

Executive Function Predictors of Learners' Language Processing Abilities: A Training Study

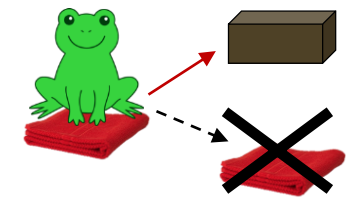
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Background

- Sentence processing is incremental and predictive
- A consequence of incrementality is that the parser might initially commit to an interpretation that turns out to be incorrect



Put the frog on the napkin into the box

- Ability to resolve conflict between competing linguistic analyses might be supported by domain-general executive function skills
 - Inhibition/Interference Suppression
 - Updating
 - Flexibility/Shifting



Evidence

- **Lesion Studies:** LIFG lesion associated with low performance in EF tasks and garden-path processing (e.g., Novick et al., 2010)
- **Co-localization** of brain activity for EF-tasks (e.g., Stroop) and garden-path processing (e.g., Fiebach et al., 2004; Mason et al., 2003)
- EF and revision abilities are not adult-like until late in **development** in children (Bunge et al. 2002; Durston et al., 2002; Trueswell et al., 1999)

Research Questions

1. Do individual differences in EF skills predict differences in sentence processing across structures involving **revision/conflict** between competing interpretations? (**Study 1**)

- Investigate link between EF skills and sentence processing abilities in **child L2 learners**
 - Revision is problematic in children (Trueswell, 1999) and language learners in general (Pozzan & Trueswell, 2013; Jacob & Felser, 2015)
 - No EF skills advantage in L2 (Poarch & van Hell, 2012)

2. Is there a **causal** link between EF skills and sentence processing abilities? (**Study 2**)

- Investigate if training-related EF improvements are associated with sentence processing improvements
 - Compare EF-training group and active controls in terms of sentence processing improvements
 - Investigate link between improvements in EF skills and sentence processing accuracy across individuals

Discussion

- Present study supports the hypothesis that the ability to resolve conflict in EF tasks is linked to ability to resolve conflict in sentence processing
 - Differences in EF skills \rightarrow Differences in Sentence Processing accuracy for **Conflict Structures** (Picture Selection Task)
 - Improvements EF skills \rightarrow Sentence Processing improvements, particularly for **Conflict Structures** (Individual-level analyses)
 - Taken together with evidence indicating that
 - Differences in EF skills predict differences language **learning** (Kapa & Colombo, 2014)
 - Difficulties revising initial interpretations have consequences for language **acquisition** (Pozzan & Trueswell, in press)
- the present results highlight the role of domain-general EF skills and a potential role for EF training on language **learning**.

Methods

Participants



Study 1:

- L1-Mandarin Child L2 learners of English in Beijing (N=20; Mean Age: 9; Range: 5-11)
- Intermediate English Proficiency (Versant Junior English: Mean: 27/50; Range 10-44)

Study 2:

- **Experimental Group**
- Same participants as Study 1
- Trained for 8 weeks on online EF-games

