



New Sounds
Montreal, Canada, 17-19 May 2013

Phonological Attention Control, Inhibition, and Second Language Speech Learning

Isabelle Darcy, Joan Carles Mora,
Danielle Daidone

Indiana University & University of Barcelona



SECOND LANGUAGE
PSYCHO LINGUISTICS



Factors affecting L2 phonological acquisition

Learning conditions:

- L1 background (e.g. Flege, Bohn, & Jang, 1997)
 - Age and length of L2 exposure (e.g. Flege, Yeni-Komshian, & Liu, 1999; Johnson & Newport, 1989)
 - Frequency or amount of L1/L2 use (e.g. Guion et al., 2000)
- when controlled, individual differences remain in L2 phonological development (e.g. Pallier et al., 1997)

Cognitive abilities:

- Working memory (e.g. Papagno & Vallar, 1995; MacKay, Meador, & Flege, 2001; Cerviño-Povedano & Mora, 2011; Service, 1992; Masoura & Gathercole, 1999)
 - Attention control (Guion & Pedersen, 2007; Segalowitz & Frenkiel-Fishman, 1997)
 - Inhibition (Lev-Ari & Peperkamp 2012)
 - Lexical retrieval (Segalowitz, 1997) and vocabulary size (Bundgaard-Nielsen, Best, & Tyler, 2011)
- Not well known: how these factors relate to **L2 phonological** development in perception and production

Possible candidates

- **Phonological attention control (AC)**
 - the ability to flexibly and efficiently shift attention between linguistic dimensions ([Segalowitz & Frenkiel-Fishman, 2005](#))
 - For L2 phonology : more efficient AC may enhance the processing of acoustic-phonetic information in the input and lead to higher performance in L2 speech perception/production ([Safronova & Mora, 2012](#); [Mora & Gilabert, 2012](#))
- **Inhibition skill**
 - Stronger inhibitory skill might result in better inhibition of the first language when using the L2, and to more efficient phonological processing when switching between languages ([Lev-Ari & Peperkamp, 2012](#))

