Relating the demands of bilingual language control to inhibition: An individual differences approach

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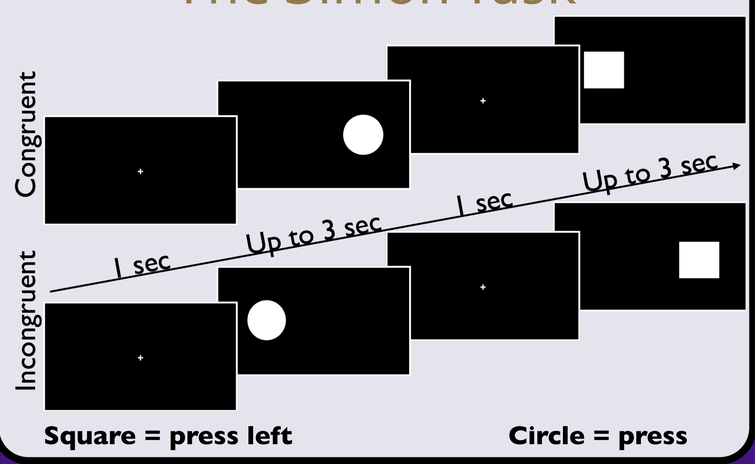
Introduction

Many research findings show that "bilinguals" outperform "monolinguals" on tasks that measure executive functioning (EF: see **1** for review); however these findings have recently been called into question due to failures to replicate (e.g., **2**, **3**).

The underlying assumption of this research, that the neurocognitive demands associated with learning and managing two languages has broader consequences for mind and brain, is firmly grounded in both developmental and training literatures.

We argue that a complete understanding of the mechanisms underpinning fluent bilingualism is necessary for making clear predictions about the broader implications of bilingualism for EF. Such an understanding requires **improved knowledge of how the many varying facets of bilingual development and language use** influence the neurocognitive demands experienced, and by virtue EF.

The Simon Task



Methods

Participants: 423 individuals with varying "bilingual" experience across 3 experiments

Data Analyses: (1) Bivariate correlations between 4 IVs and 6 DVs were computed. (2) Simultaneous multiple regressions were conducted using 4 IVs to simultaneously predict EF (Simon effect).

Dependent Variables: Performance on Simon Task (**4**: above). Reaction times (RTs) and accuracies for congruent (75%) and incongruent (25%) trials were examined separately along with "Simon effect" (incongruent-congruent RTs and congruent-incongruent accuracies).

Methods

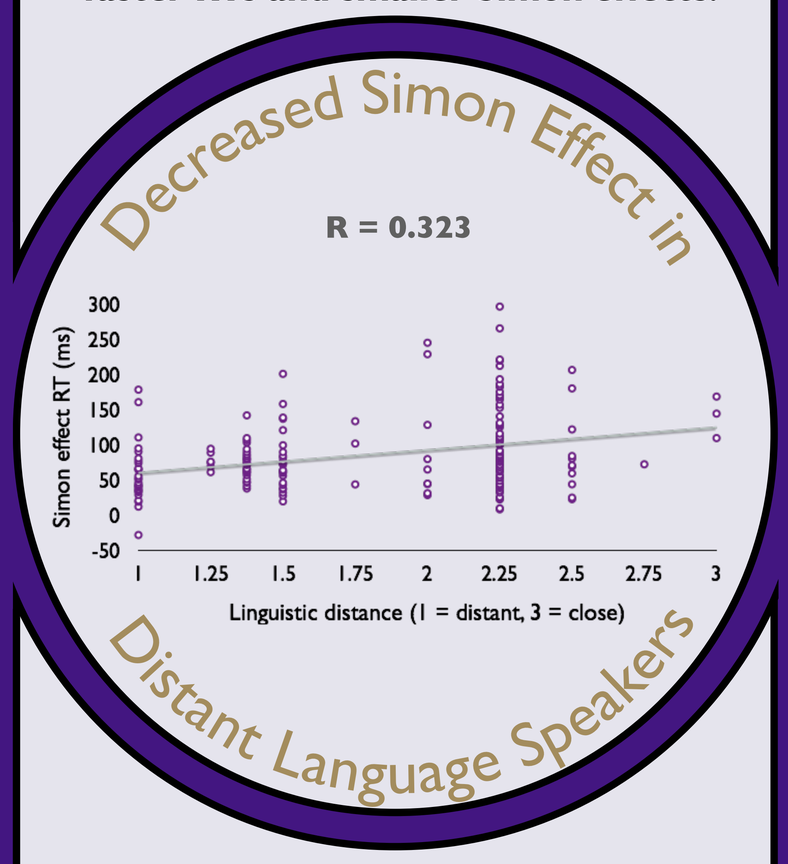
Independent Variables: Data from a modified version of the LEAP-Q (**5**) were used to compute four linguistic variables of interest:

