Assessing cross-linguistic influence in L3 phonology through language switching tasks: the role of L1 dominance and individual differences in attention and inhibitory control.

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Workshop on Multilingual Language Acquisition, Processing and Use: Evidence in L3 Research. 6-7 May 2017, Poznań, Poland.

Outline

> Background and research context
> L3 Phonology (distinct from L2 Phonology?)
> Language switching tasks a testing ground for L3 phonology research (phonetic CLI)
> IDs in Attention and Inhibition mediate performance in language switching tasks
> Data (and preliminary results) from on-going project on IDs in phonological acquisition (L3) that uses some language switching tasks

Background

Our research context:

- Bilingual speakers learning an L3 (usually instructed SLA)
  - L1 & L2 acquired sequentially (home/school/job)
  - L1 & L2 acquired simultaneously (home/school/job)
  - L1 & L2 may be used daily to varying extents
  - All possible combinations of bilingualism co-exist
  - Acquisition order ≠ Language dominance
  - Speakers may shift language dominance
  - Large variation in L1/L2 experience, use and degree of dominance: Monolingualism → Bilingualism
    - L1+L2=**L1** or L1+L2= **L1**+**L2**
    - **L1** & **L2** generally mostly active
- Not the right/best context to conduct L3 research?
- Research in this context relevant to other contexts: L1, L2, L3

Background

Why L3 phonology?

- Different in nature from L2 phonology:
  - Multiple sources of Phonological CLI (PCLI)
  - Cumulative sensitization to phonological features (L1+L2 > greater perceptual sensitivity).
  - Complexity of L1-L2-L3 interactions.
  - L3 phonology effects on L2 larger than L1.
  - L2 phonology (& awareness) may be aided by L3 acquisition.
- Predictions of L2 speech learning models may not hold for multilingualism.

How can we investigate L3 phonology?

Background

L3 phonology research

A, B, C = different degrees of dominance

1, 2, 3 = orders of acquisition

L1A + L2B + L3C(A/B?)

L1B + L2A + L3C(LA)

L1B + L2A + L3C(LB)

Many other options...

L1A + L2B + L3C

L1A + L2B + L3C(LA)

L1A + L2B(LA) + L3C

L1A + L2B + L3C...?

How can we investigate L3 phonology?

Language Switching Tasks

Language switching tasks

- Insight into phonological processing in multilinguals:
    - PCLI in processing = PCLI in acquisition?
    - Research: phonological processing vs acquisition.
    - Complexity of L1-L2-L3 interactions.
    - L3 phonology effects on L2 larger than L1.
    - L2 phonology (& awareness) may be aided by L3 acquisition.
- May provide interesting insights into the mechanisms of phonological processing in multilinguals.
- May provide more sensitive measures of CLI in language-contact situations (bilinguals learning L3 in bilingual context).

Language Switching Tasks

Bilingual picture naming (speeded, RTs)

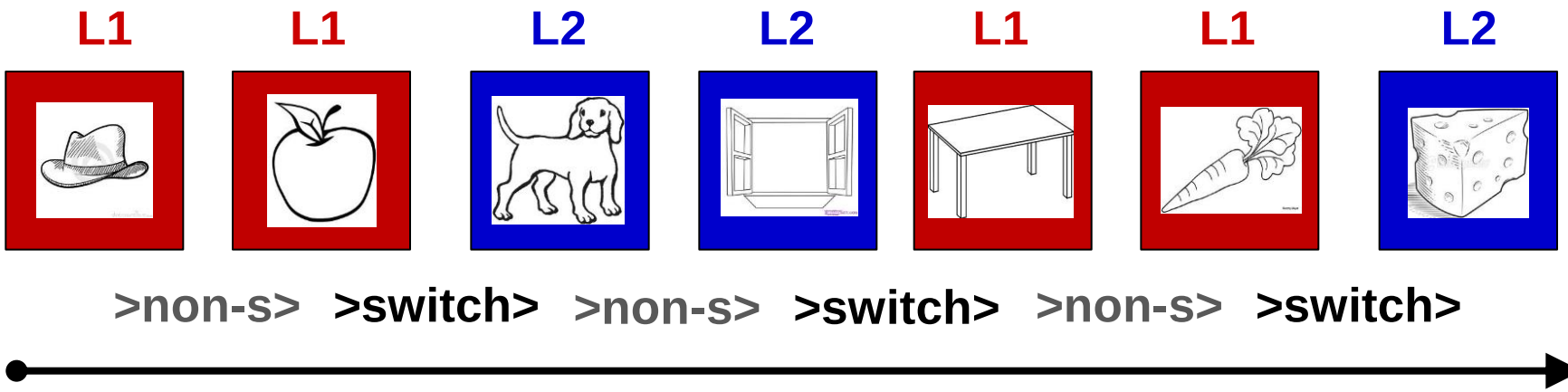
Trials: - switch (L1-L2 / L2-L1) and non-switch (L1-L1 / L2-L2)

- language cued by background colour: L1 L2

Measure: RTs from stimuli onset to voice-key activation

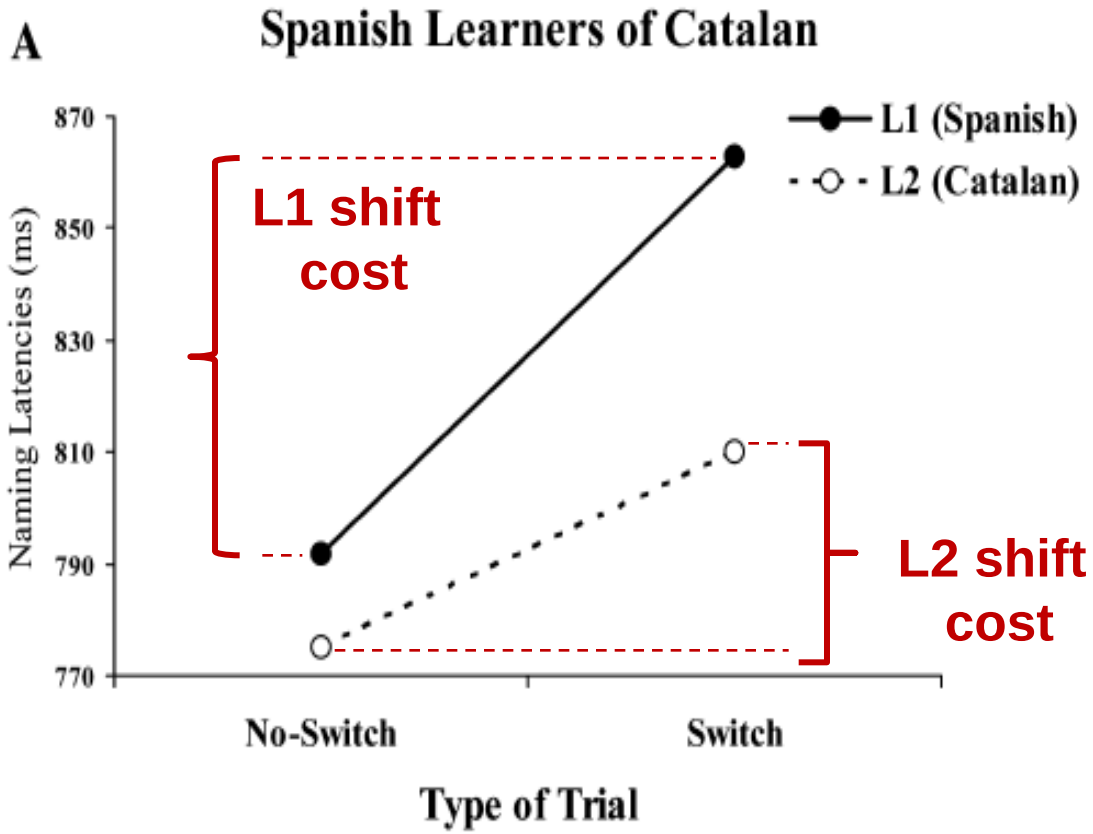
Amount of inhibition = Level of proficiency

- Activation HIGH in L1 > strong inhibition
- Activation LOW in L2 (if proficiency is LOW) > little inhibition



(Costa & Santesteban, 2004; Costa, Santesteban & Ivanova, 2006; Calabria et al. 2012)

Language Switching Tasks



- RTs are slower in Switch than Nonswitch trials.

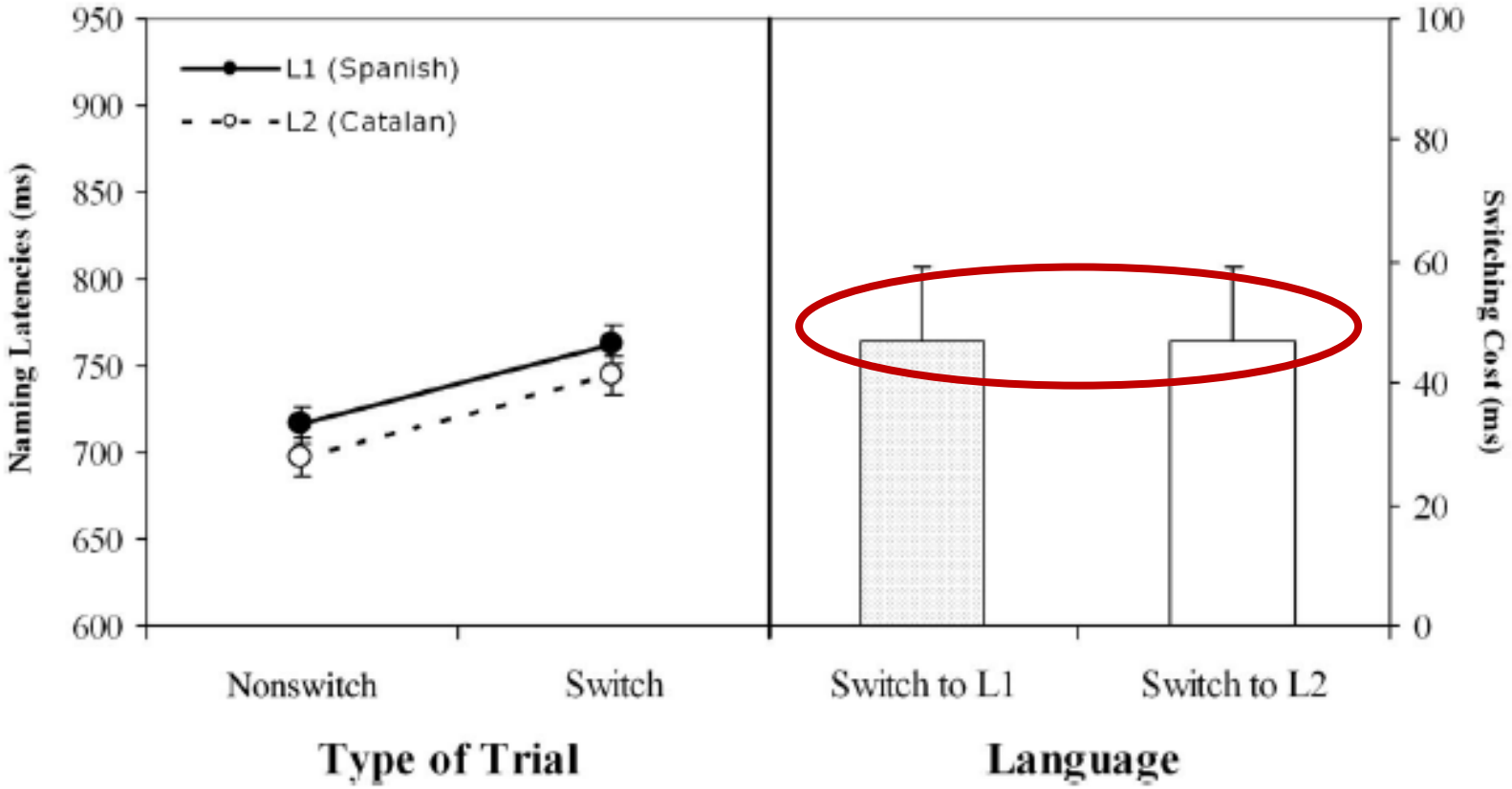
- L1-to-L2 and L2-to-L1 switching costs are asymmetrical:

> shifting to L1 requires more time (to overcome inhibition)

(Costa & Santesteban, 2004; Costa, Santesteban & Ivanova, 2006; Calabria et al. 2012)

Language Switching Tasks

Spanish-Catalan highly proficient early bilinguals



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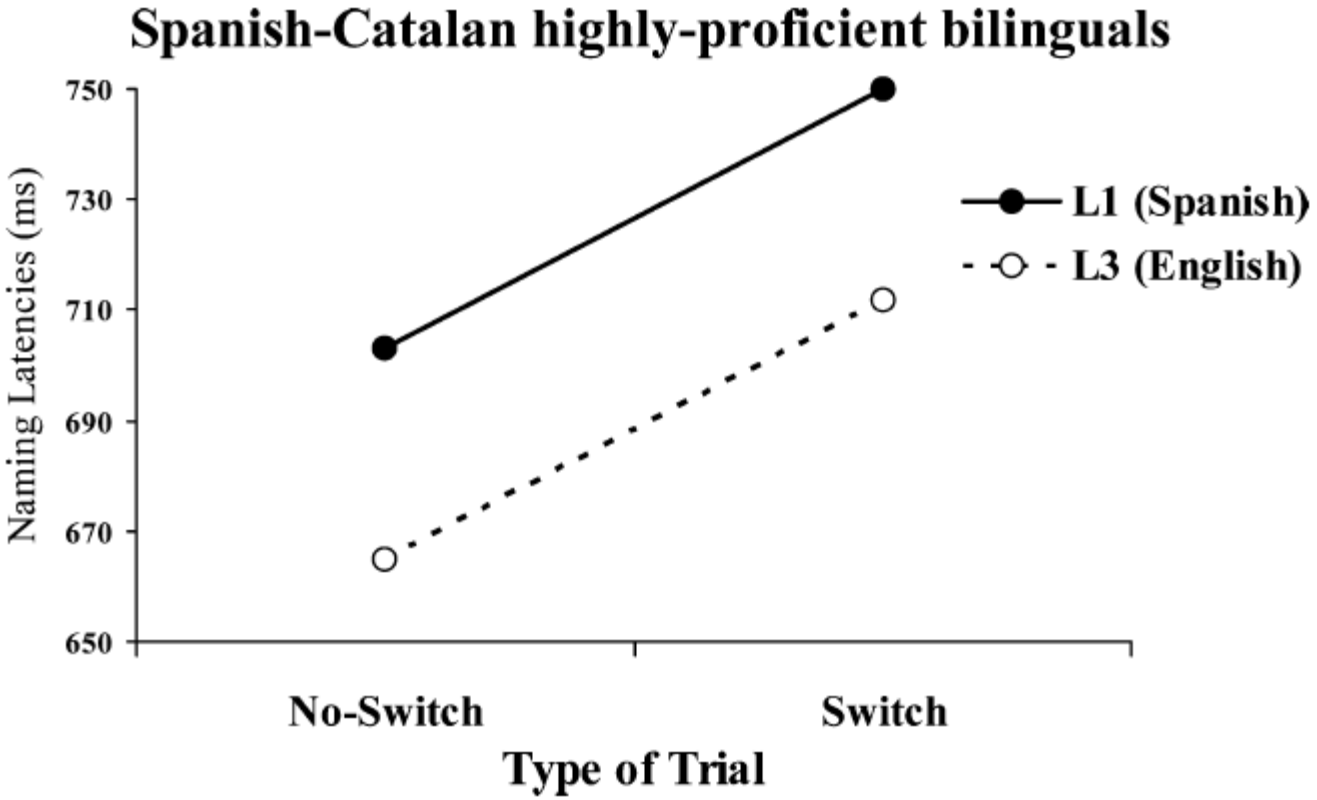
Language Switching Tasks

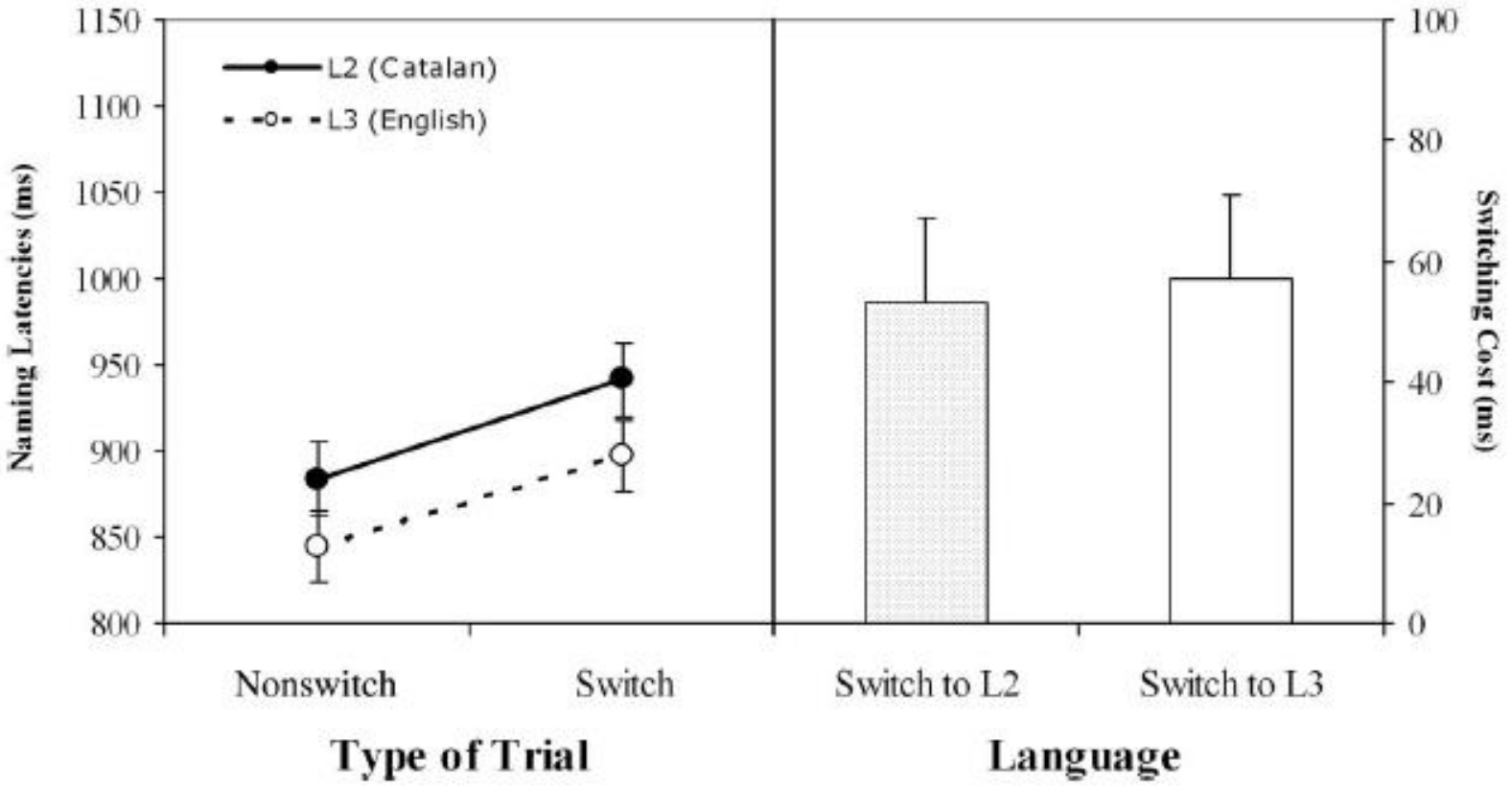
Bilingual picture naming (RT switching costs)
L1 – L3



(Costa, Santesteban & Ivanova, 2006)

