Words With Amigos

Exploring the effect of bilingualism in the human brain as it relates to switching tasks.

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EXPERIMENTAL PURPOSE:

The purpose of this experiment is to compare the speed and accuracy of bilingual and non-bilingual students when they are asked to complete two competing memory tasks.

DRIVING QUESTION:

Does being bilingual improve how fast and accurately your brain can complete two competing memory tasks?

HYPOTHESIS:

I predict bilingual students will be faster at successfully completing competing memory tasks with fewer mistakes than non-bilingual students. Bilingual students have to switch between languages from home to school, and they also are involved in conversations with friends during the day that use both languages. Therefore, their brains are used to switching tasks. Non-bilingual students do not have their same sets of experiences, so I believe their brains will have a harder time with the switching required in this test. This will lead them to make more mistakes and take longer to finish the task.

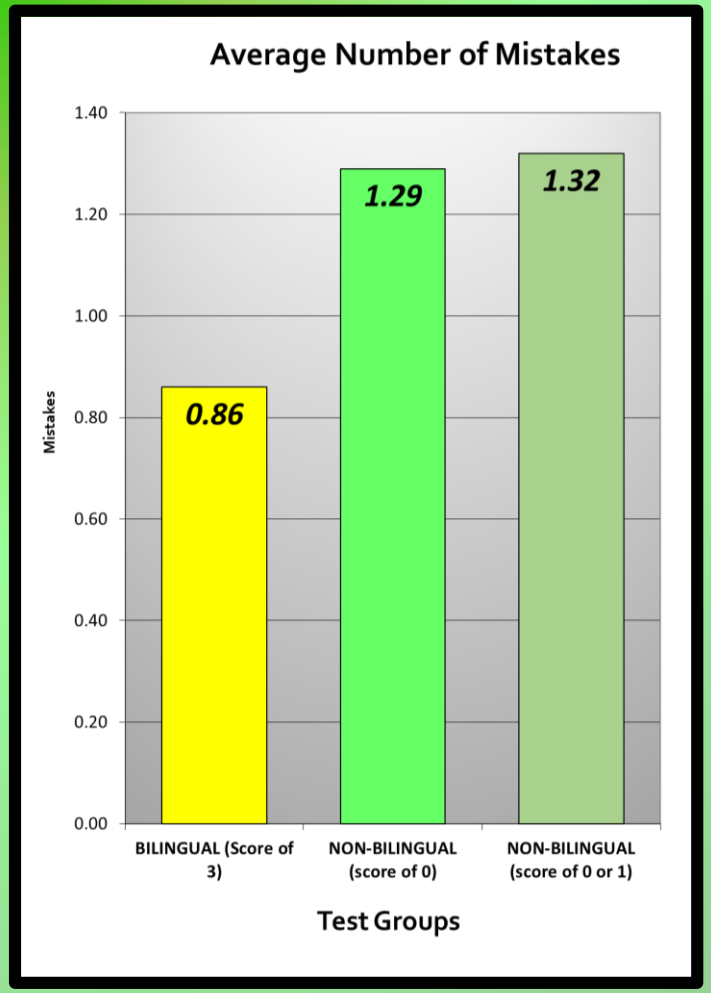
PROCEDURE:

- The main part of this experiment that took some time was making the computer program that will do the testing.
- The program starts by asking three Spanish questions that are basic but not easy. They are simple enough for a bilingual to understand but too difficult for a non-bilingual who might just guess. Students answer each question.
- Next, a pattern task is explained. This involves alternating letters and numbers (up to 9), like this:

  A 0 B 1 C 2…

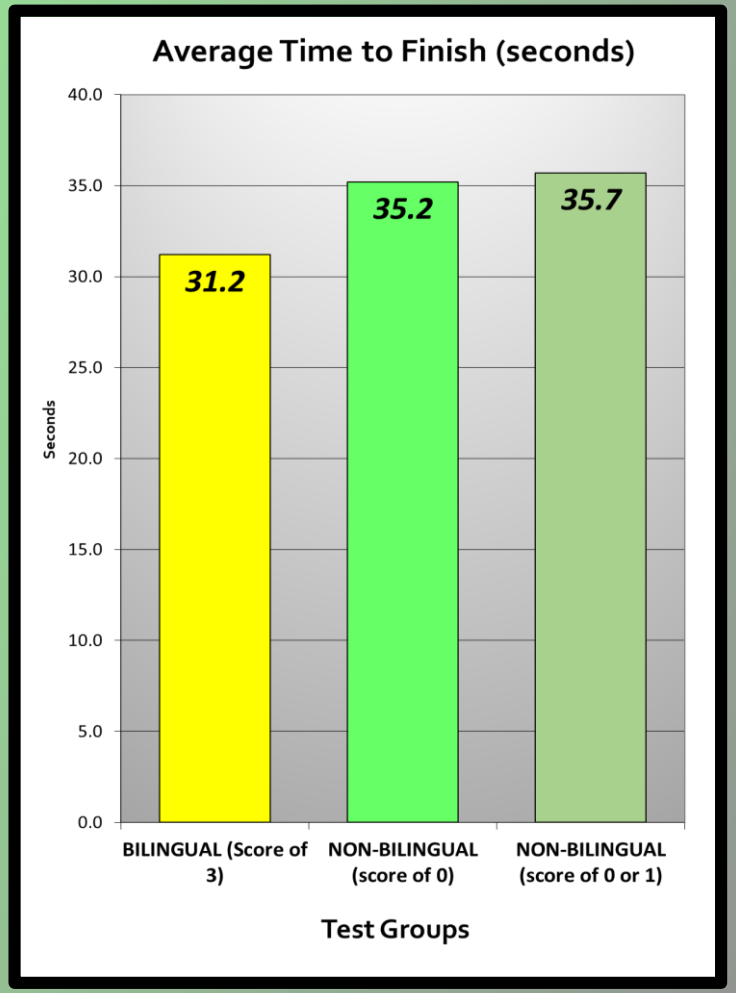
PROCEDURE (continued):

- The screen shows the pattern the student has to duplicate. Then there is a brief READY...SET...GO prompt for students to begin typing the pattern.
- Once a student is finished, the program ends. In a file on the flash drive, it records the pattern they typed and how long it took them to type it. I accessed this information later when compiling my results.
- I tested middle school volunteers. The test is completed on the student's device through a flash drive.



DATA and RESULTS:

In both areas, bilinguals outperform their non-bilingual peers.



ANALYSIS:

My initial classification method grouped all of the students who scored a “3” on the question part as bilingual, while all of the students who scored a “0” were classified as non-bilingual. Anyone scoring a “1” or “2” was discarded from the data set. These results of these two extreme groups were compared.

My results from that initial grouping show that the bilingual students are, on average, about 4 seconds faster to complete the task and do so with a smaller number of errors (by about half an error per person).

ANALYSIS (continued):

Because so much of my data was discarded in my initial classification method, I also conducted a second analysis where I included the "1" group as non-bilingual. This would add more data to my non-bilingual group and could also possibly close the gap between the average scores of the two groups. However, it did not. Adding more data to the non-bilingual group still produced the same gaps in results. This gives me further confidence that the differences in the groups are meaningful.

CONCLUSION:

My hypothesis was correct. Bilingual students were faster than non-bilingual students with the pattern task, and they produced the pattern with fewer mistakes. This occurs because the bilingual brain is already used to juggling multiple tasks and switching back and forth, so their brains have developed over time to being more efficient with managing multiple tasks. I believe my project shows that teaching all students dual languages from an early age would be good for overall brain development by creating a greater capacity in the brain to work flexibly.

REFERENCES:

Sources utilized when collecting background information to understand language and the human brain:

- *cambridge.org/elt/blog/2022/04/29/learning-language-changes-your-brain/*
- *memory.ucsf.edu/brain-health/speech-language*
- *www.sciencedirect.com/science/article/pii/S0001691825001167*
- *www.nationalgeographic.com/health/article/speaking-multiple-languages-slow-brain-aging*
- *news.mit.edu/2024/mit-study-polyglots-brain-processing-native-language*