

Inhibition and Phonological Processing in a Second Language

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SECOND LANGUAGE
PSYCHO LINGUISTICS



Introduction: L2 phonological acquisition is influenced...

Contextual factors:

- L1 background
- L2 exposure (AOL, LoR)
- L2 vocabulary size (Bundgaard-Nielsen, Best & Tyler, 2011)
- Frequency and amount of L1/L2 use (e.g. Flege, Bohn, & Jang, 1997, Flege, Yeni-Komshian, & Liu, 1999; Guion et al., 2000)

→ individual differences remain in L2 phonological development (e.g. Pallier et al., 1997)

Cognitive factors:

- Working memory (phonological short-term memory), attention control, speed of lexical retrieval, inhibition

(Cerviño-Povedano & Mora, 2011; Guion & Pederson, 2007; Lev-Ari & Peperkamp, 2012; MacKay, Meador & Flege, 2001; Masoura & Gathercole, 1999; Papagno & Vallar, 1995; Safronova & Mora, 2013; Segalowitz 1997; Service 1992)

→ no study relates cognitive factors to both perception and production of Vs and Cs; Inhibition under-researched for L2 phonology

Introduction: Inhibition and L2 phonology

Inhibitory skill

A person's ability to bring to the background stimuli types (visual, auditory) or stimuli features (colour, shape) that are irrelevant to the mental process at hand. (Miyake et al. 2000)

- few studies relating Inhibition to L2 phonological development

(Lev-Ari & Peperkamp, 2012, forthcoming; Darcy, Mora & Daidone, 2013)

- Stronger inhibitory skill might result in better inhibition of the language not in use, and in more efficient phonological processing when switching between speech dimensions or languages.
- Greater inhibitory capacity may lead to more successful suppression of L1 interference in L2 phonological processing.
 - more accurate L2 speech perception/production.

(Costa & Santesteban, 2004; Costa, Santesteban & Ivanova, 2006)

Introduction: Attention control and PSTM

Phonological attention control (AC):

A person's ability to shift focus of attention from one speech dimension (e.g.: **duration**) to another (e.g. **voice quality**)

→ more efficient AC may enhance the processing of acoustic-phonetic information in the input and lead to more accurate L2 speech perception/production

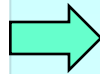
Phonological short-term memory (PSTM):

Holds phonological elements and their serial order in memory for a few seconds before decay (refreshed through sub-vocal rehearsal).

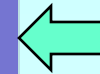
→ larger PSTM capacity may facilitate discrimination of L1-L2 phonetic differences, leading to the development of more accurate representations for L2 categories.

The present study

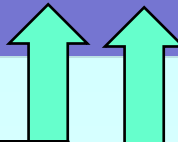
Inhibition
Attention control
PSTM



L2 production
L2 perception



- Pure tone hearing test
- Vocabulary size
- Background questionnaire



Spain

35 L2 learners of English
(L1 Spanish Monolinguals)
+ 10 native speakers (control)
Universidad de Sevilla

52 L2 learners of English
(Spanish-Catalan Bilinguals)
Universitat de Barcelona

United States

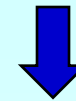
26 L2 learners of Spanish
(L1 English Monolinguals)
+ 9 native speakers (control)
Indiana University

The present study

Spain

52 L2 learners of English
(Spanish-Catalan Bilinguals)
Universitat de Barcelona

- Could understand & speak both Ls
- Used Spanish & Catalan daily
- Differed in **amount of use of less dominant language.**



2 groups:

- | | |
|-------|--------------|
| < 30% | “unbalanced” |
| > 30% | “balanced” |

Unbalanced bilinguals need to strongly inhibit their more proficient language when using their less dominant one (≠ “balanced” bilinguals).

> enhanced inhibitory skill

> more efficient L1 inhibition when using L2 English

L2 phonological processing

L2 production

- Delayed sentence repetition task

Vowel production

Consonant production

L2 perception

- ABX Categorization

Vowel contrasts

Consonant contrasts

Production task

- Delayed Sentence Repetition task
- 4 pairs of sentences for each contrast (total: 16 per language)
- Learners produced L2 sentences
- Native speakers produced the control measures in L1

Spanish L2

/e/ - /eɪ/

- *¿Qué ruido ha sido ese? Es la **maceta** que se ha roto.*
- *¿Qué le pones a la ensalada? Un buen **aceite** de oliva.*

/r/ - /ð/

- *Parece que tienes frío! Tengo la **cara** helada del frío.*
- *No nos ha contado esta historia antes? Cuenta **cada** historia mil veces.*

English L2

/i:/ - /ɪ/

- *Which one do you like best? I like the **cheap** one.*
- *What would you like with it? I'll have the **chips** please.*

/ʃ/ - /tʃ/

- *Could you buy some wine? All the **shops** are closed, sorry.*
- *Are you not finishing the pork chops? The **chops** are too much, I'm full.*

Production measures

- Delayed Sentence Repetition task
- 4 pairs of sentences for each contrast (total: 16 per language)
- Learners produced L2 sentences
- Native speakers produced the control measures in L1

Spanish L2

/e/ - /eɪ/

- 3 measurement points (MP) within vowels: F1, F2, F3, F0
- Amount of tongue movement (Bark difference score) from MP2 to MP1

/r/ - /ð/

- Visual and auditory examination of spectrogram
- Categorical decision about tap vs. spirantized /ð/
- Score out of 8

English L2

/i:/ - /ɪ/

- 3 measurement points (MP) within vowels: F1, F2, F3, F0
- Spectral distances (Bark) at midpoint and Euclidean distances

/ʃ/ - /tʃ/

- Visual and auditory examination of spectrogram
- Categorical decision about presence vs. absence of closure
- Score out of 8