Language Switching Tasks

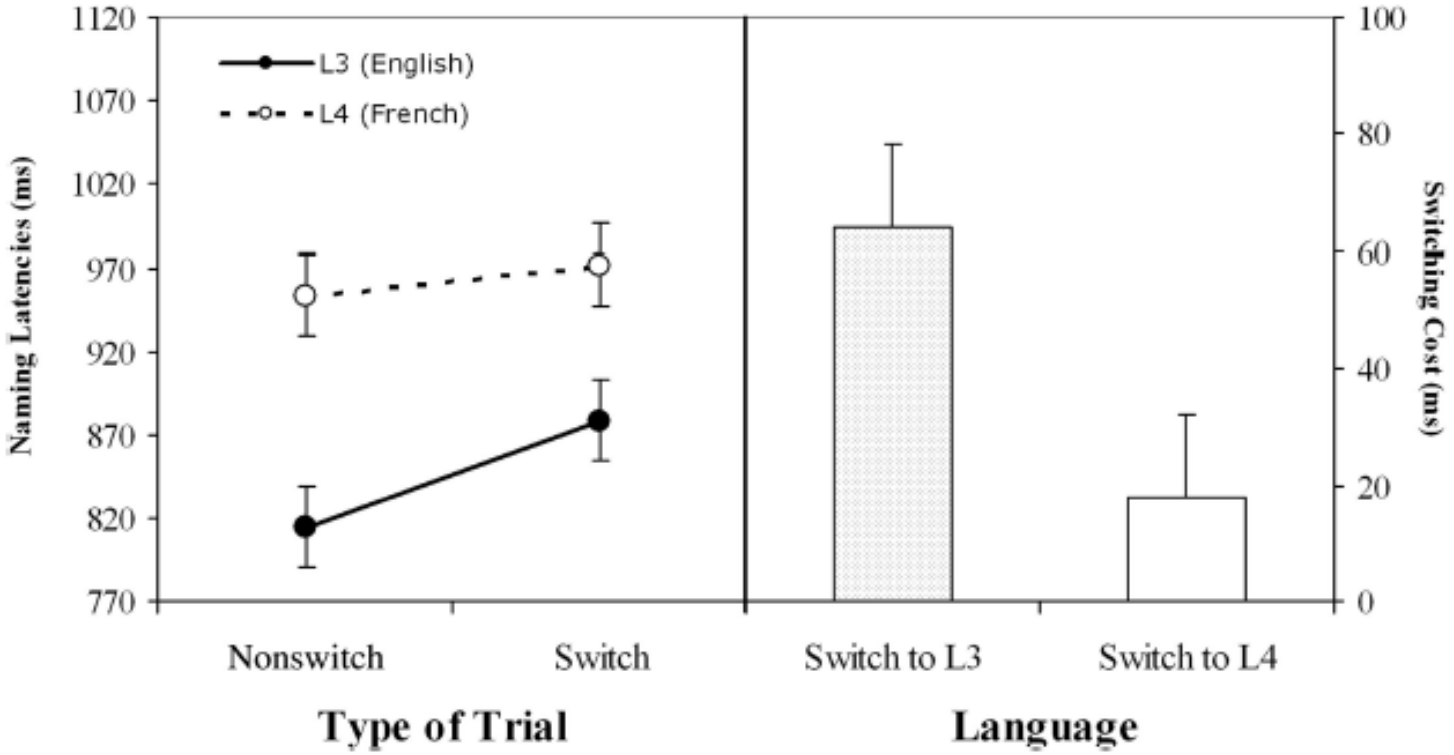
Bilingual picture naming (RT switching costs)
L2 – L3



(Costa, Santesteban & Ivanova, 2006)

Language Switching Tasks

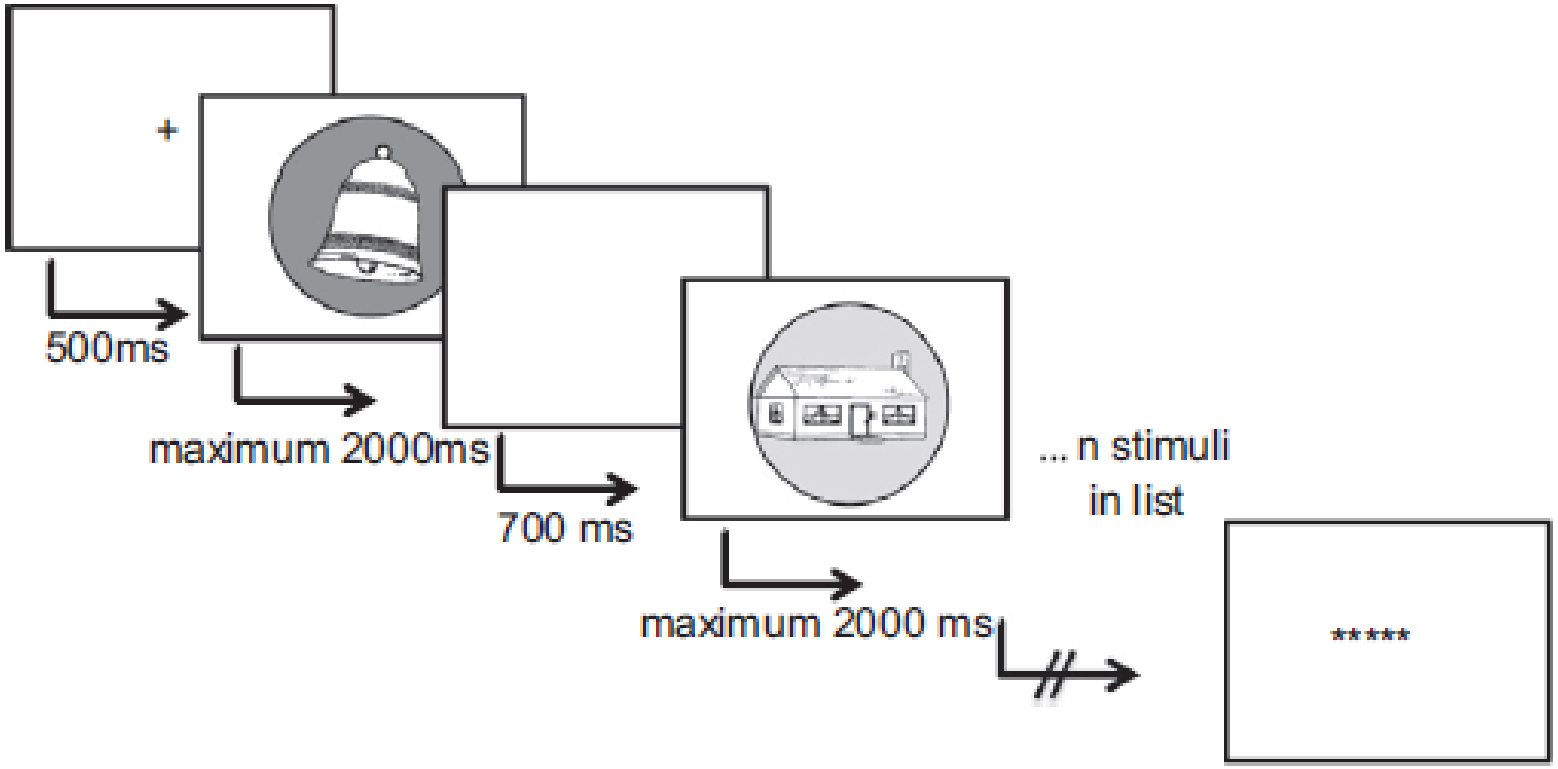
Bilingual picture naming (RT switching costs)
L3 – L4



(Costa, Santesteban & Ivanova, 2006)

Language Switching Tasks

Bilingual picture naming (not speeded, asymmetric CLI)

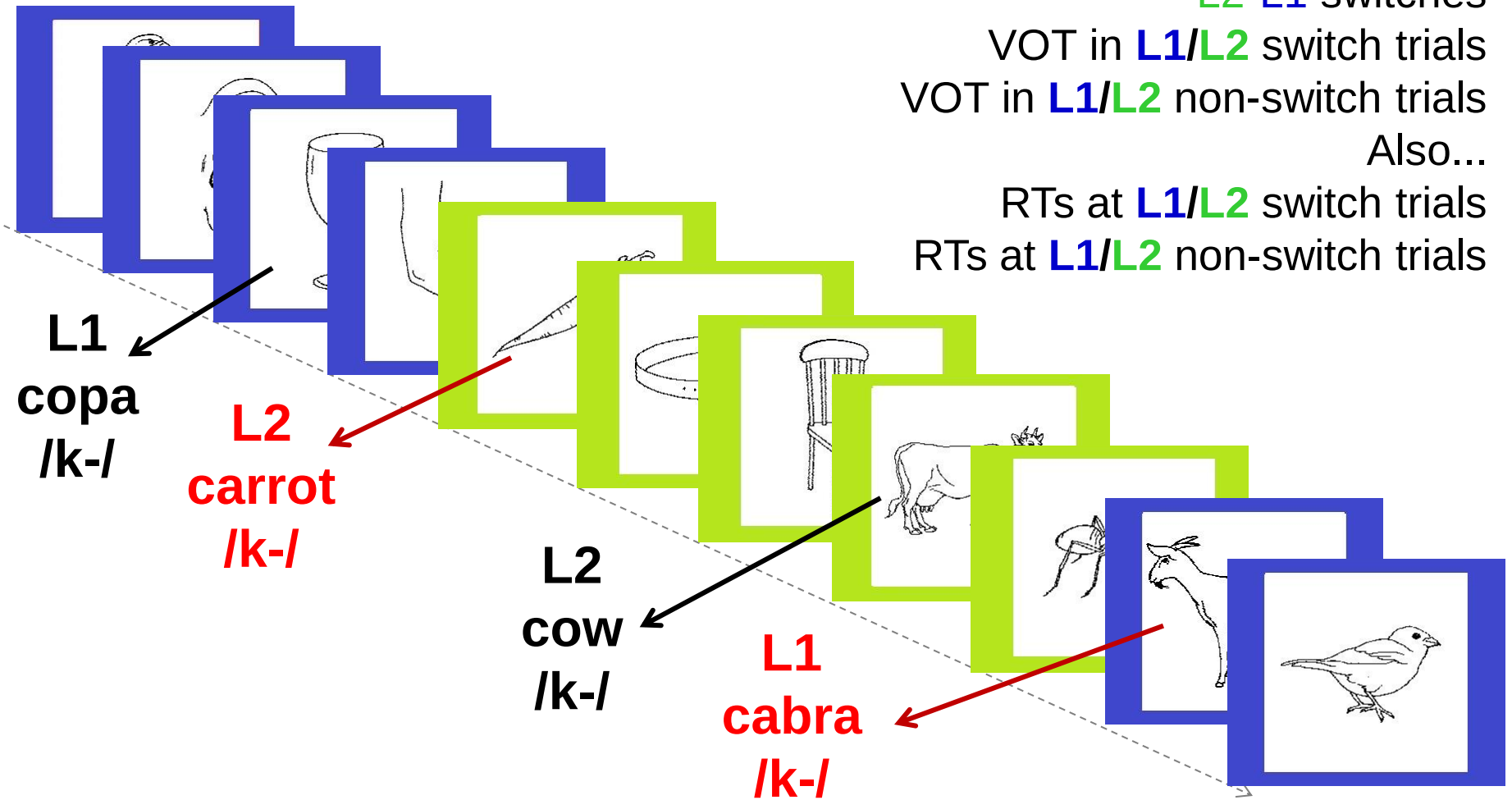


(Goldrick et al., 2014; Olson, 2013, 2015)

Language Switching Tasks

Bilingual picture naming (not speeded, asymmetric CLI)

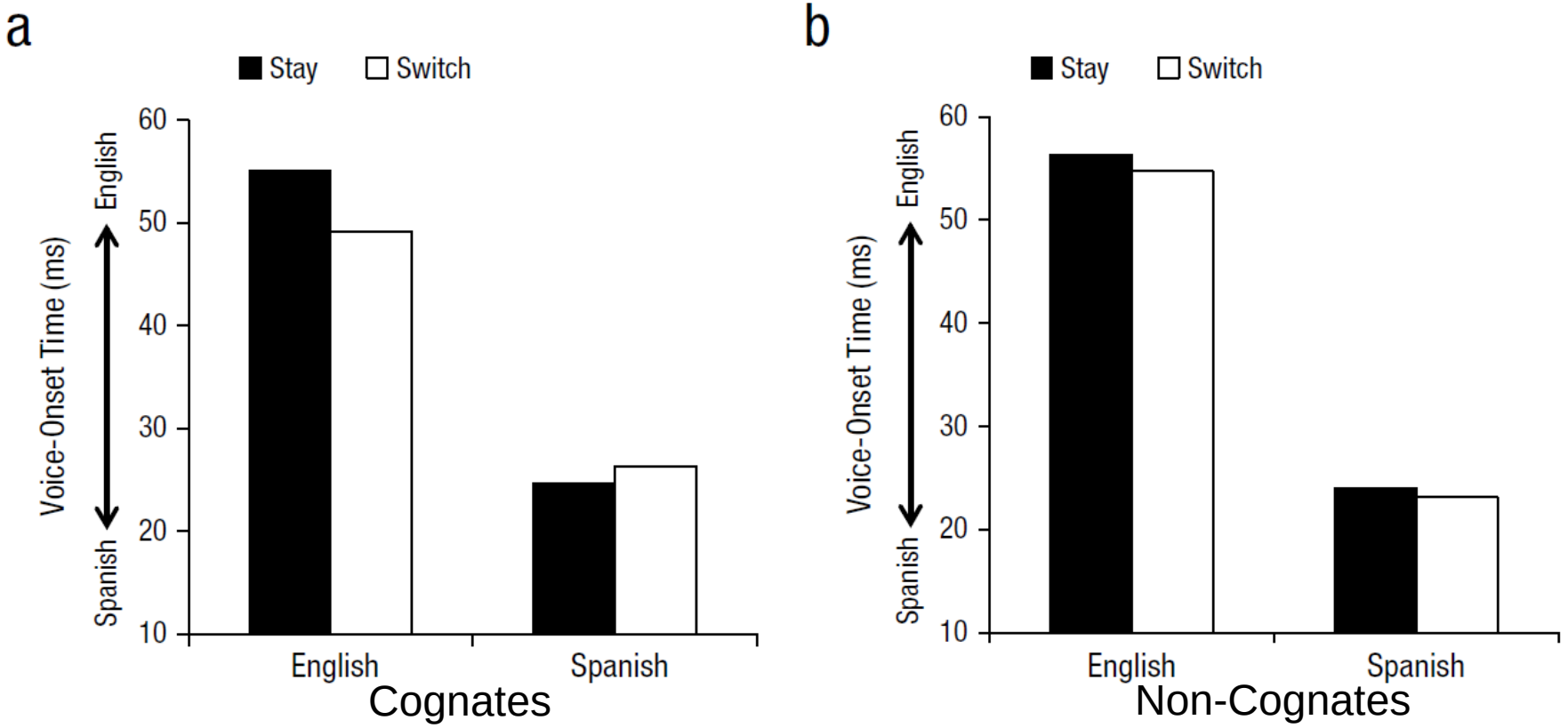
L1-L2 switches
L2-L1 switches
VOT in **L1**/**L2** switch trials
VOT in **L1**/**L2** non-switch trials
Also...
RTs at **L1**/**L2** switch trials
RTs at **L1**/**L2** non-switch trials



Language Switching Tasks

Bilingual picture naming (not speeded, asymmetric CLI)

Non-target representations (partially active during lexical access in picture naming) have an effect on phonetic processing > phonetic CLI (e.g. VOT)



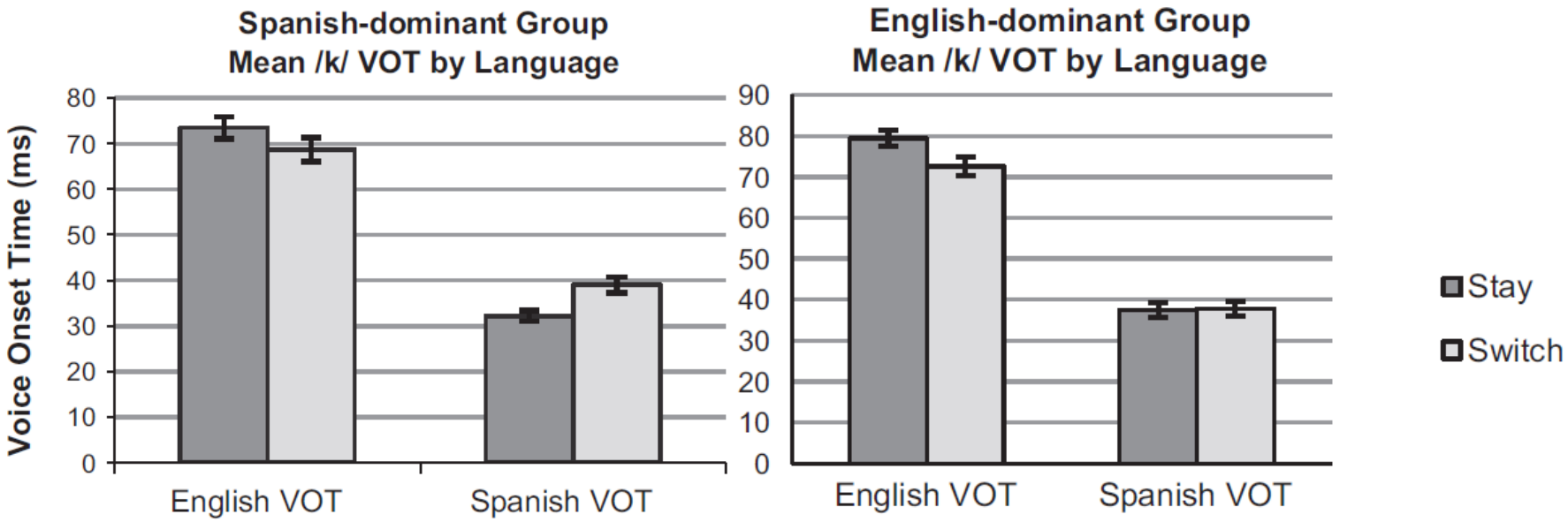
- Effects larger for switches into **non-dominant** language: VOT on English words is more Spanish-like (in a balanced context)

(Goldrick et al., 2014)

Language Switching Tasks

Bilingual picture naming (not speeded, asymmetric CLI)

Non-target representations (partially active during lexical access in picture naming) have an effect on phonetic processing > phonetic CLI (e.g. VOT)



- Larger phonetic CLI when switching between languages
- Effects larger for switches into **dominant** language: For Spanish-dominant speakers VOT on Spanish words is more English-like (if the context is biased towards English).

→ **asymmetries in degree of phonetic CLI!** (Olson, 2013)

Language Switching Tasks

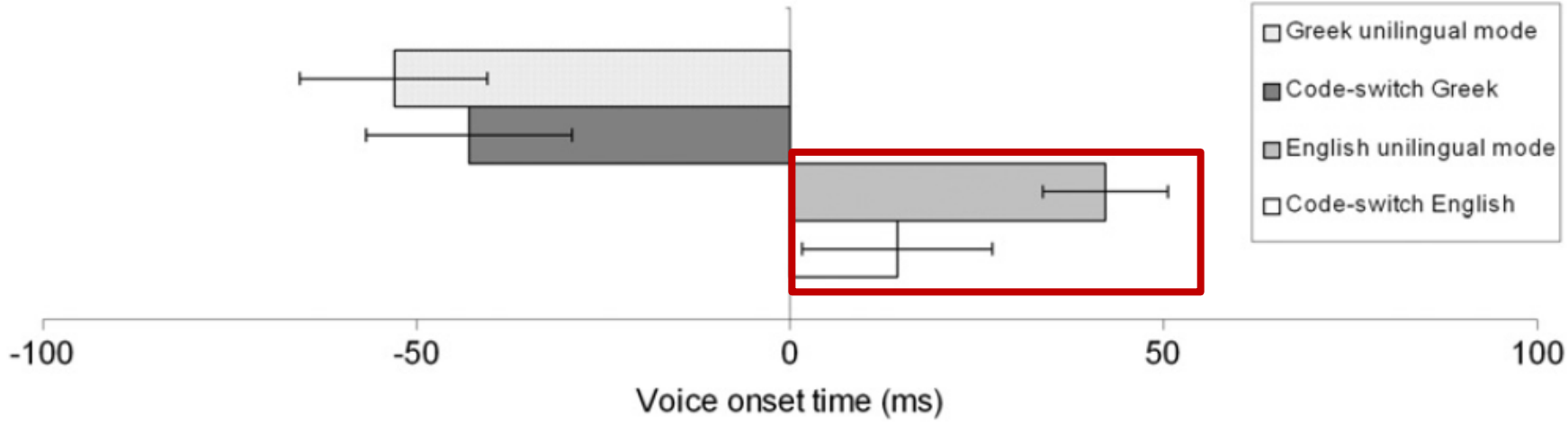
Code-switching in read-aloud tasks

Previously activated non-target representations may have an effect on phonetic processing > phonetic CLI (e.g. VOT)

Carrier sentences:

Greek target in English sentence *say* **πα** *again*

English target in Greek sentence λέει **pa** άλλο



(Antoniou et al, 2011)

Language Switching Tasks

Code-switching in read-aloud tasks

Previously activated non-target representations may have an effect on phonetic processing > phonetic CLI (e.g. VOT)

Code-switched sentences:

*Los viajeros | **p**acked their bags*

Spanish.....English.....

