Advantages of Executive Processing in Bilingual Students

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Abstract

A research study was conducted measuring the differences in attention control for bilingual English and Spanish speaking students and monolingual English-speaking students in second and third grade. Attention control was measured using a series of listening tasks, one being a singular listening task and one being a dichotic listening task. The students were asked to listen to audio recordings of English words and to recall the words that they remembered. The recall of the monolingual and bilingual students was recorded for each task and the mean differences between the singular and dichotic listening tasks were found for each group. The mean difference between the bilingual students' recall for the singular and dichotic listening tasks was lower than the mean difference for the monolingual students, showing that the bilingual students' recall without distraction was more similar to their recall with distraction. These findings support the hypothesis that the bilingual students would have significantly higher attending recall than the monolingual students, demonstrating their heightened ability to control their attention.

Introduction

Language is a defining part of our humanity. Though there are roughly 6,500 languages spoken in the modern world, early language acquisition remains relatively similar among all speakers. However, significant differences begin to be seen in speakers of two languages, both in their initial language development as infants and in the brain mechanics utilized in everyday speech and comprehension of language. Speakers of two languages in the United States, specifically those whose first language is not English, have been widely misunderstood and underestimated. Individuals who speak languages other than English have been considered intellectually inferior because of the belief that understanding multiple languages creates confusion. These negative ideas are impacted by traditionally racist beliefs which paint a negative picture of individuals who speak different languages due to cultural and ethnic differences. This is especially evident in U.S. schools as English Language Learners are viewed as social outcasts and their unique language needs are not accommodated in their classrooms.

However, studies show that bilingualism actually creates social and cognitive advantages. The most notable of these advantages being related to executive processing, thought to have been created by bilingual individuals continuous use of the executive control center of their brain to preform language code switching including the inhibition and activation of their multiple languages. Because of their greater experience with inhibition of the language not in use, bilingual individuals have greater ability to inhibit inferring stimuli, resulting in better attention control. In order to create greater support for the research surrounding the advantages of bilingualism and to prove that bilingualism also creates advantages for young students in U.S. schools, a research study was performed in a NC elementary school with monolingual English-speakers and bilingual Spanish and English speakers in second and third grade. The students

were asked to participate in a series of listening and recall tasks that measured attention control and stimuli inhibition. By comparing the executive processing for bilingual and monolingual students, it is hoped to discover advantages in the processing ability for bilingual students. If advantages for bilingualism are discovered and shared, stigmas surrounding non-English speakers may be broken down and better education practices for bilingual students may be further studied.

Background

With the United States' continuous influx of immigrants, English Language Learners have come to be a prominent population in the country's school systems. English Language Learners, also referred to as ELLs or ESLs, "speak a minority language mainly at home and learn the majority societal language, English, primarily in preschool and school programs." (Paradis 2016) These students are considered "late bilinguals," meaning they "acquire the second language (L2) only after early childhood, once a native language has been firmly established." (Kroll et al. 2015) Though at many schools there are ESL classes that help students to increase vocabulary and fluency in English, ELLs spend most of their school day in mainstream classrooms in which they are immersed in the English language. If teachers do not make modifications to their instruction and assignments, these students can often become left behind due to the language disconnection. Their academic issues are not confined to literacy, though their reading level is usually far below grade reading level, but their problems also transcend into other subjects as lessons and instructions are delivered in English with few visual cues.

Despite these challenges that bilingual students continue to face due to uninformed teaching practices, it has been demonstrated that bilingualism does have apparent advantages. Researchers have carried out studies to look into the executive processing of bilingual

individuals. In the study "Bilingualism: Consequences for Mind and Brain," Ellen Bialystok (2012) says:

> Bilingual children outperformed monolinguals on the conflict tasks, but children in the two groups were comparable on tasks that did not include distracting perceptual information. This pattern has been confirmed in studies of both children and adults using a flanker task (children: [70,71]), theory of mind task (children: [72,73]; adults: [74]), Simon task (children: [75]; adults: [40]). Other studies with adults have shown better performance by bilinguals in naming the font color in a Stroop task [21], smaller costs in task switching [76], better ability to maintain task set in an attention task [77], and more susceptibility to negative priming, presumably because of greater inhibition [78]. (p. 242)

Bialystok suggests that these results from visually focused tasks are likely due to the bilingual brain's "joint activation of languages," which has been seen to occur in fluent bilinguals as their two spoken languages are both activated to a degree at all times (Bialystok et. al., 2012, p. 241). Because bilingual individuals must manage the simultaneous activation of two languages, there is an "enhancement of frontal-posterior attentional control mechanisms," leading to additional executive control (Bialystok et al., 2012, p. 245).

