IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

BRAIN SIZE ANALYSIS SYSTEM USING MACHINE LEARNING

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Abstract: Many studies on the human brain have found evidence of genetic effects and changes in intellectual function of certain forebrain nerves and psychiatric diseases. Little is known about the genetic influence of the size and shape of the human forebrain and its macromorphological breakdown. Using each indicator as a dependent variable and genotype, birth order, and gender were used for individual factors. The correlation between pain scores was also calculated. We found that genotype had a significant effect on the following neuroanatomical variables, but not on birth order: forebrain volume, cortical surface, and corn area. We also found a significant genotype, but the birth order had no effect on head circumference and total circumference. Apart from the hardening of the head circumference, there is no significant sexual effect. Significant correlations were observed between forebrain volume, cortical surface and callus area, and between each measurement of brain head circumference. There is no significant correlation between any measurements of the brain or head circumference.

***Index Terms* – Numpy, TensorFlow, Linear Regression**

I. INTRODUCTION

Monozygotic (MZ) twins share cognitive abilities and other behavioral features, which can be attributed to the identity of their genes for the most part.[1] Given what we know about brain-behavior correlations in humans and the cellular and physiologic mechanisms driving brain development in animals, it's reasonable to assume that MZ twins have brain anatomical similarities.[2] It has been impossible to test this theory numerically until lately. The development of computer-based image processing techniques that allow quantitative analysis of neuroanatomic data concurrently with behavioral assessment has accompanied the introduction of in vivo brain imaging as a clinical tool over the last quarter century. [4] Total forebrain volume, total cerebral cortical surface area, callosal cross-sectional area, head circumference, and full-scale intelligence quotient (IQ) in normal adult MZ twins were investigated in this study. We looked for connections between brain measurements, head circumference, and IQ in addition to examining co-twin similarities.[6] The Objective of this application is Calculate Brain Size using Head weight and age and Using MRI and quantitative image analysis techniques, we examined neuroanatomic similarities in humans and their relationship to head size and intelligence quotient. [9] The main aim of this project is calculating the size of human's brain and comparison between both male and female brain size which one is having higher intelligent quotient. The scope of this proposed is to check the Brain size and intelligent quotient of human brain, its analysis the correlation between the brain size which suggests the intellectual similarity in Humans.[10]

II. LITERATURE SURVEY

The neural basis for differences in human intelligence has not been clearly outlined. Many studies link brain size measurements (such as brain weight, head circumference, brain volume) using computed tomography or magnetic resonance imaging with the results of various intelligence tests of differently defined test subject samples, indicating that the correlation between the results is 0 Inconsistent within the range of 0.6, most of the correlations are between 0.3 or 0.4. It is currently not possible to study the intelligence related to brain volume after death. We prospectively evaluated the results of this study on the complete Wexler Adult Intelligence Scale of 100 patients (58 women and 42 men): volume is related to brain volume, but this relationship depends on the study Intellectual power. And the functional lateralization of objects along gender and hemisphere. The volume of right-handed women and men is 36% of the difference in verbal intelligence. There is no evidence that this association exists in just males, which suggests that functional asymmetry may be an important factor in male structure-function relationships, at least for language intelligence, but not for females.[1]

This multivariate study examined the head circumference (CH) and IQ (IQ), learning, nutritional status, and brain development of Chilean school children with a high school diploma. Relationship. Co-educational, high and low IQ and socioeconomic grade (SES) The sample included 96 healthy right-handed school children born at legal age (mean age 18.0 ± 0.9 years). HC is measured on children and their parents and is expressed as Zscore (ZHC). The child's IQ is determined using the Wechsler Revised Intelligence Scale (WAISR), and the school performance (SA) is determined using language and math standard tests. Spanish and Academic Aptitude Test (AAT), nutritional status is determined by anthropometric indicators, brain development is determined by magnetic resonance imaging (MRI) and SES, using modified Graffard technology. The results showed that the scores of children with microcephaly were significantly lower, mainly due to brain volume (BV), ZHC, IQ, SA, parental AAT, body length at birth (BL), and a significantly higher incidence of malnutrition in the first year after birth. Compared with their giant counterparts. Multiple regression analysis showed that BV, parent ZHC and BL are the independent variables with the highest explanatory power for the variance of children's ZHC ($r2=0.727$). These results support the hypothesis of this study: (1) Regardless of age, gender and SES, brain parameters, parental growth hormone and prenatal nutrition indicators are the main independent variables that determine CH, (2) children with microcephaly suffer from a variety of the disease is not only related to BV, but also to CI, SA and background nutrition. [2]