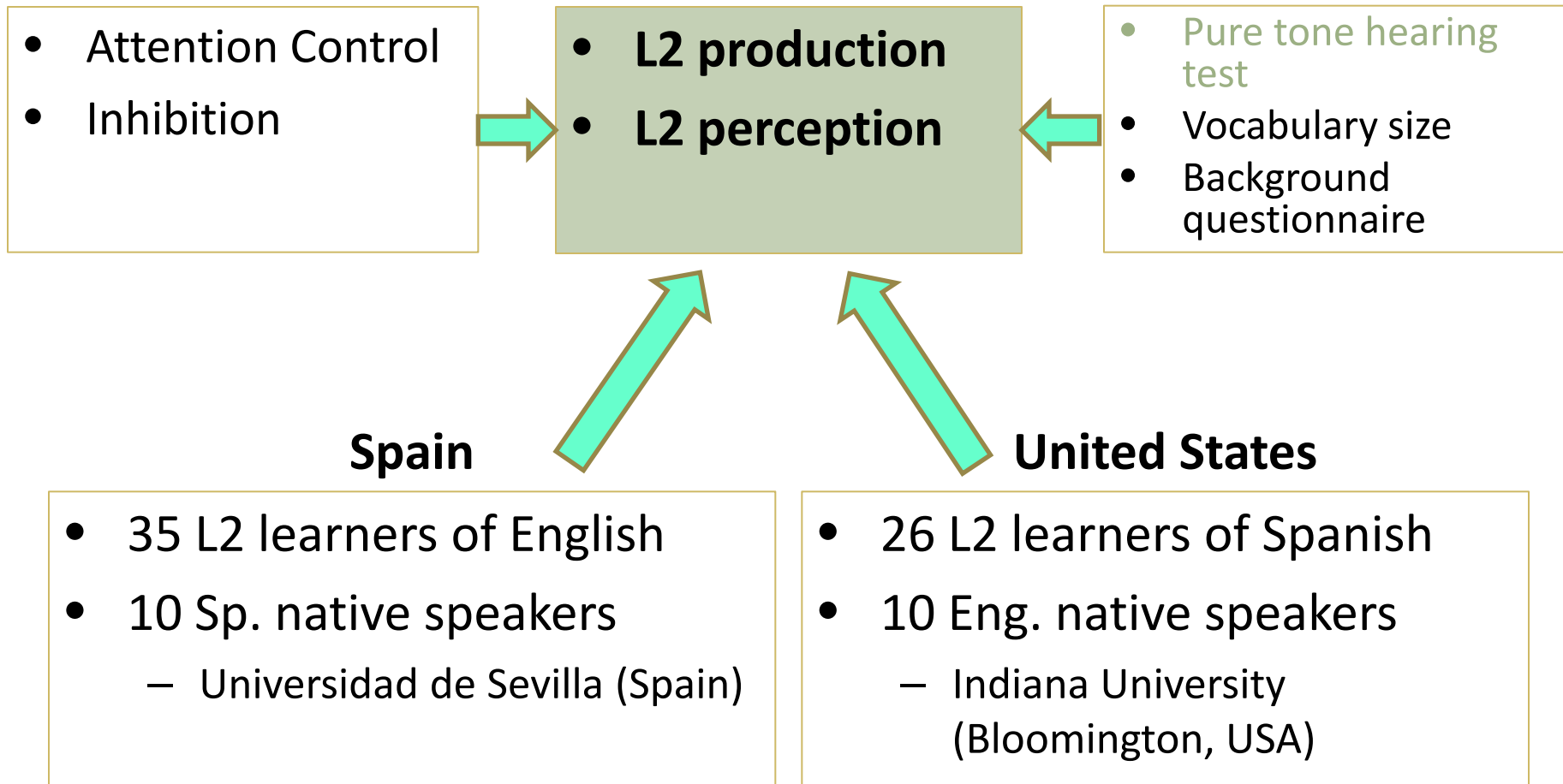


In addition

- Vocabulary size
 - Good measure of overall proficiency
 - A larger vocabulary facilitates phonological inference in L1 acquisition ([Munson et al., 2005](#))
 - In L2, it may also be related to phonological competence (vowel perception: [Bundgaard-Nielsen, Best, & Tyler, 2011](#))
- => we use vocabulary size as a (phonologically related) measure of proficiency, and include it as a covariate in analyses



Our study





L2 phonological processing: group data

- Production
- Perception



Production

- 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/ - /d/

- *¡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

- 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, F0
- Amount of tongue movement (Bark difference score) from MP2 to MP1

/r/ - /d/

- 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, F0
- Spectral distances (Bark) at midpoint and Euclidean distances

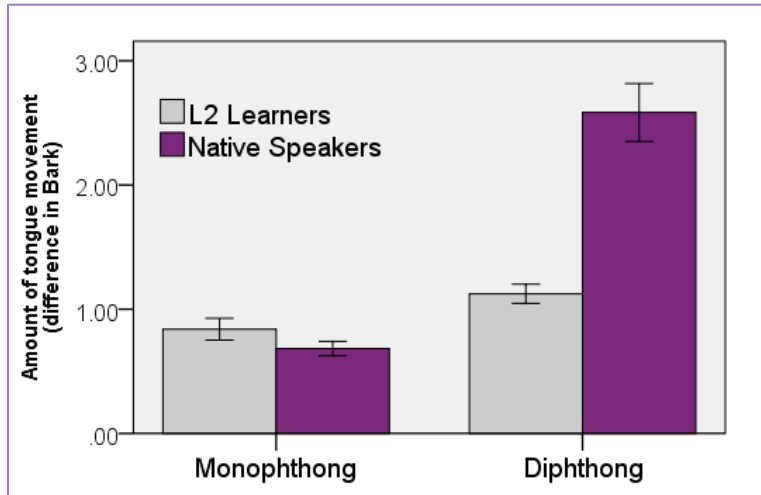
/ʃ/ - /tʃ/

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

Production: results

Spanish L2

/e/ - /eɪ/: amount of tongue movement

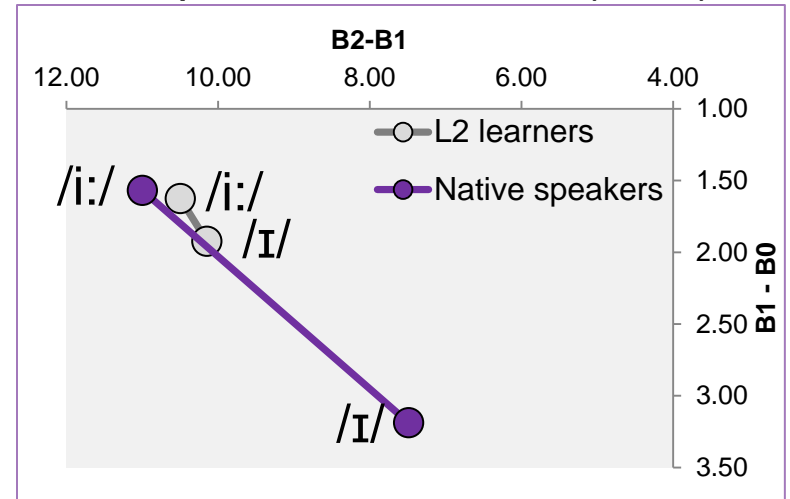


/r/ - /d/: Average score (max. 8)

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

English L2

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

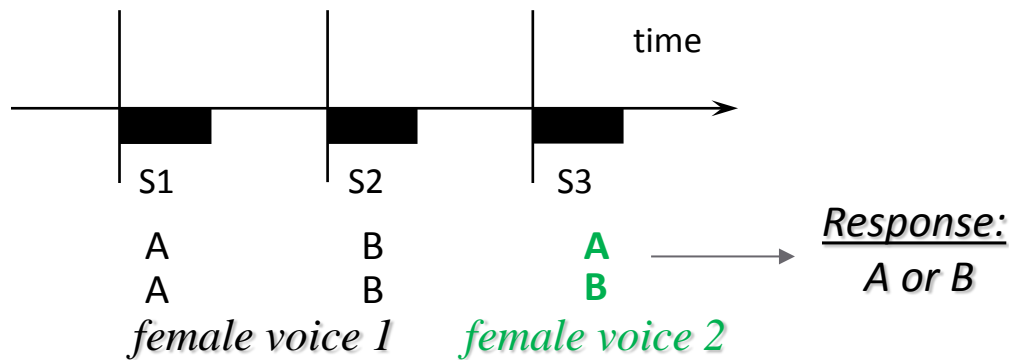


/ʃ/ - /tʃ/: Average score (max. 8)

