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Phonological Attention Control, Inhibition, and Second Language Speech Learning

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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

- Attention Control
- Inhibition

→

- **L2 production**
- **L2 perception**

←

- Pure tone hearing test
- Vocabulary size
- Background questionnaire

Spain

- 35 L2 learners of English
- 10 Sp. native speakers
  - Universidad de Sevilla (Spain)

United States

- 26 L2 learners of Spanish
- 10 Eng. native speakers
  - Indiana University (Bloomington, USA)

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/

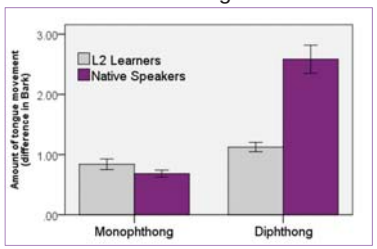
- 3 measurement points (MP) within vowels: F1, F2, F0
- Spectral distances (Bark) at midpoint and Euclidean distances

/ʃ/ - /tʃ/

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

Production: results

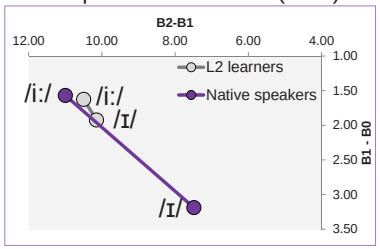
Spanish L2
/e/ - /eɪ/: amount of tongue movement



/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)

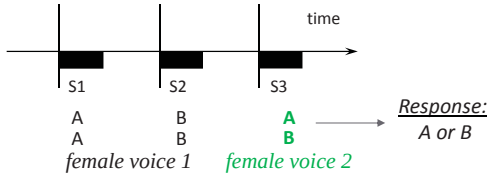


/ʃ/ - /tʃ/: Average score (max. 8)

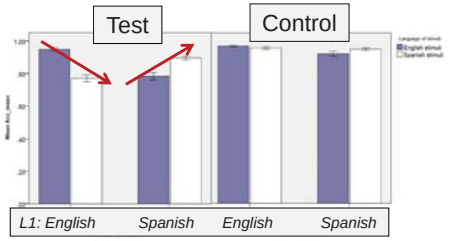
L2 learners	Mean score	*SD*
n = 35	6.89	*1.32*
Native speakers (English)		
n = 10	8	*0*

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	saˈreβo	saˈðeβo	Test C
English	səˈʃiːdən	səˈtʃiːdən	Test C
Spanish	faˈneða	faˈneɪða	Test V
English	fəˈniːdɪʃ	fəˈnɪdɪʃ	Test V
Spanish	gaˈtaso	gaˈðaso	Control C
English	gəˈtæfɪn	gəˈdæfɪn	Control C
Spanish	luˈpito	luˈpato	Control V
English	ləˈpiːdɪk	ləˈpædɪk	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

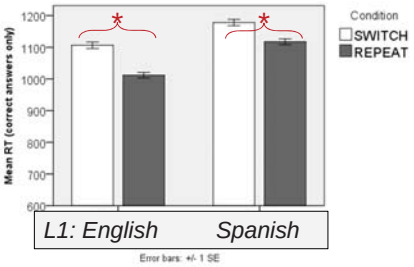
Spanish Nasal	English Nasal
ˈnoma	ˈnoʊmə
ˈnole	ˈnoʊleɪ
ˈniso	ˈnɪsoʊ
Spanish Nonnasal	**English Nonnasal**
ˈpiɣo	ˈpɪgoʊ
ˈdofe	ˈdoʊfeɪ
ˈsaso	ˈsæsoʊ

Attention Control: results

Question	Auditory stimulus	Response	
English?	['doʊfeɪ]	YES	
English?	['noma]	NO	(L1 English subject)
Nasal?	['sæsoʊ]	NO	
Nasal?	['niso]	YES	

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

Inhibition score = (RT to inhibited)/(RT to control)

Memorize	Practice	Recognize
• Vegetables	• Vegetables	• Vegetables
– Lettuce	– Lettuce	– Lettuce
– Potato	– Potato	– Potato
– Artichoke	– Artichoke	– Artichoke
– Onion	– Onion	– **Onion**
– Spinach	– Spinach	– **Spinach**
– Tomato	– Tomato	– **Tomato**
• Animals	• Animals	• Animals
– Duck	– Duck	– Duck
– Snake	– Snake	– Snake
– Elephant	– Elephant	– Elephant
– Horse	– Horse	– **Horse**
– Tiger	– Tiger	– **Tiger**
– Cow	– Cow	– **Cow**
• Occupations	• Occupations	• Occupations
– Plumber	– Plumber	– **Plumber**
– Teacher	– Teacher	– **Teacher**
– Fireman	– Fireman	– **Fireman**
– Carpenter	– Carpenter	– **Carpenter**
– Engineer	– Engineer	– **Engineer**
– Nurse	– Nurse	– **Nurse**

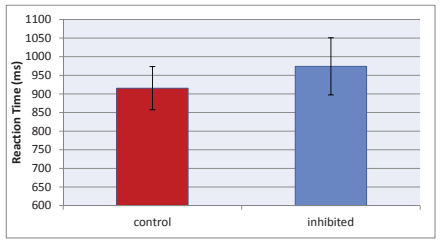
Inhibited

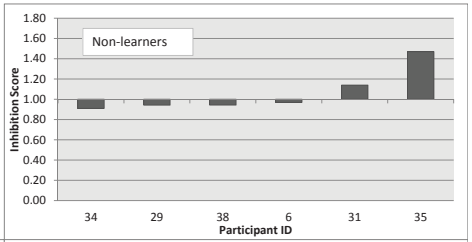
Control (non practiced category)

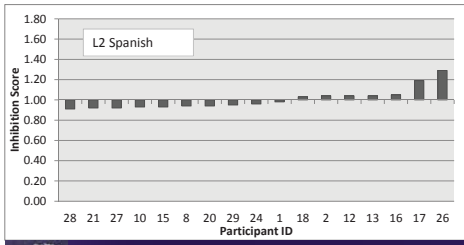
RT on inhibited / RT on control

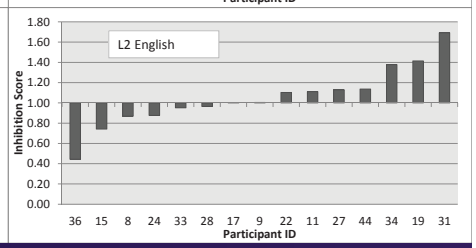
PLUS additional items never presented before (e.g. secretary)

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: 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

- Shift Cost (Attention)
- Inhibition

→ **Phonetic score (consonants vs. vowels)**
ABX accuracy

← Audiometry
Vocabulary size
Background variables
n.s.

n.s.

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)

- Shift Cost (Attention)
- Inhibition

→ **Phonetic score (consonants vs. vowels)**
ABX accuracy

← Audiometry
Vocabulary size
Background variables

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)

- Shift Cost (Attention)
- Inhibition

→ **Phonetic score (consonants vs. vowels)**
ABX accuracy

← Audiometry
Vocabulary size
Background variables

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!

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