“Smart People Have Big Heads”:True or False?

**Introduction:**

People in the middle ages thought that people with small heads were less intelligent than those with bigger heads. Even though modern studies have shown that it was not true, I wanted to see it for myself.[[1]](#footnote-1) However, instead of measuring just plain (IQ) intelligence like modern studies (refer to cited source), I am going to use the scores on the ACT to see how well students test. The aim of this project is to measure the correlation between the circumferences of human heads to scores on the ACT. This study will focus on results based off of seniors at Metro High School. In terms of the procedure, I will go around the school and find seniors personally to measure their heads. Starting with the crook between the cerebellum and occipital lobe, I will wrap the tape measure (on the centimeter side) all the way around the top of the forehead, and then end again at the crook. After measuring circumference, I will ask the student for his/her ACT score. From here, I will plot my data in a scatter plot and find the correlation (correlation coefficient: R) between the two variables: circumference of the head and ACT score. For a further process, I will create a zoomed in version of the initial graph to find the correlation of the higher achieving students (refer to graph 2).



Top of Forehead

Crook

*Model of Measurement Technique*: The light blue band wrapped around the head is the way I am measuring brain circumference.

(Self Made Diagram)

**Procedure** (intro continued)**:**

I had to have a minimum of 30 students for this experiment to work because it would be 10 percent of the school’s population so I measured the heads of most of the seniors who were in my classes at school. Since students tend to be a little more academically inclined at my school, the ACT score data might be skewed in a measurement involving the general population, but a in such a competitive pool, the relationship between those variables should still remain. The perfect times to measure their heads were before and after class, when people had time to walk around school.

Measuring tape (around sixty inches) was used to measure students’ heads in centimeters and was recorded on a written raw data table with two columns labeled “Circumference” and “ACT Score.” Students agreed to share their ACT scores honestly after measuring their heads. All of the data was anonymously recorded.

This raw data had to be processed to create scatter plots and calculate certain values like the correlation coefficient (R) or the mean (µ). First, the easy calculations such as the mean, median, and mode were done (refer to information box next to data table). The mean was calculated for both the circumference and ACT scores separately by adding all the values in the respective column and dividing it by the total number of entries (31). The median was the middle number in each column. The mode was the most recurring number in both columns also.

Last, the R value was calculated by the statistics program on the calculator. The circumference values were put into list one and the ACT scores were put into list two. I was able to find all the values such as the slope, Y-intercept, and the correlation coefficient (R).

|  |  |
| --- | --- |
| Circumference of Head (cm) ± 0.5  **DATA**: | ACT SCORE  \*This data table is raw data collected from every individual that was observed for the two main variables:  **ACT SCORE** and **CIRCUMFERENCE OF HEAD**.  \*The **circumferences** range from 53.5cm to 60.3cm.  \*The **ACT scores** range from 20-35.  ***Circumference of Head:***  Mean (µ)- 57.08cm  Median- 57.00cm  Mode- 57.00cm  ***ACT Score:***  Mean (µ)- 30.2  Median- 30  Mode- 31  **(REFER TO APPENDIX FOR THE DEFINITIONS AND SAMPLE CALCULATIONS OF MEAN, MEDIAN, AND MODE.)** |
| 53.5 | 29 |
| 55 | 30 |
| 55.1 | 20 |
| 55.2 | 29 |
| 55.5 | 32 |
| 55.5 | 31 |
| 56 | 31 |
| 56 | 28 |
| 56.1 | 33 |
| 56.4 | 28 |
| 56.5 | 30 |
| 56.5 | 30 |
| 56.8 | 29 |
| 56.8 | 31 |
| 57 | 29 |
| 57 | 33 |
| 57 | 34 |
| 57 | 33 |
| 57 | 28 |
| 57.1 | 31 |
| 57.3 | 28 |
| 57.5 | 35 |
| 57.5 | 31 |
| 58 | 34 |
| 58.2 | 30 |
| 59 | 27 |
| 59.3 | 32 |
| 59.5 | 28 |
| 60 | 31 |
| 60.1 | 30 |
| 60.3 | 33 |

1. **GRAPH 1**
2. **GRAPH 2**

[Zoomed up version with a restricted range (55.1cm≤ x ≤58.2cm) of Circumference]

\*This allowed me to get a closer look of the correlation within the competitive group of students

**Analysis**:

During the study, several of the students that were measured for head circumference, were within a range less than 10cm as shown by the difference between the lowest and highest value: 60.3 - 53.5= 6.8cm. Such a small range infers that kids in our senior class, aged either seventeen or eighteen years old, have similar sized heads. This could have possibly meant that a few centimeters difference was all it takes to get a higher or lower ACT score.

