School of Psychology and Clinical Language Sciences

University of Reading

Are all code-switchers equally "switched-on"? Exploring the differential impact of code-switching styles on bilinguals' executive control functions.

Julia Hofweber Theodoros Marinis Jeanine Treffers-Daller

Centre for Literacy & Multilingualism

Background

Recently reported bilingual advantages at inhibitory control and task-switching suggest that similar processes underlie bilingual language control and general executive control (Bialystok, 2009). Key to the bilingual experience is code-switching, i.e. mixing languages within the same utterance. This study explores how different code-switching styles may impact executive control differentially by comparing participants with different code-switching profiles in terms of their executive control performance.

Code-switching types (Muysken, 2000)

(1) Alternation: structurally fairly independent L1 and L2 phrases alternate implying temporary inhibition of one language
Ich kann heute nicht kommen BECAUSE I'M ILL.
I can't come today BECAUSE I'M ILL.
-> requiring maximal inhibition and minimal task-switching

(2) Insertion : L2 constituents inserted into L1 structure implying L2 grammar inhibition but co-activation at lexical level
Wir suchen VOLUNTEERS *fuer das Projekt.*
We are looking for VOLUNTEERS for the project.
-> requiring medium inhibition and medium task-switching

(3) Dense code-switching (Green & Li Wei, 2014)
L1 and L2 converge on grammatical, lexical, semantic levels implying little inhibition and co-activation at multiple levels
THAT'S WHAT *papa meinS TO SAY*.
THAT'S WHAT *papa meanS* TO SAY
-> requiring minimal inhibition and maximal task-switching

INHIBITORY CONTROL

TASK SWITCHING

Research question

How do different code-switching habits modulate bilinguals' performance at tasks measuring inhibitory control and task-switching?

Predictions

1. Bilinguals will outperform monolinguals at inhibitory control and task-switching.
2. A greater tendency towards engaging in dense code-switching will correlate positively with task-switching skills thus enhancing mental flexibility.

Methodology

Participants and their language profiles

Table 1 Participants' language mixing profile

Languages	Community Type	Bilingualism Type	Code-switching Tendency	Location	Age	Number
German-English	6th generation immigrants	simultaneous balanced	dense code-switching	South-Africa	M = 43	N = 12
German-English	1st generation immigrants	sequential dominant	insertion	UK	M = 30	N = 9
English	control	monolingual	none	UK	M = 25	N = 20

Tasks measuring the independent variable code-switching preferences

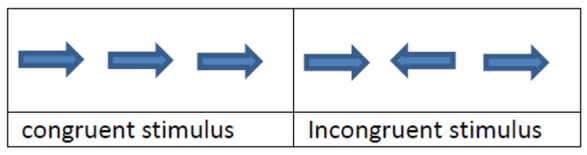
multiple methods: questionnaires (scores for code-switching frequency, attitude, intentionality, type), sentence repetition, elicited and authentic email production
focus this poster: acceptability judgements indicating cognitive embedding

- instruction: "How frequently do you come across this type of sentence when talking to other German-English bilinguals in informal settings? Use a rating scale from 1 = *never* to 7 = *all the time*"
- authentic utterances containing code-switching instances
- presented in pseudo-randomized order in audio and visual format
- stimulus utterances: 14 insertion English into German, 14 insertion German into English, 14 alternation, 14 dense, 14 monolingual

Tasks measuring the dependent variable executive control functions

- **inhibitory control** measured as **conflict effect CE** in **flanker tasks**
- flanker task instruction: "indicate direction of central arrow, i.e. *left* or *right*"
- **task-switching** measured as **mixing cost** using **experimental blocking**
- next study: flanker tasks interspersed with code-switches inducing bilingual modes

Flanker tasks presented in 5 blocks varying in proportion of congruent to incongruent trial types and resulting mixing cost measuring task-switching effort (Costa et al., 2009)



conflict effect (CE)
measures inhibitory control
RTs incongruent trials– RTs congruent trials