*The university | **p**aga muy poco a los empleados*

English.....Spanish.....

***T**odos mis amigos **t**alked Spanish as **k**ids*

Pre-switch	Switch
	Post-Switch

*The **t**yphoon damaged **t**echos y **p**aredes*

Pre-switch	Switch	Post-Switch

(Bullock et al, 2016)

Language Switching Tasks

Code-switching in read-aloud tasks

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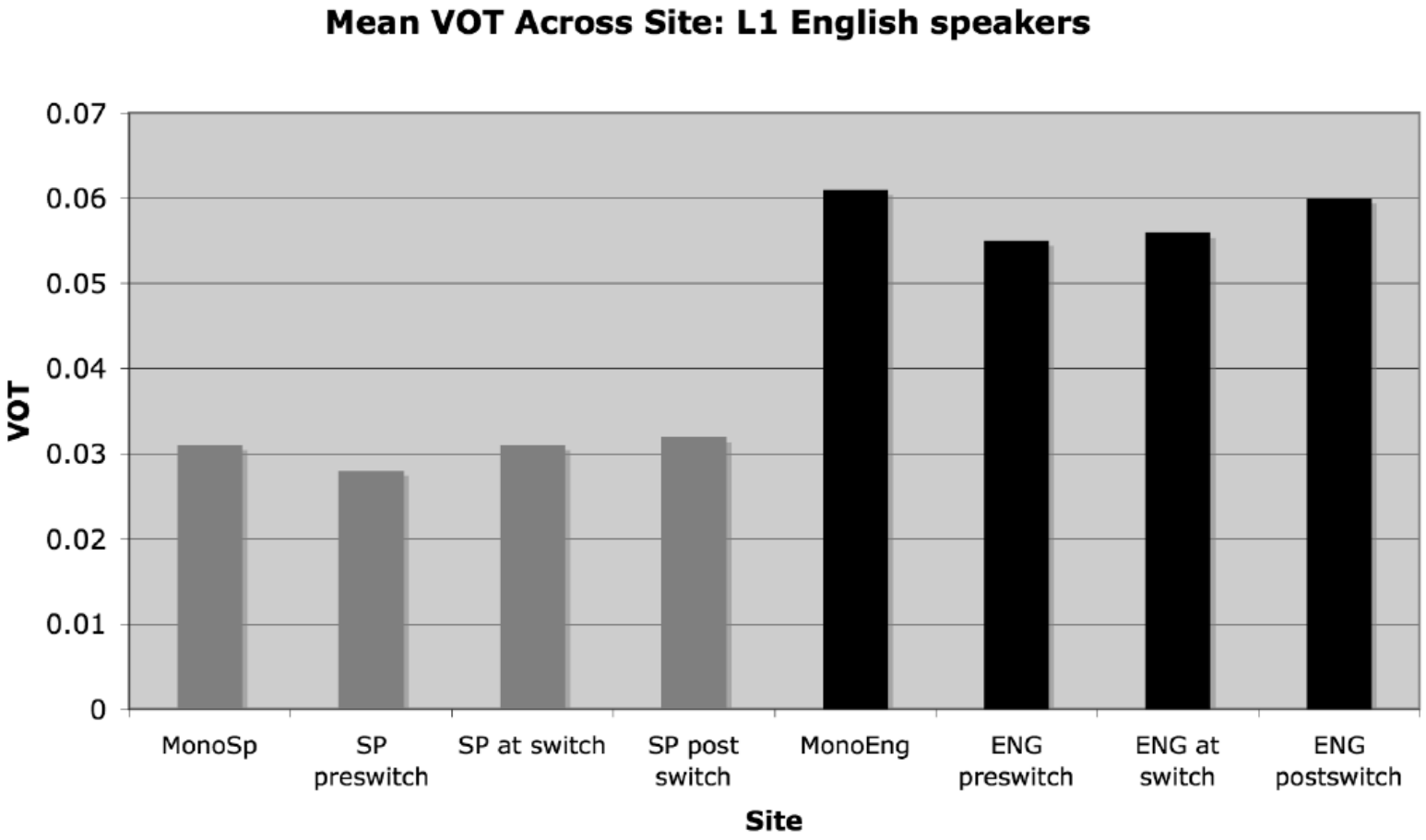

(Bullock et al, 2016)

Language Switching Tasks

Code-switching in read-aloud tasks

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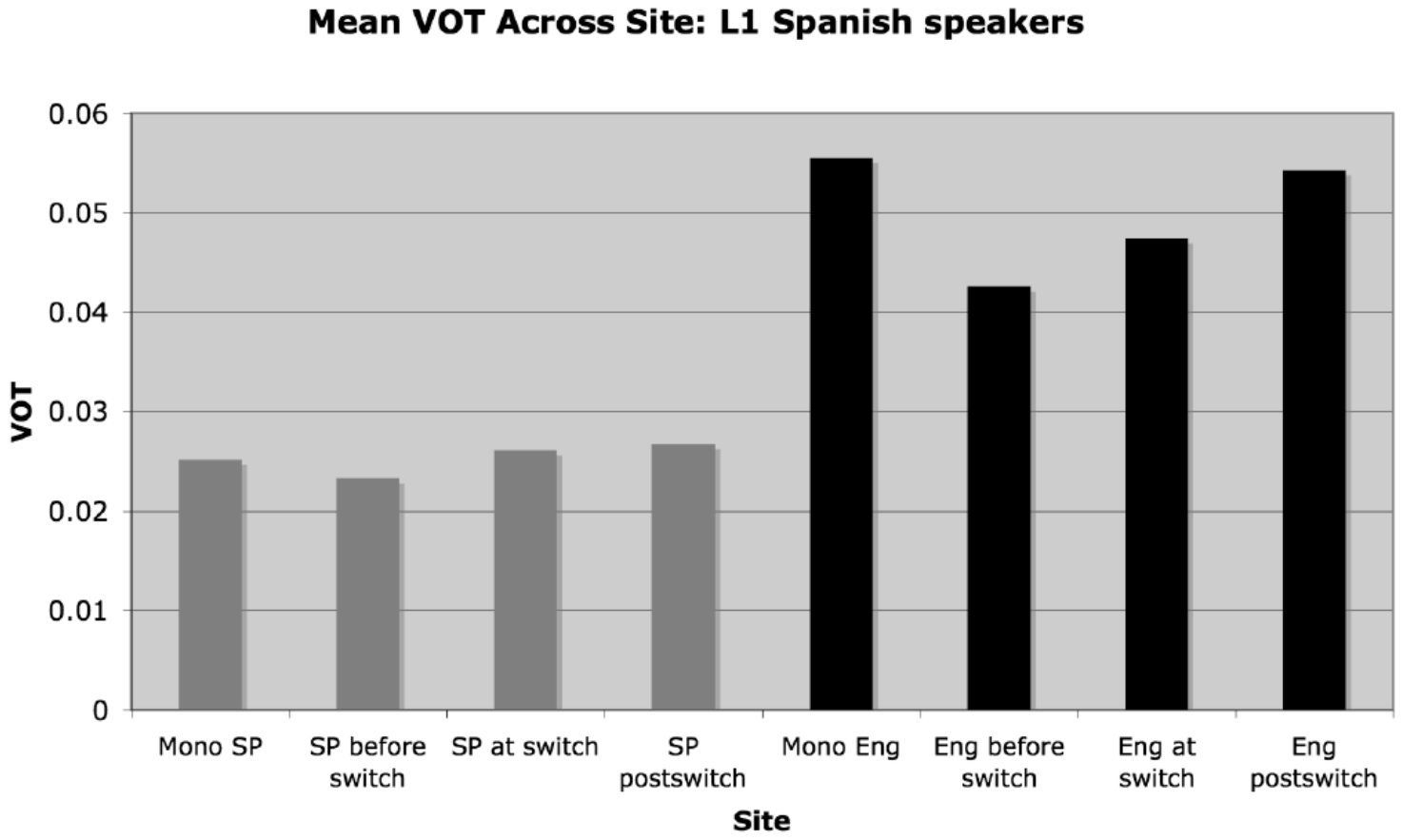


(Bullock et al, 2016)

Language Switching Tasks

Code-switching in read-aloud tasks

Read-aloud paragraph (error rate and language intrusions)

Grammatical Low-switch

He then lit it by striking un cerillo debajo del asiento de su chair. The truly meticulous manera en que hacía papá his cigarettes was indeed an art. He took his first puff, detuvo la respiración, and then exhaled smoke through his nose with a healthy satisfaction. Blowing smoke through his nose siempre me fascinaba. For me it was nothing short of a miracle. Me pregunté, how did he do it? Someday I would find out. Someday yo aprendería, porque todos los hombres learn how, and I would get to be a man como mi padre.

(Gollan & Goldrick, 2016)

Language Switching Tasks

Code-switching in read-aloud tasks

Read-aloud paragraph (error rate and language intrusions)

Ungrammatical High-switch

Luego lo lit by striking a match debajo del seat of his chair. The verdadera meticulous manner in which Dad rolled his cigarrillos era un art. He dio el primer puff, held his breath, and luego echó humo through his nose with a healthy satisfaction. Blowing humo through his nose always me fascinaba. For me it was nothing short de un miracle. I asked myself, ¿cómo did he do it? Someday yo would find out. Someday yo aprendería how, because all hombres learn how, and I would get to be a hombre como mi papá.

(Gollan & Goldrick, 2016)

Language Switching Tasks

Code-switching in read-aloud tasks

Not tested for phonetic CLI !

(Gollan & Goldrick, 2016)

Language Switching Tasks

What we know from research on code-switching:

- Asymetries (in RT & phonetic CLI) occur as a function of differences in language proficiency / dominance.
- Size of asymmetries could vary as a function of inhibitory control:
  Weaker inhibitory control → greater phonetic CLI (to be investigated!)

Can the code-switching paradigm be used to test hypothesis about phonetic interference in L3 phonology?

- **Language dominance**
- **Order of acquisition**
- **L1 / L2 primacy?**

- What factors influence phonetic interference in code-switching?
  - Language proficiency / dominance
  - Context biases & language modes
  - Individual differences in: inhibitory control
    attention
    WM (PSTM)

L3 phonology?

Factors in L2 / L3 phonological development

Contextual factors (in L2):

Age- and experience-related factors

- **L1 background**
- **Age of Onset of L2 learning**
- **L2 exposure (Length of Residence)**
- **Frequency/amount of L1/L2 use**

→ **Immigrant populations living in L2 community**

(Baker et al., 2008; Baker and Trofimovich, 2005; Flege 2009; Flege, Bohn, & Jang, 1997, Flege, Yeni-Komshian, & Liu, 1999; Guion et al., 2000; Moyer 2009; among others)

→ **The earlier the better for L2 phonology**

→ **Higher L2 quality and quantity input received is better**

→ **Does this apply to L3 phonological development?**

Factors in L2 / L3 phonological development

Contextual factors:

- Instructed SLA :
> Classroom instruction
> Short-term immersion /study abroad

→ **Student populations in Foreign Language**

(Avello, 2013; Avello, Mora & Pérez-Vidal, 2012; Bongaerts, van Summeren, Planken, & Schils, 1997; Cebrian, 2006; Díaz-Campos, 2004; Fullana, 2006; García-Lecumberri & Gallardo, 2003; Højen 2003; Llanes, Mora & Serrano, 2016; Llanes & Muñoz, 2013; Mora, 2008; Muñoz & Llanes, 2009; Piske, 2007; among others)

→ **Very limited gains in L2 phonology**

> Phonetic training in the lab (esp. high variability)

→ **Adult learners in L1 & L2 contexts**

(Bradlow et al. 1999; Hazan et al., 2005; Iverson and Evans 2009; Logan et al. 1991; Ylinen et al. 2010; among others)

→ **Robust gains in L2 speech perception and production**

Factors in L2 / L3 phonological development

Very large inter-subject variation even in the LAB context where input and exposure factors are tightly controlled in the experimental design.

Bradlow, Akahane-Yamad, Pisoni & Tohkura, 1997; Golestani & Zatorre, 2009; Hazan & Kim, 2012; Kim & Hazan, 2010; MacKay, Meador & Flege, 2001; Pallier, Bosch & Sebastián-Gallés, 1997; Polka, 1991)

Individual factors:

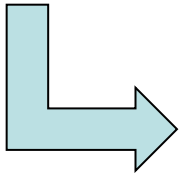
- **Motivation**
- **Personality (extroversion, introversion)**
- **Musicality (singing and musical ability)**
- **Sound processing skills (auditory acuity, frequency discrimination)**
- **Imitation skills (aptitude for oral mimicry)**
- **Cognitive skills (memory, attention, inhibition)**
- **…..** → **in L3 phonological processing and acquisition**

(Bongaerts et al., 1997; Christiner & Reiterer, in press; Hazan & Kim, 2012; Kim & Hazan, 2010; Lengeris & Hazan, 2010; Moyer, 1999; Gottfried, 2007; Slevk and Miyake, 2006; Reiterer et al. 2011; Hu et al. 2013

Factors in L2 / L3 phonological development

Cognitive factors (IDs in executive function):

- **Working memory - Phonological short-term memory**
- **Acoustic memory**
- **Attention Control: attention switching, selective attention**
- **Inhibitory control**
- **…**



Cognitive resources likely to be used in L2/L3 speech processing.

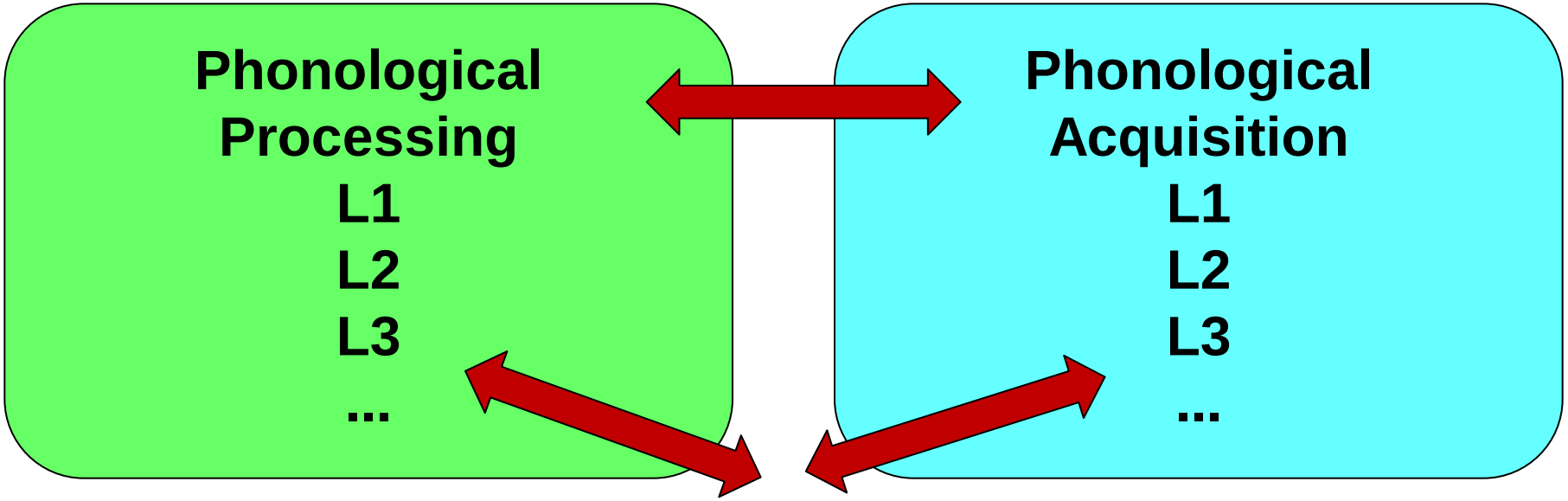
(Cerviño-Povedano & Mora, 2011; Darcy et al. 2016; Lev-Ari & Peperkamp, 2013, 2014; MacKay et al., 2001; Masoura & Gathercole, 1999; Mora & Darcy, 2016; Papagno & Vallar, 1995; Safronova & Mora, 2013; Segalowitz 1997; Service 1992;)

Factors in L2 / L3 phonological development

Do IDs in EF mediate CLI in L3?

e.g. Inhibitory Control / Attention / PSTM / ...

EFs Important for L2/L3 speech processing & acquisition



Code-Switching Tasks

(testing cross-language phonetic interference)

(testing predictions of L3 models)

(testing production & perception in L3 phonology)

Attention & Inhibition in L2 / L3 phonology

Cognitive factors: Attention (ATT) & Inhibition (INH)

Phonological Processing

- ATT → guides auditory processes in selecting acoustically relevant information for phonological processing
  (Akeroyd, 2008; Astheimer et al. 2016; Baese-Berk et al., 2015; Bialystok et al., 2012).
- ATT → facilitates perceptual learning
  (Adank & Janse, 2010; Francis & Nusbaum, 2002; Francis et al. 2000; Janse & Adank, 2012)
- ATT → facilitates processing of L2 phonological contrasts
  (Darcy et al., 2015; Safronova & Mora, 2013; Ou et al., 2015)
- ATT → selection of cross-linguistically co-activated representations
  (Kroll et al, 2008)
- INH → diminishes cross-language interference in lexical selection and phonological processing.
  (Mercier et al., 2013; Spivey & Marian, 1999)

WM (PSTM) is by far the most widely researched EF in SLA & L2 phonology

Attention & Inhibition in L2 / L3 phonology

Cognitive factors: Attention (ATT) & Inhibition (INH)

Phonological Acquisition

- INH → diminished CLI in long-term immersion
(Lev-Ari & Peperkamp, 2013, 2014)
- INH → reduced access to L1 phonology during L2 processing and use.
(Levy et al., 2007)
- INH → modulates amount of cross-language interference.
- INH & ATT → enhanced L2 phonological processing in instructed SLA
(Darcy & Mora 2016; Mora & Darcy, 2016).