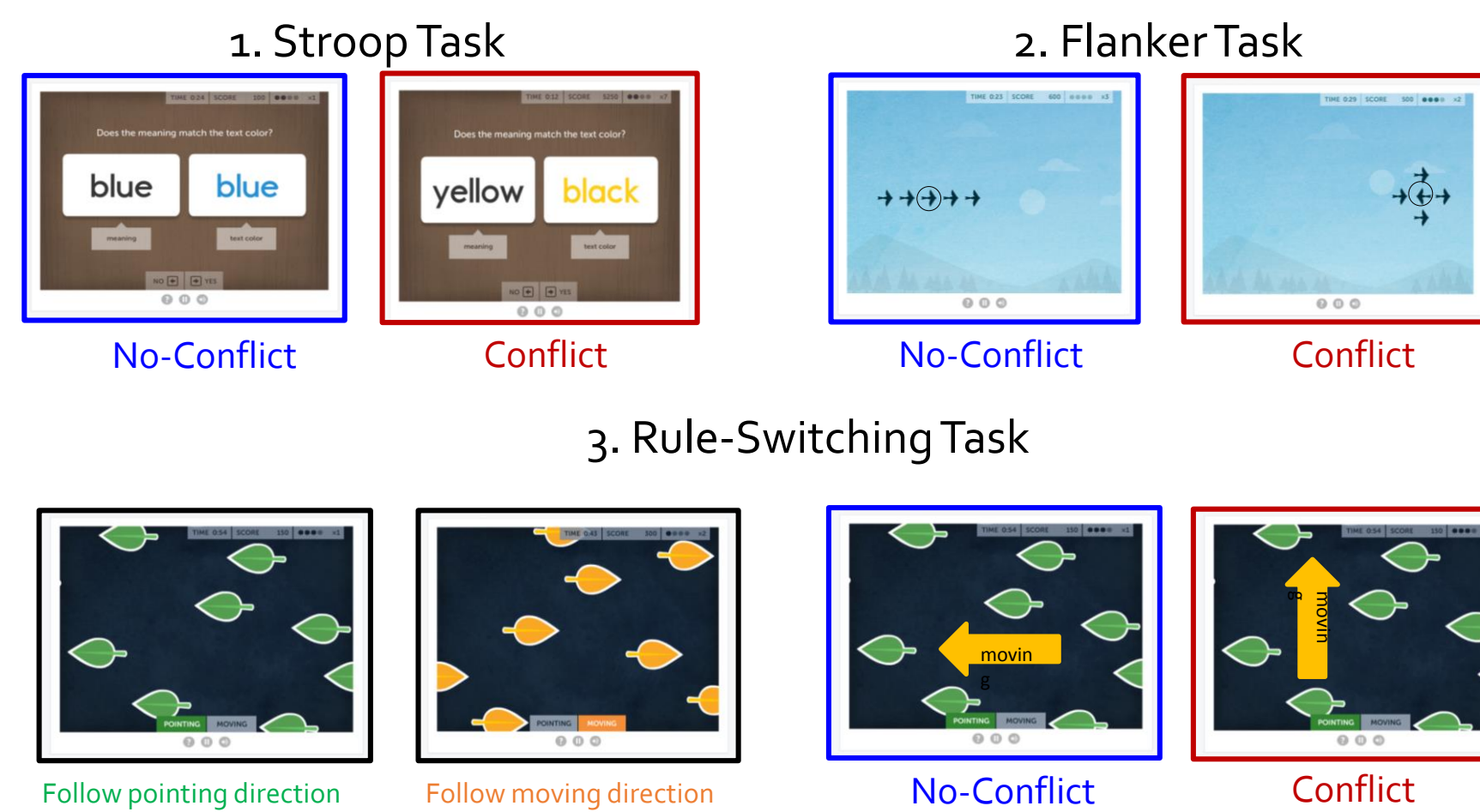


Control Group

- L1-Mandarin Child L2 learners of English in Beijing (N=16, Age: 9, Range: 5-11)
- Intermediate English Proficiency (Mean: 27/50, Range 10-44)
- Trained for 8 weeks on online geography games