III. PROPOSED MODEL

Head circumference for both total head circumference and body weight normalized head circumference, very significant genotypic effects were observed. No effect of standardized birth order was found, and the effect of gender on total head circumference was observed, but no standardized head circumference was observed.[1] has observed a very significant genotypic effect on all brain parameters, but has no significant effect on the birth order, which indicates the difference in the total forebrain volume, total cortical area and callus cross-sectional area between uncorrelated pairs Significantly larger than the inside of Cotvin.[6] Consistent with previous twin studies, the head circumference of twins is more similar than that of unrelated couples. The genotype effect has nothing to do with the sex difference between unrelated couples. Paediatrics and obstetrics often measure head size to assess brain development, and microcephaly and macrocephaly have long been considered as potential brain pathological indicators; however, the relationship between head size and brain size in healthy adults is still uncertain. We found that there is a strong correlation between head circumference and forebrain volume, as well as between head circumference and cortical area in our 18 to 43-year-old people.[9] The strong correlation between the cortical area and the corpus callosum found in this study indicates that the proportion of cortical neurons is constant, sending projections from one hemisphere to the other.[13]

3.1 Methods

3.1.1 Research pop elation.

Ten pairs of young, healthy, identical twins were recruited for compensated participation. All participants gave written informed consents for phlebotomy, magnetic resonance scanning, and pencil-and-paper assessments. A board-certified neurologist or psychiatrist extracted each subject's medical history; all histories and system reviews were negative for symptoms of neurologic or mental illness. The 10 co-twin pairs were raised together and now live-in close proximity. All 20 participants were right-handed (Edinburgh Laterality Quotient"' range,[16] 74 to 100; median, 88; all wrote and ate with the right hand), had a high school education, and were between the ages of 24 and 43 (median 34). The researchers used a validated questionnaire and nine RBC surface indicators. [17-18]

3.1.2 Data on anthropometry and neuropsychology.

At the time of phlebotomy or in the MRI suite, the head circumference (cm) and body weight (kg) were measured. The "Wechsler Adult Intelligence Scale-Revised"[19] was given to each subject independently in a quiet room. The full-scale IQ test was administered. The raw forebrain volume, cortical surface area, callosal area, and head circumference were divided into raw forebrain volume, cortical surface area, callosal area, and head circumference to obtain normalised data for further analyses.

3.1.3 Image capturing

Tl-weighted MRIs were collected using either a Siemens (Grand Island, NY) 1.0 Magnetum system (in-plane resolution, 1.2 mm) or a General Electric (Milwaukee, WI) 1.5 Signa system' (in-plane resolution, 0.9 mm). [15-24] A horizontal laser defined the intercanthal line, and a vertical laser intersected the middle of the nasion and philtrum when the head was placed in the scanner. The effective thickness of serial coronal slices was 3.0 mm, and the in-plane resolution was 0.9 to 1.2 mm. The thickness of sagittal sections ranged from 5.0 to 8.0 mm, with an interslice gap of 1.0 to 2.0 mm and in-plane resolution of 0.9 to 1.2 mm. Coronal sections were taken in 16 of the 20 individuals using 3D FLASH (TE/TR = 20/400 mess [Siemens] or 9/50 mess [GE]). Four patients (two pairs of female twins) were scanned in serial coronal section before this technology became accessible at our institution by interleaving two sets of 3.0-mm slices separated by 3.0-mm intervals. The latter photos had no discernible variations in quality, and statistical analysis of a subset of the data from the 16 participants scanned through 3D FLASH revealed the results for all 20 patients followed the same pattern. As a result, merged data is reported.