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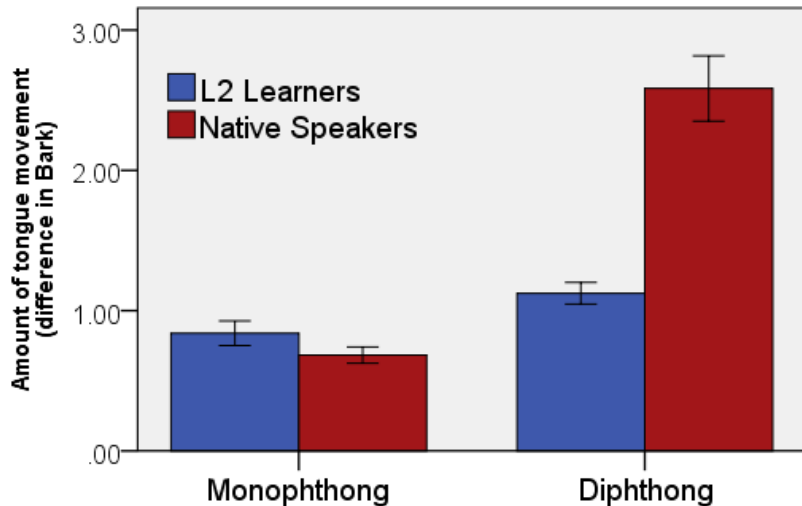
/f/ - /tʃ/

- Visual and auditory examination of spectrogram
- Categorical decision about presence vs. absence of closure
- Score out of 8

Production results

L2 Spanish

/e/ - /eɪ /: amount of tongue movement

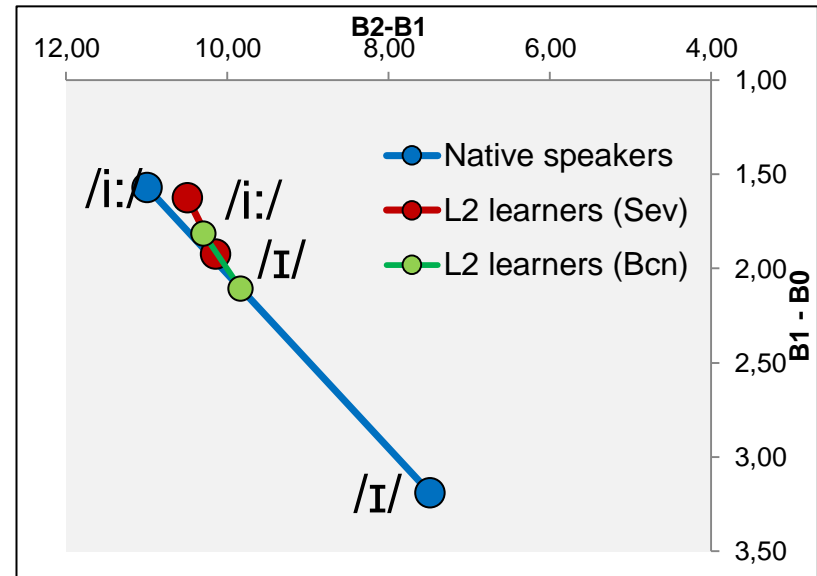


/r/ - /ɾ/ Average score (max. 8)

L2 learners	Mean score	SD
n = 26	4.27	2.20
Native speakers (Spanish)		
n = 9	7.89	0.3

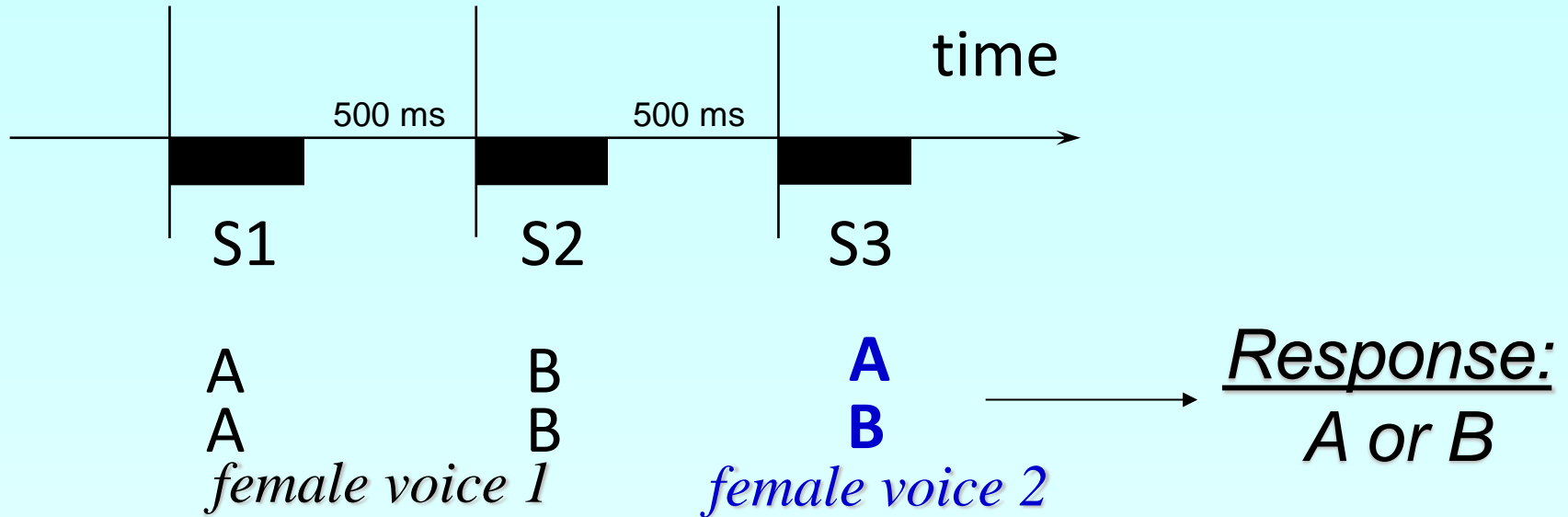
L2 English

/i:/ - /ɪ/ : spectral differences (Bark)