Executive Function Tasks



Executive Function Measures

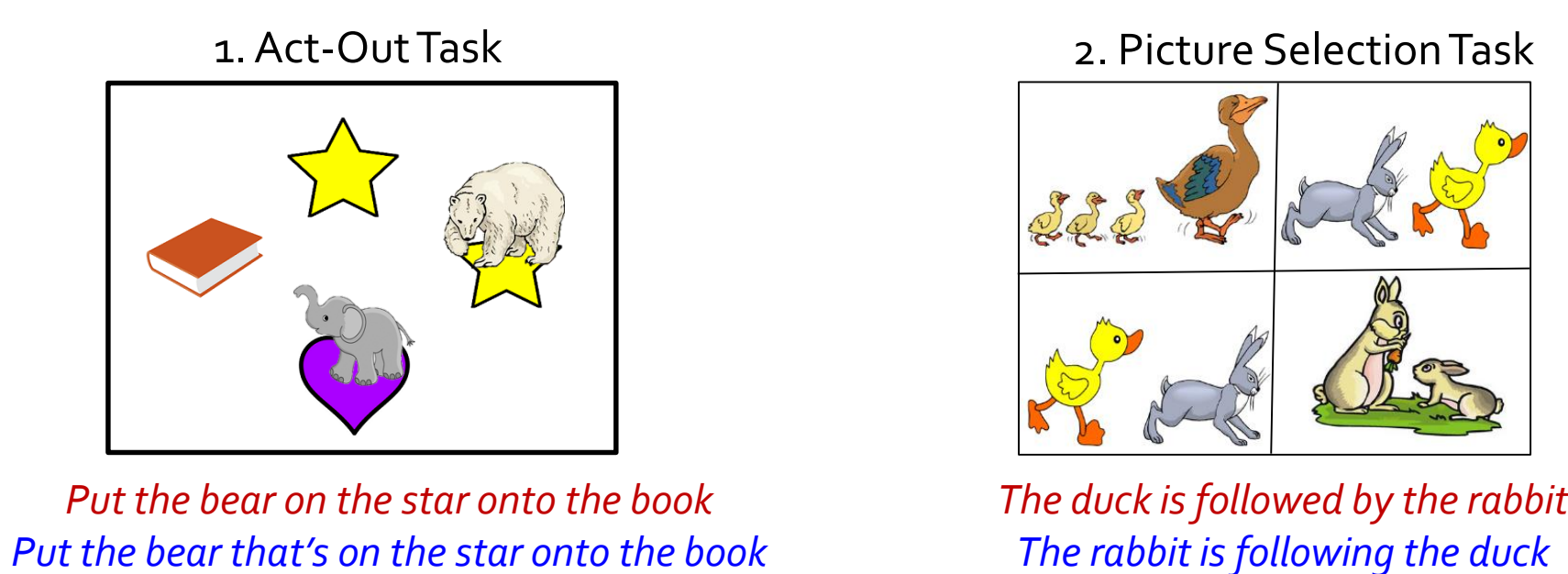
Study 1 (Pre-Training)

- Accuracy Difference (NC vs. C)
- Speed Difference (NC vs. C)

Study 2 (Training Improvements)

- Accuracy Difference Improvement (NC vs. C)
- Speed Difference Improvement (NC vs. C)

Language Processing Tasks



Language Processing Measures

Study 1 (Pre-Training)