Recent data on L3 phonological processing:

- IDs in INH & ATT

- Language Switching Tasks

- L1 degree of dominance in bilingual context

- L3 English in instructed SLA

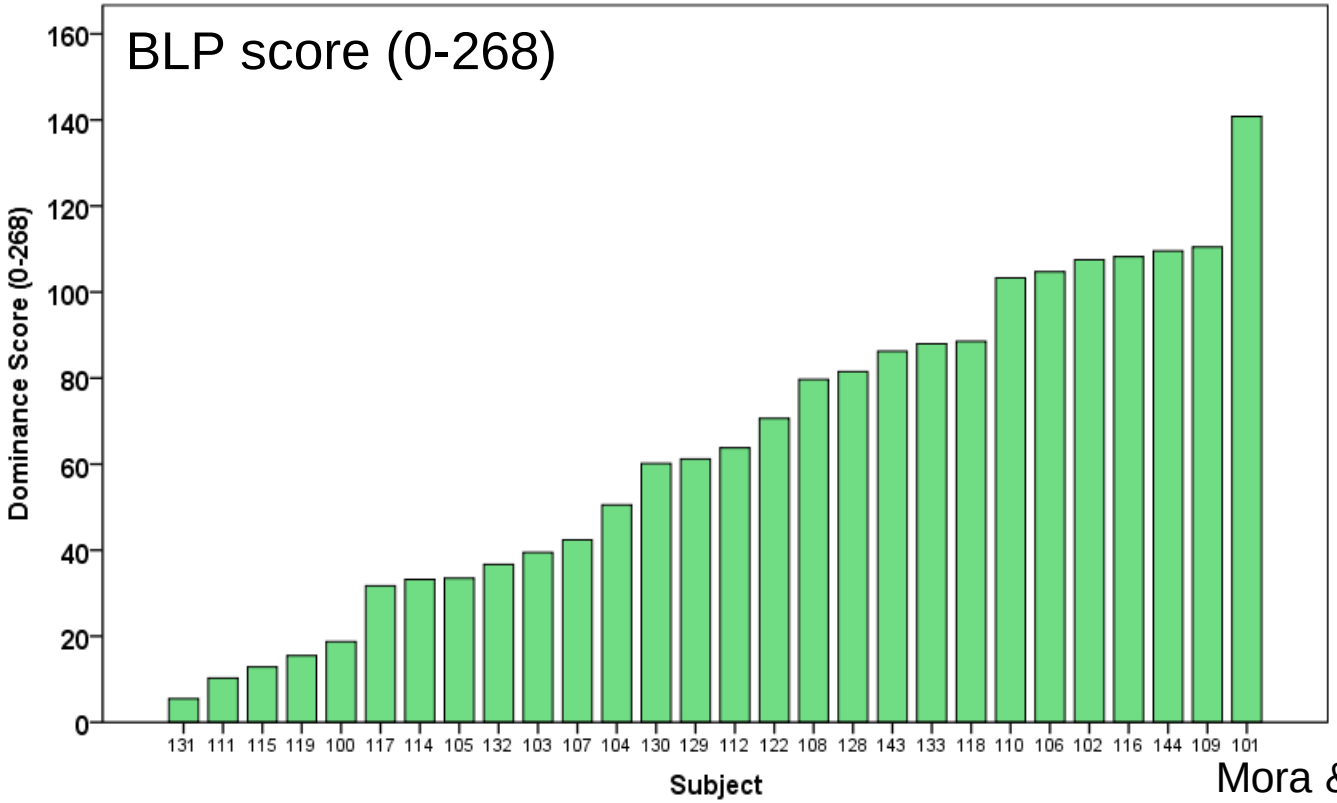
On-going study on IDs & L3 phonology

Participants:

- 29 L1-Catalan dominant Catalan-Spanish bilinguals selected from a larger pool of bilinguals varying in degree of dominance in Cat / Sp

- Bilingual Language Profile (BLP) questionnaire adapted: scores 0-268 (Bridsong et al. 2012; Safronova, 2016).

- L1 = Catalan, L2 = Spanish, L3 = English (sequential bilinguals)



Mora & Darcy (in prep.)

On-going study on IDs & L3 phonology

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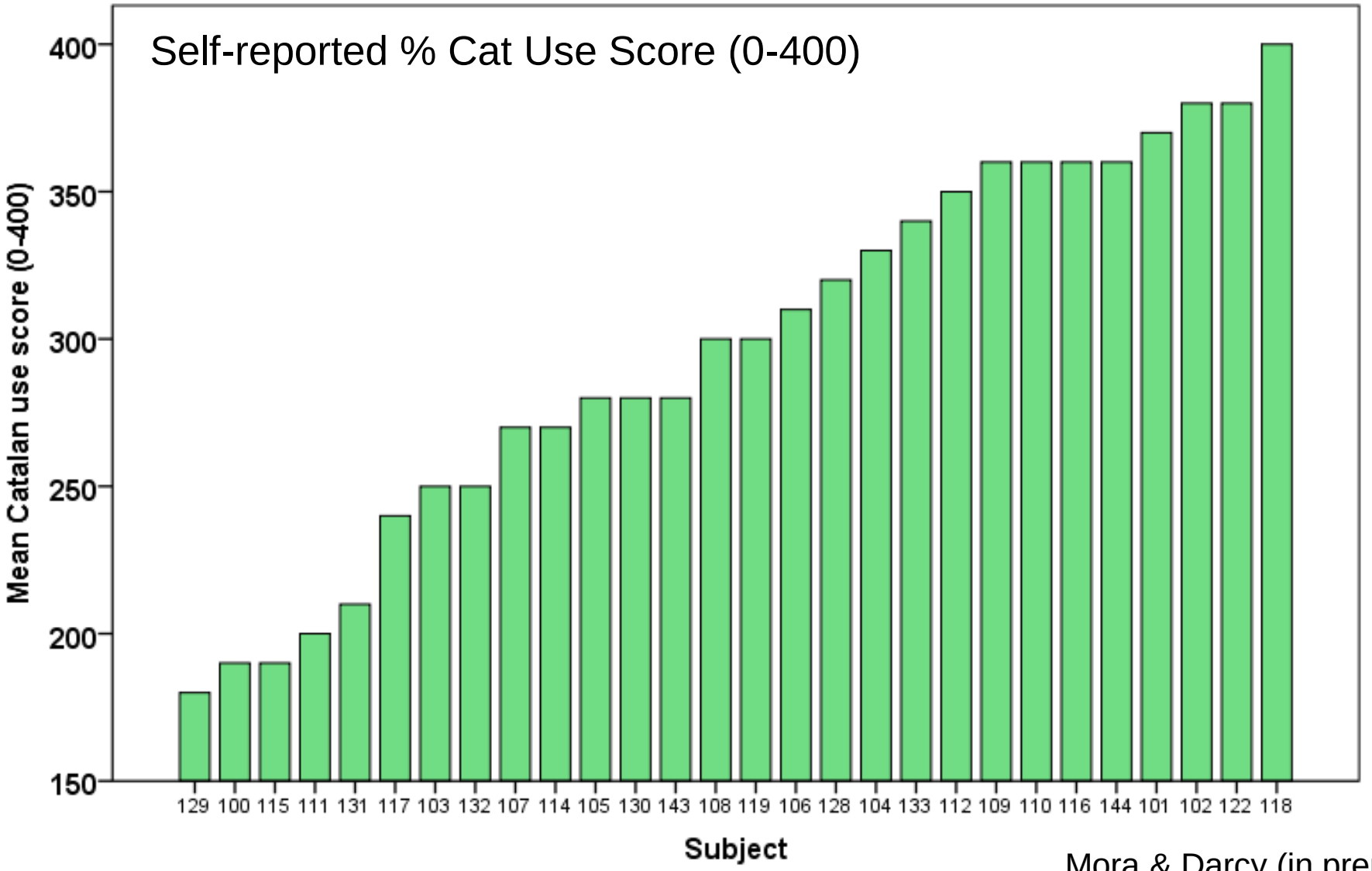

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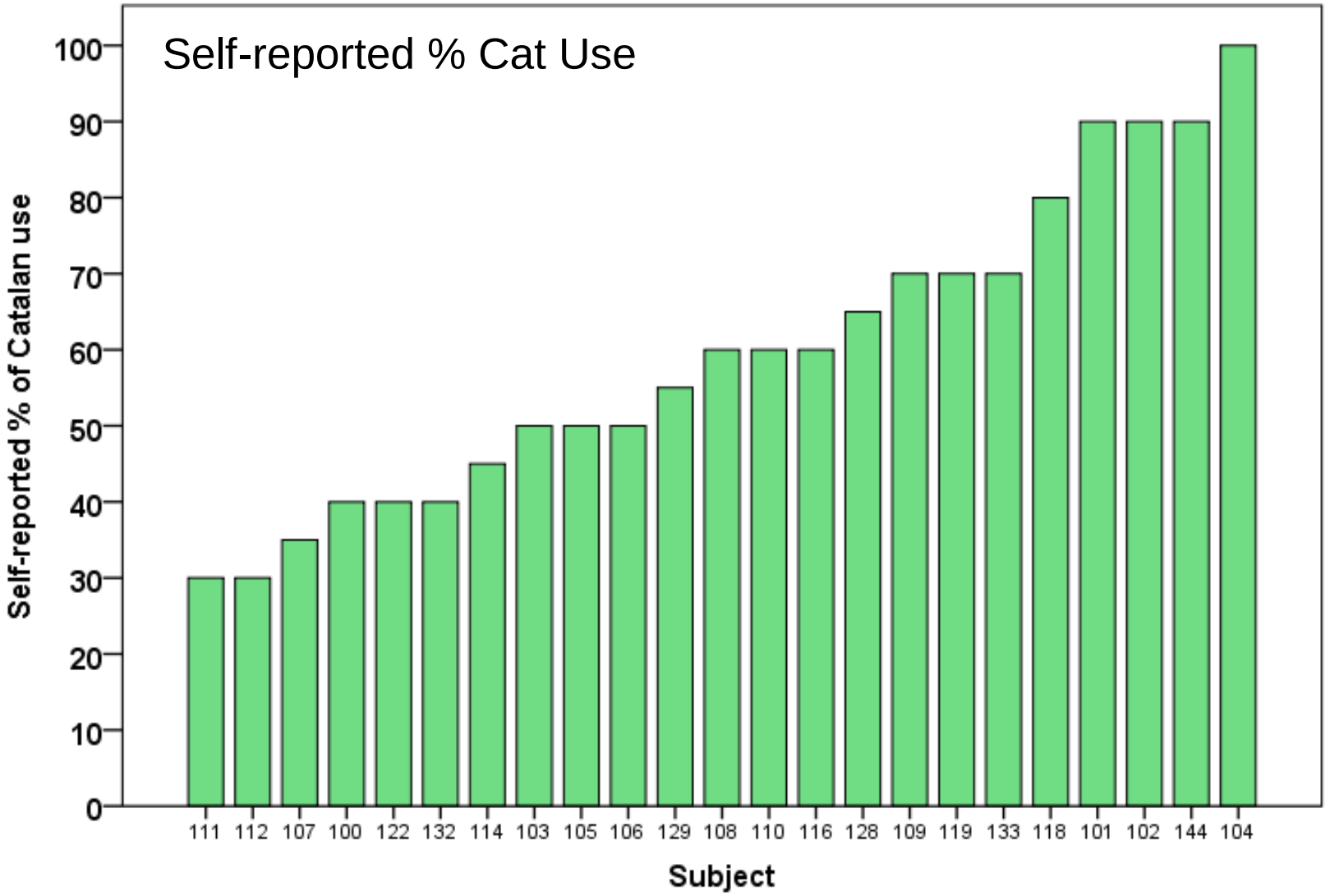

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On-going study on IDs & L3 phonology

Tasks

L3 Phonology
/iː/-/ɪ/; /æ/-/ʌ/
VOT

Perception
- ABX discrimination
- Lexical Decision

Production
- VOT in picture naming

Attention

Domain-general
- Flanker

Linguistic
- Auditory stroop

Inhibition

Domain-general
- Simon

Linguistic
- Retrieval-ind. forgetting
- Auditory inhibition

Mora & Darcy (in prep.)

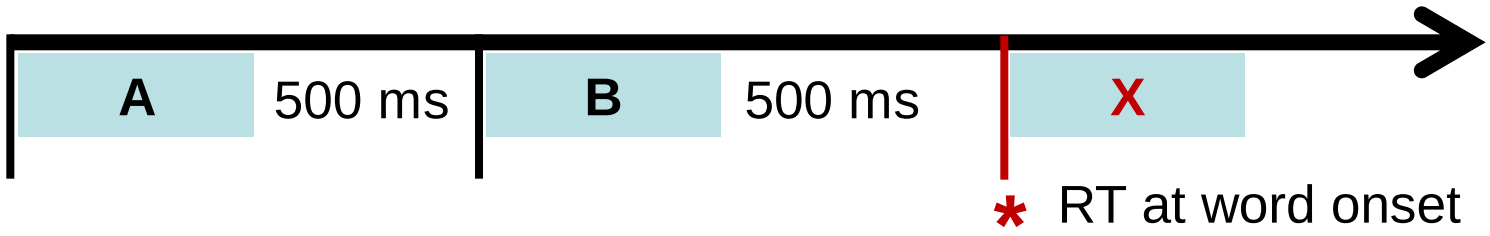
L3 Phonology: ABX categorical discrimination

ABX categorical discrimination task (forced choice) tests perceptual sensitivity to a pair of contrasting sounds:

X = male/female voice different from **A** or **B**

Nonwords presented at **ISI** = 500 ms

ABB	/ləˈpiːfən/	/ləˈpɪfən/	/ləˈpɪfən/
ABA	/ləˈpiːfən/	/ləˈpɪfən/	/ləˈpiːfən/
BAA	/ləˈpɪfən/	/ləˈpiːfən/	/ləˈpiːfən/
BAB	/ləˈpɪfən/	/ləˈpiːfən/	/ləˈpɪfən/



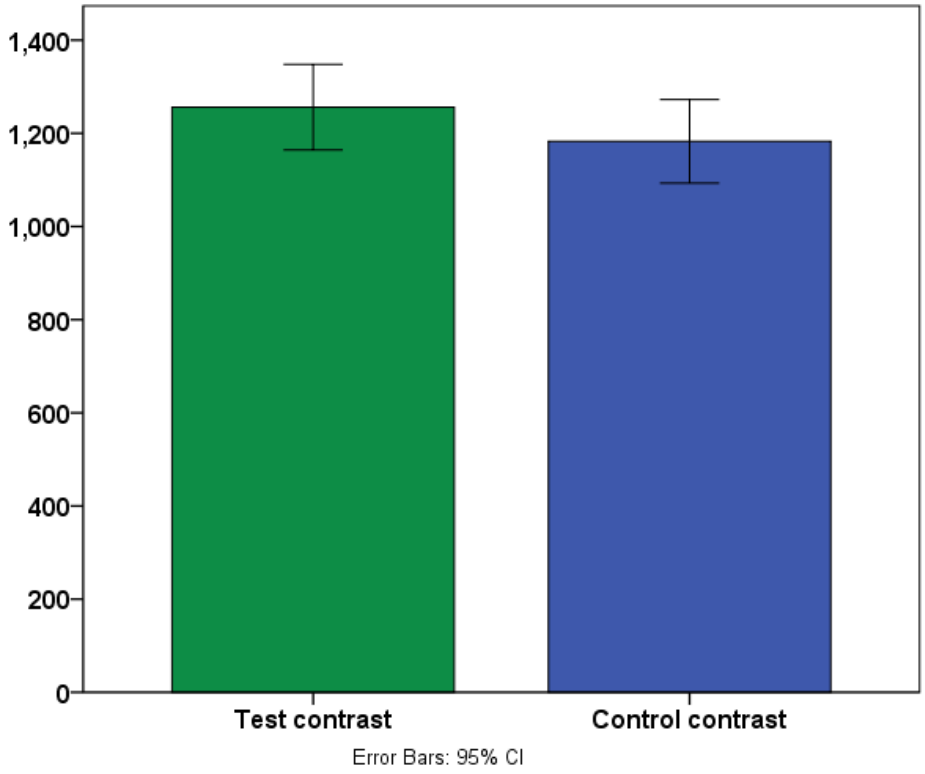
Measures:
- Accuracy (proportion correctly identified **X**s)
- RT in milliseconds (from **X** onset)

Mora & Darcy (in prep.)

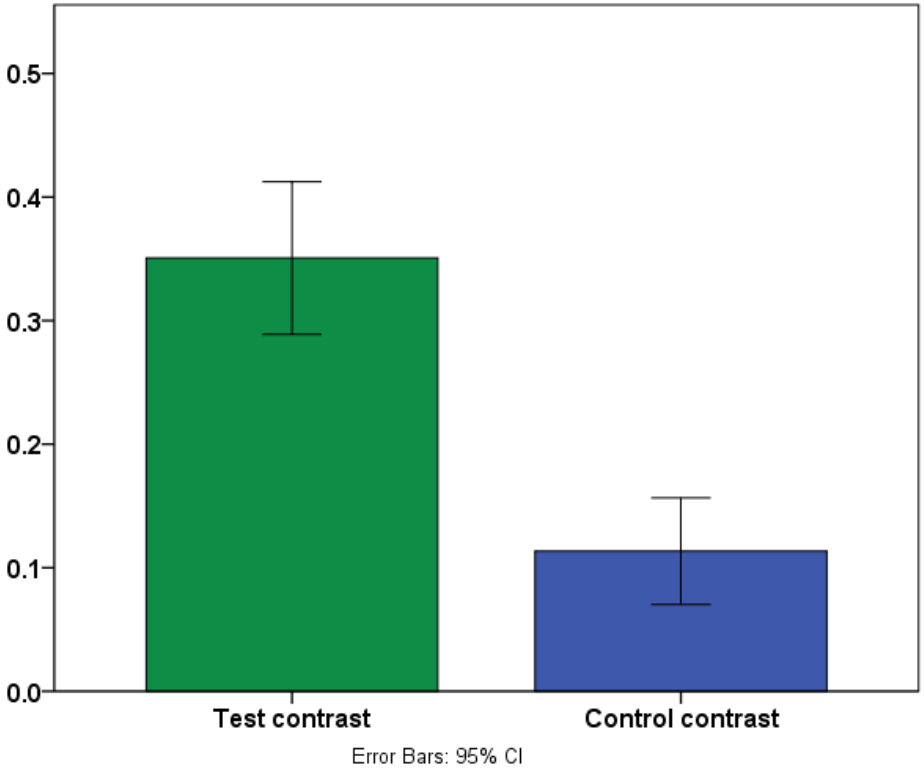
L3 Phonology: ABX categorical discrimination

Results

RT (milliseconds)



Error Rate (proportion)



Mora & Darcy (in prep.)

L3 Phonology: ABX categorical discrimination

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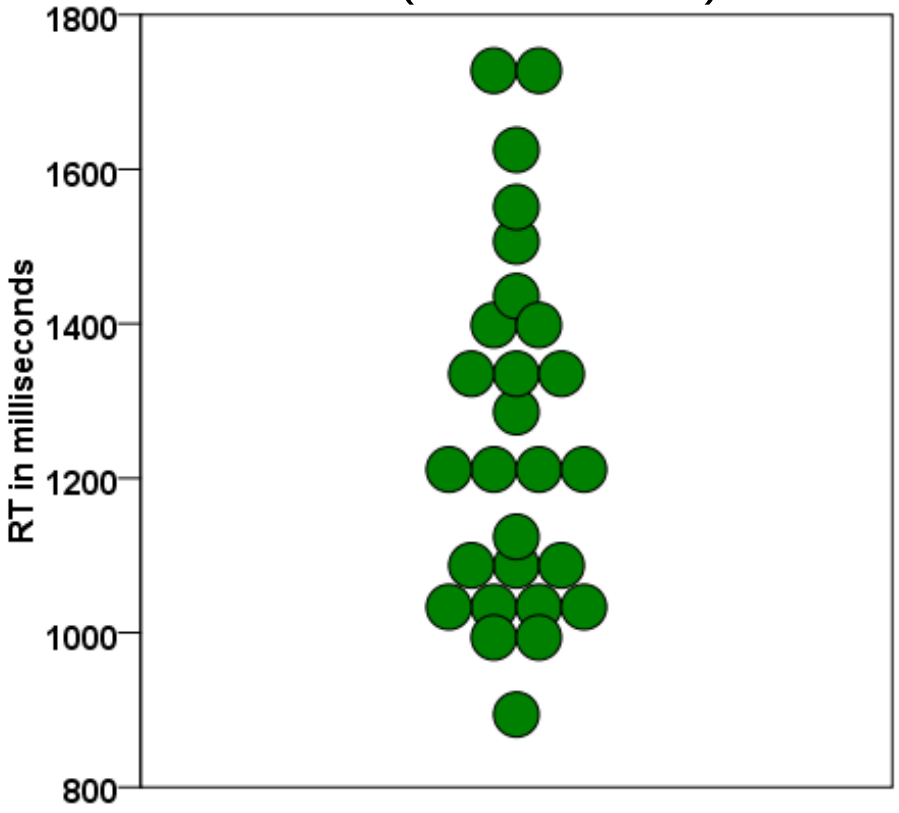

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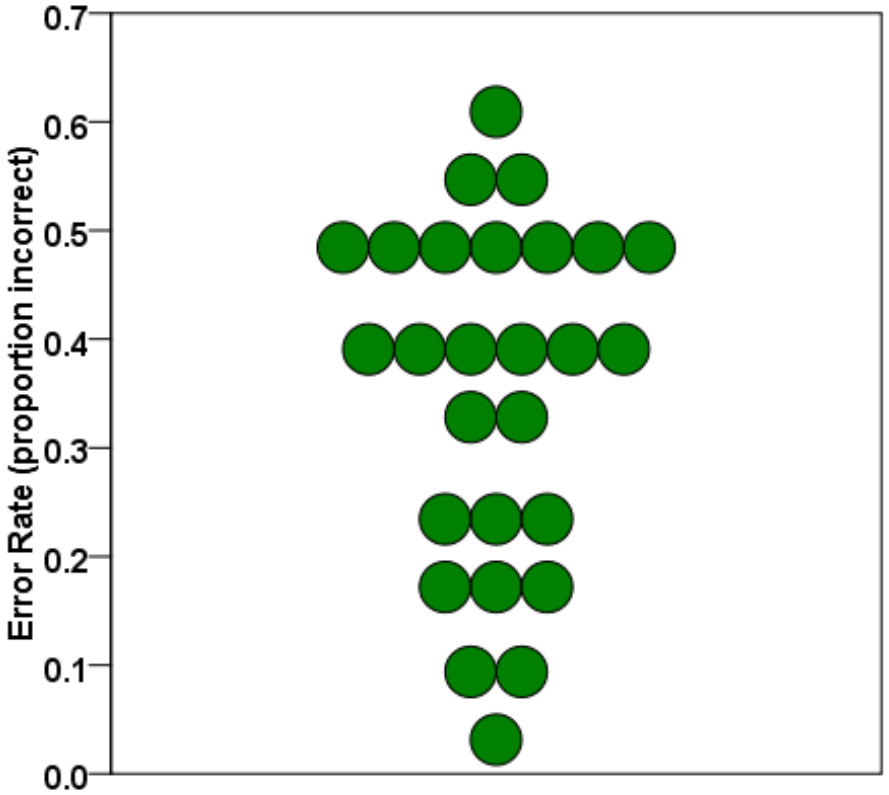
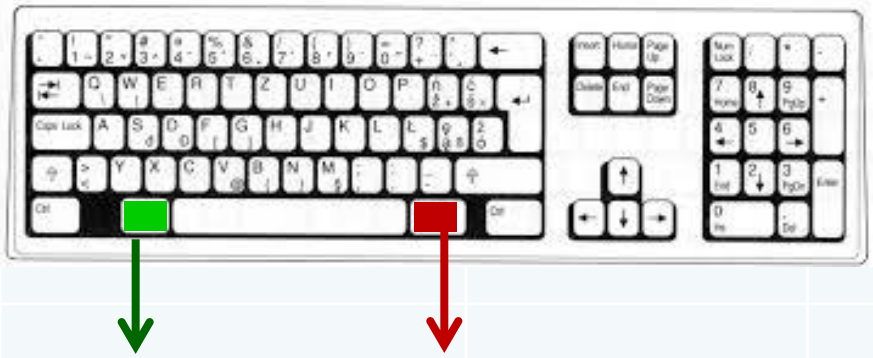


Mora & Darcy (in prep.)

