Parallel development trajectories of L2 language proficiency, cross-language interaction, and executive functions in child L2 learners, bilinguals, and trilinguals?

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INTRODUCTION

Do children acquiring multiple languages show bidirectional cross-language activation (CLA) and enhanced executive functions (EF)? (Poarch & Van Hell, 2012a, b)

- Evidence of CLA during lexical access in adult bilinguals (Costa et al., 2000)
- Evidence of enhanced EF in conflict resolution tasks (Simon Task, Simon & Rudell, 1967; Attentional Networks Task, Fan et al., 2002) in adult and child bilinguals (Bialystok et al., 2004; Carlson & Meltzoff, 2008; Costa 2009; Yang, Yang, & Lust, 2011)

Research questions:

- Will CLA become evident in dominant and non-dominant languages in child L2 learners, bilinguals, and trilinguals enrolled in dual-immersion programs?
- Will these children who need to regularly resolve competition between multiple languages (Green, 1998) outperform the monolingual children in two EF tasks?
- **Will CLA and EF develop in parallel trajectories?**

METHOD

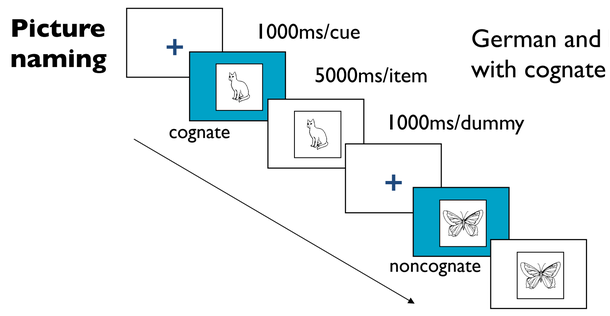
Participants

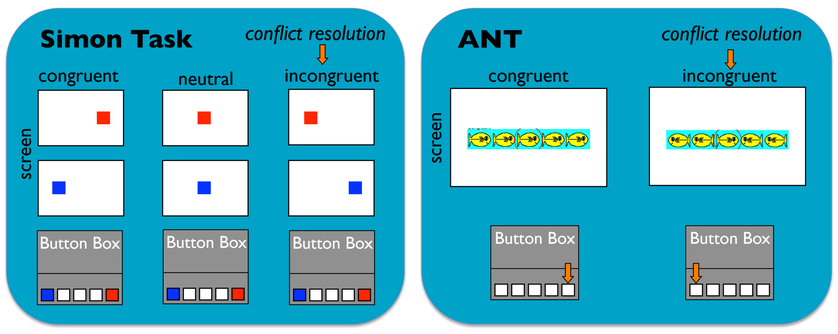
76 children (age range = 5.9 – 7.9; ♀37, ♂39)

Group	Monolinguals	L2 Learners	Bilinguals	Trilinguals
N (girls/boys)	20 (9:11)	19 (8:11)	18 (9:9)	19 (11:8)
Mean Age	7.1 (0.5)	7.1 (0.6)	6.8 (0.7)	6.8 (0.9)
Languages	L1 German	L1 German L2 English	L1 German L2 English	L1 German L2 Language X L3 English
Length of L2 immersion*	N/A	1.7 (0.8)	3.7 (1.5)	2.2 (1.0)
Setting	Primary school	Kindergarten & primary school 'dual-immersion'		
SES	M: 3.5 / F: 3.6	M: 3.5 / F: 3.5	M: 3.2 / F: 3.3	M: 3.7 / F: 3.6
TROG-D German proficiency	114 (14)	111 (12)	107 (16)	104 (19)
TROG-2 English proficiency*	56 (1)	72 (12)	111 (16)	93 (18)

* denotes measures with significant differences across groups.

Tasks





Simon effect & ANT conflict effect = incongruent RTs - congruent RTs

- Effect magnitude index of conflict resolution (smaller = better)

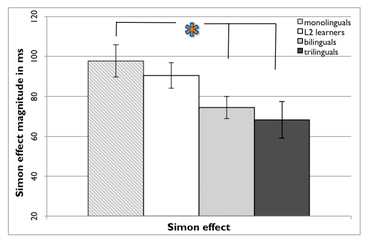
Results

Picture naming task

- Bidirectional cognate facilitation (CF) in bilinguals and trilinguals
- Unidirectional CF in L2 learners (L1 influenced L2 only)
- Slower picture naming in L1 for bilinguals and trilinguals

Simon task

- Faster conflict resolution for trilinguals than monolinguals and marginally so for bilinguals than monolinguals
- No global RT difference



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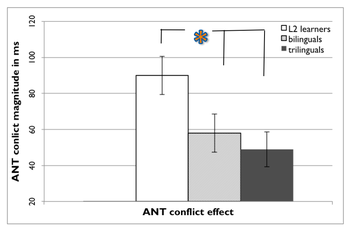


- Faster conflict resolution for bilinguals and trilinguals than L2 learners
- No global RT difference

RESULTS

Correlation & Regression

Is there a relationship between cross-language activation (CLA) and executive functions (EF) in these children? What are the main factors of influence?