L2 learners	Mean score	SD
n = 35	6.89	1.32
Native speakers (English)		
n = 10	8	0

Perception

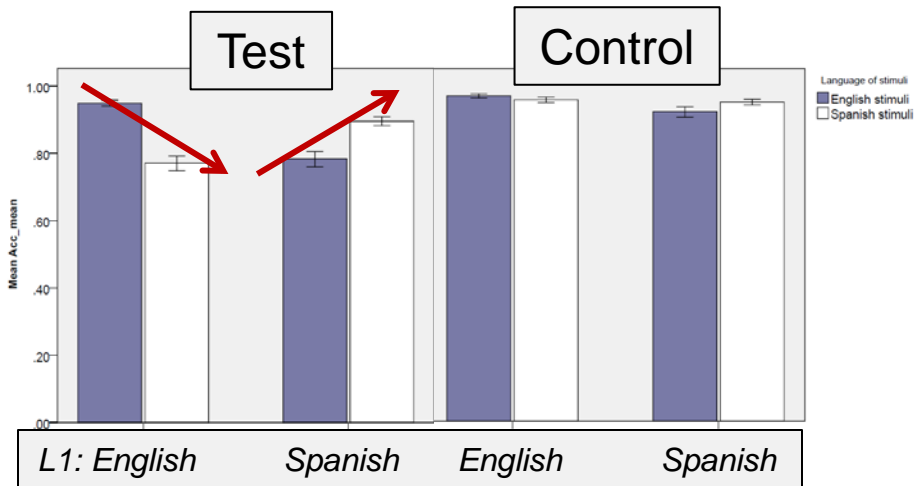
Speeded categorial ABX task



- Stimuli recorded by two native bilingual speakers (Sp./Am.Eng.)
- All subjects heard the same stimuli
- Language switch between 2 blocks
- 4 items per condition
- ABA, ABB, BAA, BAB = 128 trials

Trisyllabic nonword stimuli

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'neiða	Test V
English	fə'ni:dɪʃ	fə'nɪdɪʃ	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





Cognitive and proficiency measures

- Attention Control
- Inhibition
- Vocabulary size

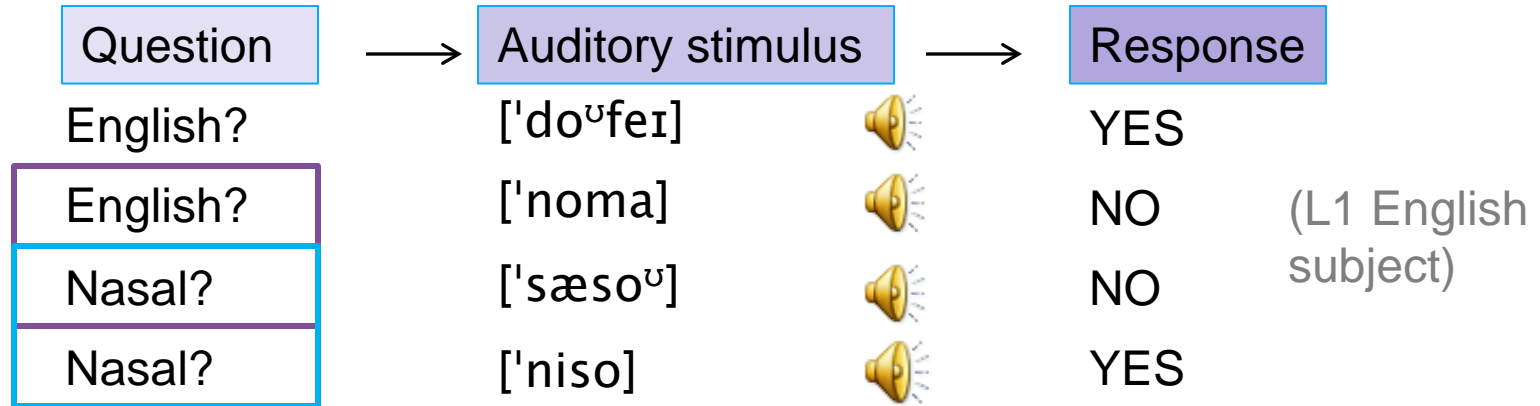


Attention Control

- New task
- Auditory analog of the Dimensional Change Card Sort Task (Bialystok & Martin 2004)
- Switch-Repeat Alternation (Segalowitz & Frenkiel-Fishman, 2005)
- Participants must switch attention between acoustic dimensions:
Nasality vs. Native language
- These two dimensions can be used for both groups equally
- Two native bilinguals (Sp./ Am.Eng) recorded both sets of stimuli

