.4%)	1,961

Chi Square (1) = 8.8415, $p = 0.003$

DISCUSSION

- This study is the first to show that mothers of children with autism are over-represented in STEM degrees in their graduate education.
- This association with risk of autism is likely to reflect:
 - genetic factors (since maternal grandfathers are also over-represented in STEM) and
 - prenatal epigenetic factors (since mothers of children with autism are more likely to have elevated endocrine conditions during pregnancy).

FUTURE DIRECTIONS

- This result needs to be replicated in an independent sample.
- We need to understand the genetic and epigenetic basis of this maternal group difference.
- This study raises the possibility of a shared genetic basis between STEM aptitude and autism risk.

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