SPANISH-ENGLISH BILINGUALISM INFLUENCES CONTROL OF ATTENTION BUT NOT IMPLICIT SEQUENCE LEARNING

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Background

Previous research has shown that bilingualism leads to earlier semantic development (Ben-Zeev, 1977), better processing of verbal material (Bochner, 1996), metalinguistic advantages (Cromdal, 1999), superior approaches and learning strategies (Ianco-Worrall, 1972) and delay of dementia symptoms (Bialystok, Craik & Freedman, 2007). Furthermore, bilinguals have been shown to be better at non-linguistic tasks requiring control of attention (Bialystok, 1999; Bialystok, Craik, Klein & Viswanthan, 2004; Bialystok & Majumber, 1998), semantic and episodic memory (Goetz, 2003) and sociolinguistic interactions (Kormi-Nouri, Moniri & Nilsson, 2003). This study attempted to replicate previous findings examining control of attention and also sought to extend this work to investigate if bilingualism has beneficial effects on implicit sequence learning. Some have argued that sequence learning requires shifts of attention (Stadler, 1995; Jimenez, 2003). If this is the case, then bilinguals should also show greater implicit sequence learning than monolinguals.

Procedure

Alternating Serial Reaction Time (ASRT) task:

- 4- element, repeating sequence
- Pattern trials alternate with Random trials (e.g. 1r2r3r4r…)
- 8 epochs of 20 blocks of 80 trials (8-item sequence repeated 10 times)
- Measure of Implicit Learning: Trial-Type Effect (Difference between Pattern and Random trials)

Simon task:

- Respond to color of red and blue squares presented on right or left side of screen
- Some squares presented on side congruent with response key, some presented on incongruent side
- 1 session of 240 trials
- Measure of Attentional Control: Simon Effect (Difference between Incongruent and Congruent Trials)

Operation Span (OSPAN):

- Simple math equations paired with a word (Example: 1 + 2 = 3 DOG)
- Read equation aloud, respond to whether the answer provided is correct or not, then say the word aloud
- Example: "Is 1 plus 2 equal to 3, YES, DOG"
- Varying numbers of equation-word pairs
- Participant recalls all words in the set
- Measure of working memory: Percentage of correctly recalled words

Digit Symbol Coding / Pairing / Free Recall:

- Coding: Numbers are paired with symbols.
- Participants fill-in boxes containing numbers with the corresponding symbol for 120 seconds.
- Pairing: Fill-in boxes containing numbers with symbol pairs from memory
- Free Recall: Recall symbols from memory

Interpretations and Conclusions

Results replicate previous findings that bilinguals have better attentional control than monolinguals (Bialystok et al., 2004); the Simon effect was significantly smaller for the bilinguals than the monolinguals. Furthermore, bilinguals were significantly more accurate overall in the Simon task and were better able to remember number-symbol coding (Digit Symbol Pairing and Free Recall) than monolinguals. In contrast, implicit sequence learning (ASRT task), spatial short-term memory (Spatial Span), logic (Matrix Reasoning), processing speed (Digit Symbol Coding) and general intelligence (Vocabulary) were not affected by bilingualism.

In summary, we have confirmed that bilingualism is associated with better attentional control, but not enhanced learning of sequences.

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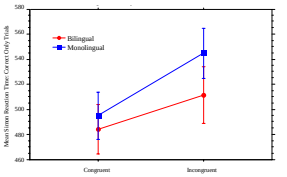
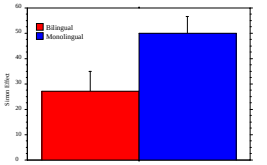
Simon Task

Respond right for blue square and left for red square





- Both Bilinguals and Monolinguals are slower at incongruent trials.
- But Bilinguals are less affected, $p < .05$.
- Bilinguals have smaller Simon Effect than Monolinguals, $p < .05$
- Thus, Bilinguals have enhanced Control of Attention.
- Consistent with Bialystok (1999).