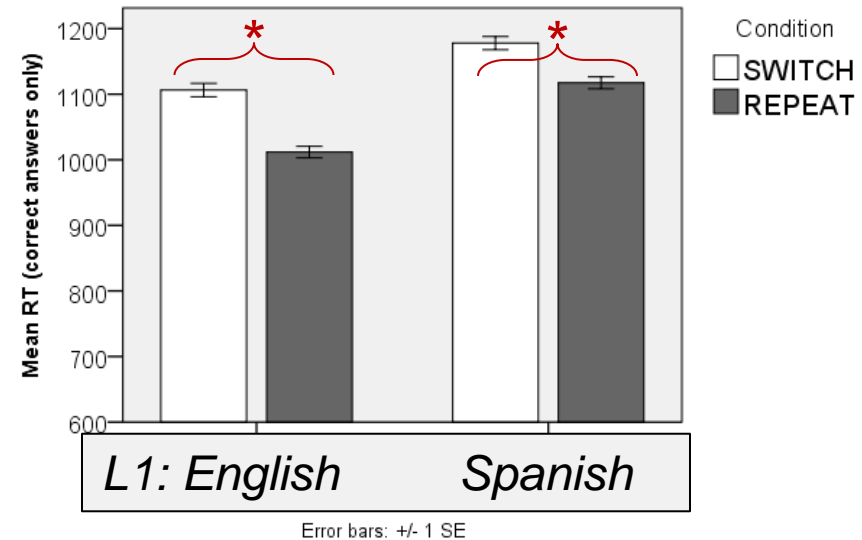
Spanish Nasal	English Nasal
'noma	'no ^ʊ mə
'nole	'no ^ʊ leɪ
 'niso 	 'niso ^ʊ 
Spanish Nonnasal	English Nonnasal
'piyo	'pi ^ʊ go
'dofe	'do ^ʊ feɪ
 'saso 	 'sæso ^ʊ 

Attention Control: results



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

Shift cost: **Switch** – **Repeat**,
for each individual



Inhibitory skill task

- Task conducted in L1 only (Spanish or English)
- Anderson, Bjork & Bjork (1994); Lev-Ari & Peperkamp (2012)



Inhibitory skill task

$$\text{Inhibition score} = \frac{\text{RT to inhibited}}{\text{RT to control}}$$

Memorize

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

Practice

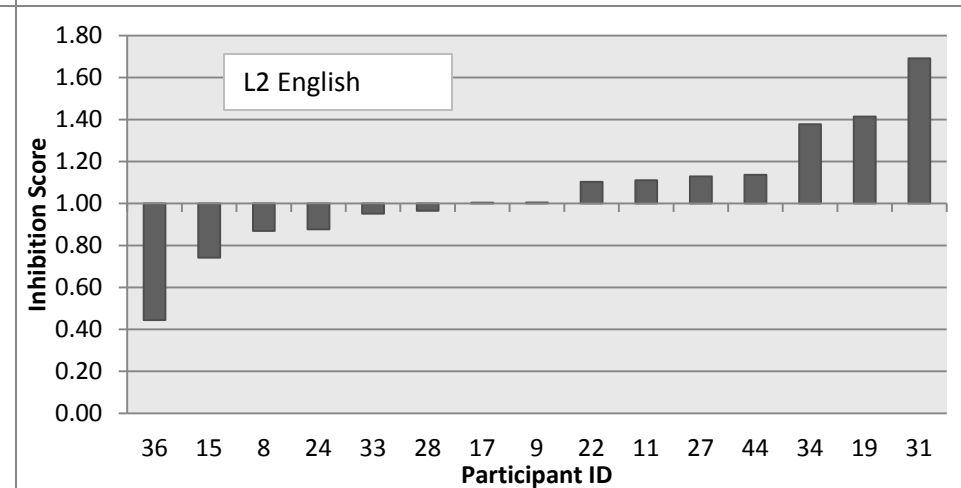
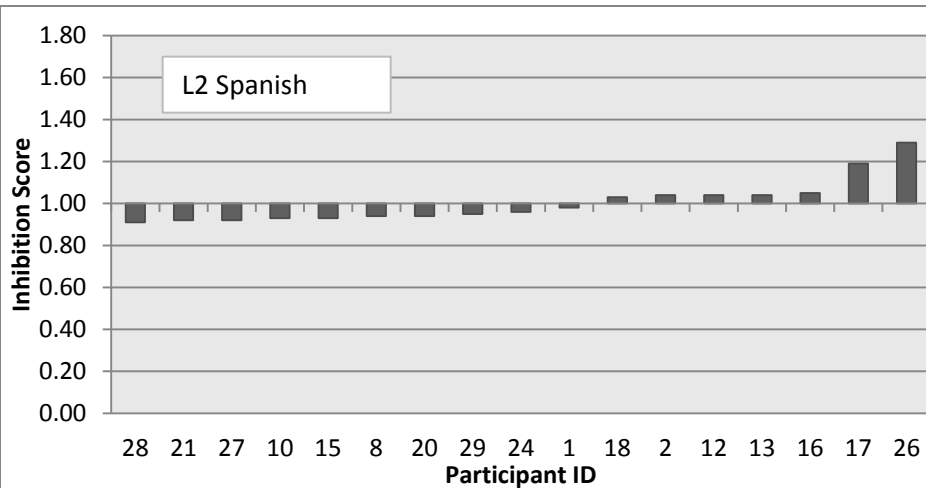
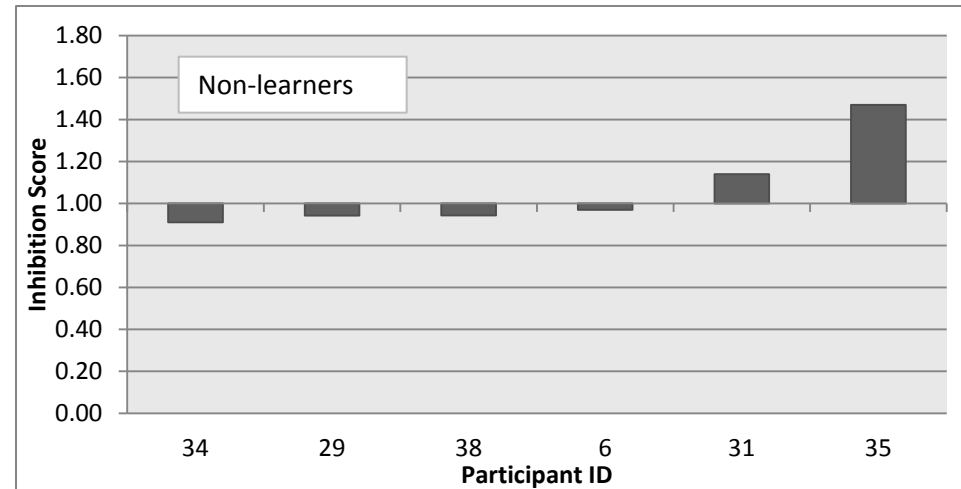
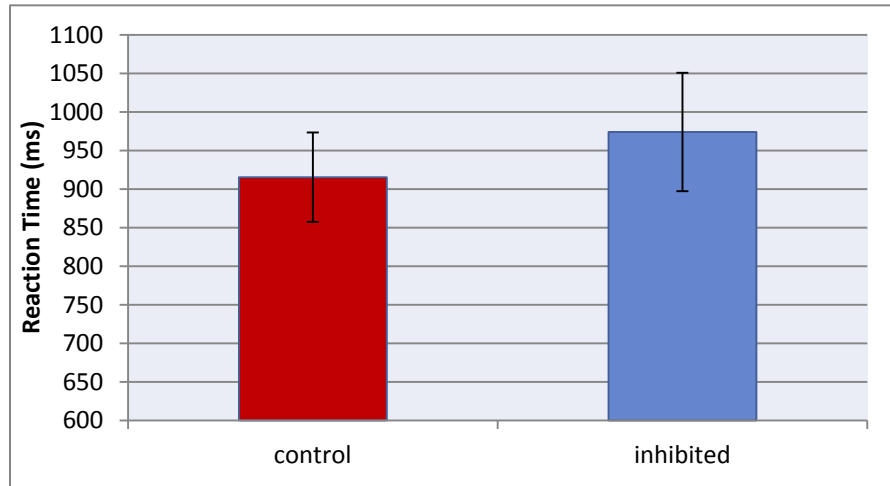
- Vegetables
 - Lettuce
 - Potato
 - Artichoke
 - Onion
 - Spinach
 - Tomato
 - Animals
 - Duck
 - Snake
 - Elephant
 - Horse
 - Tiger
 - Cow
 - Occupations
 - Plumber
 - Teacher
 - Fireman
 - Carpenter
 - Engineer
 - Nurse
- Inhibited**
- Control**
(non practiced category)

