



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

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Background

Previous studies have found that bilinguals demonstrate better verbal-processing abilities (Bochner, 1996; Cromdal, 1999; Lee & Naigles, 2005), attentional control (Bialystok, 1999; Bialystok, Craik, Klain & Viswanathan, 2004; Bialystok & Majumber 1998; Masuda, T. & Nisbett, R.E., 2001; Romano, Garlipp, Mays, Howard & Howard, 2007; Sumiya & Healy, 2004), and are less likely to develop dementia symptoms when compared with monolinguals (Bialystok, Craik & Freedman, 2007). This study investigated the effects of bilingualism on implicit sequence learning in Japanese-English bilinguals and English monolinguals as well as replicated previous findings of greater attentional control compared to 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)

Consonant Trigrams

- Participants listen to 3 letters and a number, then count backwards from that number for varying amounts of time, then recall the 3 letters.

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

Digit Span:

- Participants respond verbally to increasing number spans
- Forward and Backward version

Spatial Span:

- Participants observe and tap the same blocks the experimenter taps
- Forward and Backward version

Interpretations and Conclusions

The results of the Simon Task were consistent with previous studies of bilinguals, and extend these results to Japanese speakers. The bilingual group displayed a significantly smaller Simon effect than the monolingual group, showing greater attentional control (Bialystok et al., 2004; Romano et al., 2007). However, there was no significant difference among the groups on the implicit learning task, which was also consistent with the previous study by Romano et al. (2007) with Spanish-English bilinguals. Japanese-English bilinguals showed significantly better performance compared to English monolinguals on the short-term memory and working memory tasks (Digit Span, Spatial Span, Digit Symbol Pairing and Free Recall and Consonant Trigrams) and Vocabulary. There was no difference between the two groups on logical reasoning (Matrix Reasoning), and visual-motor speed (Digit Symbol Coding).

In summary, we found that Japanese-English bilingualism was associated with better attentional control and enhanced short-term and working memory, but not with better implicit sequence learning.

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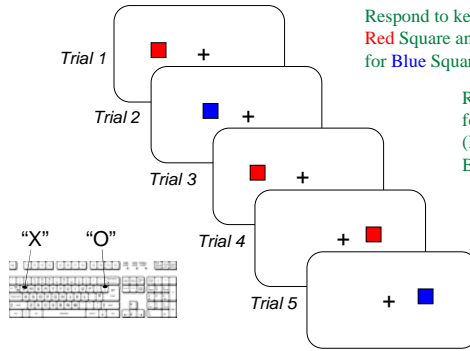
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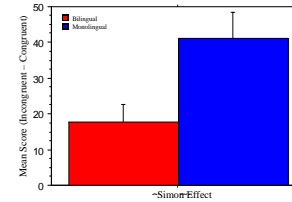
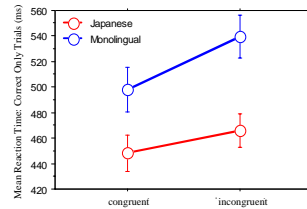
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Simon Task



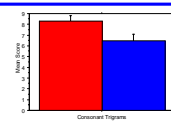
Respond to key on left ("X") for Red Square and key on right ("O") for Blue Square.

Reaction time slows for incongruent trials (Red on right and Blue on left).



• Both Bilinguals and Monolinguals are slower at incongruent trials.

• Bilinguals have smaller Simon Effect than Monolinguals, $p < .05$
• Bilinguals have enhanced Control of Attention.
• Consistent with Bialystok (1999, 2004) and Romano et al. (2007).

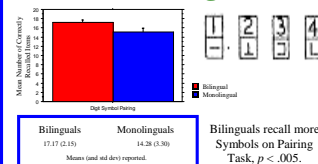


Consonant Trigrams

Bilinguals recall more Trigrams than Monolinguals. $p < .05$.

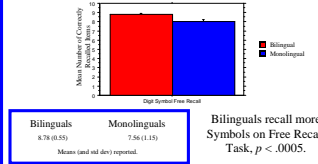
Digit Symbol

Pairing



Bilinguals recall more Symbols on Pairing Task, $p < .005$.

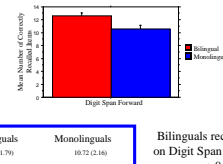
Free Recall



Bilinguals recall more Symbols on Free Recall Task, $p < .0005$.

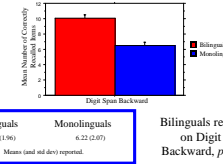
Digit Span

Forward



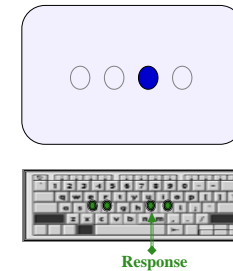
Bilinguals recall more on Digit Span Forward, $p < .01$.

Backward



Bilinguals recall more on Digit Span Backward, $p < .0001$.

Alternating Serial Reaction Time Task



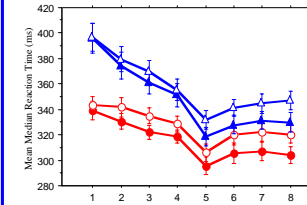
Pattern trials alternate with Random trials

Example sequences:

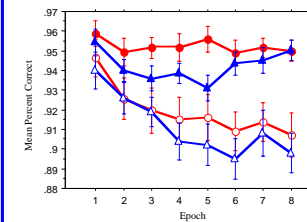
1r2r3r4r...

1r3r4r2r...

1r4r3r2r...



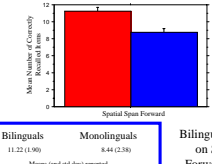
• For Reaction Time, both groups show learning: high frequency trials and low frequency trials diverge across epochs.
• No group difference in learning.



• For Accuracy, both groups show learning: high frequency trials and low frequency trials diverge across epochs.
• No group difference in learning.

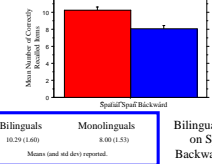
Spatial Span

Forward



Bilinguals recall more on Spatial Span Forward, $p = .0005$.

Backward



Bilinguals recall more on Spatial Span Backward, $p = .0001$.

Participants

	Monolinguals	Bilinguals
Gender	6M / 12F	4M / 14F
Age (in years)	20.1 (18.5-28.7)	24.31 (19.9-29.6)
Education	13 (12-18)	15.56 (13-18)
WAIS-III Vocabulary*	58.22 (42-68)	76.44 (43-80)

Means (and ranges) reported
 $*p < .0001$

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