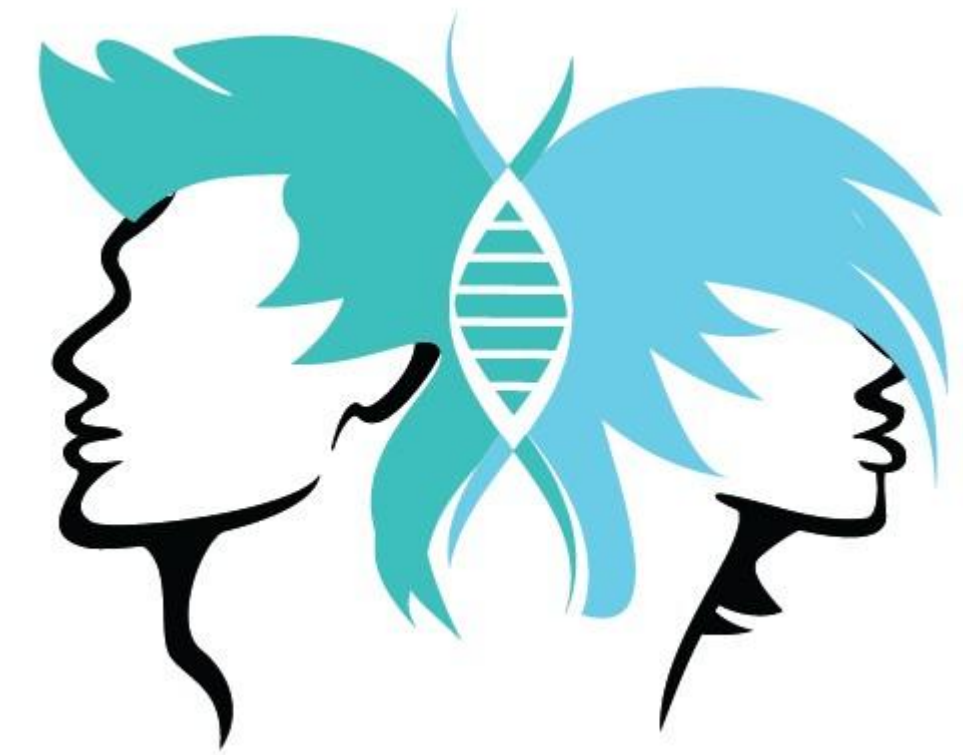




INVESTIGATION OF GENETIC ASSOCIATION BETWEEN CEREBELLAR VOLUME, ATTENTION PROBLEMS AND COGNITION IN CHILDREN



Suzanne Swagerman¹, Inge van Soelen³, Marieke van Leeuwen⁴, Jiska Peper⁵, Marinka Koenis², Rachel Brouwer², Toos van Beijsterveldt¹, Eco de Geus¹, Hilleke Hulshoff Pol², Dorret Boomsma¹

¹Department of Biological Psychology, VU University Amsterdam. ²Rudolf Magnus Institute of Neuroscience, Department of Psychiatry, University Medical Center Utrecht. ³Department of Public Health and Primary Care, Leiden University Medical Centre. ⁴Department of Psychosocial Research and Epidemiology, The Netherlands Cancer Institute, Amsterdam. ⁵Institute of Psychology, Brain and Development Laboratory, Leiden University.

BrainSCALE

Brain Structure and Cognition:
an Adolescent Longitudinal Twin Study into
the Genetic Etiology of Individual Differences

Aim

The importance of genetic factors has been established for a wide range of structural brain measures, for example total and regional brain size, volumetric changes and cortical thinning.

The **cerebellum**, one of the last maturing areas, is well known for its role in motor skills, and has recently been implicated to be important in **cognitive** functioning.

Cerebellar development also seems to be of importance for healthy development, as it has been implicated in developmental disorders like **ADHD**.

Both cerebellar volume and attention problems are highly heritable in childhood. Whether there is an association between these two measures, and possibly IQ, and how this relation might be influenced by genetic factors will be investigated.

METHODS

Sample and data collection

Twins and older siblings from 112 families have participated in BrainSCALE at one or two time points (twins age 9 and 12). MRI, behavioral, IQ, neurocognitive, physical and hormonal data were collected.

Twin pairs: 23 monozygotic male & 25 female, 23 dizygotic male & 21 female, 20 opposite sex. Siblings: 44 male, 59 female.

Measures

- ◆ For twins: Overactive (OA) and attention problem (AP) behavior rated at ages 3 - 7 - 10 - 12 by parents (child behavior checklist)
For siblings: AP behavior rated around age 12 and 15
- ◆ Total cerebellum volume, gray & white matter (CBt, CBgm, CBwm)
- ◆ IQ measured by the WISC, verbal, performat, total (VIQ, PIQ, TIQ)

Analyses

Trivariate modeling in Mx was used to estimate genetic and environmental contributions to (co)variance of attention problems, cerebellar volume and IQ. Sex was included in the analysis as a covariate.

RESULTS

Attention	Age 3	Age 7	Age 10	Age 12
Mean (N)	2.26 (198)	2.54 (192)	2.64 (158)	2.34 (193)

Cerebellum	CBt age 9	CBgm age 9	CBwm age 9	CBt age 12	CBgm age 12	CBwm age 12
Mean (N)	153.5 (195)	108.0 (195)	45.6 (195)	159.9 (127)	109.8 (127)	50.2 (127)

IQ	VIQ age 9	PIQ age 9	TIQ age 9	VIQ age 12	PIQ age 12	TIQ age 12
Mean (N)	99.9 (227)	100.4 (227)	100.2 (227)	102.5 (199)	98.7 (199)	100.7 (199)

- ◆ Cerebellar volume (age 9) correlates 0.24 with OA behavior (age3). No associations were found with later attention problems.
- ◆ However, there was a relation between IQ and cerebellar volumes (around 0.2) at both age 9 and 12, and a negative association with OA and AP (around -0.22) over time.
- ◆ Twin correlations show a greater MZ correlation on all measures compared to DZ correlations.

	OA age 3	AP age 7	AP age 10	AP age 12	CBt age 9	CBt age 12	TIQ age 9	TIQ age 12
MZM	0.916	0.777	0.538	0.900	0.985	0.903	0.839	0.817
DZM	0.007	0.351	0.155	0.319	0.504	0.646	0.603	0.408
MZF	0.931	0.637	0.857	0.826	0.957	0.986	0.614	0.670
DZF	0.426	0.218	0.573	0.131	0.741	0.546	0.582	0.611
DOS	0.270	0.246	0.823	0.811	0.330	0.020	0.310	0.607

Genetic architecture of OA₃, CBt₉ and TIQ₉

- ◆ Cerebellar volume was significantly influenced by sex, with boys having a larger cerebellum.
- ◆ Genetic factors account for 89, 94, and 42% of the variance in OA, CBt and TIQ, respectively. Shared environmental factors explain 33% of the variance in IQ.
- ◆ Genetic correlations are significant between all measures.



The associations of cerebellar volume with attention problems and cognitive functioning seem to have a shared genetic influence.

s.c.swagerman@vu.nl
www.brains4teens.nl
www.tweelingenregister.org/brainscale



Universitair Medisch Centrum
Utrecht