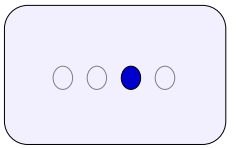
Determining Bilingualism By Fluency

Fluency was measured based on responses to five force-choice questions on language abilities.

High Fluency = Bilingual; Low Fluency = Monolingual

1. Listening Comprehension
_____ I can understand a limited number of high frequency words and common conversational set expressions such as "How are you?" or "My name is –".
_____ I can understand simple questions and statements in short dialogues or passages if it is repeated at slower-than-normal speed.
_____ I can understand the main points of a short dialogue or passage if spoken at slower-than-normal speed. I may need some repetition.
_____ I can understand most of what is said (all main points and most details) at near normal speed.
_____ I can understand nearly everything at normal speed, although occasional repetition may be necessary.
_____ I can understand everything at normal speed like a native speaker.
2. Fluency
_____ I can speak using only short question-answer patterns such as "How are you? I am fine, thank you."
3. Vocabulary in Speech
_____ I know a limited number of high frequency words and common conversational set expressions (e.g., How are you? My name is…)
4. Pronunciation
_____ I have difficulty in accurately producing the sounds and sound patterns of the language.
5. Grammar in Speech
_____ I can only use common conversational set expressions.

Alternating Serial Reaction Time Task



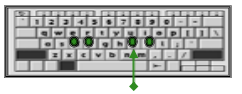
Pattern trials alternate with Random trials

Example sequences:

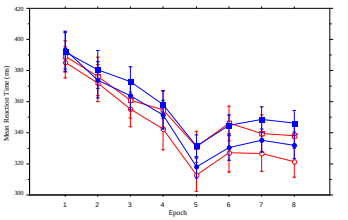
1r2r3r4r…

1r3r4r2r…

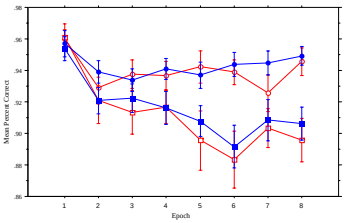
1r4r3r2r…



Response

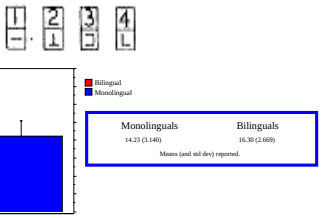


- For Reaction Time, both groups show learning: pattern and random trials diverge across epochs.
- No group difference.



- For Accuracy, both groups show learning: pattern and random trials diverge across epochs.
- No group difference.

Digit Symbol Pairing



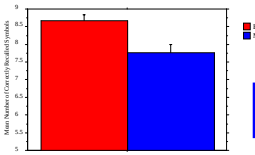
Monolinguals	Bilinguals
14.23 (3.140)	16.30 (2.669)

Means (and std dev) reported.

Bilinguals do not recall significantly more Symbols on Pairing Task.

$p = .110$

Digit Symbol Free Recall



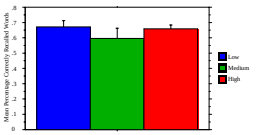
Monolinguals	Bilinguals
7.77 (.992)	8.70 (233)

Means (and std dev) reported.

Bilinguals recall more Symbols on Free Recall Task.

$p < .05$

OSPAN



Low Fluency	Medium Fluency	High Fluency
.698 (.014)	.576 (.043)	.660 (.086)

Means (and std dev) reported.

- There is a significant difference between medium fluency and low fluency, $p < .05$, but no difference for low versus high fluency or for medium versus high fluency.
- Consistent with Ricciardelli (1992): partial bilinguals do not reap the same benefits as full bilinguals.
- Partial bilingualism seems to cause a deficit in this task.

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Participants

	Monolinguals	Bilinguals
Gender	6M / 12F	8M / 9F
Age (in years)	20.1 (18.5-28.7)	20.4 (18.37-24.24)
Education	13 (12-18)	13.42 (12-16)
WAIS-III Vocabulary	56.94 (42-75)	56.47 (42-74)
WAIS-III Digit Span	17.06 (13-27)	15.53 (10-23)

Means (and ranges) reported.