While bilingual individuals show enhanced control over attention during visual tasks, research also suggests that bilingual adults also have advantages in executive control during auditory tasks as well. Anna Soveri studied such advantages using the "forced attention dichotic listening paradigm," which she explains is a listening task in which "two different stimuli are presented simultaneously to each ear and the task is to modulate attention according to instructions" (Soveri et al., 2010, p. 372). Participants were asked to attend to stimuli from either the left or right ear and inhibit stimuli from the non-attending ear and then asked to recall. She

found that bilingual adults did significantly better on these dichotic listening tasks. Soveri thus demonstrates that bilinguals are "more effective in focusing attention and ignoring task-irrelevant stimuli" (Soveri et al., 2010, p. 377).

Methodology

These previous research studies were primarily focused on the advantages of bilingualism for adults. However, in order to demonstrate how these advantages occur earlier in childhood, this study has been developed to observe the attention control for second and third grade students. Similar to Soveri's methods of research, dichotic listening tasks were used in order to measure differences in executive processing and attention control between the bilingual and monolingual students.

Study Population and Sample

In order to observe the differences in attention in children due to bilingualism, a NC elementary school was selected to draw participants from. This school has implemented a dual language immersion program in which students engage in learning activities in both Spanish and English. The bilingual students for this study were pulled from these dual language program classes while the monolingual English-speaking students were pulled from the traditional English-only classes. All of the students for this study were in either second or third grade to limit the number of years that the students have been in school as an extraneous variable. After the students' guardians signed their consent for their children to participate in the study, there were 22 students in all who participated in the study. Twelve of these students were bilingual students who spoke both Spanish and English as part of the dual language immersion program and ten of the students were monolingual English-speaking students who were part of the traditional education track at the school. Both bilingual and monolingual students were selected

to participate in this study so that the differences between their attention could be observed. The monolingual English-speaking students acted as the control group and the Spanish-English bilingual students acted as the experimental group.

Materials

The listening tasks in this study revolved around a series of two singular and dual audio recordings that the student participants were asked to listen to. The first audio consisted of one recording of 7 spoken English words that were played in both ears of a pair of headphones. The second audio involved two different recordings of 7 spoken English words that were each played in a single ear. When listening this audio, the student participants heard one list of spoken words in one ear and another set of spoken words in the other ear. The English words for these recordings were selected specifically for this study with English-Spanish bilingual speakers as the words are Spanish-English cognates, meaning that the words sound phonetically similar in both languages. Spanish-English cognates were chosen for these recordings so as to eliminate any disadvantage to the bilingual English and Spanish speakers who may have more experience in one language versus the other.

Dichotic Listening Paradigm

The dichotic listening paradigm of which this study is focused consisted of a series of two listening and recall tasks. These tasks were given to each participant individually in order to eliminate distraction and participant discussion. Thus, each participant was brought into the research room and participated in the two listening tasks consecutively. The entire session took approximately 8 minutes per participant. In the first listening task, called the singular listening task, the student participants were asked to listen to the single audio recording of 7 English

words, seen in table 1. The students were told that they would be listening to some words and would be asked to remember all of the words that they could. The students were then given the pair of headphones and the audio was played. After listening to the audio, the students were then asked to immediately recall the words that they heard in any order. The words that they remembered, both correct and incorrect, were recorded on individual participant recording sheets. This singular listening task acted as a control as this task measured the students' undistracted general recall. The students then were then introduced to the second listening task.