(consonants not presented)

Perception task: speeded categorical ABX task



- Stimuli in Spanish and English (non-words)
- Stimuli recorded by two female early balanced bilinguals (Mexican Spanish / American English)
- All subjects heard all stimuli
- Language switch between 2 blocks
- 4 orderings: ABA, ABB, BAA, BAB = 128 trials

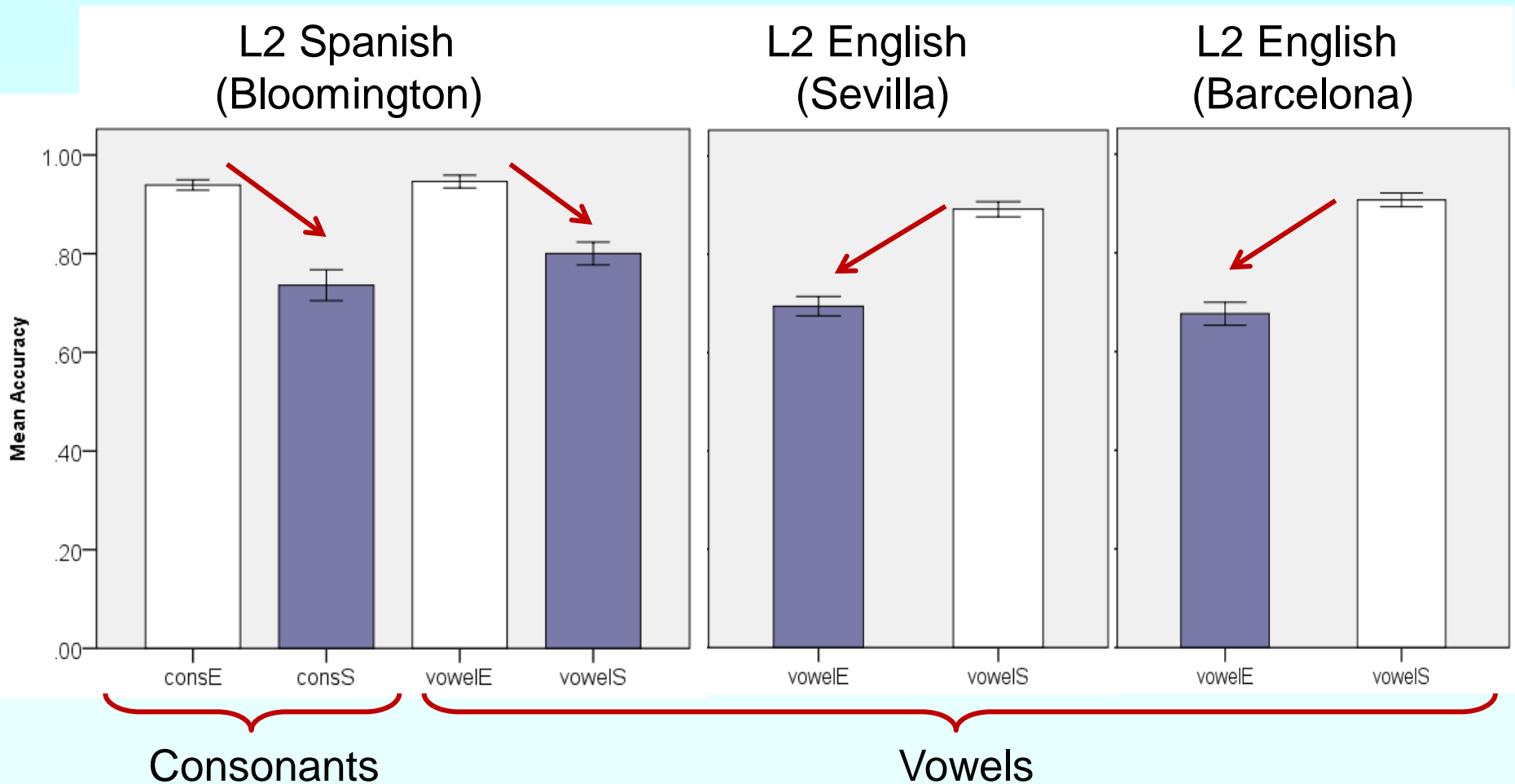
Perception task: speeded categorical ABX task

Sample of trisyllabic nonword stimuli in Spanish and English
[4 items per condition]

Stimulus language	item A	item B	Condition
Spanish	sa'reβo	sa'ðeβo	Test C
English	sə'ʃi:dən	sə'tʃi:dən	Test C
Spanish	fa'neða	fa'neɪða	Test V
English	fə'ni:dɪf	fə'nɪdɪf	Test V
Spanish	ga'taso	ga'ðaso	Control C
English	gə'tæfɪn	gə'dæfɪn	Control C
Spanish	lu'pito	lu'pato	Control V
English	lə'pi:dɪk	lə'pædɪk	Control V

Perception results (test conditions)

■ L2 Stimuli □ L1 Stimuli



Cognitive tasks

Inhibition

- **Retrieval-induced inhibition task**

Attention control

- **Novel speech-based attention-switching task**

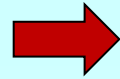
Phonological short-term memory (PSTM)