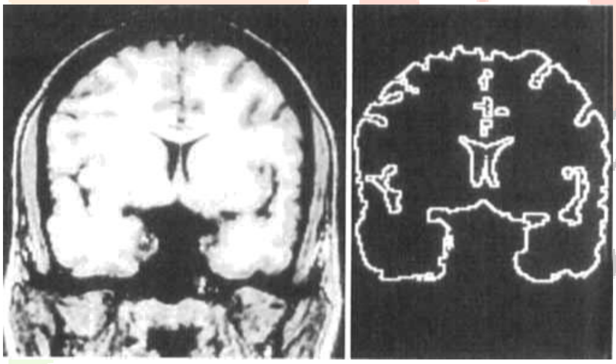
3.1.4 Analyze images

Magnetic tape was used to store MR pictures, which were then transferred and shown on a Silicon Graphics (Mountain View, CA) computer. Each coronal section's pial surface was traced by hand.[25] Previous analyses of intra- and interobserver reliability for pial surface tracings found a coefficient of variation (CV) of 2.79% for hemisphere surface area measurements based on three separate tracings by one technician, CV of 5.4 percent for hemisphere surface area measurements based on one tracing by four separate technicians, and pairwise correlations ranging from 95.9 to 99.0% for hemisphere surface area measurements based on one tracing by four separate technicians, based on one tracing by four technicians for surface area measurements of 27 large morphologic features (e.g., gyri). Pial surface tracings were performed by three technicians in this investigation, and tracings for each member of a co-twin pair were never done by the same person.

Outlining the pial surface of each hemisphere, outlining the ventricles, subtracting the number of voxels within the latter from the number within the former, summing the voxel count across sections, and converting voxel count to volume were used to calculate total forebrain volume from serial coronal sections (cm"; figure 1). This is essentially the same procedure as Uylings et al" [26] basic's volume estimator," with the exception that there was no need to include a correction factor for postmortem shrinkage in the expression volume — (slice thickness) ($\sum^{N}_{i=1}$, A_i), where A is the cross-sectional area of the ith of N sections. This measurement includes telencephalic and diencephalic grey and white matter. Our method was similar to previously published methods for measuring the cross-sectional size of the corpus callosum in the midsagittal plane. [27-28] On the computer monitor, the midsagittal MRI section was presented, and the outline of the callosum was traced with a computerized planimeter (figure 2).

The methods we used to calculate cortical surface area are described in more detail elsewhere. [15-24] Using a triangulation algorithm, a three-dimensional computer model of the entire intra- and extrasulcal surface was reconstructed from the pial surface tracings. After that, the areas of all triangles in the model were added together. Previously reported total cortical surface area was used in the original studies for associations between cortical surface area, forebrain volume, callosal area, head circumference, and IQ provided here. [15] Area analyses are presented alongside the original forebrain volume, callosal area, head circumference, and IQ tests to facilitate comparisons among ANOVAs for all brain measures.[15] Along with the original forebrain volume, callosal area, head circumference, and IQ studies, previously reported total cortical surface area analyses are presented.

figure 1: a t_1-weighted coronal segment across the frontal and temporal lobes (left) and the associated pial and ventricular outlines (right) for total forebrain volume analysis.



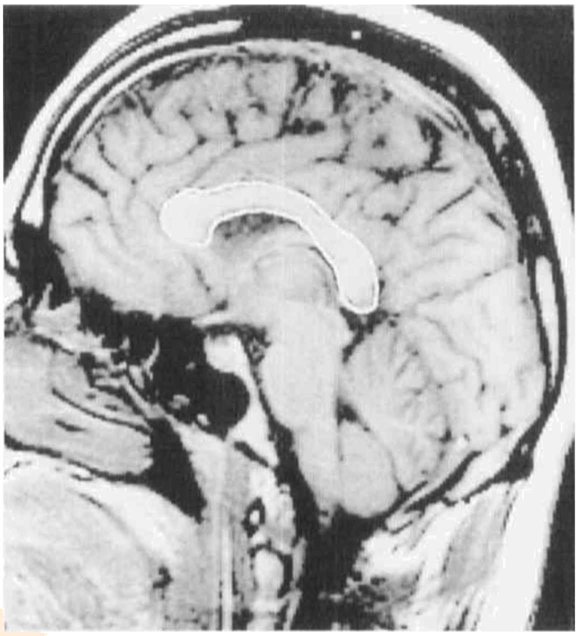
3.1.5 Statistical evaluations

The working hypothesis was that people with identical genotypes had more in common than those with different genotypes in terms of brain size, head size, and IQ. ANOVAs were used to compare differences in each dependent variable between unrelated twin pairs (genotype factor: Twins A vs Twins B versus... Twins J) and among co-twins (birth order factor: Twin A_1 against Twin A_2, Twin B_1 versus Twin B_2... Twin J_1, versus Twin J_2).[29]