L3 Phonology: Lexical Decision

Auditory presentation of test (target /i:/-/ɪ/ contrast) and control (/ɪ/-/æ/) words and nonwords (words with changed vowels):

	word /ɪ/	nonword /i:/	word /i:/	nonword /ɪ/
1	gift	geeft	leaf	liff
2	kiss	keess	please	pliz
3	drip	dreep	beam	bim
4				
5				
...				



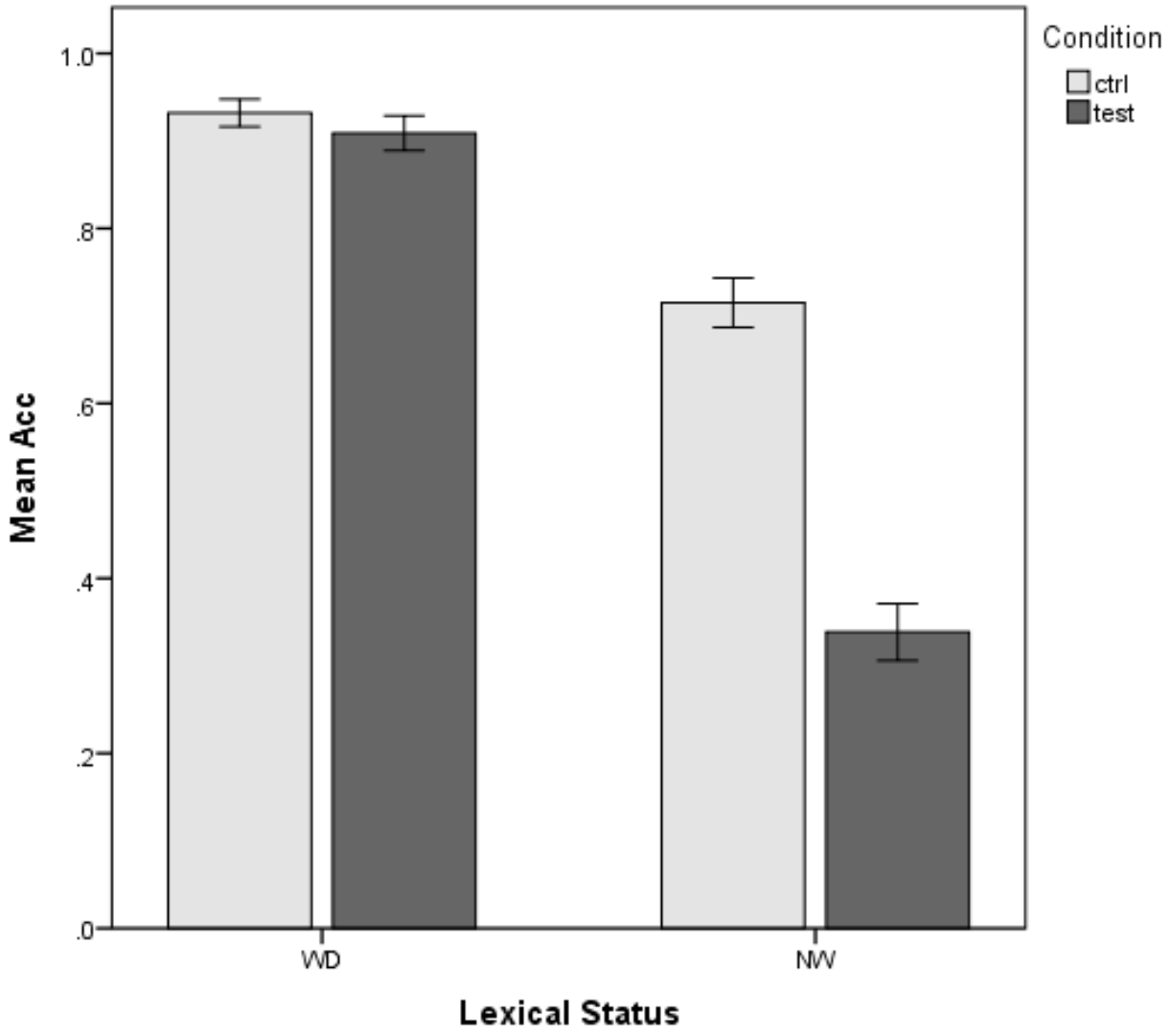
word non-word 124 trials

Measures:
- Accuracy (proportion correctly identified **nonwords**)
- RT in milliseconds (from **trial** onset)

Mora & Darcy (in prep.)

L3 Phonology: Lexical Decision

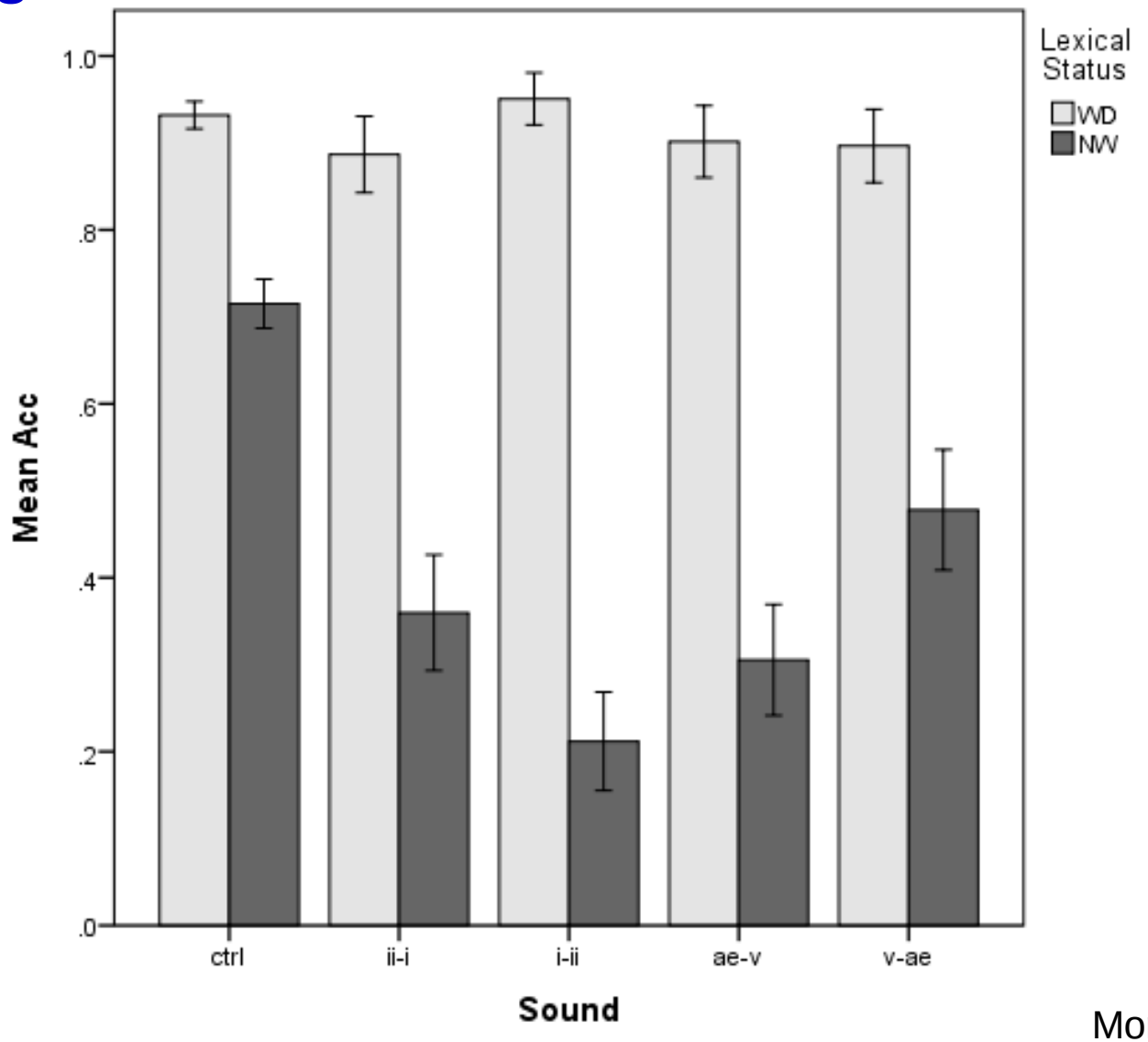
Results



. & Darcy (in prep.)

L3 Phonology: Lexical Decision

Results



Mora & Darcy (in prep.)

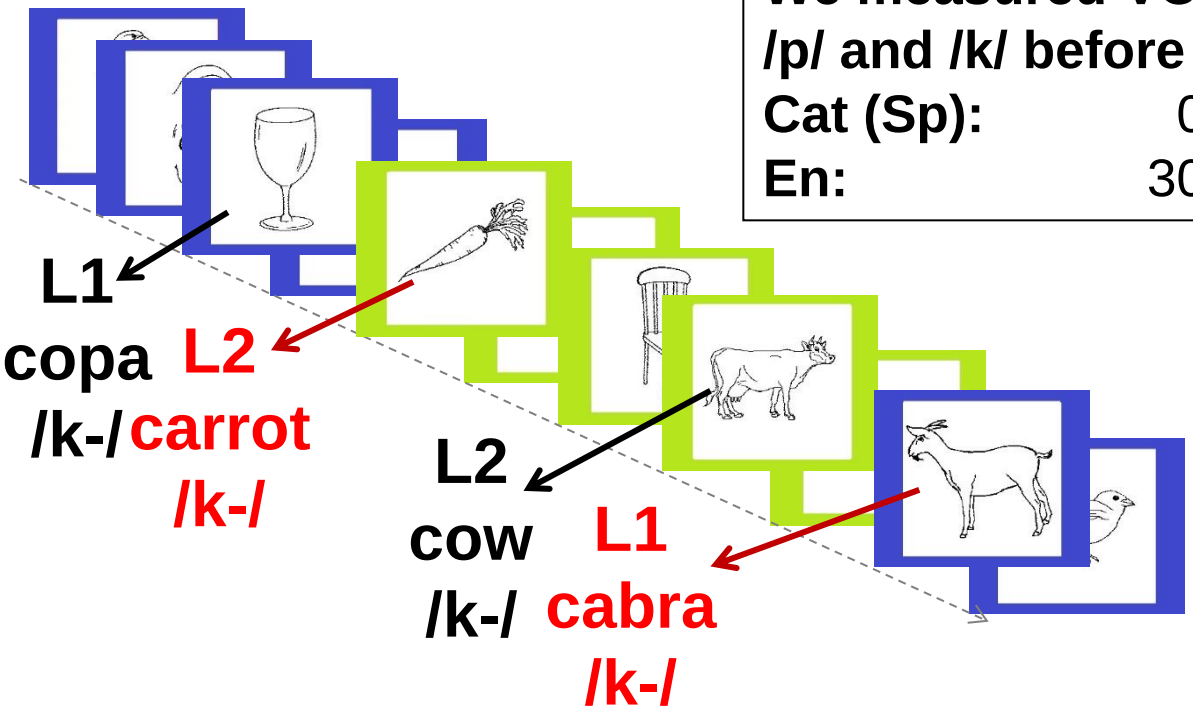
L3 Phonology: bilingual picture naming

- Trial Types
  - Switch ⟷ Non-Switch
- Naming Language
  - Catalan (L1) ⟷ English (L3)
- Language switches occurred unpredictably

We measured VOT on word-initial /p/ and /k/ before stressed Vs:

Cat (Sp): 0-25 ms (short-lag)

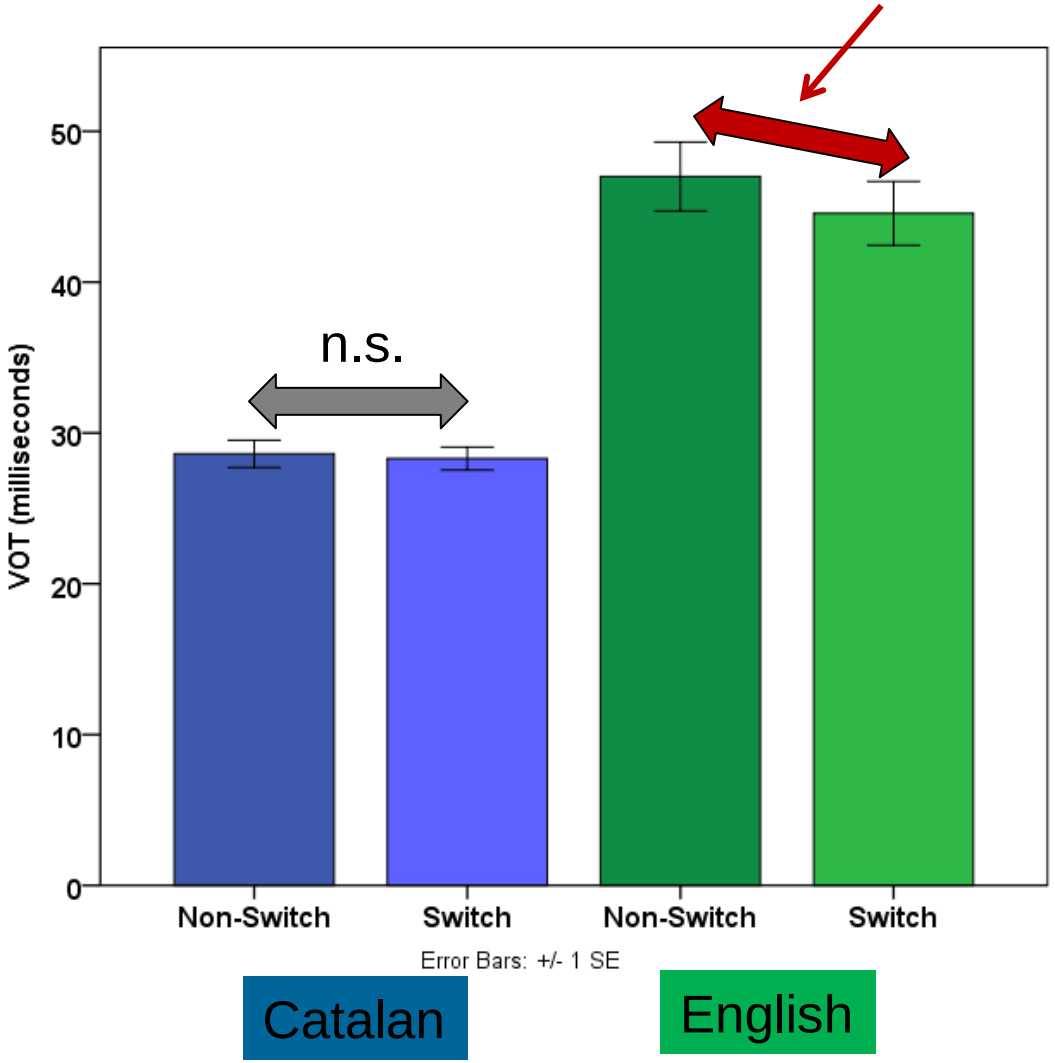
En: 30-80 ms (long-lag)



L3 Phonology: bilingual picture naming

Results

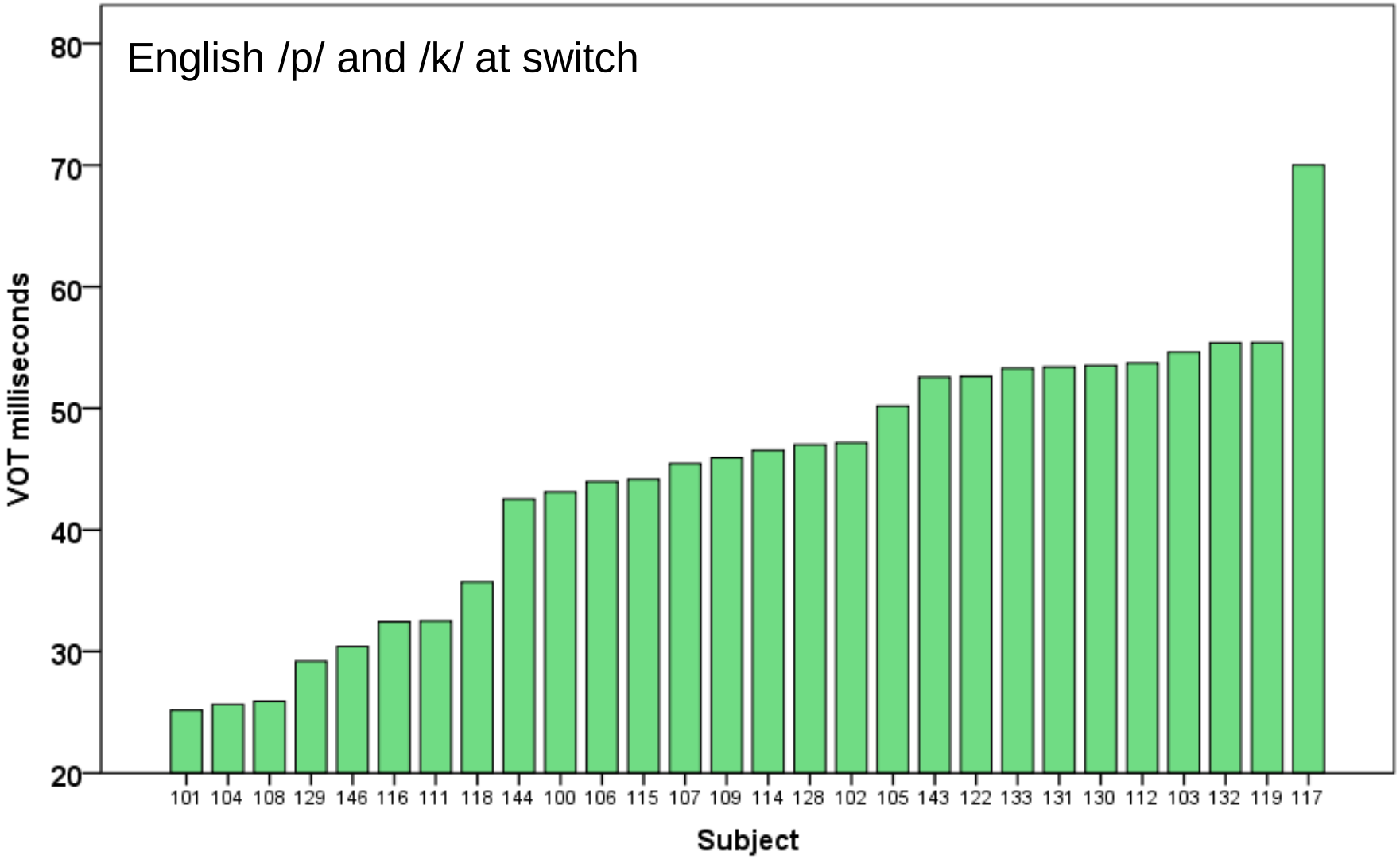
A switching cost was only observable for English. VOT in English was significantly was shorter after naming in Catalan.