Recognize

- Vegetables
 - Lettuce
 - Potato
 - Artichoke
 - **Onion**
 - **Spinach**
 - **Tomato**
 - Animals
 - Duck
 - Snake
 - Elephant
 - **Horse**
 - **Tiger**
 - **Cow**
 - Occupations
 - **Plumber**
 - **Teacher**
 - **Fireman**
 - **Carpenter**
 - **Engineer**
 - **Nurse**
- RT on inhibited**
/
RT on control

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

Inhibition: results



Vocabulary size (receptive)

X-Lex/Y-Lex Test (Meara & Miralpeix, 2006)

- For L2 learners
- See a printed word and decide if it is known or not
- Various frequency bands
- X-Lex = 5000 most frequent
- Y-Lex = 10,000 most freq.

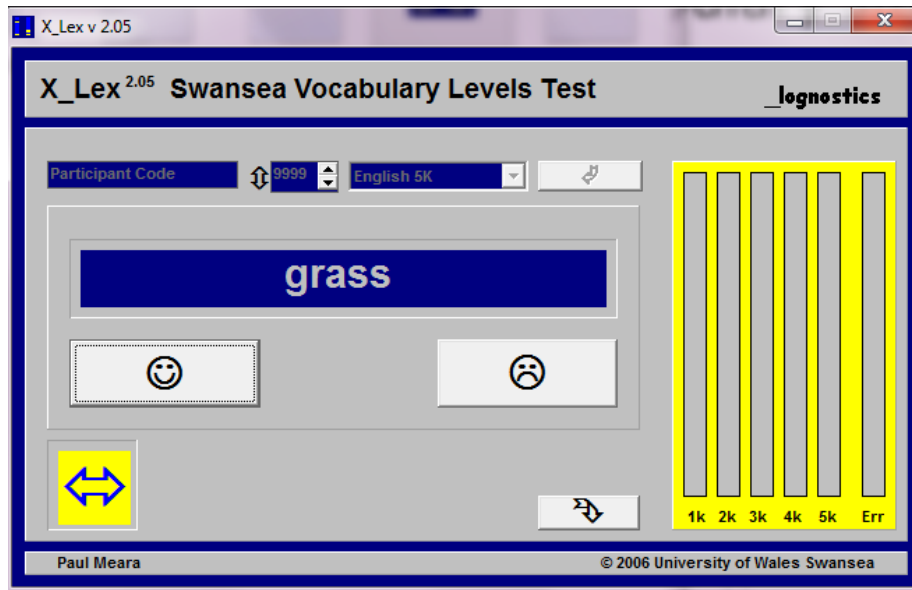
- For L2 Spanish, only X-Lex available

Peabody Picture Vocabulary Test (PPVT, Dunn & Dunn, 2007)