- **Serial non-word recognition in Danish (L0)**

Inhibitory skill task (L1 only)

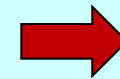
Memorize

- Vegetables
 - Lettuce
 - Potato
 - Artichoke
 - Onion
 - Spinach
 - Tomato
- Animals
 - Duck
 - Snake
 - Elephant
 - Horse
 - Tiger
 - Cow
- Occupations
 - Plumber
 - Teacher
 - Fireman
 - Carpenter
 - Engineer
 - Nurse



Practice

- Vegetables
 - Lettuce
 - Potato
 - Artichoke
 - Onion
 - Spinach
 - Tomato
 - Animals
 - Duck
 - Snake
 - Elephant
 - Horse
 - Tiger
 - Cow
 - Occupations
 - Plumber
 - Teacher
 - Fireman
 - Carpenter
 - Engineer
 - Nurse
- Control**
(non practiced category)



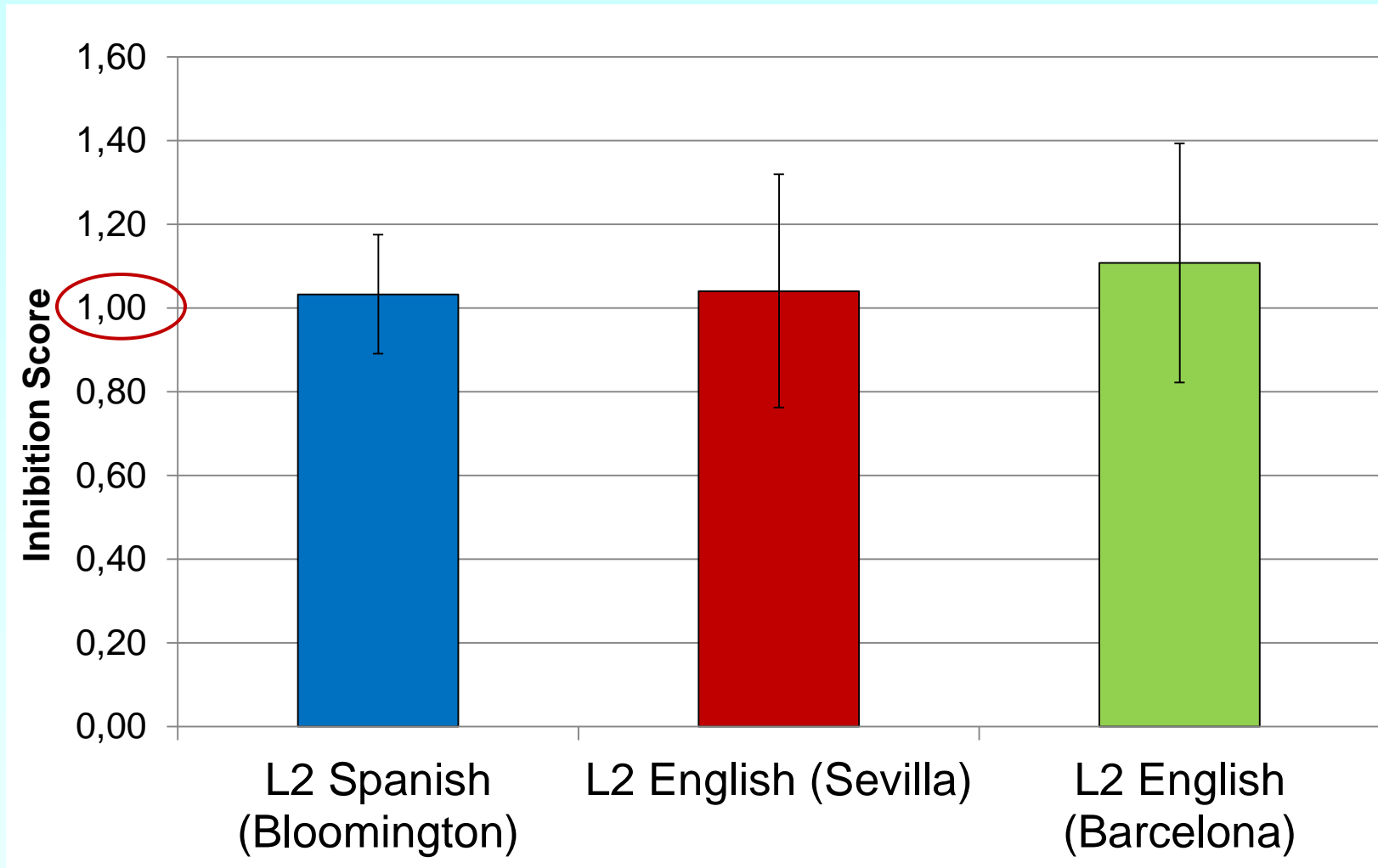
Recognize

- Vegetables
 - Lettuce
 - Potato
 - Artichoke
 - **Onion**
 - **Spinach**
 - **Tomato**
 - Animals
 - Duck
 - Snake
 - Elephant
 - **Horse**
 - **Tiger**
 - **Cow**
 - Occupations
 - **Plumber**
 - **Teacher**
 - **Fireman**
 - **Carpenter**
 - **Engineer**
 - **Nurse**
- Inhibition score =**