Singular Listening Task Words
Rat
Police
Banana
Monster
Lamp
Camera
Tiger

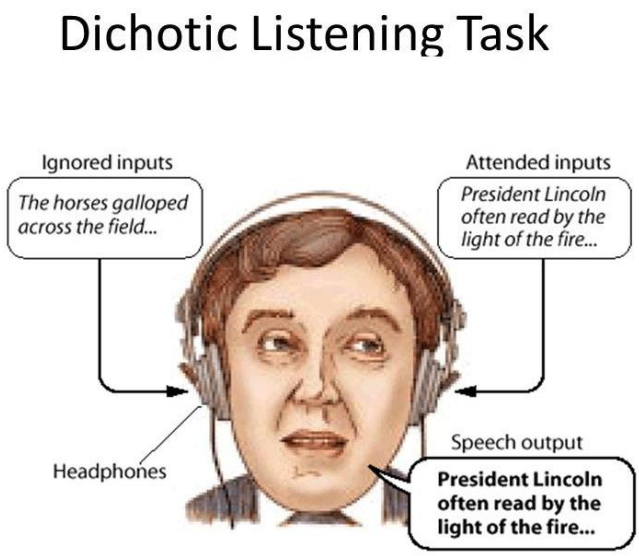
Table 1

In the second listening task, called dichotic listening task, the students were asked to listen to an audio of two separate audio recordings that would be played in each ear, seen in table 2. The students were told to pay attention only to the words that they heard in their left ear and to ignore the words that they heard in their right ear. After listening to the second audio, the students were asked to immediately recall all of the words that they remembered from their attending or left ear. These words were added to each participants individual participant recording sheet. The dichotic listening task acted as the experimental task for the study. The dichotic listening task allowed the attention control of the participants to be measured as they had to actively attend to the specified stimulus and ignore the unimportant stimulus. In these

tasks, the number of languages spoken by the participants acted as the independent variable with the number of words recalled acting as the dependent variable.

Dichotic Listening Task Words	
Left Ear	**Right Ear**
Traffic	Student
Hotel	Salad
Piano	Bicycle
Doctor	Circle
Train	Rose
Animal	Chocolate
Lemon	Music

Table 2



(McLeod, 2018)

Results

The hypothesis of this study was that the bilingual students would have significantly higher attending recall than monolingual students, as bilingual individuals are believed to have greater attention control which would give them better recall abilities under distraction. Upon completion of this study, the student data was compiled and thoroughly analyzed in order to

determine significance and connection to this overarching hypothesis. In table three, a set of the raw data for the 22 students is presented, including values for each student's total correct recall responses for each of the 2 listening tasks. Each of the values represents the number of correct words that the student recalled out of the 7 total words that were listened to in each task. For example, for the singular listening task for student 1, this student recalled 4 out of the total 7 words in this task according to the data set in table 3.

Student	Grade	Language Status	Singular Listening Task	Dichotic Listening Task	Difference in Singular Listening Task and Dichotic Listening Task Recall
Student 1	3	Dual	4	2	2
Student 2	3	Dual	3	2	1
Student 3	3	Dual	3	2	1
Student 4	3	Dual	4	1	3
Student 5	2	Dual	2	4	2
Student 6	2	Dual	3	1	2
Student 7	2	Dual	3	2	1
Student 8	2	Dual	3	1	2
Student 9	2	Dual	3	2	1
Student 10	2	Dual	2	2	0
Student 11	2	Dual	2	2	0
Student 12	2	Dual	4	1	3
Student 13	3	English	3	2	1
Student 14	2	English	2	0	2
Student 15	2	English	3	0	3
Student 16	3	English	4	2	2
Student 17	3	English	4	0	4
Student 18	3	English	3	1	2
Student 19	3	English	2	2	0
Student 20	3	English	3	0	3
Student 21	2	English	5	4	1
Student 22	3	English	3	1	2

Table 3

For each student, the difference was then found between the number of recalled words for the singular listening task and the number of recalled words for the number of recalled words for the dichotic listening task, seen in table 3. The mean difference between the recall for the two tasks was then found for both the monolingual students and the bilingual students, seen in figure 1. The bilingual students had a mean difference of 1.167 between their recall for the singular listening task and for the dichotic listening task. The monolingual students had a mean difference of 2 between their recall for the singular listening task and for the dichotic listening task. The confidence interval for the mean difference of recall for bilingual students is [0.373, 1.961] and [1.284, 2.716] for the mean difference of recall for monolingual students. In order to reject the null hypothesis (Ho), that there is no significant difference in the attending recall of bilingual and monolingual students, there would need to be a Two Sample T-Test probability lower than P=0.1. A Two Sample T-Test was conducted with the data and a probability of P=0.0712 was found. With this P value, I can reject the null hypothesis with 90% confidence that there is no significant difference between the attending recall for bilingual and monolingual students.