Figure 1 Flanker task congruent and incongruent stimulus

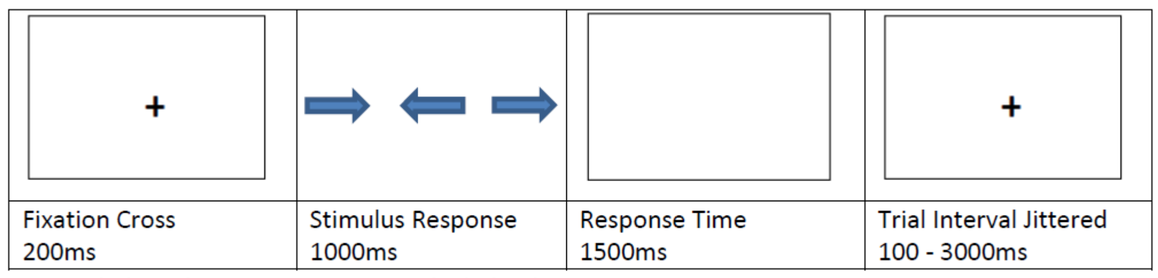


Figure 2 Flanker task presentation sequence individual trial

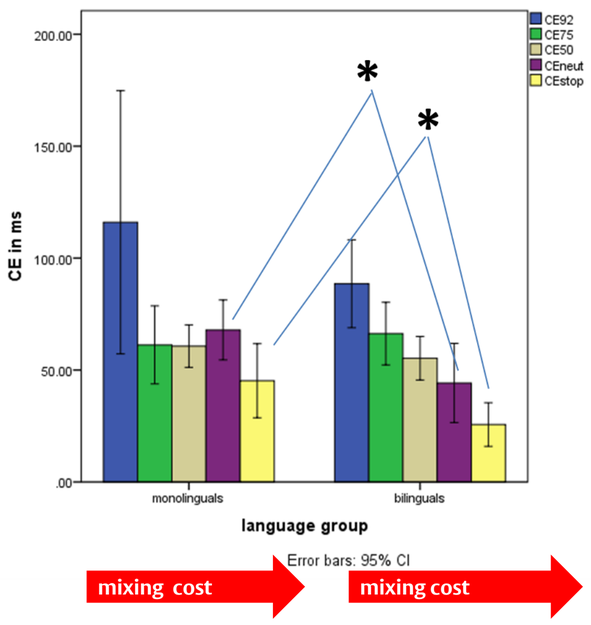
Table 2 Experimental blocking of flanker tasks designed to derive a mixing cost measuring task-switching effort

block label	congruent trials	incongruent trials	neutral or no-go trials	mixing cost
CE92	92 %	8 %	0 %	low
CE75	75 %	25 %	0 %	low medium
CE50	50 %	50 %	0 %	high medium
CEneut	33.3 %	33.3 %	33.3 %	high
CEstop	33.3 %	33.3 %	33.3 %	high

mixing cost
measures task-switching
RTs block CEneut
minus
RTs block CE92

Results

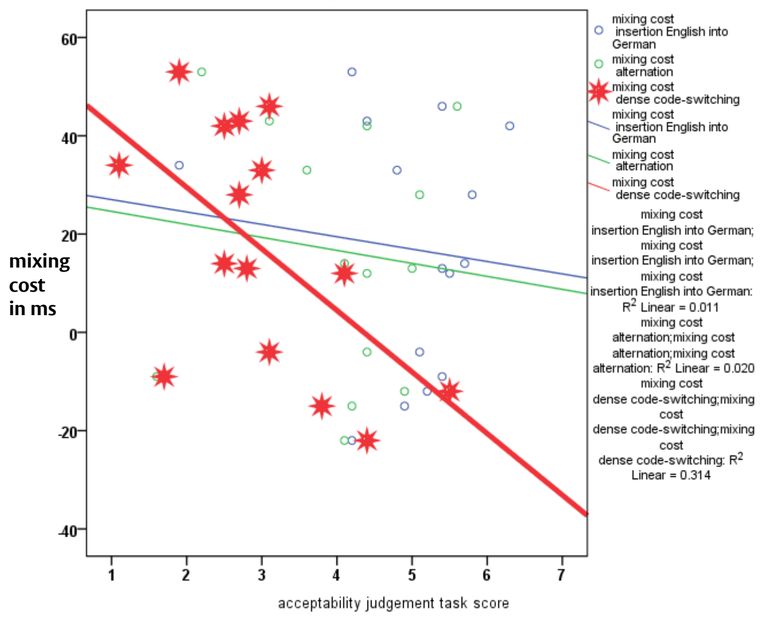
Conflict effect CE comparing monolinguals to bilinguals



- **CE monolingual > bilingual difference statistically significant* mean difference = 19.7 milliseconds ms (Ancova, Covariate age, $p < 0.05$)**
- **bilingual advantage due to performance at blocks with greatest mixing cost, i.e. requiring greatest task-switching effort**

Figure 3 Conflict effect by language group for experimental blocks arranged in order of increasing mixing cost

Correlation mixing cost x dense code-switching scores



When correlating mixing cost magnitude with scores given to code-switching types in the acceptability judgement task, all code-switching scores show a negative correlation with mixing cost but this is only significant for dense code-switching scores ($r = -0.56$, strong effect size, $p < 0.05$).

Figure 4 Correlation of mixing cost magnitude and code-switching scores from acceptability judgement task

Conclusion

Bilingual advantages appear in conditions posing greatest load to task-switching. More specifically, dense code-switching correlates positively with task-switching indicating that mental flexibility may be enhanced most by the act of mixing languages at multiple levels.

References

1. Bialystok, E. (2009). Bilingualism: The good, the bad, and the indifferent. *Bilingualism: Language and Cognition*, 12 (1), 3 – 11.
2. Costa, A., Hernandez, M., Costa-Faidella, J., Sebastian-Galles, N. (2009). On the bilingual advantage in conflict processing: Now you see it, now you don't. *Cognition*, 113, 135-149.
3. Green, D.W., Wei, L. (2014). A control process model of CS. *Language, Cognition and Neuroscience*, 24 (9), 499 – 511.
5. Muysken, P. (2000). *Bilingual Speech: A Typology of Code-mixing*. Cambridge: Cambridge University Press.

This study was conducted as part of a PhD project by Julia Hofweber, email: j.e.hofweber@pgr.reading..ac.uk