Total forebrain volume (raw and normalised by body weight), total cortical surface area (raw and normalised by body weight), corpus callosum midsagittal area (raw and normalised by total forebrain volume head circumference draw and normalised by body weights, and Full-Scale IQ were the dependent variables. We divided the overall effect of genotype into the independent contributions of sex and genotype in separate series of ANOVAs, removing the sex effect.

Forebrain volume and cortical surface area, forebrain volume and callosal cross-sectional area, cortical surface area and callosal cross-sectional area, forebrain volume and head circumference, cortical surface area and head circumference, forebrain volume and IQ, cortical surface area and IQ, callosal area, head circumference and IQ, and hippocampus volume and IQ, pair wise correlation coefficients and simple regressions were computed.[28] The researchers looked at raw and standardized (by body weight) brain measurements as well as head circumference. The full study population (n = 20) and a subgroup of one twin randomly selected from each twin pair (n = 10) were both evaluated for correlations. The latter was done to see how much correlation ions in the population as a whole might be caused by redundancy introduced by co-twin similarities.

figure 2: a t_1-weighted midsagittal mri example showing the contour of the corpus callosum for cross-sectional area analysis.



IV. RESULTS AND DISCUSSION

After controlling for sex differences measure and the results of the ANOVAs, Table 1 shows the range, mean, and SD of each type effect.

Total [forebrain volume] (raw, F (8,9) = 19.50, p n 0.0001; normalised F (8,9) = 5.23, There were statistically significant differences (p — 0.01). Effects of genotype on raw forebrain volume (F(9,9) = Head circumference and raw forebrain volume (F(9,9) = Raw forebrain volume (F(9,9) = Raw forebrain There was a huge geological shift For both raw head circumference (F(9,9) = body weight (F(9,9) = 14.30, p — 0.0003), indicating great 14.84, p — 0.0002) and head circumference normalised by variation across unrelated pairs (.ge- 19.49, p 0.0001) and forebrain volume normalised by no type effect for both raw head circumference (F(9,9) = body weight (F(9,9) = 14.30, p — 0.000 Body weight had no significant influence (F (9,9) = 16.80, p n 0.0001). There will be no birth. Within co-twins, there was a sex impact for consuming minimal variance. There were no significant effects of sex on raw head circumference but not normalised head circumference (raw, F (1,8) = 1.29, p — 0.29; conference (raw, F (1,8) — 7.48, p — 0.03; normalised, F (1,8) 0.01, p — 0.98), showing minimal variation – F (1,8) = 0.11, p — 0.98). Between women and males, the genetic effects remained. The extremely significant genotype effects persisted after the contribution of sex unrelated pairs (raw, F (8,9) = 8.63, p — 0.002; normalised, differences across unrelated pairs were removed (raw, F (8,9) = 18.65, p 0.0001).

4.1 Total cortical surface area.

The pattern of results for cortical surface area and forebrain volume was comparable. Both raw cortical surface area (F (9,9) = 8.66, p — 0.002) and cortical surface area normalised by body weight (F (9,9) — 9.96, p — 0.001) had extremely significant genotype effects, demonstrating significant variance across unrelated pairings. For raw cortical surface area (F (1,9) = 3.76, p — 0.08) but not for normalised cortical surface area (F (1,9) = 0.83, p —— 0.39), there was a trend showing very minor variation within co-twins, especially when body weight was taken into consideration. There were no significant sex effects (raw, F (1,8) = 0.01, p — 0.93; normalised, F (1,8) = 0.01, p — 0.93). After controlling for sex differences among unrelated pairs, the extremely significant genotype effects remained (raw, F (8,9) = 9.73, p — 0.001; normalised, F (8,9) = 10.23, p — 0.001).