- L1 > L2 CLI only;
- no L2>L1 CLI

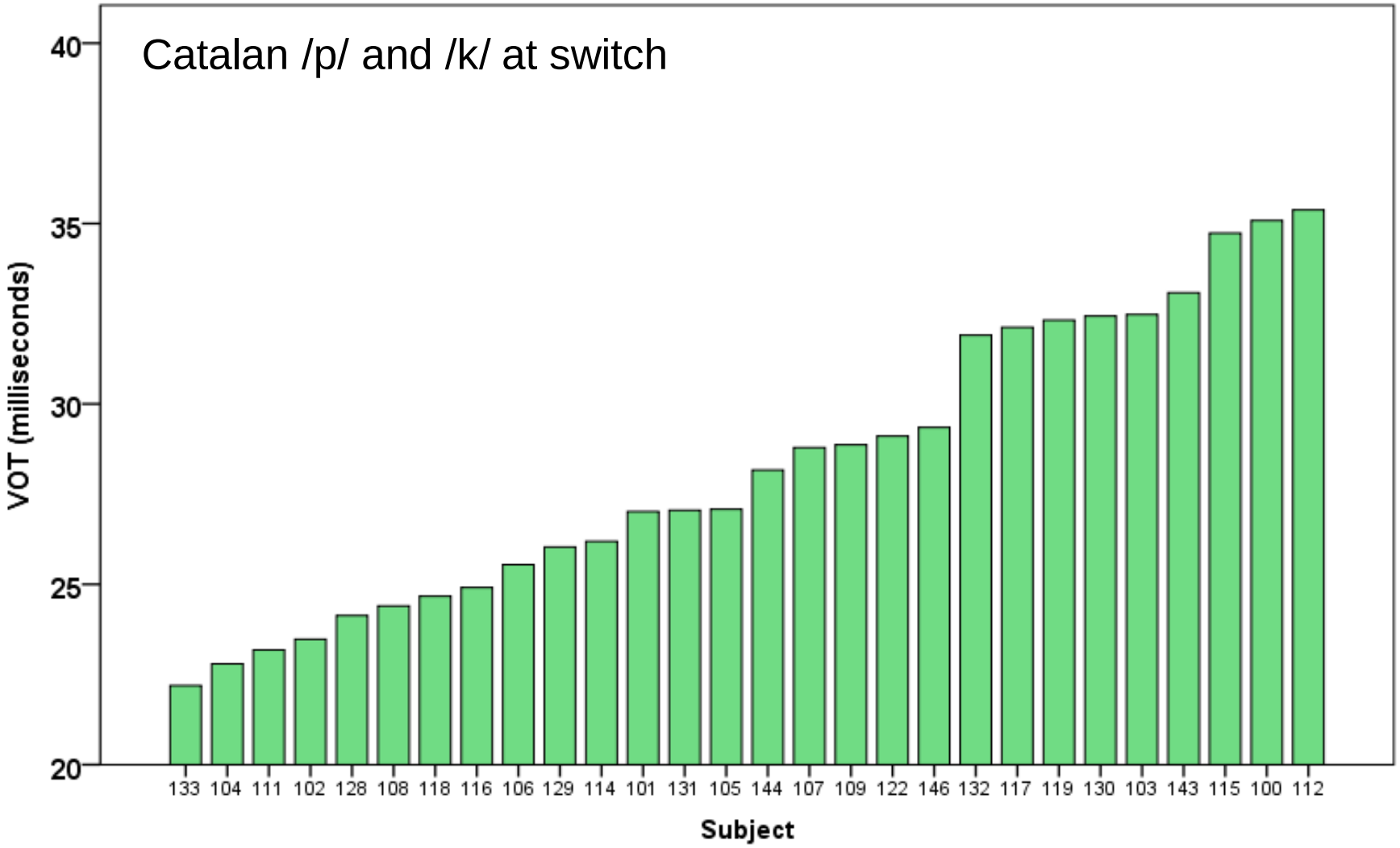
L3 Phonology: bilingual picture naming

Results



L3 Phonology: bilingual picture naming

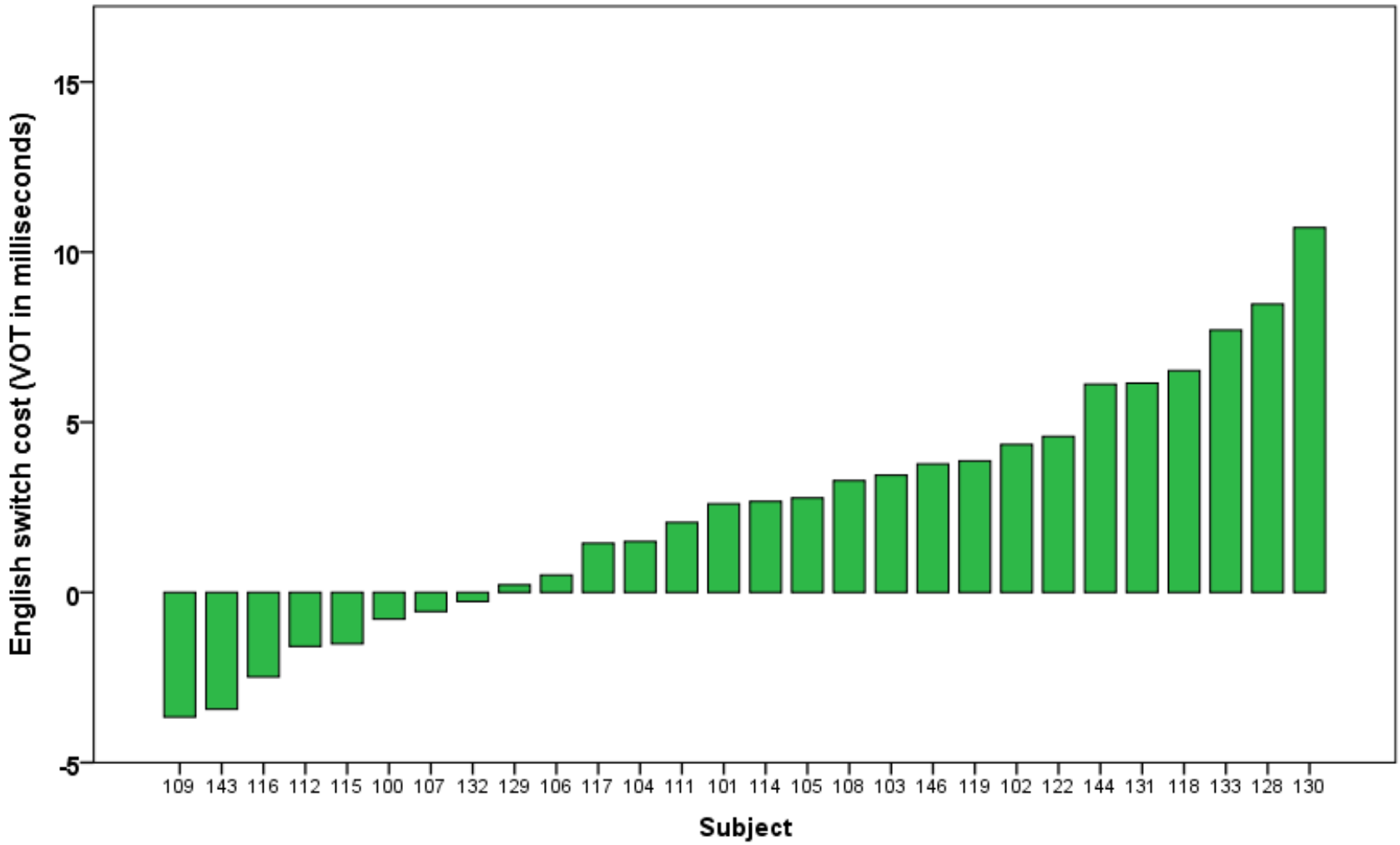
Results



L3 Phonology: bilingual picture naming

Results

English naming switch cost (English non-switch minus English switch VOT)



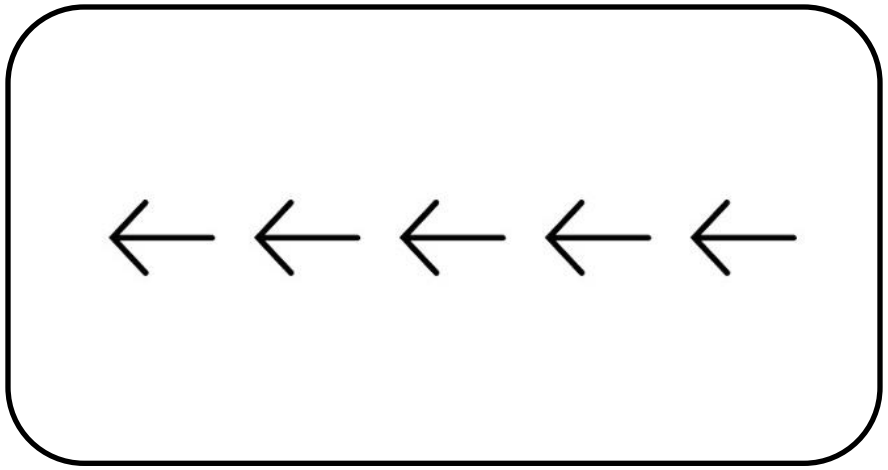
Attention: Flanker (domain general)

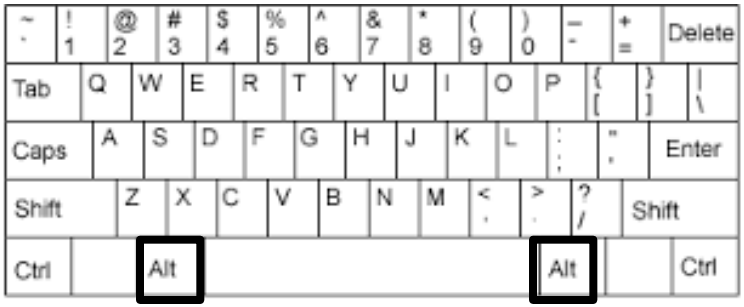
Ability to ignore visual information in the background

Look at the arrow in the centre.

Press the left key for the left-pointing arrow, as fast as you can.

Press the right key for the right-pointing arrow, as fast as you can.





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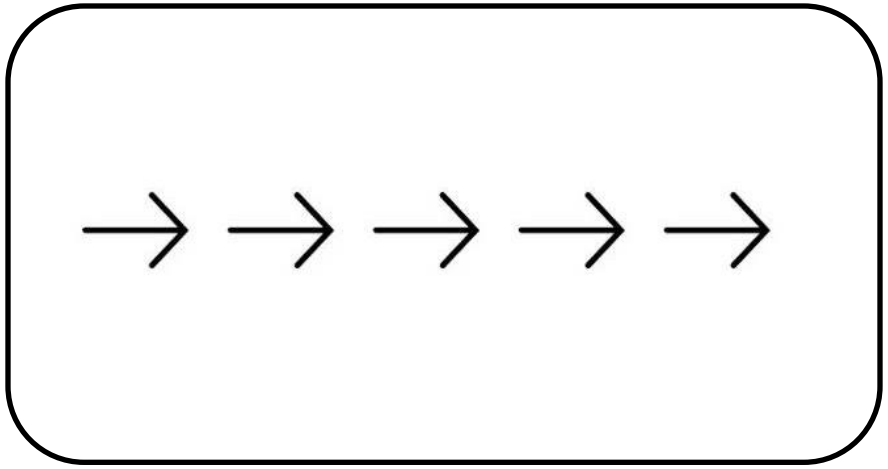

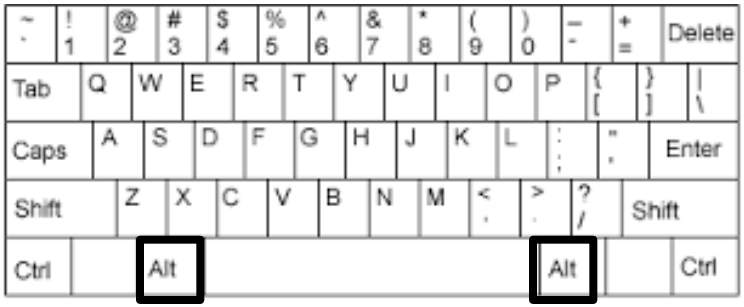

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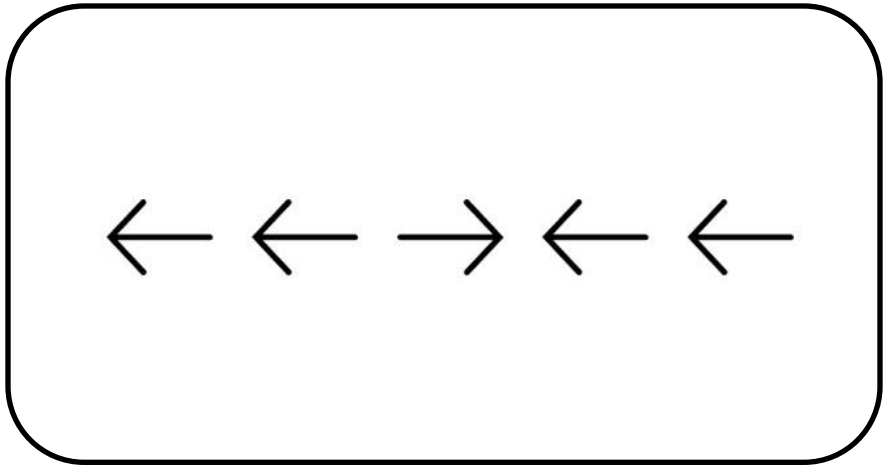

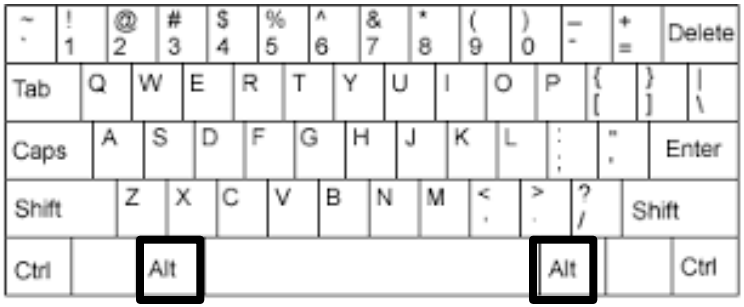

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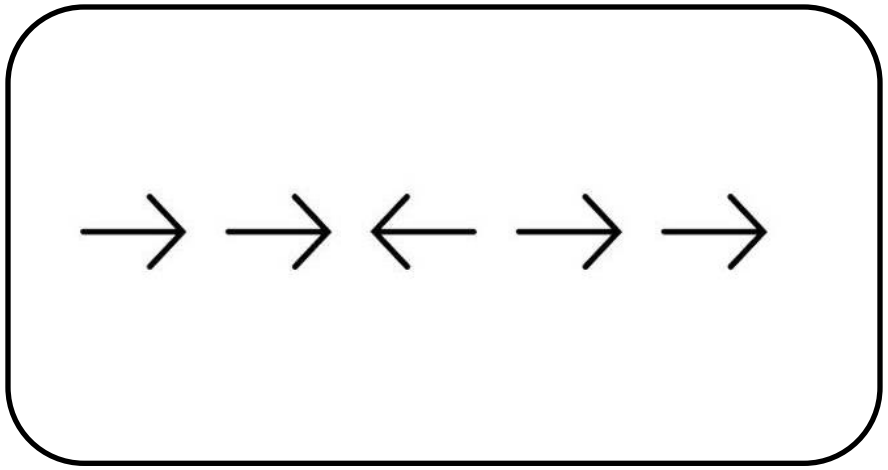
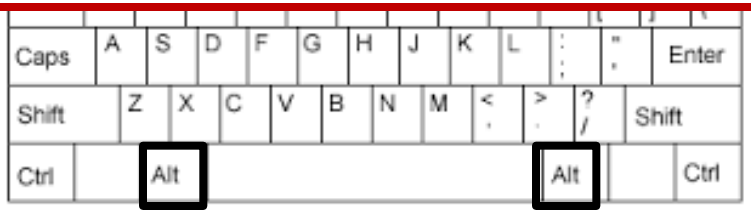
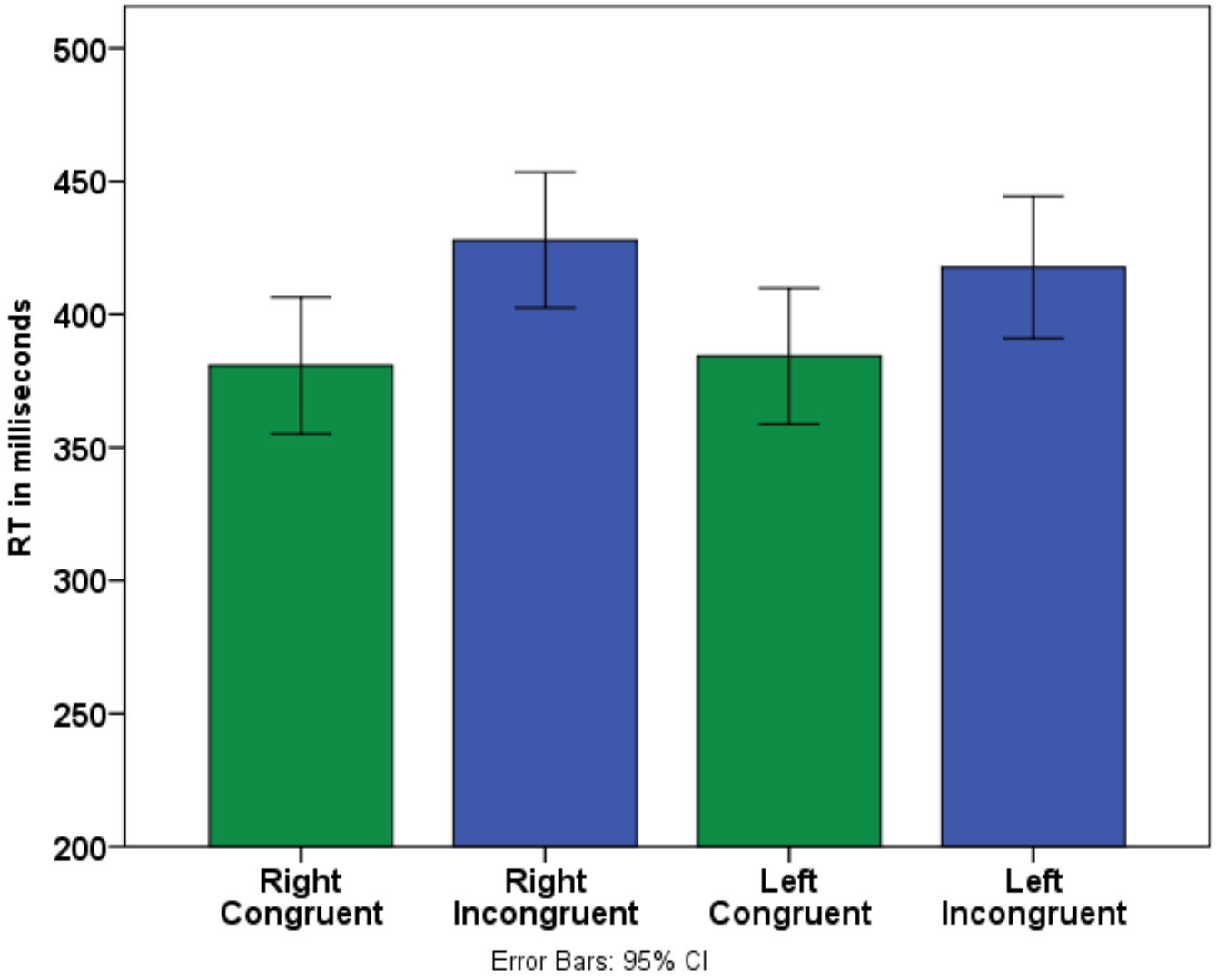