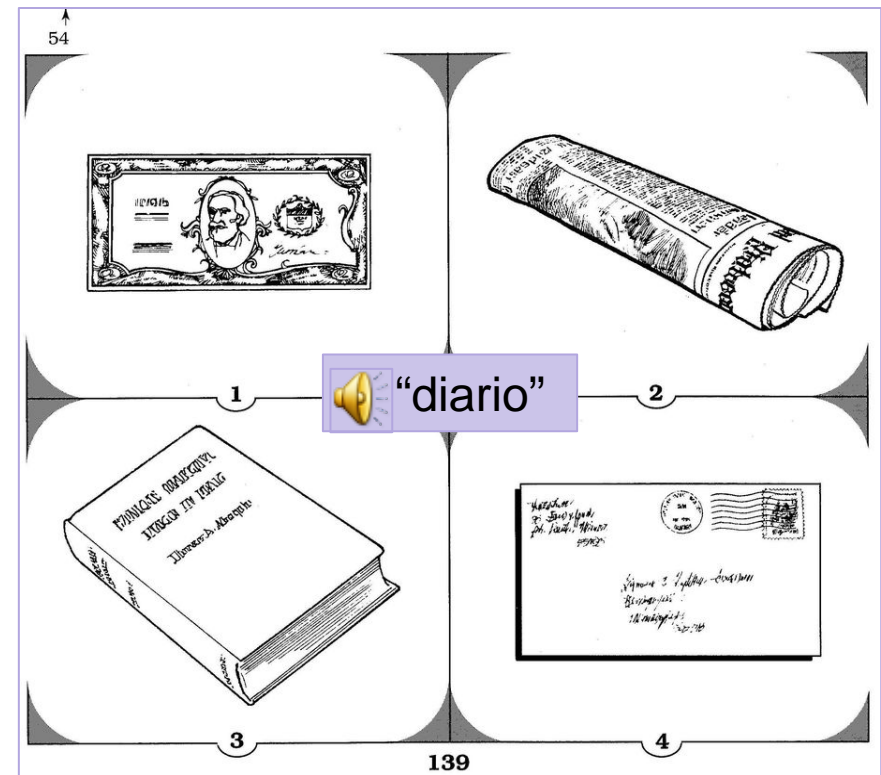
- For native speakers, children and adults
- Hear a spoken word and choose one out of four pictures
- Items arranged from “easiest” to “hardest” (but: for native speakers)
- For L2 English: PPVT 4
 - (British or American English versions)
- For L2 Spanish: PPVT 3
 - (Peninsular or Latin Am. Spanish versions)

Vocabulary size (examples)

X-Lex/Y-Lex Test (Meara & Miralpeix, 2006)



Peabody Picture Vocabulary Test (PPVT, Dunn & Dunn, 2007)



Vocabulary size: rationale

- X-Lex / Y-lex is a great measure of vocabulary size, but for L2 Spanish, only X-lex available
- So we decided to use PPVT as well because both Spanish and English versions were available
- However : PPVT was developed for L1
 - Need to make sure that the PPVT scores (error rate) and X-lex/Y-lex scores are correlated, before using PPVT as valid vocabulary size measure for the two groups.
- Results: X-lex/Y-lex scores significantly correlate with PPVT for the Spanish L1 group (for whom we have that score): $r = -.633, p < .01$

Correlations



Data

- Only participants with valid data in all tasks are selected for this analysis (82 → 40)
 - Audiometry (- n = 18)
 - Background questionnaire (- n = 15)
 - speech pathology, bilingual or fluent in another language using our test contrasts (e.g. Italian), not English or Spanish native speaker, use L2 too early ...
 - Attention Control (- n = 3)
 - Inhibition (- n = 2)
 - ABX (- n = 4)
- Total of 40 participants : **16** L2-English + **18** L2-Spanish + **6** Native speakers



L2 learners

	L2	N	Mean	(SD)	t	df	p
Age (years)	English	16	23.3	5.38	2.77	15.4	.014
	Spanish	18	19.6	0.70			
Motivation	English	16	6.0	0.71	2.11	23.3	.046
	Spanish	18	5.6	0.41			
Current L2 use	English	16	17.4	5.93	3.7	32	.001
	Spanish	18	9.1	7.06			
Self-evaluation (1-5)	English	16	4.0	0.37	.67	28.9	.506
	Spanish	18	3.9	0.58			
LoR abroad (weeks)	English	16	5.4	10.1	-.11	32	.911
	Spanish	18	5.9	15.2			
Years of study	English	16	11.9	2.77	3.21	32	.003
	Spanish	18	8.8	2.94			
First Exposure (age)	English	16	7.6	2.13	-1.15	26.2	.259
	Spanish	18	8.8	4.09			
First Use (age)	English	16	13.5	4.40	2.29	32	.029
	Spanish	18	10.2	3.96			