4.2 Midsagittal callosal area.

The results for callosal area followed the same pattern as those for forebrain volume and cortical surface area. Raw callosal area (F (9,9) = 18.90, p 0.0001) and callosal area adjusted by forebrain volume (F (9,9) — 4.65, p —— 0.02) both had a significant genotype effect, showing that the large difference in raw callosal area among unrelated pairs could not be totally explained. demonstrating that difference in forebrain volume could not account for all of the variation in raw callosal area across unrelated couples. For raw (F (1,9) = 1.06, p — 0.33) or normalised callosal area (F (1,9) = 1.55, p — 0.24), however, there was no birth order effect. No gender difference was found (raw, F (1,8) = 0.72, p —— 0.42; normalised, F(1,8) 0.01, p > 0.99).

table1: Total forebrain volume (FV, cm3), total cerebral cortical surface area (CSA, cm2), midsagittal callosal area (CA, cm2), head circumference (HC, cm), and intelligence quotient (IQ, cm) are all measured.

	Range	Mean	SD	Genotype		Birth Order		Sex	
				Rawp	Nlzdp	Rawp	Nlzdp	Rawp	Nlzdp
FV	936—1439	1126	125	≤0.0001	0.0003	0.65	0.84	0.29	0.98
CSA	1,685—2264	1906	175	0.002	0.001	0.08	0.39	0.93	0.41
CA	5.7—8.8	7.0	0.9	≤0.0001	0.02	0.33	0.24	0.42	>0.99
HC	54.7—57.2	56.1	1.8	0.0002	≤0.0001	0.42	0.42	0.03	0.75
IQ	8â-127	110.8	13.4	0.001	NA	0.66	NA	0.91	NA

p Values for each dependent variable (raw and normalized [NlzdJ) and each between-subjects factor l genotype, birth order, and sex) are also tabulated. See text for corresponding F ratios and degrees of freedom.
NA = not applicable.

table2: Matrix of correlations. The raw FV, CSA, CA, and HC coefficients are in the upper right half of the matrix, while the normalised FV, CSA, CA, and HC coefficients are in the lower left half.

Nlzd p	Raw p	Nlzd p	Raw p	Nlzd p
0.0003	0.65	0.84	0.29	0.98
0.001	0.08	0.39	0.93	0.41
0.02	0.33	0.24	0.42	>0.99
0.0001	0.42	0.42	0.03	0.75
NA	0.66	NA	0.91	NA

*p≤0.0222.

*p≤0.0015.

FV = forebrain volume; CSA — cortical surface area;
CA callosal area; HC = head circumference; IQ = intelligence quotient.

There was a significant effect of genotype (F (9,9) 9.51, p 0.001) but not of birth order (F (1,9) = 0.21, p 0.66) or of sex (F (1,8) = 0.01, p 0.91). After correcting for sex differences, the significant genotype effect remained (F (8,9) = 10.68; p 0.001).

4.3 Correlations between measures.

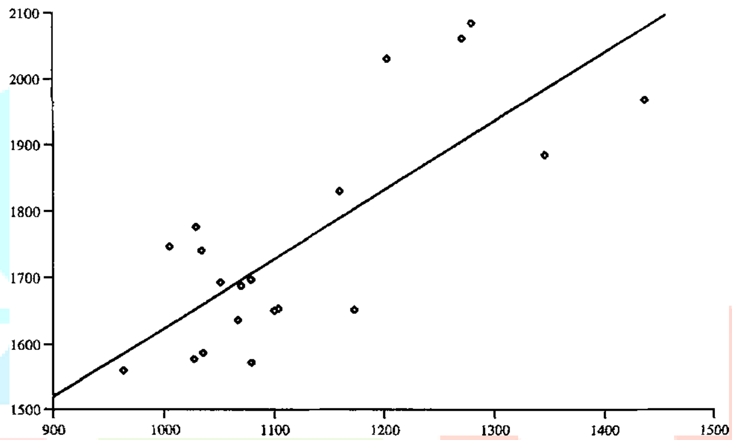
Table 2 shows a correlation matrix for all raw and normalised measures. All pairwise relationships between forebrain volume, cortical surface area, callosal area, and head circumference were positive and significant, with r values ranging from 0.51 (p= 0.0222) to 0.95 ($p \leq 0.0001$).