Measure: RTs Incongruent – RT congruent



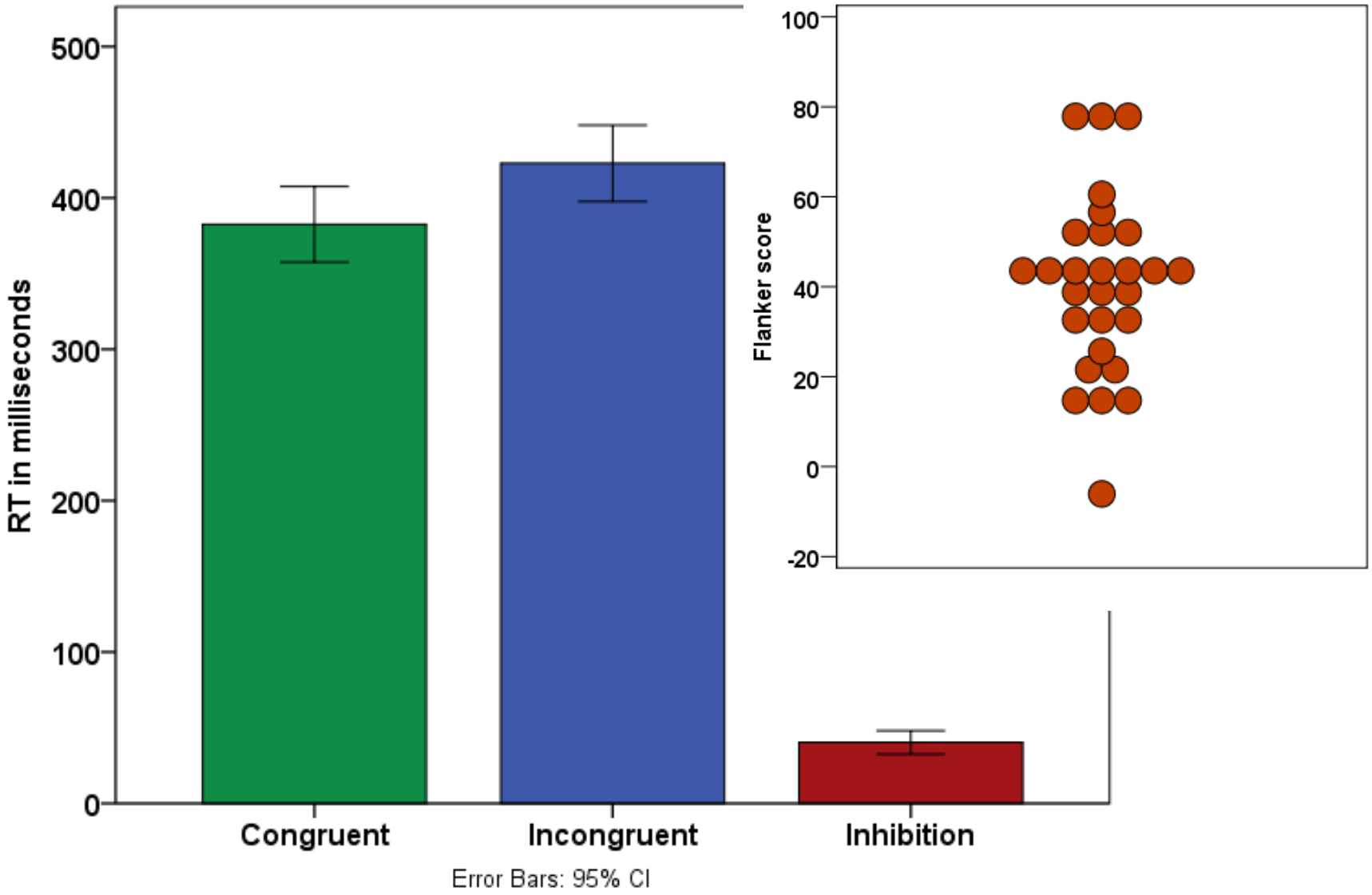
Attention: Flanker (domain general)

Results



Attention: Flanker (domain general)

Results



Attention: Auditory stroop (linguistic – speech)

Ability to suppress conflicting lexical activation

Participants listen to 6 words (2 test words, 4 filler words) spoken by one male and one female voice:

72 trials (6 words x 6 realizations x 2 voices)

HOME, NATA, NÚVOL, OCA, OLI, NOIA

man, cream, cloud, goose, oil, young woman

Decide on the voice: *male* or *female*

- Response latencies longer for Incongruent trials

HOME by female voice NOIA by male voice

- Response latencies shorter for Congruent trials

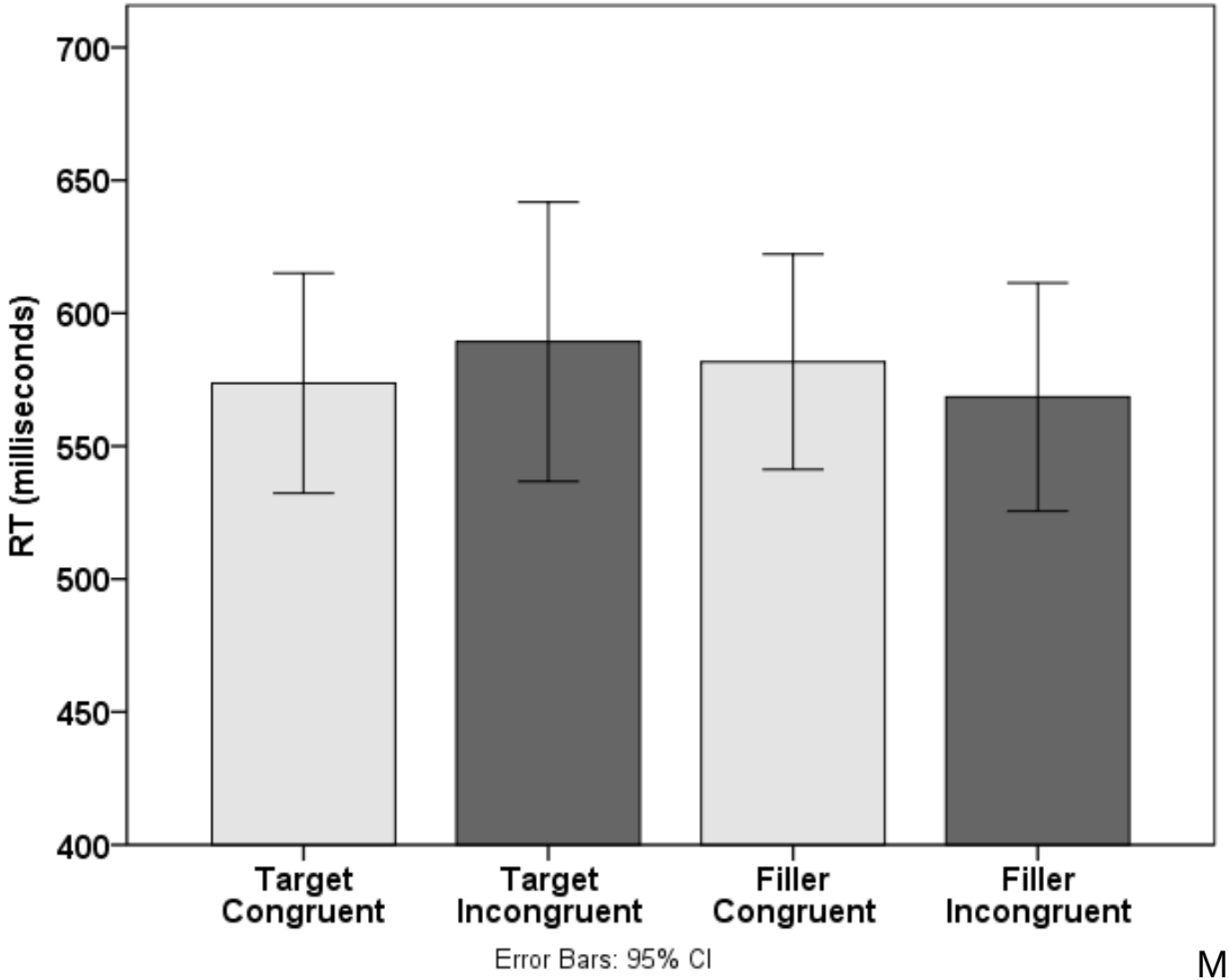
HOME by male voice NOIA by female voice

Measure: RTs Incongruent – RT congruent

Mora & Darcy (in prep.)

Attention: Auditory stroop (linguistic – speech)

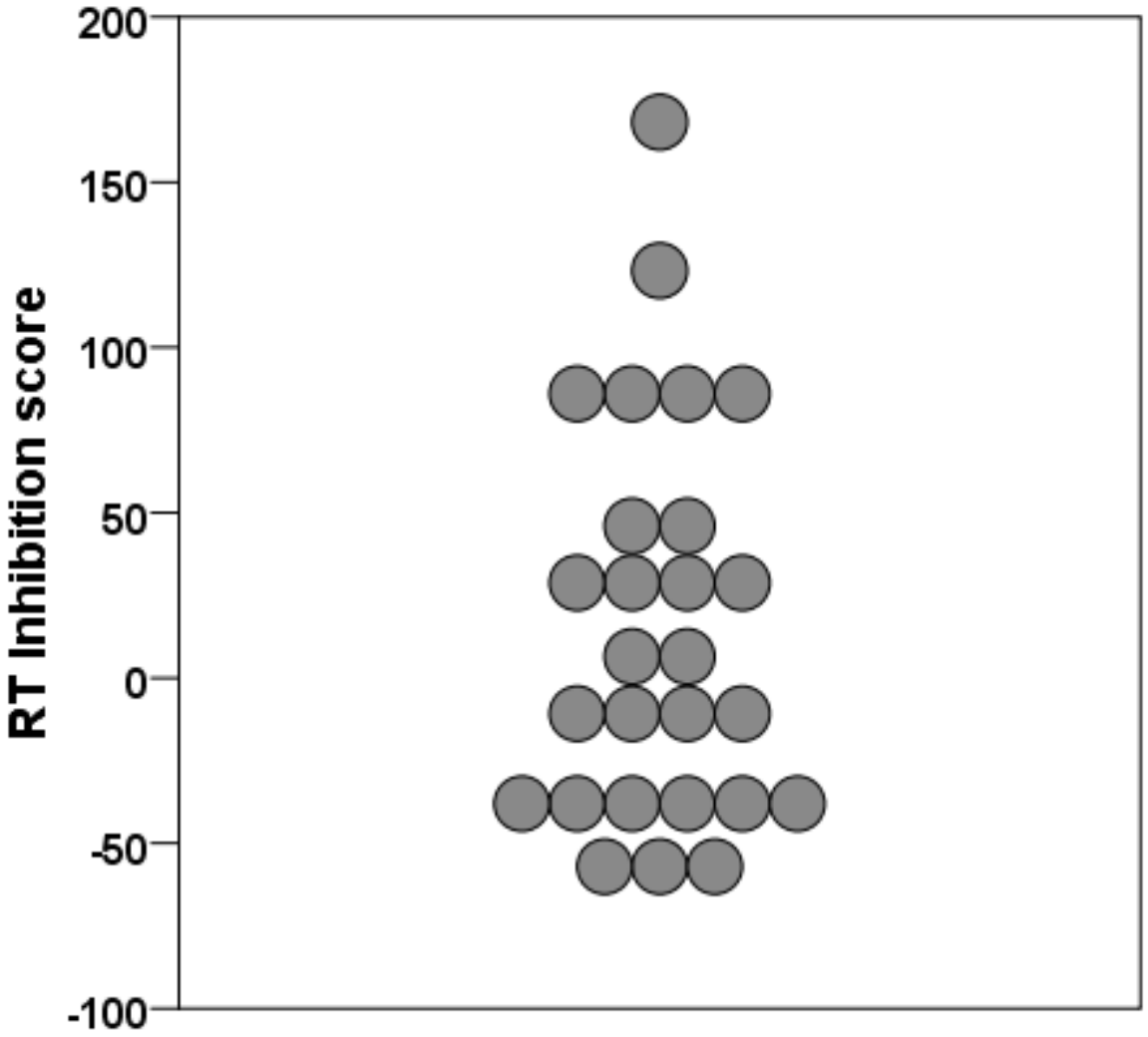
Results



Mora & Darcy (in prep.)

Attention: Auditory stroop (linguistic – speech)

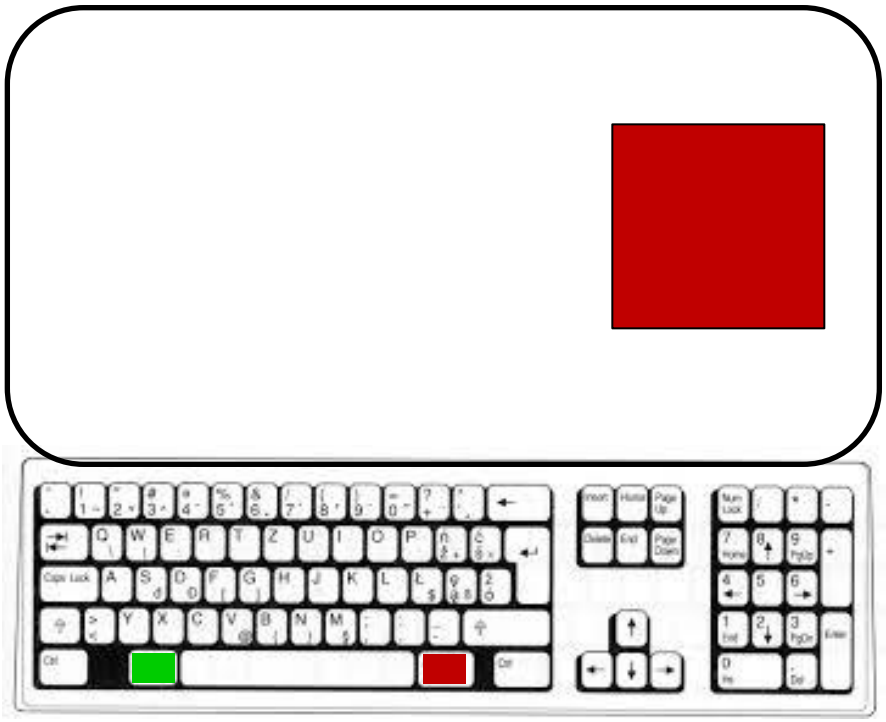
Results



Mora & Darcy (in prep.)

Inhibition: Simon (domain-general)

Press the left key for the GREEN square, and the right key for the RED square (ignore the position of the square)

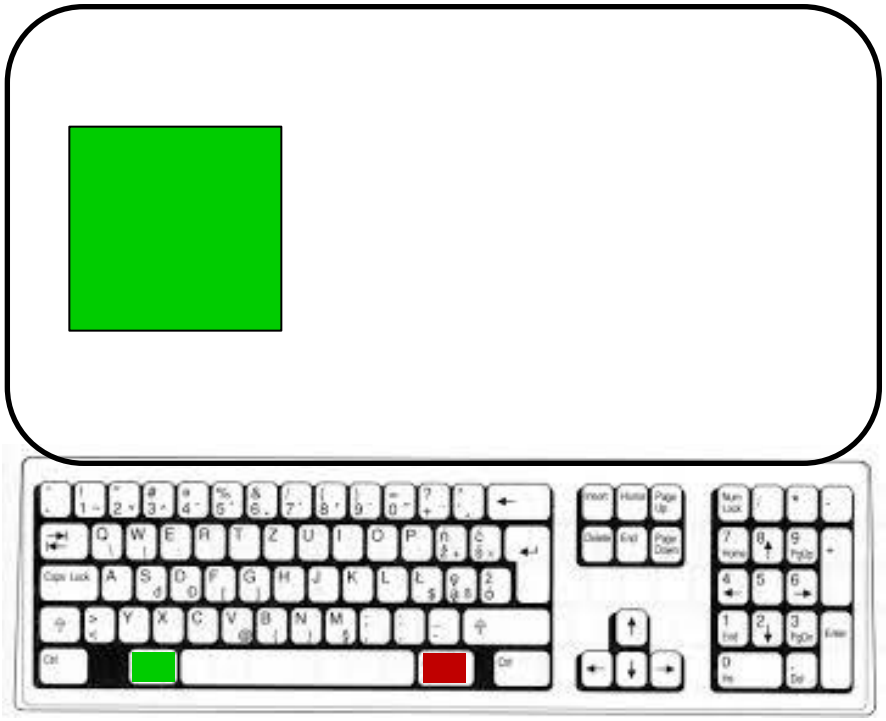


Congruent

Ability to inhibit response based on spatial position

Inhibition: Simon (domain-general)

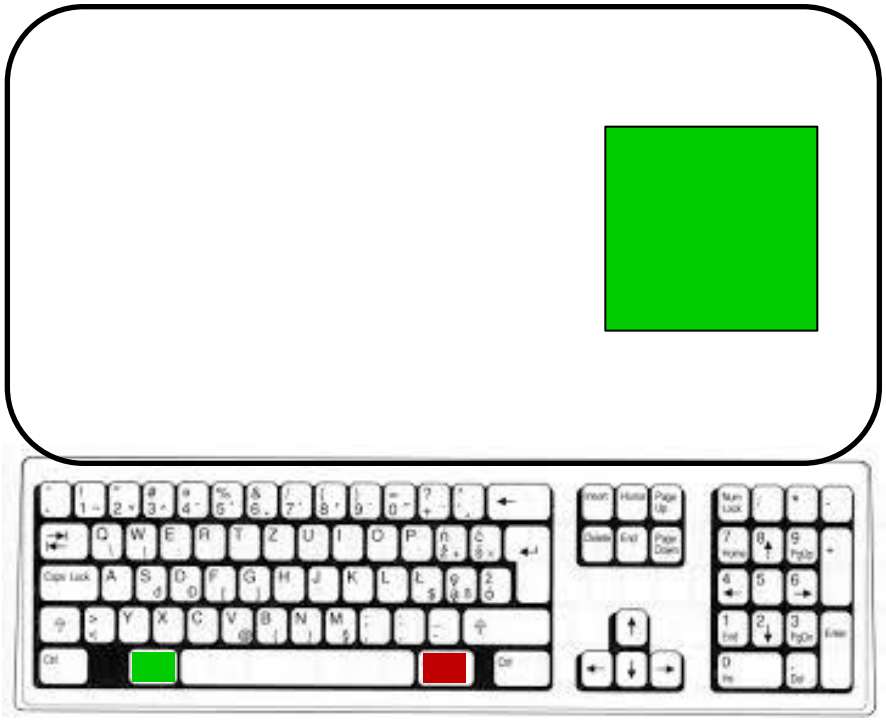
Press the left key for the GREEN square, and the right key for the RED square (ignore the position of the square)



Congruent

Inhibition: Simon (domain-general)

