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WHAT ARE THE BENEFITS OF LEARNING A SECOND LANGUAGE?

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YOUNG REVIEWERS:

ETHAN
AGE: 12

JAIDEN
AGE: 15

YUAN
AGE: 12

Bilingualism, which means speaking more than one language, allows a person to communicate with a larger number of people. Some research suggests that speaking more than one language may also improve brain function. We wanted to see whether the relationship between improved brain function and being bilingual differed based on how well or how much a person uses their second language. To ask our question, we recruited a group of high school students who spoke both Mandarin and English. Because speaking two languages is thought to improve how well a person performs on certain tasks, we thought that the students who were better at their second language would have better performance on those tasks. Our findings support the idea that developing your second language, especially if you speak it well, can improve the way your brain functions. Keep reading to learn about our research!

WHY USE YOUR SECOND LANGUAGE?

Most people on Earth can speak at least two languages—they are **bilingual**. Speaking more than one language allows a person to communicate with a larger number of people. Bilingual people have an easier time when they travel to other parts of the world. They can also work and study outside of their home countries. Research shows that both languages a bilingual person speaks are active in the brain at the same time [1]. This means a bilingual person must inhibit or "turn off" an unneeded language to communicate successfully. The experience of inhibiting an unneeded but active language may actually help the brain by improving a person's **executive function**, which is a set of mental processes that coordinate our thinking and behavior [2] (To learn more about executive function, see this Frontiers for Young Minds article.). Scientists who study this topic call this brain boost the **bilingual advantage**.

Not all scientists agree that speaking two languages helps the brain [3]. Even those that do agree are not exactly sure how being bilingual improves brain function. Some claim that bilingual people have better **inhibition**. In other words, they are better at ignoring distractions like noise when they are having a conversation. Others say bilingual people are better at **monitoring**, which means they are better at paying attention to their environments. For example, they might be better at noticing when a person switches from using one language to another. The way that speaking two languages improves brain function seems to depend a lot on the person and their individual language experience [4].

BILINGUAL

A person who can use at least two different languages.

EXECUTIVE FUNCTION

A set of mental processes, like updating, inhibition, and monitoring, that coordinate a person's thoughts and actions.

BILINGUAL ADVANTAGE

A benefit in brain function from speaking two languages.

INHIBITION

Component of executive function that helps people ignore distractions.

MONITORING

The ability to pay attention to the environment.

DO PEOPLE HAVE DIFFERENT LANGUAGE EXPERIENCES?

It turns out that bilingual people differ a lot in their language experiences including how well they use their languages and how much they use them. For example, a teen from China who speaks Chinese (Mandarin) and English might never use English in their home country. However, they would use it a lot if they attended school in the UK. Bilingual people in the same city also differ a lot in their language habits. A Mandarin-English bilingual person studying in the UK might have a group of friends who always speak Mandarin, while another might have more diverse friends and may communicate in English more often. We wanted to see if these differences between bilingual people influenced executive functions. This means we had to find a way to measure language experience.

HOW DID WE MEASURE LANGUAGE EXPERIENCE?

There are many ways to measure language experience. We used a survey called the Language History Questionnaire [5]. This survey

requires a person to answer questions about each language they use. These questions ask things like how well the person can speak, listen, read, or write in each language. The survey also asks how many hours each day the person uses a language. This survey gave us three separate scores that we used to measure language experience: 1) *proficiency*—how well a person can speak, listen, read, or write in a language; 2) *immersion*—how long a person has used or been exposed to a language, and; 3) *dominance*—how often a person uses a language. Together, these scores allowed us to describe a person's language experience in a lot of detail.

HOW DID WE MEASURE EXECUTIVE FUNCTION?

To test for differences in executive function, we used two popular tasks. The Simon task requires a person to press a button as quickly and accurately as possible when a certain color shape is shown on a screen (Figure 1). For example, a person might be told to press the "Q" button on a computer keyboard with their left hand when they see a brown square, or the "P" button with their right hand when they see a blue square. What makes this task tricky is that the shapes are shown on either the left or right side of the screen. This means that sometimes a person will have to press a button with their right hand when a shape is on the same (right) side of the screen. These **congruent** trials are easy. However, sometimes a person will have to press a button with their right hand when a shape is on the *left* side of the screen. The conflict between the side of the screen the shape is on and the response key makes these **incongruent** trials more difficult. The flanker task is similar to the Simon task, only the conflict is due to a center arrow pointing in the opposite direction of the four surrounding arrows (Figure 2).