FIGURE 1 shows the linear relationship between raw cortical surface area and raw forebrain volume. Figure 1 shows the linear relationship between raw cortical surface area and raw forebrain volume (cortical surface area = 585 + 1.04 forebrain volume; r = 0.77, R^2= 0.59, p≤ 0.0001).IQ had no statistically significant associations with forebrain volume, cortical surface area, callosal area, or head circumference (r range = -0.06 to + 0.20; all p ≥0.40a). Pairwise correlations between brain measures were the same in sign and magnitude for the subpopulation of 10 unrelated individuals, and they all remained significant (r range = 0.63 to r — 0.76 for raw forebrain volume and cortical surface area (p = 0.0111) and r = 0.94 for normalised forebrain volume ($p \leq 0.0001$) and cortical surface area ($p \leq 0.0001$); All normalised measures and raw head circumference and callosal area reached significance (r range = 0.72 to 0.94; p range = 0.0181 to ≤ 0.0001), raw head circumference and forebrain volume showed a trend (r = 0.62, p= 0.058), and raw head circumference and forebrain volume showed a trend (r =0.62, p= 0.058). Raw head circumference and cortical surface area were not statistically significant [r = 0.48, p =0.164].There were no statistically significant associations between IQ and forebrain volume, cortical surface area, callosal area, or head circumference (r range =- 0.26 to +0.25, $p \geq 0.47$).

Discussion.

There were extremely significant genotype effects for all brain parameters, but no significant birth order effects, implying that total forebrain volume, total cortical surface area, and callosal cross-sectional area varied significantly more between unrelated pairs than among co-twins. Co-twins were also more similar to unrelated pairings in terms of head circumference 1 and IQ, which was in line with other twin studies' findings.[4] "Sex differences between unrelated pairings had no effect on genotype effects.

figure 3: cortical surface area (csa) and forebrain volume are linearly related. cortical surface area =585 + 1.04 forebrain volume (FV; R^2 = 0.59, $p \leq 0.0001$).



Hrubec and Robinette have already discussed the value of researching human twins in medical research. We view the current findings as evidence that prenatal impacts on brain development in humans are substantial enough to be discernible at the gross morphologic level in vivo using MRI, given the considerable literature on phenotypic similarities between MZ twins grown apart.

This interpretation is supported by the fact that the size and form of the adult brain are mostly determined by cellular and physiologic changes that occur during pregnancy. Cortical neurogenesis in humans begins around the middle of the first trimester and terminates around the middle of the second." "From the beginning of the second trimester till birth, cortical surface area expands 30-fold and brain volume increases 60-fold."" Cortical fissuration begins around the fourth week of life and nearly reaches adulthood by the time a child is born. From the first trimester to five months after delivery, the number of callosal axons increases by four orders of magnitude.

V. CONCLUSION

Our findings of co-twin similarity in both brain size and IQ, as well as the lack of a correlation between brain size and IQ, show that intellectual similarities in MZ twins cannot be explained by a simple “bigger is better” explanation based on genetically driven neuroanatomic similarities. It's still possible, and we think it's likely, that MZ twins' intellectual similarities are due to hereditary influences on brain structure (i.e., how the brain is put together, not just how big it is). For example, similarities in the local geometry of folds in the left cerebral cortex,[15] which governs language and abstract reasoning in the great majority of individuals, may indicate genetic influences on brain organization at the macroscopic morphologic level. [26] The cognitive abilities that have distinguished our species throughout primate history and contribute the most to IQ test results. The idea that genetic influences on cognitive functions might be reflected in regional measures rather than, or in addition to, global measures of brain size align with the widely held belief [29]] that intelligence arises from the coordinated action of functionally specialized neural systems dispersed throughout specific forebrain regions.

VI. FUTURE ENHANCEMENTS

In the future, the comparison of brain size, head size and IQ between MZ twins raised together and MZ twins raised alone will be able to assess the postpartum impact. Although it is generally believed that the postpartum impact will overestimate the genetic impact on the similarity between twins, some authors believe that the postpartum impact may underestimate the genetic impact.

VII. ACKNOWLEDGEMENT

Catherine Thomas, Leila Mott, Robert Ferranti, Patrick Brown, and Robert Nordgren all contributed to this project.

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