Rationale:

- EF enhancement in bilinguals stems from need to control two languages
- Bidirectional CLA modulated by L2 language proficiency and use

Correlation Matrix for Background Measures and Simon task

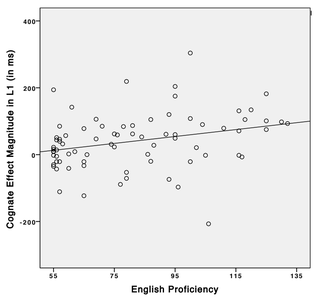
	German RTs	German CFE	Simon Effect	German Proficiency	English Proficiency	Length of Immersion
GE_RTs	--	.117	-.118	-.279*	.404***	.385***
GE_CFE		--	-.140	-.012	.291*	.262*
Simon_E			--	-.076	-.378***	-.262*
GE_prof				--	-.057	-.092
EN_prof					--	.827***
L_o_I						--

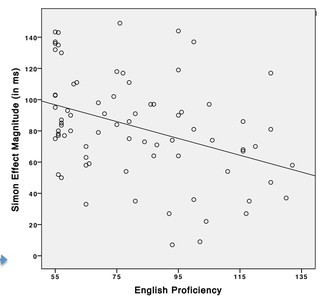
* $p < .05$, ** $p < .01$, *** $p < .01$

4 groups:
monolinguals
L2 learners
bilinguals
trilinguals

Regression Models (all 4 groups)

DV	Predictor(s)	B	SE	β	*t*	R^2	*F(1,74)*	*p*	Best Fit
German RTs	English Prof.	3.19	0.84	0.40	3.80	.163	14.41	< .001	Model 1
German CFE	English Prof.	1.03	0.40	0.29	2.61	.084	6.82	.011	Model 1
Simon Effect	English Prof.	-0.54	0.15	-0.38	-3.52	.143	12.37	< .001	Model 1





Assumptions:

- CLA and EF develop in parallel along same trajectory and linked to relative L2 proficiency and length of L2 immersion

Correlation Matrix for Background Measures and ANT

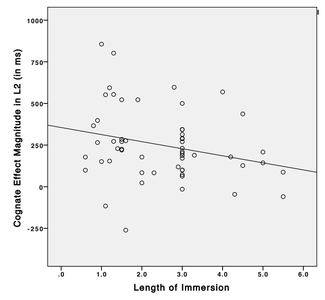
	English RTs	English CFE	ANT Conflict	German Proficiency	English Proficiency	Length of Immersion
EN_RTs	--	.551***	.093	.144	-.405**	-.330*
EN_CFE		--	-.039	.007	-.198	-.278*
ANT_C			--	.232+	-.102	-.012
GE_prof				--	.065	.032
EN_prof					--	.693***
L_o_I						--

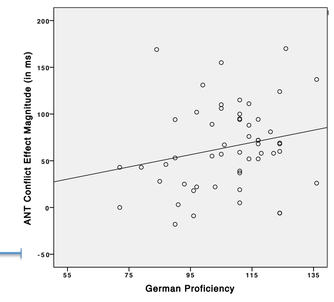
+$p < .09$, * $p < .05$, ** $p < .01$, *** $p < .01$

3 groups:
--
L2 learners
bilinguals
trilinguals

Regression Models (3 groups, no monolinguals)

DV	Predictor(s)	B	SE	β	*t*	R^2	*F(1,54)*	*p*	Best Fit
English RTs	English Prof.	-6.58	2.02	-0.41	-3.25	.164	10.57	.002	Model 1
English CFE	LoI	-54.65	25.70	-0.28	-2.13	.077	4.52	.038	-
ANT Effect	German Prof.	0.65	0.37	0.23	1.75	.054	3.07	.085	-





DISCUSSION

Experiments

- Bilinguals and trilinguals showed cognate effects in L1 and L2 while L2 learners did so only in L2.
  → L2 learners have not reached proficiency threshold to result in bidirectional CLA
- Bilinguals and trilinguals were slower naming L1 pictures than monolinguals and L2 learners
  → increased CLA and the need to control languages incurs naming cost even in dominant language
- Bilinguals and trilinguals showed enhanced conflict resolution over monolinguals in the Simon task
- Bilinguals and trilinguals showed enhanced conflict resolution over L2 learners in the Attentional Networks Task
  → length of immersion (+ quantity of L2 usage in immersion) was insufficient to incur significant EF advantage for L2 learners

Correlation & Regression

Strong correlation between L2 proficiency and length of L2 immersion:
→ both entered as predictors into multiple regression models
Where significant, one of the two alone was a better fit than both jointly.

- Growing L2 English proficiency linked to faster L2 English picture naming and slower L1 German picture naming
- Length of L2 immersion attenuates CLA in L2 English
- English proficiency linked to emergence of CLA in L1 German
- Negative correlation: English proficiency and Simon effect magnitude
- Positive correlation (marginal): German proficiency and ANT conflict magnitude
- CLA in either language and EF measures did not correlate

Overall, the results indicate growing English proficiency through prolonged L2 immersion and, concurrently, emerging cross-language effects along with gradually enhanced executive functions.

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