CONGRUENT

Trials where there is no conflict between the stimulus and the response such as a flanker task trial where all arrows are pointing in the same direction.

INCONGRUENT

Trials where the stimulus and the response conflict such as a flanker task trial where the center arrow is pointing in the opposite direction as the surrounding arrows.

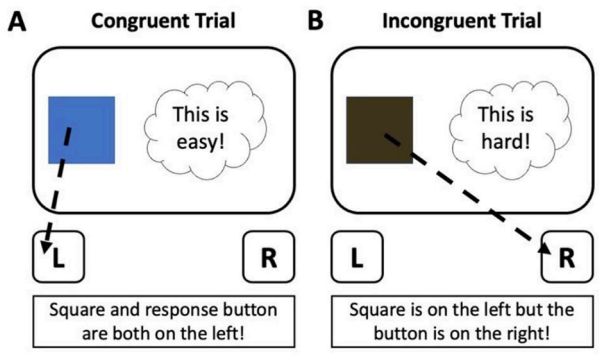

Figure 1

(A) On the Simon task, students had to press the left button when a blue square appeared. This is easy when the square is on the same side as the button. **(B)** However, this task is harder when the square is on the opposite side as the button! Dashed lines show the response button location.

HOW DID WE ANSWER OUR QUESTION?

We worked with an international high school in Southern China to conduct our study. This school is special because all the students are native Mandarin speakers, but all their courses are taught in English.

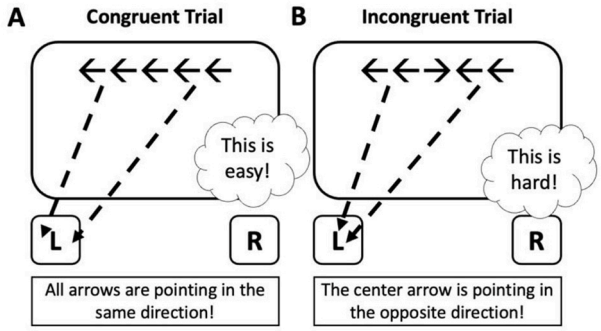

Figure 2

Figure 2

(A) On the flanker task, students had to press the left button if the center arrow was pointing to the left. This is easy when all the arrows face the same direction. **(B)** However, this task is harder when the center arrow is pointing in the opposite direction from the other arrows! Solid lines show the information the student needed to pay attention to, and dashed lines show the information that may help **(A)** or distract **(B)** the student.

We recruited 41 students between the ages of 13–19 and had them complete a few tasks on the Internet. First, each participant filled in the Language History Questionnaire and answered other questions about how often they play video games or musical instruments. Next, they completed the Simon and flanker tasks in random order. Even though these tasks are very similar, studies like ours normally ask people to do more than one task to see if the results are the same. Finally, the students answered a few questions about their stress levels. For each task, we measured how quickly students gave their responses, and whether their responses were correct or not. We included video game and musical instrument experience as well as other **variables** like age and stress in our analyses to control for their influence on task performance. This helps us to be sure that the results we see have to do with language experience and are not due to other factors.

VARIABLE

A characteristic, like language proficiency, that can change and be measured.

WHAT DID WE FIND?

Our results were different for each task and each measure of language experience. On the Simon task, higher English proficiency was related to better inhibition, even when we controlled for the influence of other variables (Figure 3). This means students with better English ability were faster on the more difficult, incongruent trials. In other words, they were better at inhibiting the automatic response of pressing the button that matched the side of the screen the shape was presented on. When controlling for other variables, we found the same result when we looked at the number of hours people spent playing musical instruments. This means playing an instrument might further improve inhibition. For the flanker task, higher English proficiency was related to improved monitoring. This means students with higher English proficiency were faster on congruent, incongruent, and neutral trials. In other words, they were better at monitoring the task in order to identify which response was appropriate.