$$\frac{\text{RT on inhibited}}{\text{RT on control}}$$

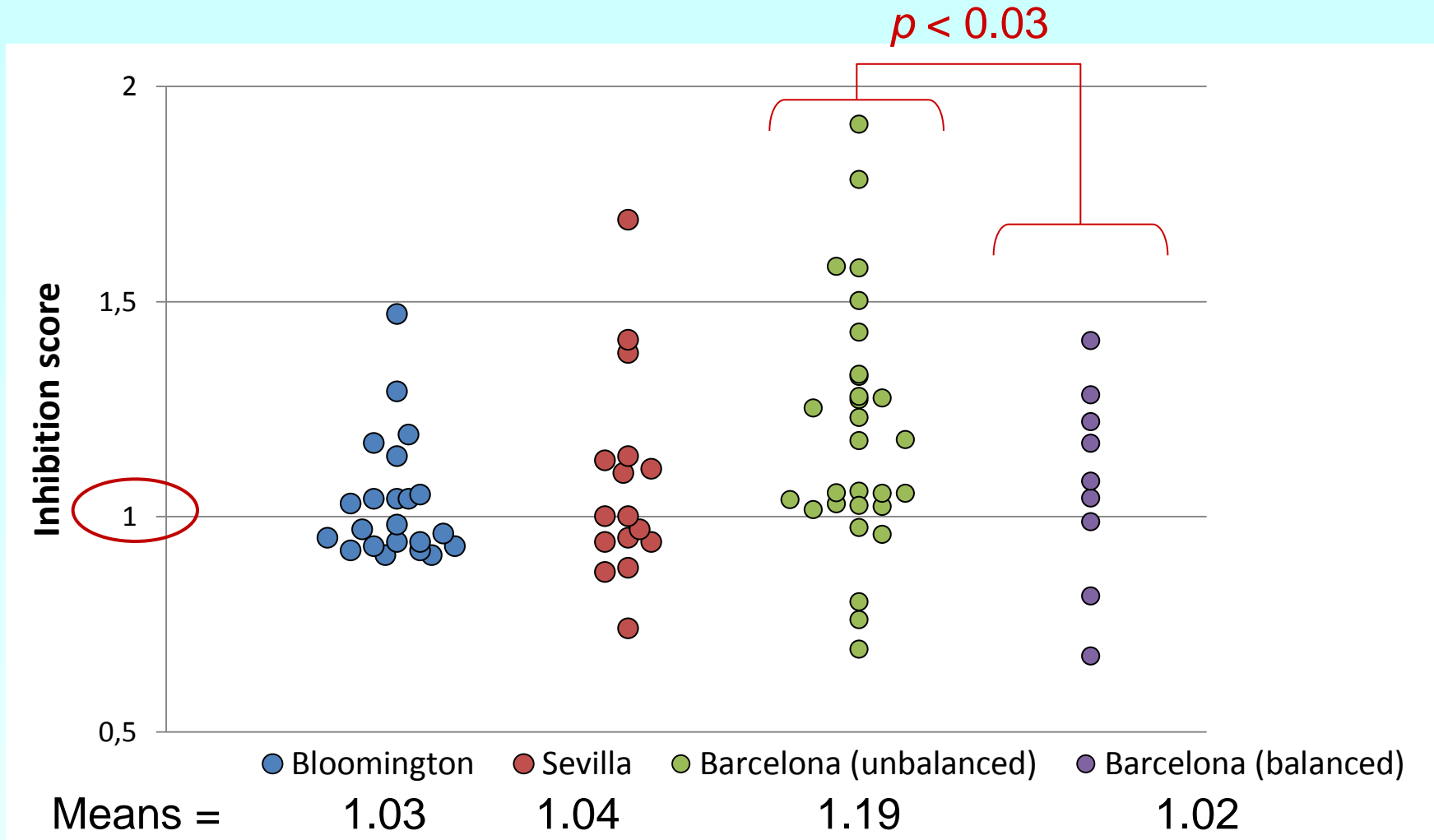
PLUS additional items never presented before (e.g. secretary)

Inhibition: Group Results



Error bar = 1 SD

Inhibition: Individual Results



Novel attention-switching task

- **Auditory** analog of the Dimensional Change Card Sort Task
(Bialystok & Martin 2004)

- **Switch-Repeat** (non-switch) **alternation** of stimuli.
(Segalowitz & Frenkiel-Fishman, 2005; Safronova, 2013)

- 2 stimuli sets (Spanish & Am.English)

- 2 native **bilinguals** recorded 2 stimuli sets.

- Participants had to switch attention between acoustic dimensions:

Nasality vs.

