Parallel language activation and inhibitory control in bimodal bilinguals

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Introduction

- Parallel language activation in spoken language bilinguals is often attributed to overlap in auditory input between the two languages
- Similarly, bilingual advantages in inhibitory control have been argued to result from experience with resolving perceptual competition between languages (Blumenfeld & Marian, in press)
  - Better inhibitory control was associated with more efficient resolution of cross-language competition in Spanish-English bilinguals

Insights from bimodal bilinguals

- Bilinguals in a spoken and a signed language, i.e., bimodal bilinguals, also activate their two languages in parallel, despite non-overlapping phonologies (Morford et al., 2011, Shook & Marian, 2012; Van Hell et al., 2009)
- But, bimodal bilinguals do not seem to experience the same advantage in inhibitory control as many spoken language bilinguals do (Emmorey et al., 2008)

Aim of the present study

Relate the degree and time course of parallel language activation to non-linguistic inhibitory control skills in hearing bimodal bilinguals

Participants

- 21 English-ASL (American Sign Language) bilinguals and 23 English monolinguals

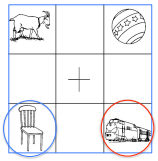
	Bimodal bilinguals (n=21, 12 F)	Monolinguals (n=23, 21 F)	
Age (yrs)	27.5 (9.2)	24.7 (6.5)	*p*=.24
English receptive vocabulary[a]	111.7 (13.1)	110.1 (13.4)	*p*=.49
Nonverbal reasoning[b]	55.4 (8.5)	54.7 (7.3)	*p*=.78
# Years of education	15.1 (2.6)	14.7 (1.2)	*p*=.52
Socialeconomic status[c]	42.0 (11.5)	44.9 (11.9)	*p*=.49
Age of exposure to ASL	4.4 (8.1)		
% Time ASL use	33.8 (16.9)		
% Time ASL exposure	39.0 (18.6)		
ASL production proficiency[d]	6.4/7 (.68)		
ASL comprehension proficiency[d]	6.6/7 (.60)		
Frequency ASL-ENG mixing[d]	4.2/7 (1.9)		

[a] PPVT-IIIb (Dunn & Dunn, 1997), *standard score*
[b] KBIT2 Matrices Subtest (Kaufman & Kaufman, 2004) or WASI Matrix Reasoning (PsychCorp, 1999), *T score*
[c] Based on Hollingshead (1975), available for 21 bimodal bilinguals and 14/23 monolinguals
[d] Self-ratings language background questionnaire

Tasks

Parallel language activation

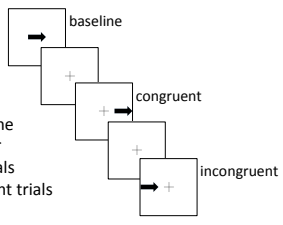
- Visual world paradigm adapted from Shook and Marian (2012)
- English target words aurally presented 600 ms after presentation of visual display
- 28 critical trials with a sign competitor, 28 control trials and 60 filler trials
- Sign competitors shared 3/4 phonological parameters with target (handshape, location, movement, orientation)
- Stimuli were controlled for English phonological overlap and frequency (Brysbaert & New, 2009)
- Eye movements were recorded with SR Eyelink® 2000 tower system



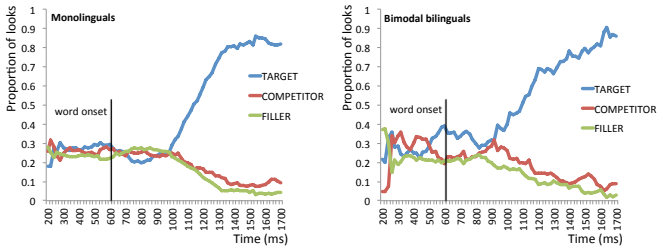
English target ("chair") | ASL competitor ("train")

Inhibitory control

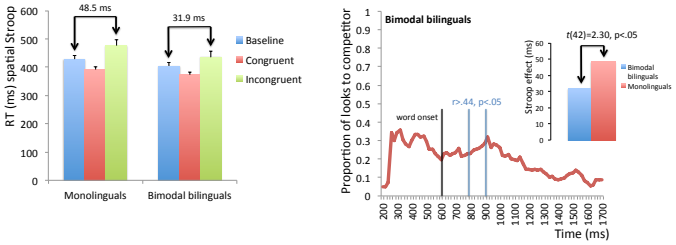
- Spatial Stroop task adapted from Blumenfeld and Marian (2011, in press)
- Participants respond to the direction of the arrow and have to ignore its location
- 120 congruent, 40 incongruent and 40 baseline trials intermixed in pseudo-randomized order
- 'Stroop effect': reaction times on baseline trials subtracted from reaction times on incongruent trials



Parallel language activation



Relationship with inhibitory control



Results

- More looks to competitor than fillers for the bimodal bilinguals from starting around 200 ms after word-onset
  - *Bimodal bilinguals co-activate ASL signs during English spoken word comprehension (replicating Shook and Marian, 2012)*
- Bimodal bilinguals show significantly smaller Stroop effects than monolinguals
  - *Suggesting a bimodal bilingual advantage in inhibitory control*
- Significant positive correlations between Stroop effects and competitor fixations 180-300 ms post word-onset
  - *The smaller the Stroop effect (i.e., more efficient inhibition), the fewer looks to ASL competitors*
  - *7 intervals p<.05 are statistically meaningful with N=20, autocorrelation=.9, time interval=25 (700-1200 ms, 20 ms intervals) (Guthrie & Buchwald, 1991)*

Discussion

- Parallel language activation in bimodal bilinguals indicates co-activation through top-down (conceptual) or lateral (lexical) influences during language processing
- Bimodal bilinguals appear to use domain-general inhibitory mechanisms to resolve competition from co-activated signs during spoken word comprehension
- Bimodal bilinguals may also have advantages in inhibitory control (on a spatial Stroop task)
  - No bimodal bilingual advantage or correlations with competitor fixations were found for the same participants on a flanker task adapted from Emmorey et al. (2008)

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