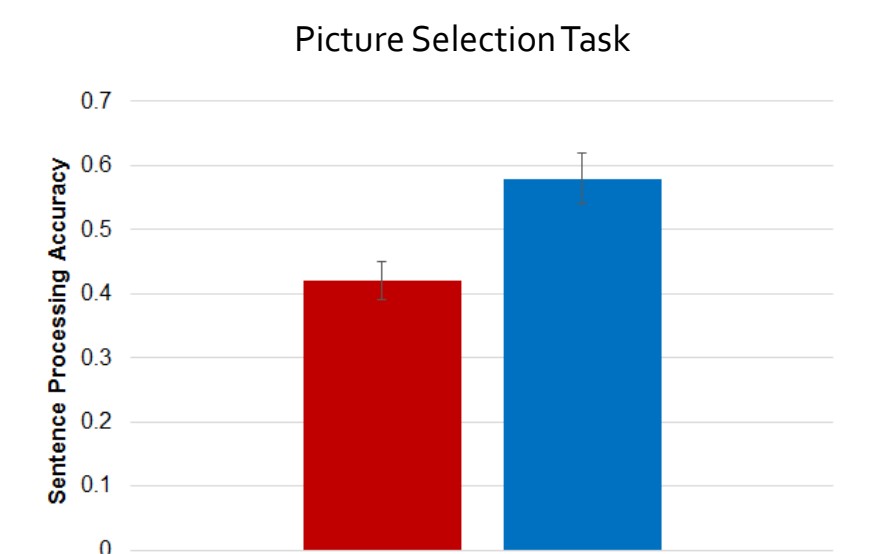
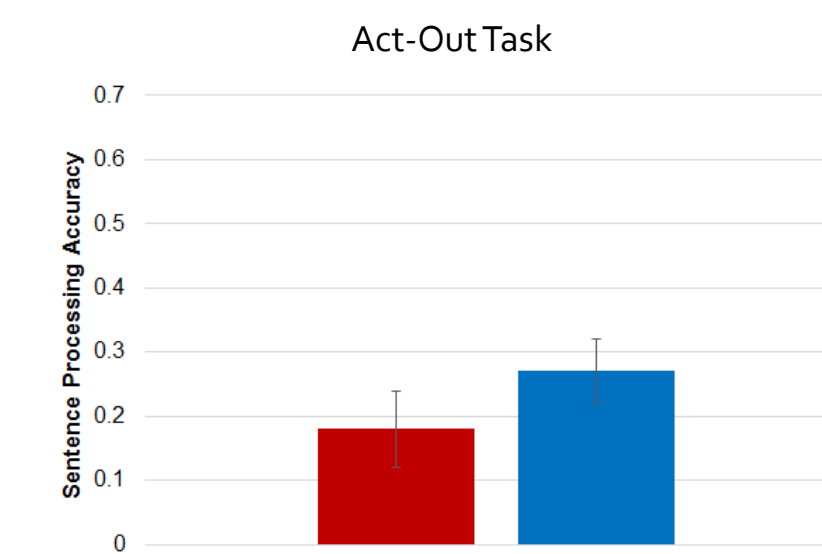
- Accuracy:
- **Conflict** Sentences
- **No-Conflict** Sentences

Study 2 (Training Improvements)

- Accuracy:
- **Conflict** Sentences
- **No-Conflict** Sentences

Study 1: Results

No-Conflict > *Conflict* Sentences



EF Measures do **not** predict Sentence Processing Performance in *No-Conflict* Sentences

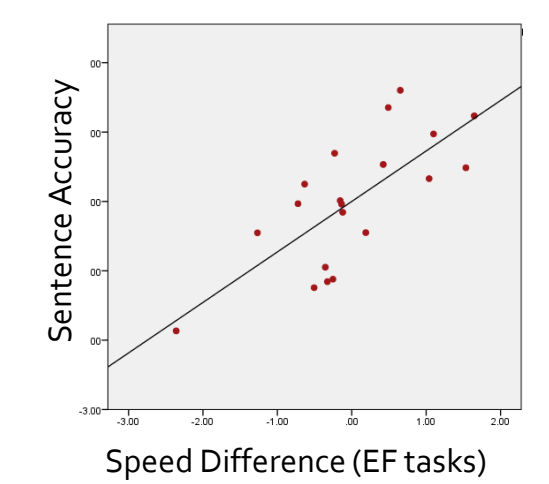
Act-Out Task				
Predictor	B	t	Sig.	
Accuracy Difference	.47	1.81	p=.09	
Speed Difference	.06	.25	p=.80	

Picture Selection Task				
Predictor	B	t	Sig.	
Accuracy Difference	-.30	-1.08	p=.30	
Speed Difference	.24	.93	p=.37	