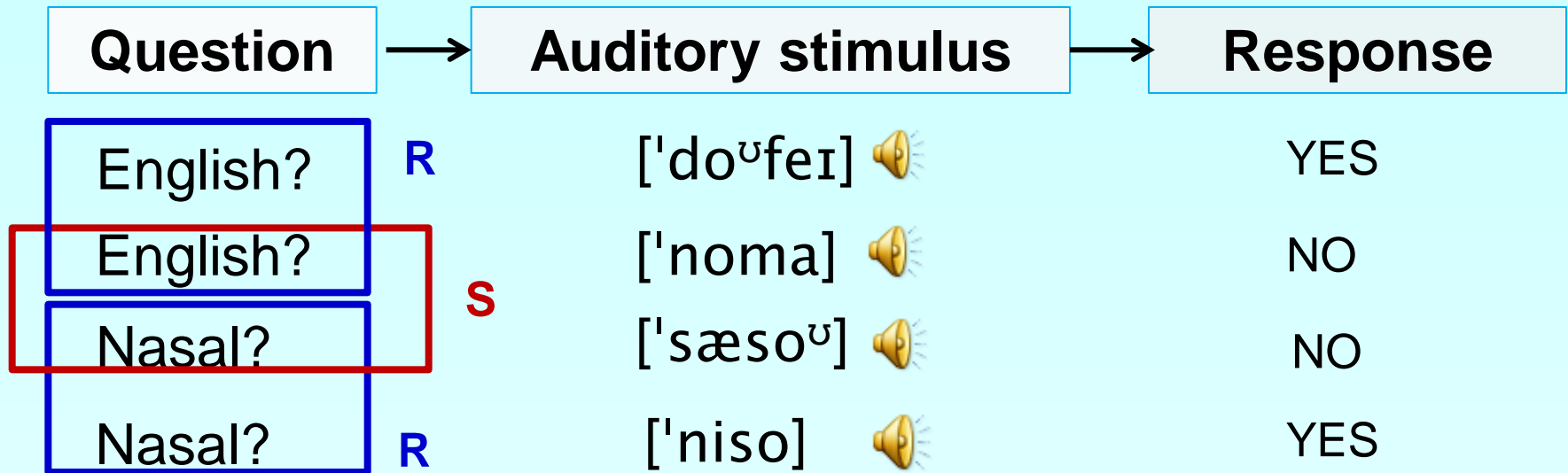
Native language phonetics

- Same dimensions for both groups

Spanish Nasal	English Nasal
'noma	'noʊmə
'nole	'noʊleɪ
 'niso 	 'nISOʊ 
Spanish Nonnasal	English Nonnasal
'piyo	'pɪgoʊ
'dofe	'doʊfeɪ
 'saso 	 'sæsoʊ 

Novel attention-switching task

Example: L1 English learner of L2 Spanish

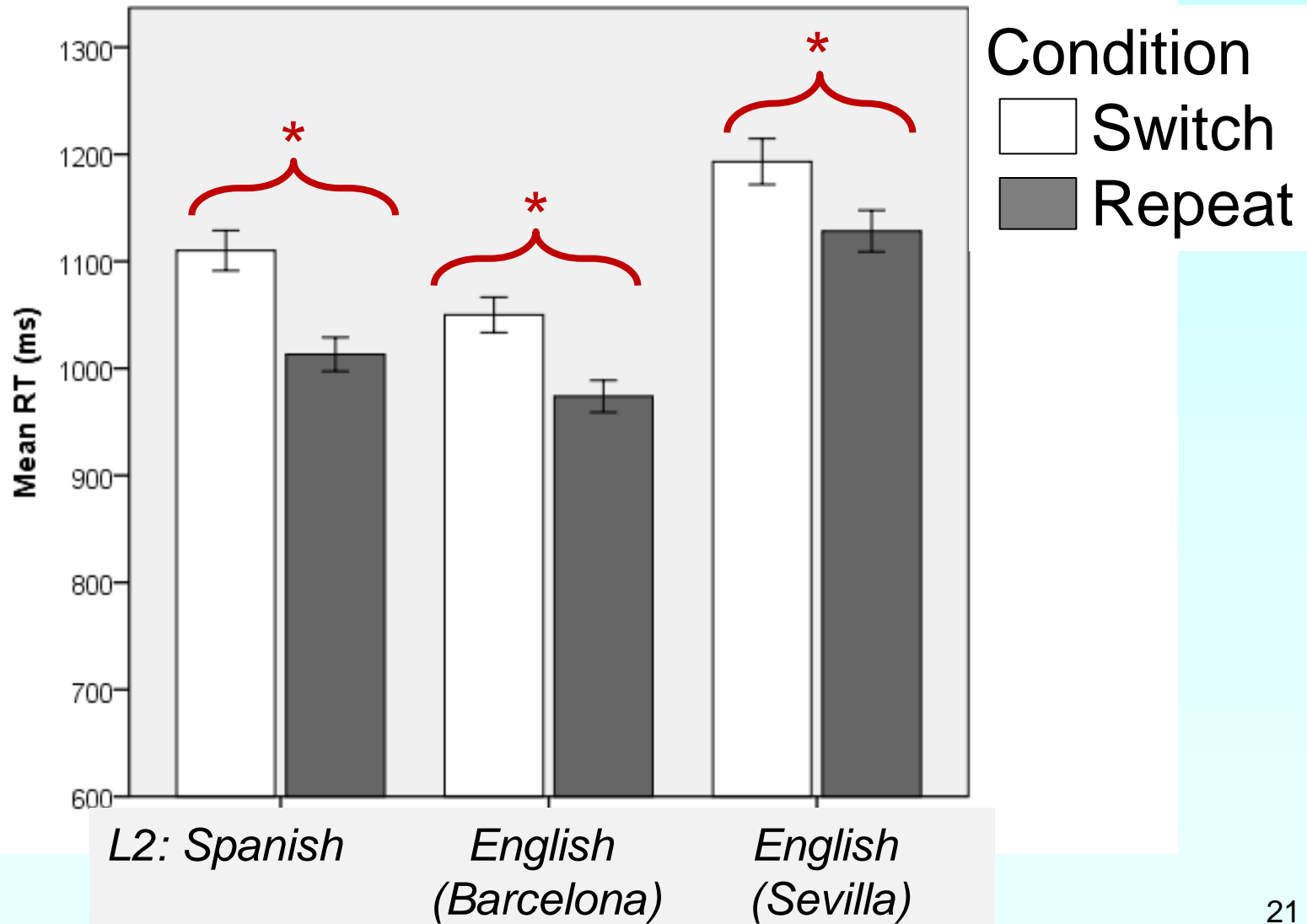


Measures:

RT on **Switch** vs. **Repeat** (baseline) conditions

Shift cost: Switch – Repeat, for each individual

Speech-based attention-shifting task



Phonological short-term memory (PSTM)

Serial nonword recognition (SNWR) in L0 (Danish)*

Identifying pairs of nonword sequences of increasing length (5-6-7) as Same/**Different**:

Danish	1	2	3	4	5	6	7
1	tys	dam	rød	mild	fup		
	tys	dam	mild	rød	fup		
2	vul	bend	sids	påk	ryd	ham	jøb
	vul	sids	bend	påk	ryd	ham	jøb

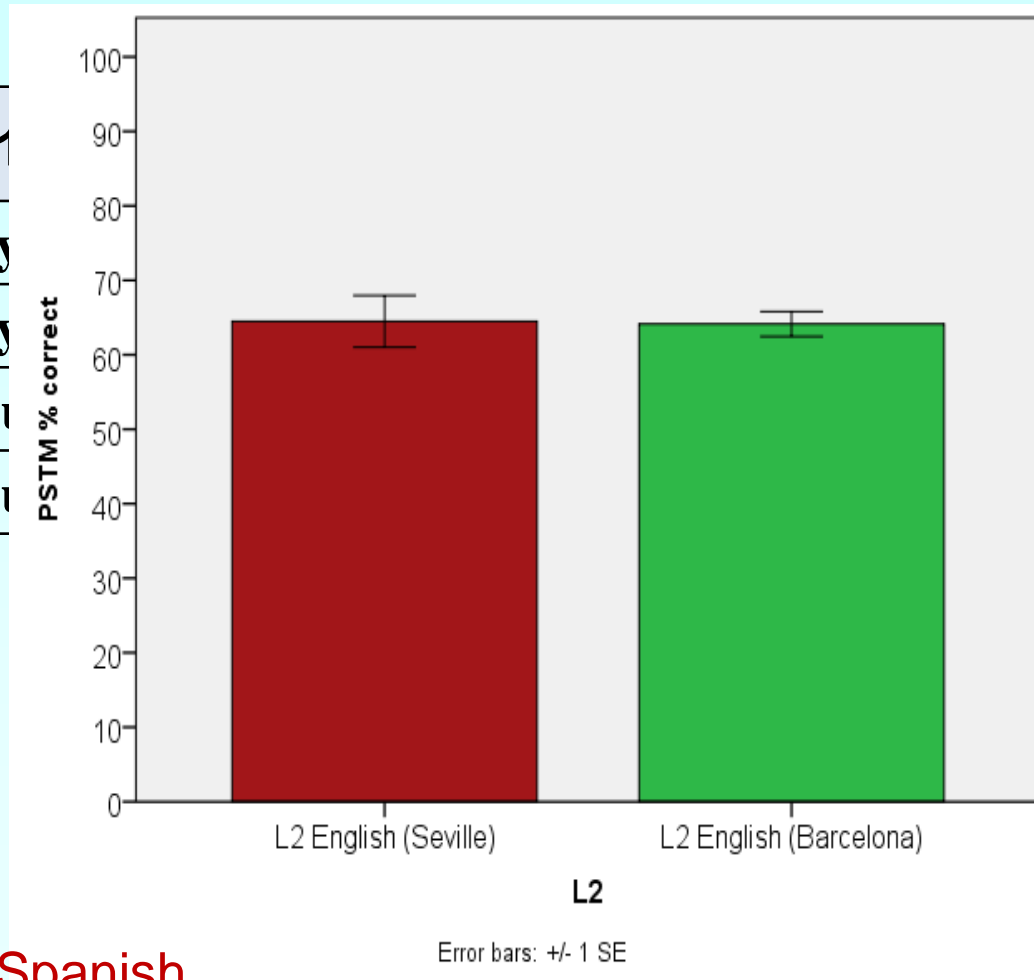
* no data for L2 Spanish

Phonological short-term memory (PSTM)

Serial nonword recognition (SNWR) in L0 (Danish)*

Identifying pairs of nonword sequences of increasing length (5-6-7) as Same/Different:

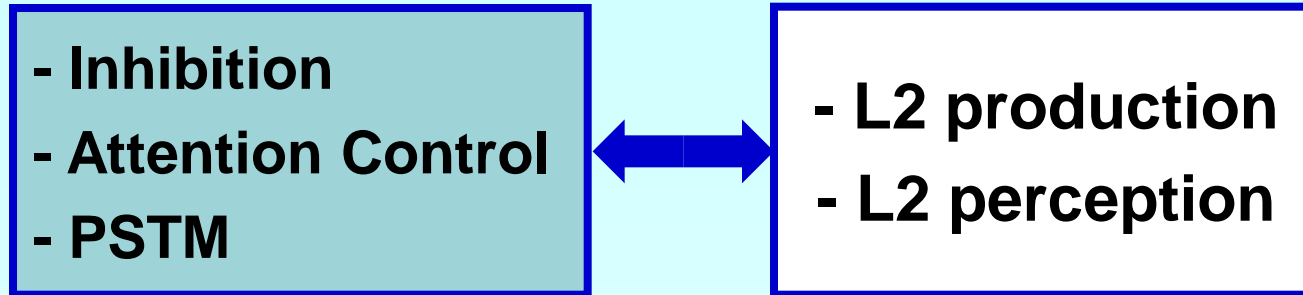
Danish	
1	ty
	ty
2	vu
	vu



	7
n	jøb
n	jøb

* no data for L2 Spanish

CORRELATIONS



Vocabulary test score
used as covariate to partial out proficiency
Peabody Picture Vocabulary Test (PPVT)