This brings us to the main body of the results shown in the two graphs. The first graph shows all of the individual values from the raw data table, including the values that stray from the lump of points in the center around 57cm. In this graph, the slope (∆y-intercept/∆x-intercept) is greater than zero, meaning that there is some type of positive relationship. However, because 0.3991 is so much smaller than 1, the slope of the first graph can be disregarded for its ineffective quantity. We can confirm that slope is ineffective by looking at the correlation coefficient (R). R is shown to be 0.2302, representing a very, very weak correlation. This is through the fact that we know 0 is the weakest and 1 is the strongest correlation coefficient. With a very low coefficient, the relationship is unlikely to exist.

I tried to see if I could find a relationship if I shortened the range of circumference on the X-axis. By creating a second graph that focused on the bulk of points near 57cm, more specifically from 55.2-58.2, I was able to create a second graph. Graph 2 was not very promising either because its slope was 0.6458 but its coefficient was still 0.2345. It was still a very weak coefficient for there to be a relationship between the two variables.

**Conclusion**:

Knowing that the correlation coefficient (R) is very small and weak, it is concluded that the circumference of the head and ACT scores are not related. 0.23 is at the bottom half of the correlation scale: 0 to 1 with 1 being the perfect correlation. I can confidently confirm that the physical size of the human head does not affect intelligence. The trend lines are almost horizontal, meaning that ACT scores were very close to one another (on the Y-axis). The line is at the top of the graph, showing that the ACT scores were in the upper twenties and mid thirties.

It can be observed that students in the senior class have similar scores on the ACT that are fairly high in value. With this observation, I can confirm that this will not affect the validity of the results because the correlation is weighing the circumference vs. ACT score relationship of intelligent students with other intelligent students. In light of this, head size does not affect intelligence (or testing capability).

**Validity**:

Overall, this study remained valid and accurate throughout all processes. Measuring the circumference of the head using the top of the forehead and the crook between the cerebellum and occipital lobe gave me a good reference as to how big a person’s brain is because it is a combination of the length, width, and height dimensions of the brain as the tape measure wraps around the head diagonally (refer to diagram on page 1). This numerical data allows me to quantify my data into reliable sources of measurement. Along with this, I also took into account the range of data I would get with higher achieving students. By weighing the performance of students against one another in this high achieving category, I still maintain validity in my results, finding the correlation coefficient (R) within the group. The 31 students (entries) I surveyed were 10 percent of the school’s total population, which is enough to measure a general trend.

I am curious, however, if I could have found a more pronounced correlation if I took into account a wider range of variables in the population such as ethnicity, or gender of students who are about the same age (17-18 years). I could have also tested brain circumferences of students who had lower ACT scores to see if they fell into the 6.8cm range I tested. This would have shown me if my conclusions about correlation remaining similar in a higher achieving range were accurate.

Appendix:

Mean (µ)- the average of all the values in a specific category. (Sum of all numbers/number of values.)

Ex. Total of all ACT scores was 938. When 938 is divided by the number of entries, 31, I get 30.2 as the average ACT score.

Median- is the middle value in any give group of values.

Mode- is the most frequently occurring value in a group of values.

Ex. 57cm occurs five times in the circumference column; more frequent than any other value.

Correlation Coefficient (R)- is a value that measures the strength of the relationship between two variables.

WORKS CITED

Horowitz, Alexandra. "Why Brain Size Doesn't Correlate With Intelligence." *The Smithsonian*,

2013, 1-2. http://www.smithsonianmag.com/science-nature/why-brain-size-doesnt-correlate-with-intelligence-180947627/?no-ist.

1. Horowitz, Alexandra. "Why Brain Size Doesn't Correlate With Intelligence." *The Smithsonian.* 1-2. [↑](#footnote-ref-1)