Surprisingly, students who reported using English more were slower on the flanker task. We did not expect to see this! We think this finding might mean that people using English more are trying to improve

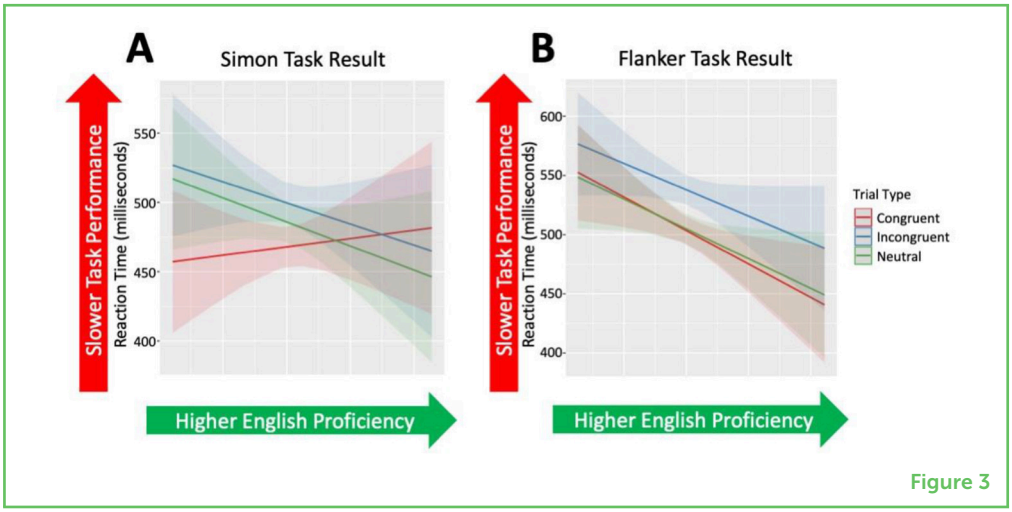

Figure 3

Figure 3

(A) Higher English proficiency was associated with better inhibition (faster responses on incongruent trials) on the Simon task. **(B)** Higher English proficiency was also associated with better monitoring (faster response on all trial types) on the flanker task. The colored lines represent the trial types. The blue lines show the difficult, incongruent trials. If we conducted our study again, we are 95% confident that our results would be somewhere in the shaded area around each line.

their proficiency and might pay more attention to the words they use—which would slow them down. However, this is just our best guess. We will need to conduct another study to see if our guess is correct. Finally, our results were a little different between the Simon and flanker tasks, even though these tasks are very similar. This finding also requires more research because it suggests that these tasks might be measuring slightly different things.

WHY ARE OUR FINDINGS IMPORTANT?

Our results show that developing proficiency in a second language may improve executive function. We also saw additional improvements in executive function from playing musical instruments. This suggests that bilingualism is just one of many possible experiences that can benefit the brain. These findings are important for young people, especially those in bilingual homes. Sometimes, children do not feel like learning their family's home language. This might be because it is not the language that the child uses when they go to school. More research is needed to better understand the benefits that using a second language has on the brain. This is especially true for high-school-age bilinguals because only a few studies have been done. We hope that our results highlight the potential benefits of learning a second language. While becoming bilingual is not easy, it is likely worth your time and energy. Who knows? You might even make a new friend!

ORIGINAL SOURCE ARTICLE

Privitera, A. J., Momenian, M., and Weekes, B. S. 2022. Task-specific bilingual effects in Mandarin-English speaking high school students in China. *Curr. Res. Behav. Sci.* 3:100066. doi: 10.1016/j.crbeha.2022.100066

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CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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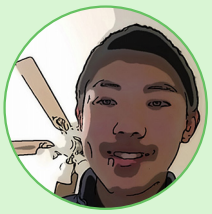
ETHAN, AGE: 12
I am fascinated by all topics in STEM, especially 3D-printing, robotics, and astronomy. My hobbies include Legos, playing card games, learning magic tricks, and watching the Office on Netflix.

JAIDEN, AGE: 15

I have been interested in science since the age of 7. My favorite journal to read is Scientific American. My academic interests include chemistry, economics, and entrepreneurship. My hobbies include equestrian show jumping, playing board & card games, and puzzles & riddles.



YUAN, AGE: 12

I am YuAn. I am in 6th grade and I go to 7th grade algebra instead of 6th grade math. My favorite subject is math and I play chess and soccer. I also play the piano and viola. I like to play video games and I use my computer a lot.

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