

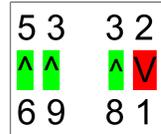
Veniamin Shiron¹, Angela de Bruin¹, Silke M Göbel^{1,2}

Number Processing in Bilinguals: Does a discrepancy in number systems between a bilingual's first and second language influence number processing?

¹ Department of Psychology, University of York, UK; ² Department of Special Needs Education, University of Oslo, Norway

Introduction

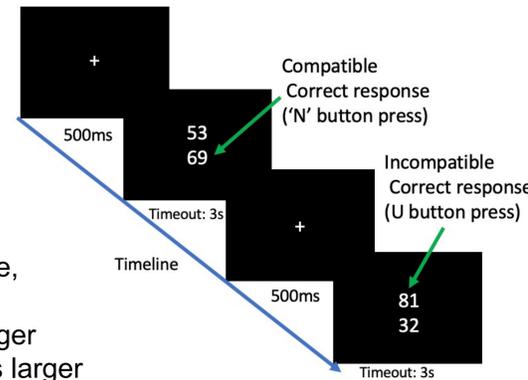
- Recent research has shown that basic number comparison is influenced by the language background of participants¹
- Unit-Decade Compatibility Effect²: participants are faster to choose the larger of two double-digit numbers for compatible than for incompatible pairs
 - Compatible (53 < 69: 5 < 6 and 3 < 9)
 - Incompatible (32 < 81: 3 < 8 BUT 2 > 1)
- Effect size is modified by language background²
 - Stronger in languages with inverted number words (e.g., in German; 53 is 'three-and-fifty')
 - Than in languages with non-inverted number words (e.g., in English; 53 is 'fifty-three')
- Previous research has compared native speakers of different languages, however, we do not know how and if the second language of a bilingual can influence number processing when the number systems differ.



Aim: to investigate whether a second language (L2) with non-inverted number words affects number comparison in native speakers of a language with number word inversion (L1).

Number Comparison Task

- All instructions in German
- Task: to indicate **which of the two numbers is numerically larger.**
- 2AFC keyboard response, press
 - U if top number is larger
 - N if bottom number is larger



Discussion

- Examined whether there is an effect of L2 (English, non-inverted number words) on number processing in native German-speakers (inverted number words) using the unit-decade compatibility effect.
- We found a unit-decade compatibility effect, i.e., RTs were longer on incompatible than compatible number pairs.
- The size of this effect was not different between monolingual German-speakers and bilingual German-English speakers.
- Overall, the bilingual's second language did not appear to influence number processing in this study.
- The lack of an influence of L2 (English) could be due to the bilingual participants activating German more strongly than English.

Second experiment (ongoing): manipulating language activation through language use before each number comparison trial.

Participants & Pre-screening

- 30 German(L1)-English(L2) bilinguals; 21 German monolinguals
- All participants: German native speakers and recruited, pre-screened and, if selected, tested online

Pre-Screening:

- LexTALE: Lexical decision task measuring language proficiency
- Full language-use questionnaire
- Selection criteria:
 - LexTALE score higher than 60 (B2 equivalent), in German for monolinguals, in German and English for bilinguals
 - Weekly use of English^a: at least 3 (Sometimes) for bilinguals, 1-2 (Never-Rarely) for monolinguals

Measure	Bilinguals	Monolinguals
Age (in years)	31.8	30.6
Gender (N of females)	21	8
Country of residence	English-speaking	German-speaking
Daily English use for numbers	50%	--
Weekly use of English ^a (1-5)	4.9	2.4
Language	German: English:	German:
Age of Acquisition (years)	0 8.4	0
LexTALE (0-100)	88.71 90.96	87.3

^a Scale 1 (Never) – 5 (Always)

Design

- Within-subject manipulation of trial type
- 300 trials broken down into:
 - 120 compatible
 - 120 incompatible
 - 60 filler trials (20%, within-decade, e.g. 41,49)
- Between-subject factor: two language groups
 - monolingual (German only)
 - bilingual (German + English)

Results

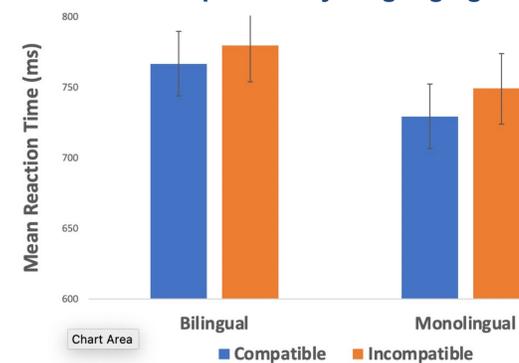
Accuracy:

- High for both bilinguals (98%) and monolinguals (97%)

Reaction times:

- Type:** Longer RTs for incompatible than compatible trials ($p < .001$)
- Language group:** No difference in RTs between the language groups ($p = .332$)
- Interaction:** The size of the compatibility effect did not differ between the language groups ($p = .222$)

Number comparison by language group



References

- Göbel, S. M., Moeller, K., Pixner, S., Kaufmann, L., & Nuerk, H. C. (2014). Language affects symbolic arithmetic in children: The case of number word inversion. *Journal of Experimental Child Psychology*, 119(1), 17–25. <https://doi.org/10.1016/J.JECP.2013.10.001>
- Nuerk, H. C., Weger, U., & Willmes, K. (2005). Language effects in magnitude comparison: Small, but not irrelevant. *Brain and language*, 92(3), 262-277.

Contact: vs814@york.ac.uk