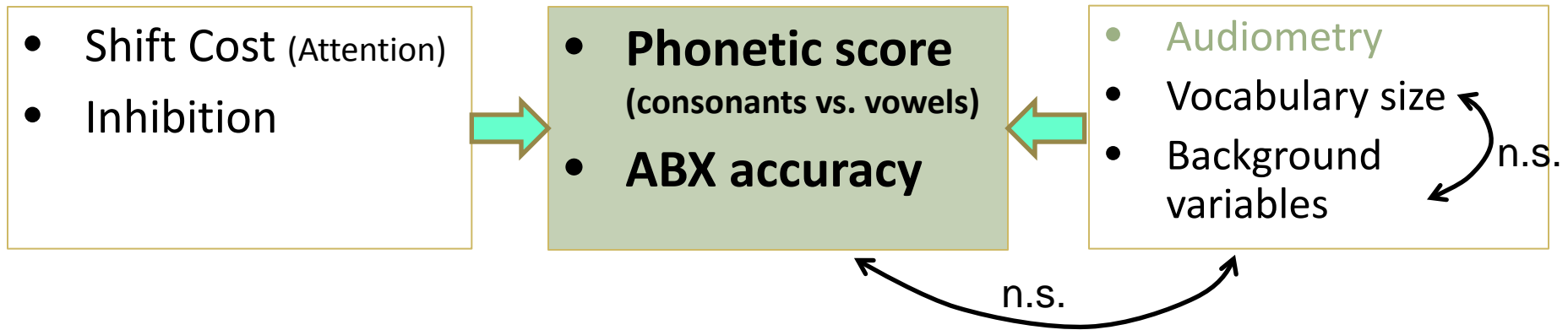
Compared to the learners in Seville (L2 English), learners in Bloomington (L2 Spanish) are younger, less motivated, speak the L2 less, have studied for less time, and started using Spanish earlier.



Our findings



PPVT error rate used as covariate to partial out proficiency



Spain

- 16 L2 learners of English
 - Universidad de Sevilla (Spain)

United States

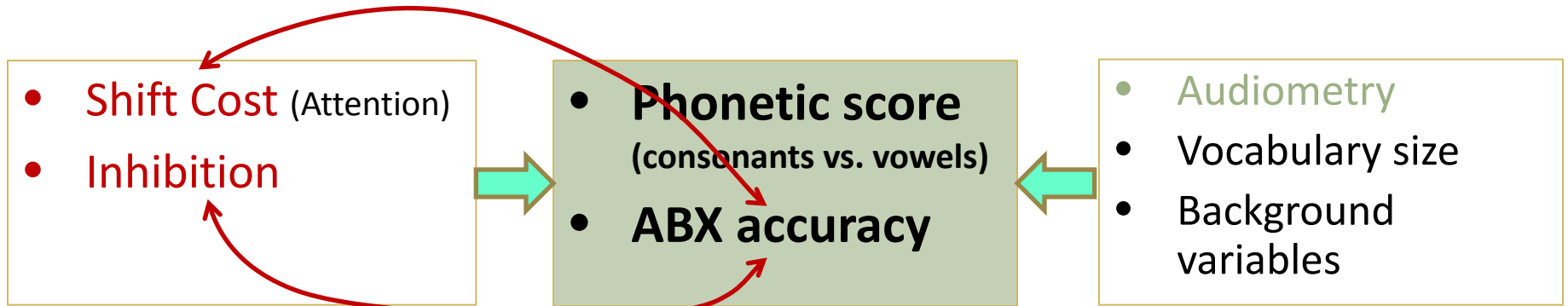
- 18 L2 learners of Spanish
 - Indiana University (Bloomington, USA)





Our findings

L2 Spanish ($r = .124$) n.s.
L2 English ($r = -.438$)



L2 Spanish ($r = .507$)
L2 English ($r = .615$)

Spain

- 16 L2 learners of English
 - Universidad de Sevilla (Spain)

United States

- 18 L2 learners of Spanish
 - Indiana University (Bloomington, USA)



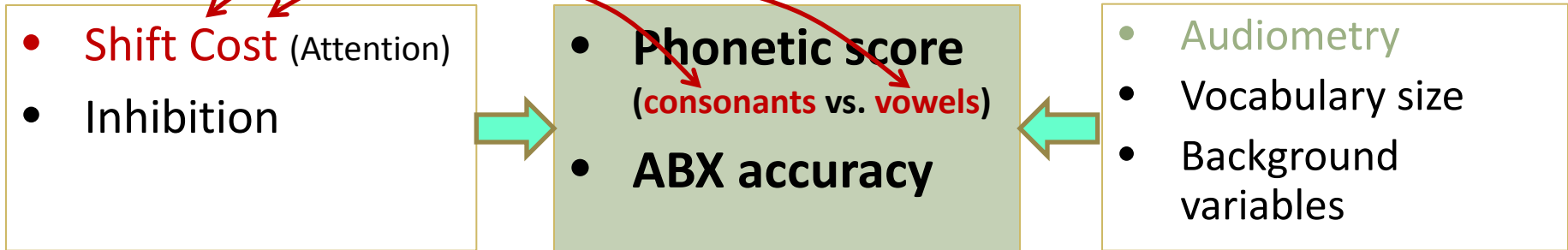


Our findings



L2 Spanish (n.s.)
L2 English (r = -.366)

L2 Spanish (n.s.)
L2 English (r = .640)



Spain

- 16 L2 learners of English
 - Universidad de Sevilla (Spain)

United States

- 18 L2 learners of Spanish
 - Indiana University (Bloomington, USA)