- Linguistic "Distance" (for participants whose 1st or 2nd language was English) from (**6**) ranging from 1 (distant) to 3 (close).
- Language Use defined as percent time most frequent language is spoken from 50% (balanced) to 100% (not balanced).
- Age of L2 Acquisition (in years)
- Self Reported L2 Proficiency from 1 (low) to 10 (high).

Results

Significant Correlations:

- Linguistic Distance was correlated with Simon effect, congruent and incongruent RTs [r(191) = .323, .455, .458, *p*s < .001] with **more distant language speakers having faster RTs and smaller Simon effects.**



Significant Correlations continued

- Language Use was correlated with the Simon effect [*r*(354) = .139, *p* = .009] with **more balanced language users having smaller Simon effects.**
- Both age of L2 acquisition and L2 proficiency significantly correlated with the Simon effect [*r*(268) = .15 and -.14, *p* = .018 and .025] respectively) with **earlier and more proficient bilinguals having smaller Simon effects**.

Multiple Regression:

- When 4 IVs were entered simultaneously, the resulting model explained 13.4% of the variance (*p* < .001); however only the beta for linguistic distance reached significance (*p* = .003).

Discussion

We demonstrate the utility of an **individual differences approach** for studying how bilingualism shapes EF.

Results from this exploratory analysis illustrate **the importance of linguistic distance, a relatively understudied facet of bilingualism,** for understanding the demands bilingualism places on mind and brain.

We also considered the possibility that socio-cultural or education-related factors may contribute to systematic variance between linguistic distance and EF. In our participants, working memory capacity was correlated with Linguistic Distance [*r*(164) = .326, *p* > .001)]. When WM was controlled for, only the correlations between linguistic distance and congruent and incongruent RTs remained significant.

The causal nature of these relations is difficult to interpret because the **IVs are highly correlated** (see below) and EF mediates success in using multiple languages (**7**).

Our results suggest that **failures to replicate may result, in part, from different sample selection or different definitions of bilingualism.**

Correlations Between IVs

Correlations

		Linguistic Distance	Language Use	L2: Acquisition	L2: Proficiency
Linguistic Distance	Pearson Correlation	1	.326**	.273**	-.255**
	Sig. (2-tailed)		.000	.000	.000
	N	191	164	191	191
Language Use	Pearson Correlation	.326**	1	.441**	-.502**
	Sig. (2-tailed)	.000		.000	.000
	N	164	354	211	211
L2: Acquisition	Pearson Correlation	.273**	.441**	1	-.731**
	Sig. (2-tailed)	.000	.000		.000
	N	191	211	268	268
L2: Proficiency	Pearson Correlation	-.255**	-.502**	-.731**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	191	211	268	268

**. Correlation is significant at the 0.01 level (2-tailed).

References

1. Bialystok, E., Craik, F. I., & Luk, G. (2012). Bilingualism: Consequences for mind and brain. *Trends in Cognitive Sciences*, *16*(4), 240-250.
2. Paap, K. R., & Greenberg, Z. I. (2013). There is no coherent evidence for a bilingual advantage in executive processing. *Cognitive Psychology*, *66*(2), 232-258.
3. Paap, K. R., Johnson, H. A., & Sawi, O. (2014). Are bilingual advantages dependent upon specific tasks or specific bilingual experiences?. *Journal of Cognitive Psychology*, *26*(6), 615-639.
4. Craft, J. L., & Simon, J. R. (1970). Processing symbolic information from a visual display: Interference from an irrelevant directional cue. *Journal of Experimental Psychology, 83*(3p1), 415.
5. Marian V., Blumenfeld, H. K & Kaushanskaya, M. (2007). The language experience and proficiency questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech, Language and Hearing Research 50*(4), 940-967.
6. Chiswick, B.R., & Miller, P.W. (2005). Linguistic distance: A quantitative measure of the distance between English and other languages. *Journal of Multilingual and Multicultural Development, 26*(1), 1-11.
7. Festman, J., Rodriguez-Fornells, A., & Münte, T. F. (2010). Individual differences in control of language interference in late bilinguals are mainly related to general executive abilities. *Behavioral and Brain Functions*, *6*(5), 1-12.

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