EF Measures predict Sentence Processing Performance in *Conflict* Sentences

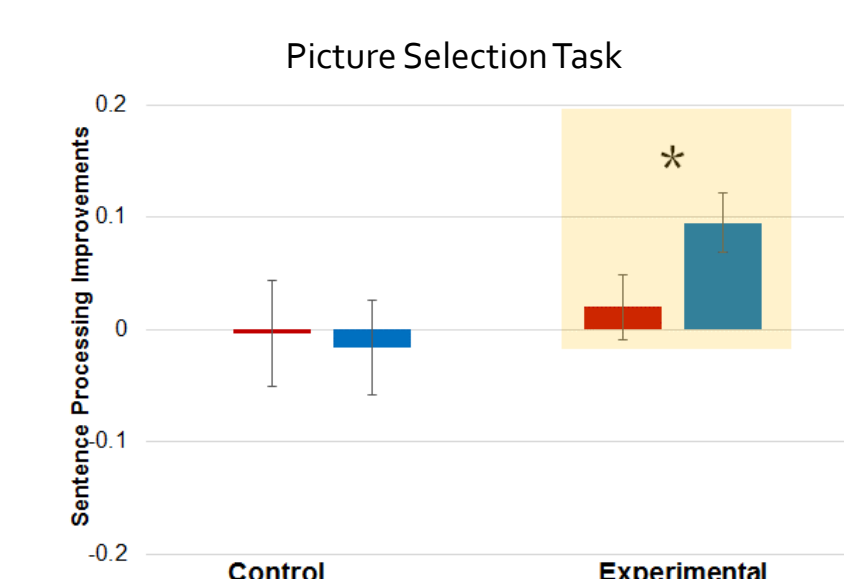
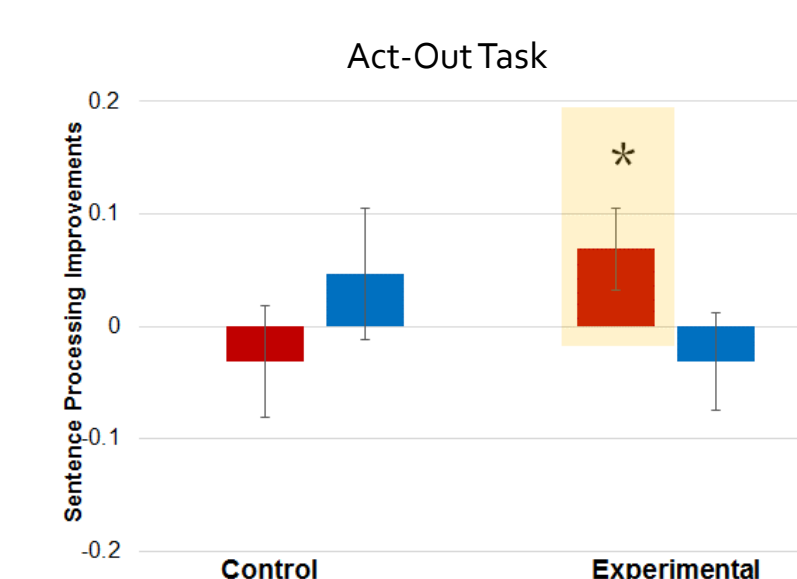
Act-Out Task				
Predictor	B	t	Sig.	
Accuracy Difference	.27	1.04	p=.31	
Speed Difference	.06	.24	p=.81	

Picture Selection Task				
Predictor	B	t	Sig.	
Accuracy Difference	.11	.60	p=.56	
Speed Difference	.68	4.09	p<.01	



Study 2: Results

Improvements in Sentence Processing Performance for *Experimental Group* only



EF Improvements do not predict Sentence Processing Improvements in *No-Conflict* Sentences

Act-Out Task				
Predictor	B	t	Sig.	
Accuracy Difference Improvements	.43	1.59	p=.13	
Speed Difference Improvements	.23	1.04	p=.31	

Picture Selection Task				
Predictor	B	t	Sig.	
Accuracy Difference Improvements	-.32	-.97	p=.35	
Speed Difference Improvements	-.06	-.24	p=.81	

EF Improvements predict Sentence Processing Improvements in *Conflict* Sentences

Act-Out Task				
Predictor	B	t	Sig.	
Accuracy Difference Improvements	.08	.29	p=.77	
Speed Difference Improvements	.63	2.91	p=.01	

Picture Selection Task				
Predictor	B	t	Sig.	
Accuracy Difference Improvements	.77	2.93	p=.01	
Speed Difference Improvements	-.22	-1.03	p=.32	