Findings

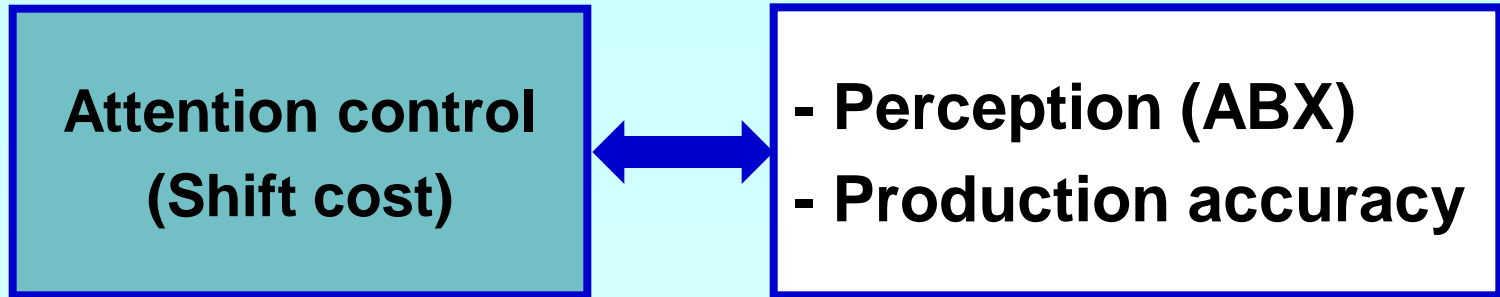
Inhibition score



- Perception (ABX)
- Production accuracy

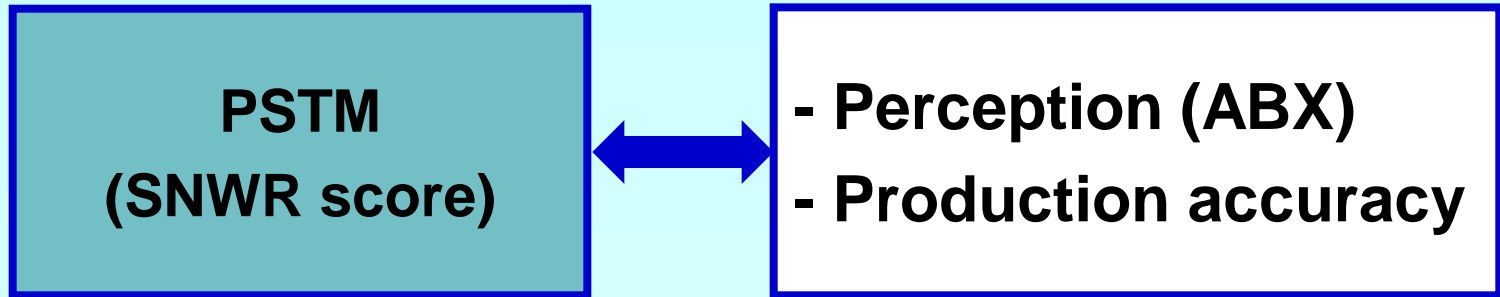
	Perception (ABX)	Production (Cs)	Production (Vs)
L2 Sp	$r = .507^*$	$r = .324$	$r = -.216$
L2 En (Sev)	$r = .615^*$	$r = .169$	$r = .024$
L2 En (Bcn)	$r = .012$	n.A.	$r = -.062$
L2 En (Bcn)			
balanced (> 30%)	$r = .160$	n.A.	$r = -.327$
unbalanced (< 30%)	$r = .047$	n.A.	$r = -.050$

Findings



	Perception (ABX)	Production (Cs)	Production (Vs)
L2 Sp	$r = .124$	$r = -.003$	$r = -.257$
L2 En (Sev)	$r = -.438^*$	$r = -.366$	$r = .640^*$
L2 En (Bcn)	$r = .220$	n.A.	$r = .132$

Findings



	Perception (ABX)	Production (Cs)	Production (Vs)
L2 Sp	n.A.	n.A.	n.A.
L2 En (Sev)	$r = .341$	$r = .322$	$r = .392$
L2 En (Bcn)	$r = .383^{**}$	n.A.	$r = .313^*$

Discussion and Conclusions

Inhibition, attention and PSTM all seem to be related to phonological processing:

- NOT for all tasks
- NOT for all groups

The relationship interacts with linguistic profile

Monolingual Context:

- Inhibition is related to L2 perception, but not L2 production.
- Attention control is related to L2 perception, but not L2 production (L2 English in Seville only)

Bilingual Context:

- PSTM is related to L2 perception and L2 production

Discussion and Conclusions

Inhibition

- Inhibitory skill contributes to greater accuracy in ABX in a monolingual but not in a bilingual context.

Why did we fail to find a relationship between Inhibition and perception for Barcelona bilinguals?

- ABX requires switching between two languages within the same task.
- Monolinguals may not be used to such switching, whereas bilinguals do it on an everyday basis.
- Perhaps the effects of individual differences in inhibitory skill are “washed out” in bilinguals due to the daily practice they receive in inhibiting one language over the other.

Thank you!

- Shiri Lev Ari, Sharon Peperkamp (LSCP, Paris)
- Paola Rodrigues, Tanya Flores, Diana Arroyo, Ana Fernandez, Maggie Peters, Fiona Pannatt
- Amanda Rabideau (Univ. of Utah)
- Aleksandra Malicka (Barcelona)
- Elena Safronova (Barcelona)
- Eva Cerviño-Povedano (Barcelona)
- Marina Barrio Parra, M. Heliadora Cuenca Villarín (Sevilla)
- Ron Roosevelt (Sevilla)
- Carmen Muñoz (Barcelona)
- Kathleen Bardovi-Harlig (Bloomington)
- SLPL lab members (Bloomington)
- Jeffrey Holliday (Bloomington)
- Danielle Daidone (Bloomington)
- Grant support :
 - Grant-in-Aid, Indiana University Bloomington
 - Grants HUM2007-64302 (Ministerio de Ciencia e Innovación) and 2009SGR137 (Generalitat de Catalunya)

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