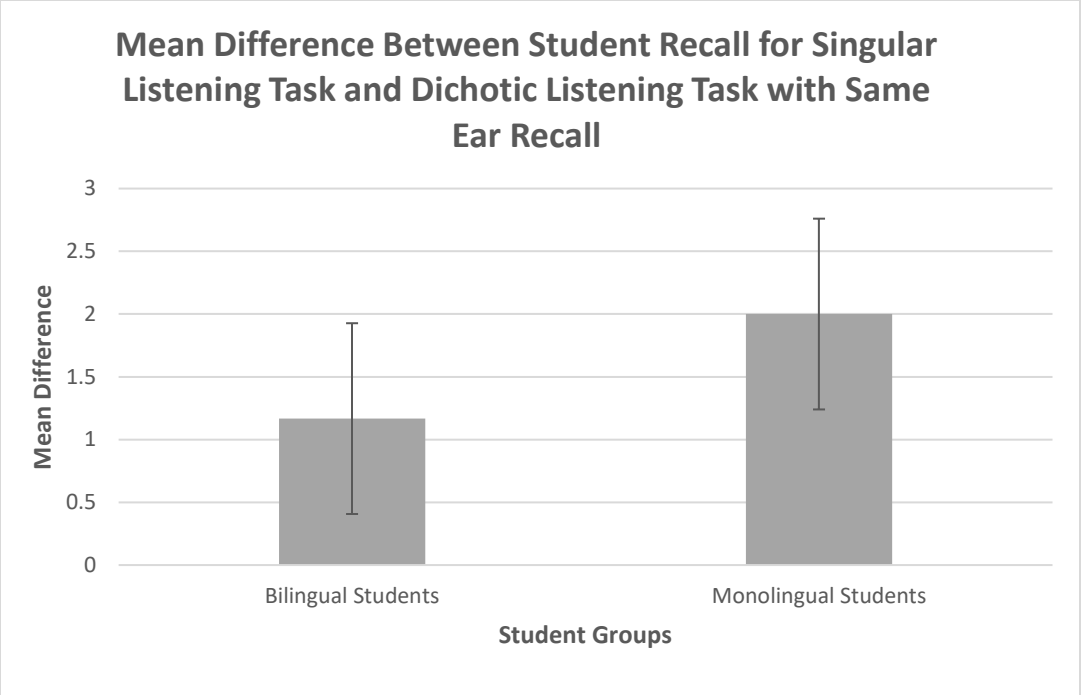


Figure 1

Discussion

The results of this study support the hypothesis that bilingual students would have significantly higher attending recall than monolingual students. The smaller difference between the bilingual students' recall for the singular listening task and their recall for the dichotic listening task shows that they have a better attending recall as their distracted recall was similar to their baseline general recall. On the other hand, the larger difference between the monolingual students' recall for the singular listening task and their recall for the dichotic listening task demonstrates that they did not recall as many words under the distraction of the dichotic listening task. This means that distraction has less of an impact on bilingual students than on monolingual students. The results thus show that the bilingual students are better at inhibiting the unnecessary information in their non-attending ear and at focusing their attention of the important information in the attending ear. These results seem to be in line with previous research conducted with bilingual adults. Just as in Anna Soveri's research, the second and third grade bilingual students

were significantly better than their monolingual counterparts during the dichotic listening task. This may be due to bilingual individuals having enhanced executive processing as they preform continuous code-switching between their spoken languages, which involves focusing on the language in use and inhibiting the language not in use. The bilingual brain is thus more well prepared to inhibit unimportant information or stimuli, such as was required of the participants in this study.

The increased attention control for these bilingual students points to their being advantages for bilingualism. If bilingual children have a better ability to control their attention and inhibit unimportant stimuli, it is likely that other executive processes are heightened as well. With additional research involving bilingual children, additional benefits may be discovered. With these bilingual advantages coming to light, it is hoped that the stigmatization of non-English speakers will be lessened. Additionally, because this advantage in attention control was discovered in elementary-age children involved in a dual language immersion program, these results may build on the collection of data supporting these types of programs. It is every educator's hope that their students will find the best education possible. Because of the advantages in executive processing and attention control in bilingual students, this best education may be found in dual-language immersion programs.

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