Take-home message

- Inhibition and attention control are associated with L2 processing of consonants and vowels, when proficiency is partialled out
- Perception
 - Learners with higher **inhibitory skill** are perhaps able to deactivate (or inhibit) the language not in use more efficiently, and this might help them obtain higher accuracy scores in our categorial ABX task
 - **Attention control** is also associated with more accurate performance in ABX (for the L2 English learners), but less strongly than inhibition
- Production
 - Inhibition is not related to production scores
 - **Attention control** is related to consonant production for L2 English learners
- Next step will examine whether such an advantage in speech processing **is *the result of*** more efficient executive function
- A stronger Inhibition and more efficient Attention control might be facilitating phonological ***learning***

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)
- Elena Safronova (Barcelona)
- Eva Cerviño-Povedano (Barcelona)
- Marina Barrio Parra, M. Heliodora Cuenca Villarín (Sevilla)
- Ron Roosevelt (Sevilla)
- Carmen Muñoz (Barcelona)
- Kathleen Bardovi-Harlig (Bloomington)
- SLPL lab members (Bloomington)
- Jeffrey Holliday (Bloomington)
- Grant support :
 - Grant-in-Aid, Indiana University Bloomington
 - Grants HUM2007-64302 (Ministerio de Ciencia e Innovación) and 2009SGR137 (Generalitat de Catalunya)

Comments/questions:

idarcy@indiana.edu

ddaidone@indiana.edu

mora@ub.edu



References

- Anderson, M. C., Bjork, R. A., & Bjork, E. L. (1994). Remembering can cause forgetting: retrieval dynamics in long-term memory. *Journal of experimental psychology. Learning, memory, and cognition*, 20, 1063-1087.
- Atkins, P. W. B., & Baddeley, A. D. (1998). Working memory and distributed vocabulary learning. *Applied Psycholinguistics*, 19, 537-552.
- Bialystok, E., & Martin, M. M. (2004). Attention and inhibition in bilingual children: evidence from the dimensional change card sort task. *Developmental Science*, 7, 325-339.
- Bundgaard-Nielsen, R. L., Best, C. T., & Tyler, M. D. (2011). Vocabulary Size Matters: The Assimilation of Second-Language Australian English Vowels to First-Language Japanese Vowel Categories. *Applied Psycholinguistics*, 32, 51-67.
- Cerviño-Povedano, E., & Mora, Joan C. (2011). Investigating Catalan learners of English over-reliance on duration: vowel cue weighting and phonological short-term memory. In K. Dziubalska-Kołodziej, M. Wrembel & M. Kul (Eds.), *Achievements and perspectives in the acquisition of second language speech: New Sounds 2010 (Vol. 1, pp. 53-64)*. Frankfurt am Main: Peter Lang.
- Flege, J. E., Bohn, O.-S., & Jang, S. (1997). Effects of experience on non-native speakers' production and perception of English vowels. *Journal of Phonetics*, 25, 437-470.
- Flege, J. E., Yeni-Komshian, G. H., & Liu, S. (1999). Age constraints on second-language acquisition. *Journal of Memory and Language*, 41, 78-104.
- Guion, S. G., Flege, J. E., & Loftin, J. D. (2000). The effect of L1 use on pronunciation in Quichua-Spanish bilinguals. *Journal of Phonetics*, 28, 27-42.
- Guion, S.G. & Pederson, E. (2007). Investigating the role of attention in phonetic learning. In O.-S. Bohn & M. Munro (Eds.) *Language Experience in Second Language Speech Learning*. Amsterdam: John Benjamins, 57-77.



References

- Johnson, J. S., & Newport, E. L. (1989). Critical Period Effects in Second Language Learning: The Influence of Maturational State on the Acquisition of English as a Second Language. *Cognitive Psychology*, 21, 60-99.
- Lev-Ari, S. & Peperkamp, S. (2012) Inhibitory skill influences late bilinguals' VOT in their native language. *Poster presented at the 13th Conference on Laboratory Phonology, Stuttgart, Germany.*
- Masoura, E. V., & Gathercole, S. E. (1999). Phonological Short-term Memory and Foreign Language Learning. *International Journal of Psychology*, 34, 383-388.
- Mora, J. C. & Gilabert, R. (2012). Individual factors in utterance and perceived fluency: some empirical issues. *Invited paper presented at the Workshop Fluent Speech, Utrecht University, The Netherlands, 12-13 November 2012.*
- Munson, B., Kurtz, Beth A., & Windsor, J. (2005). The Influence of Vocabulary Size, Phonotactic Probability, and Wordlikeness on Nonword Repetitions of Children With and Without Specific Language Impairment. *Journal of Speech, Language and Hearing Research*, 48, 1033-1047
- Pallier, C., Bosch, L., & Sebastian-Gallés, N. (1997). A limit on behavioral plasticity in speech perception. *Cognition*, 64, B9-B17.
- Papagno, C., & Vallar, G. (1995). Verbal short-term memory and vocabulary learning in polyglots. *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology*, 48, 98-107.
- Segalowitz, N. (1997). Individual differences in second language acquisition. In A. de Groot & J. F. Kroll (Eds.), *Tutorials in bilingualism* (pp. 85-112). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Segalowitz, N. and Frenkiel-Fishman, S. (2005) Attention control and ability level in a complex cognitive skill: attention-shifting and second language proficiency. *Memory and Cognition*, 33, 644-653.
- Service, Elisabet. (1992). Phonology, working memory, and foreign-language learning. *The Quarterly Journal of Experimental Psychology. A. Human experimental psychology*, 45A, 21-50.