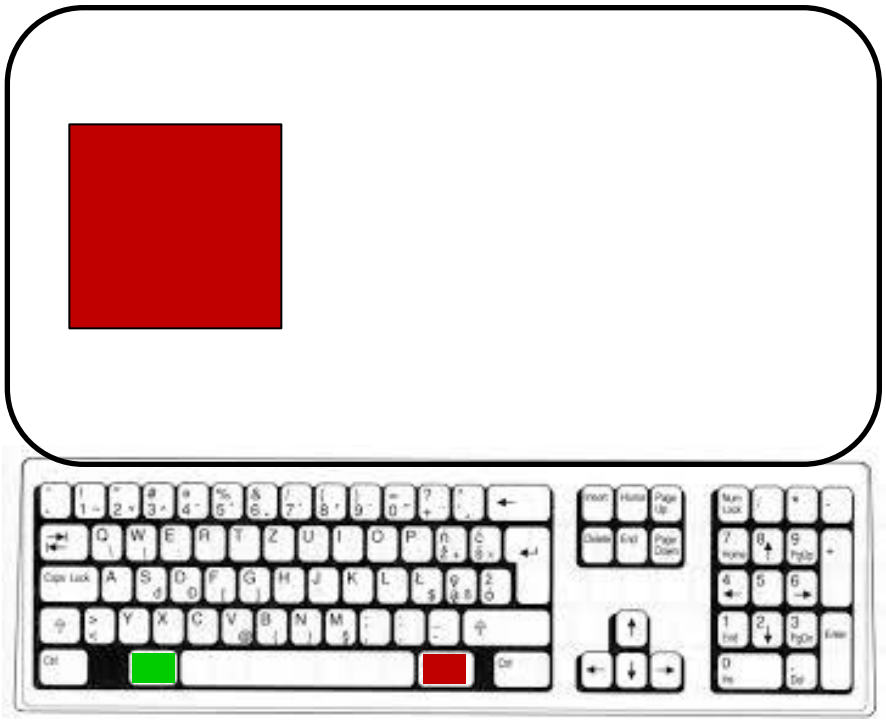
Press the left key for the GREEN square, and the right key for the RED square (ignore the position of the square)



Incongruent

Inhibition: Simon (domain-general)

Press the left key for the GREEN square, and the right key for the RED square (ignore the position of the square)

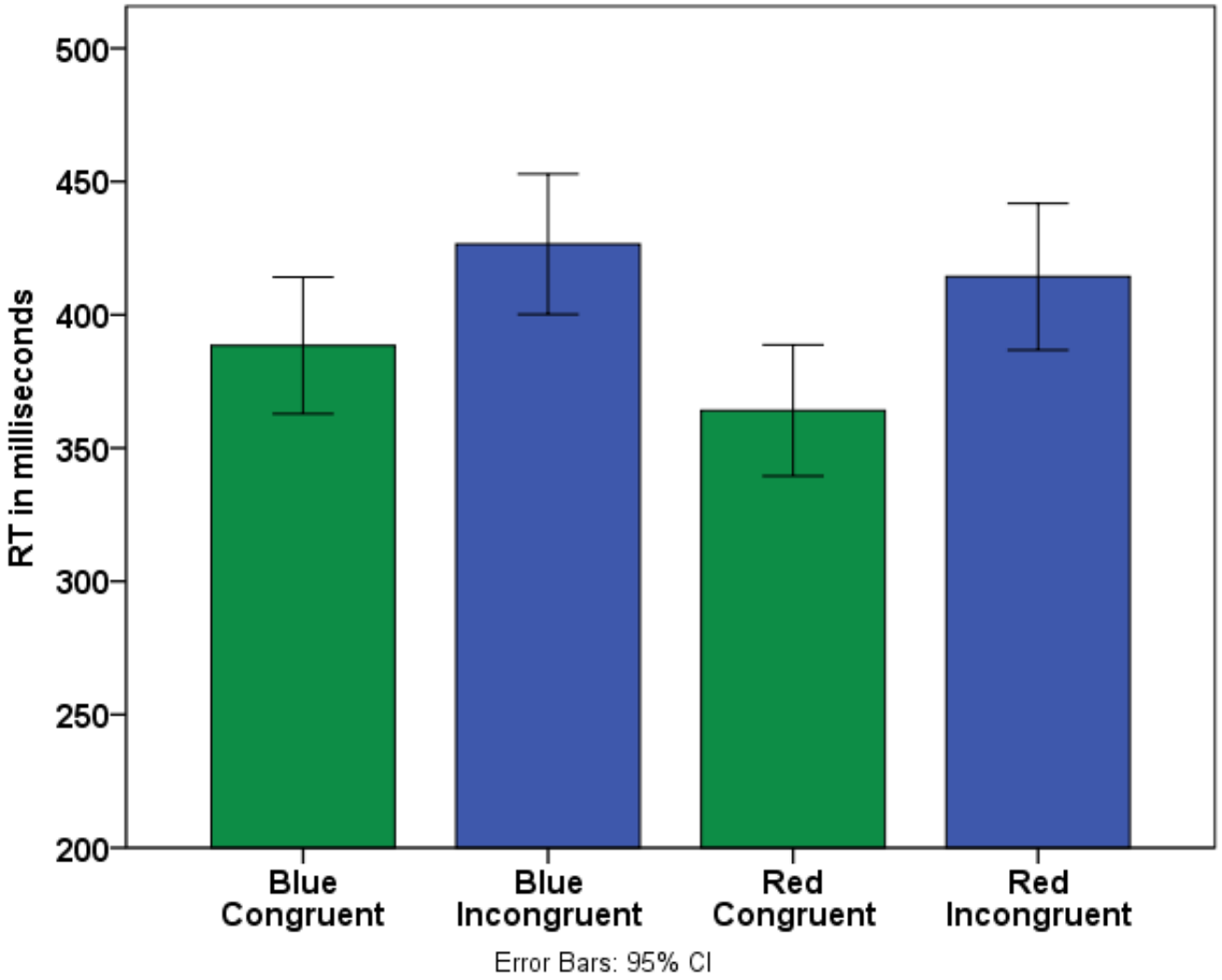


Incongruent

Measure: RTs Incongruent – RT congruent

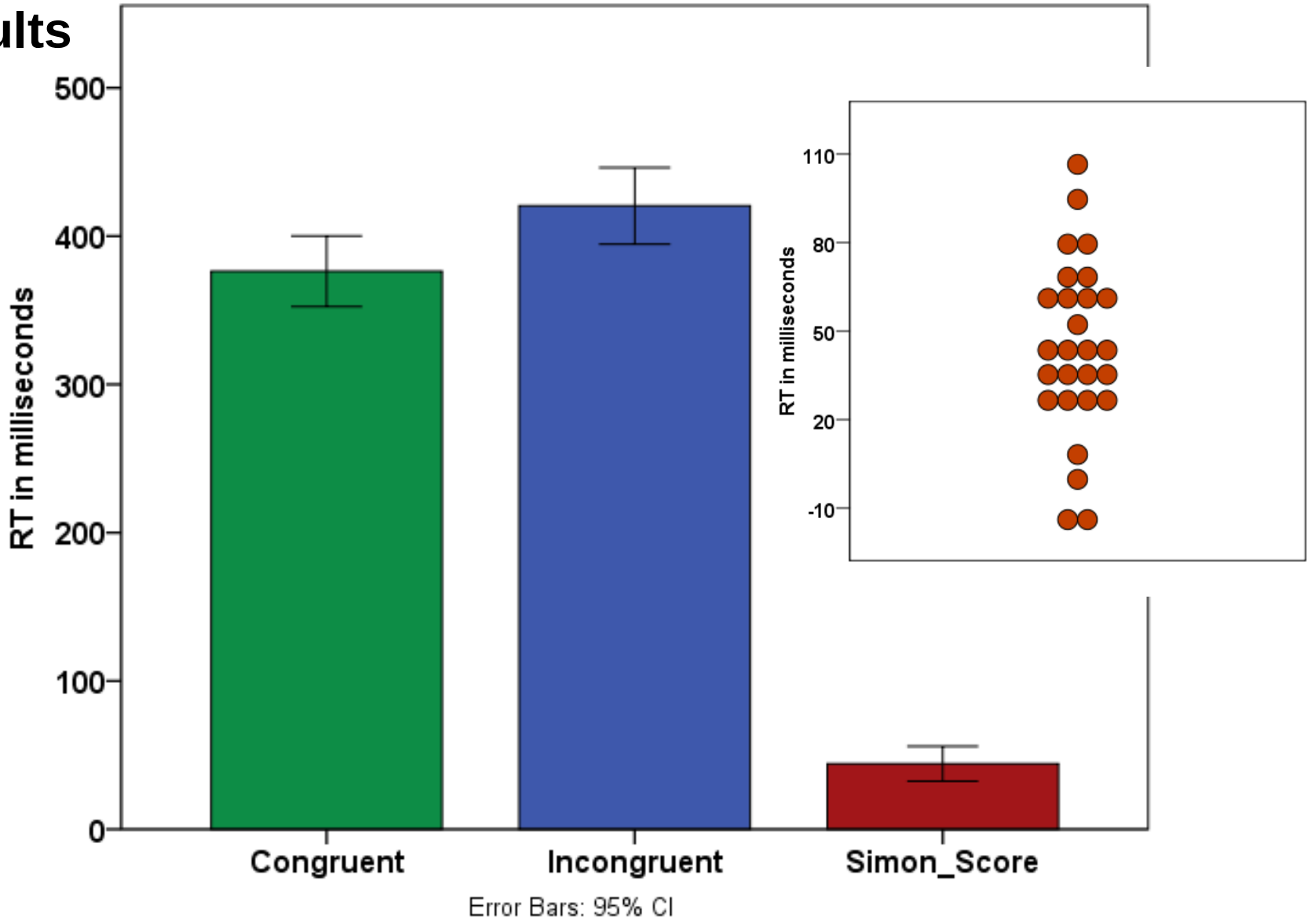
Inhibition: Simon (domain-general)

Results



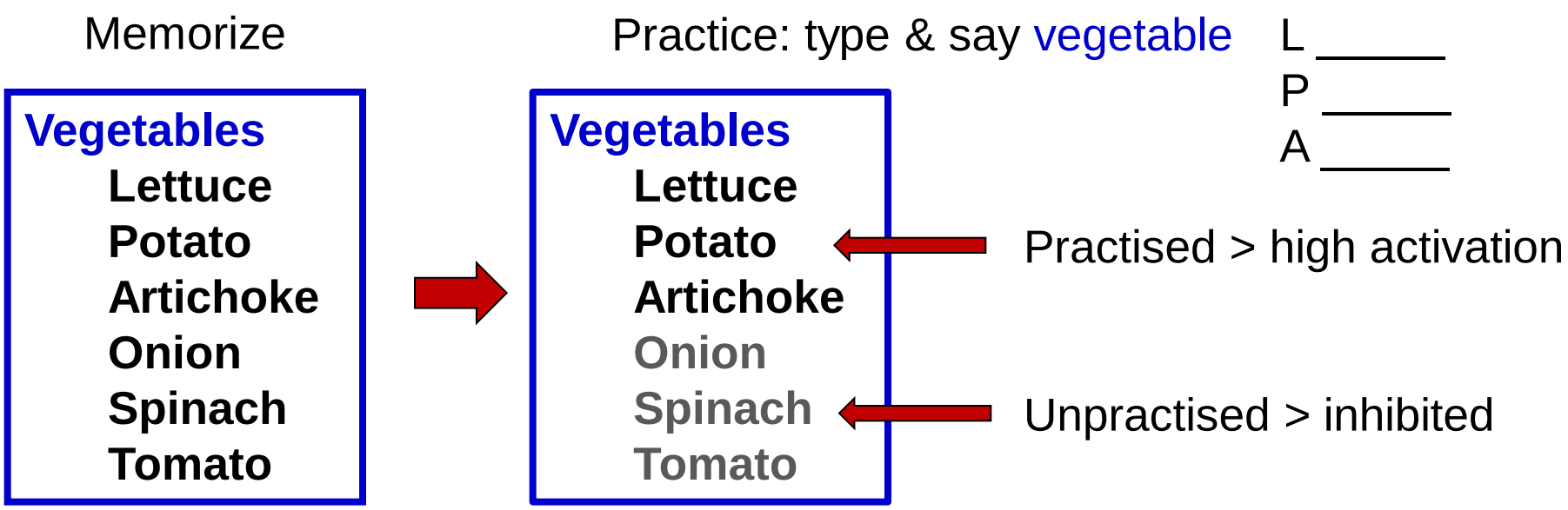
Inhibition: Simon (domain-general)

Results



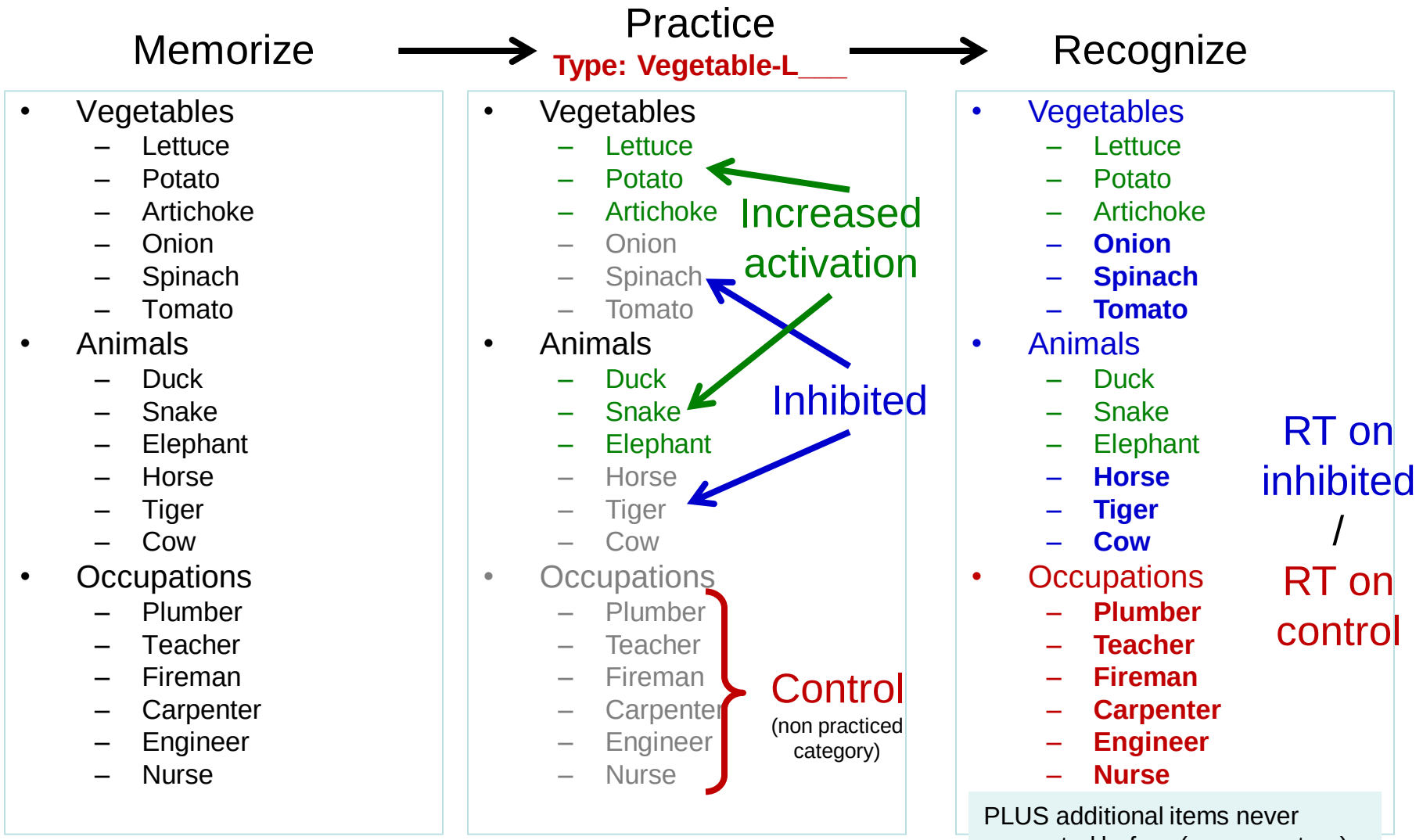
Inhibition: Retrieval-induced forgetting

- **Task conducted in L1 (Catalan)**
- **Based on lexical retrieval RTs**
- **Inhibition of lexical items achieved by increasing activation of lexical items in the same category**



(Anderson, Bjork & Bjork, 1994; Lev-Ari & Peperkamp, 2012)

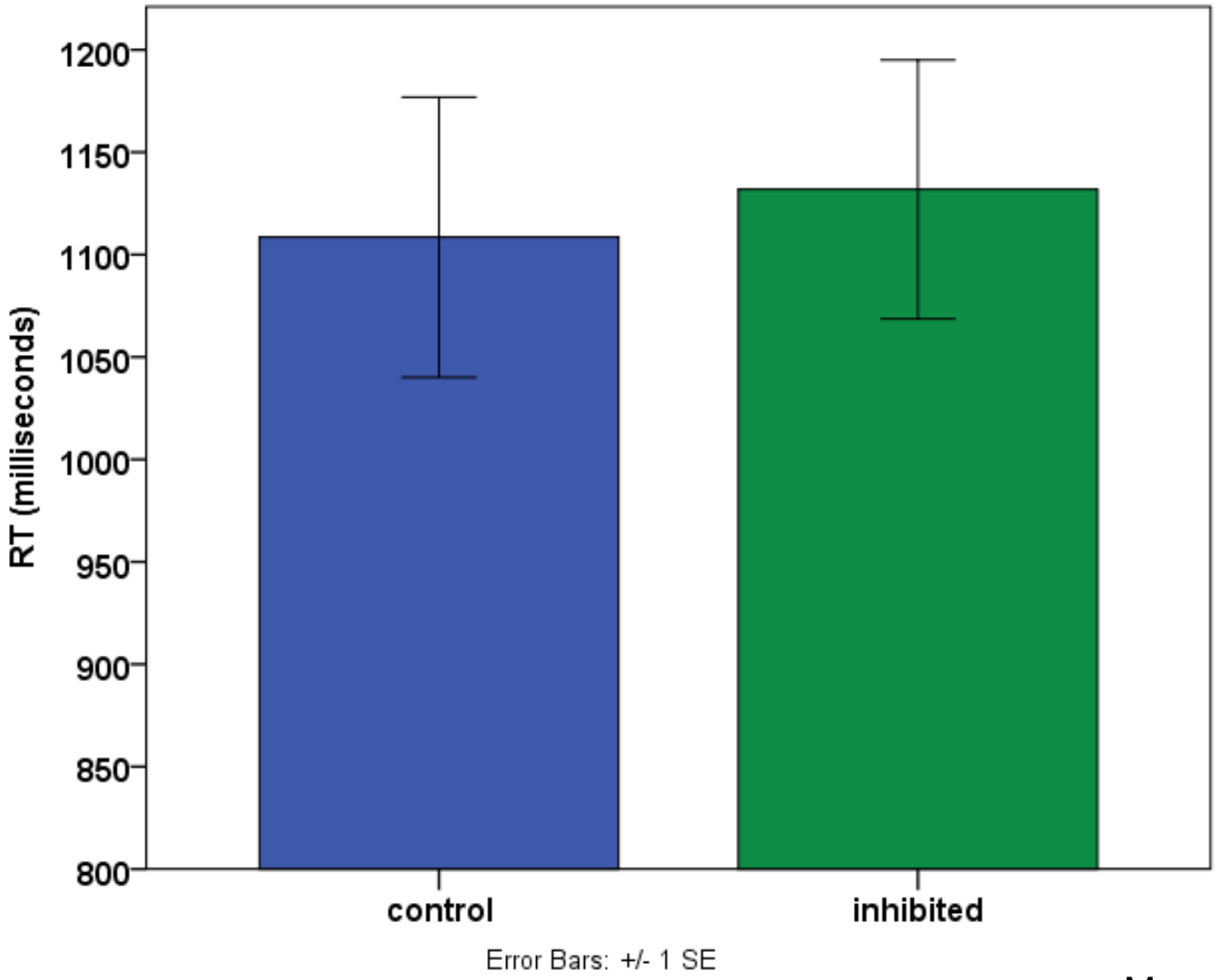
Inhibition: Retrieval-induced forgetting



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

Inhibition: Retrieval-induced forgetting

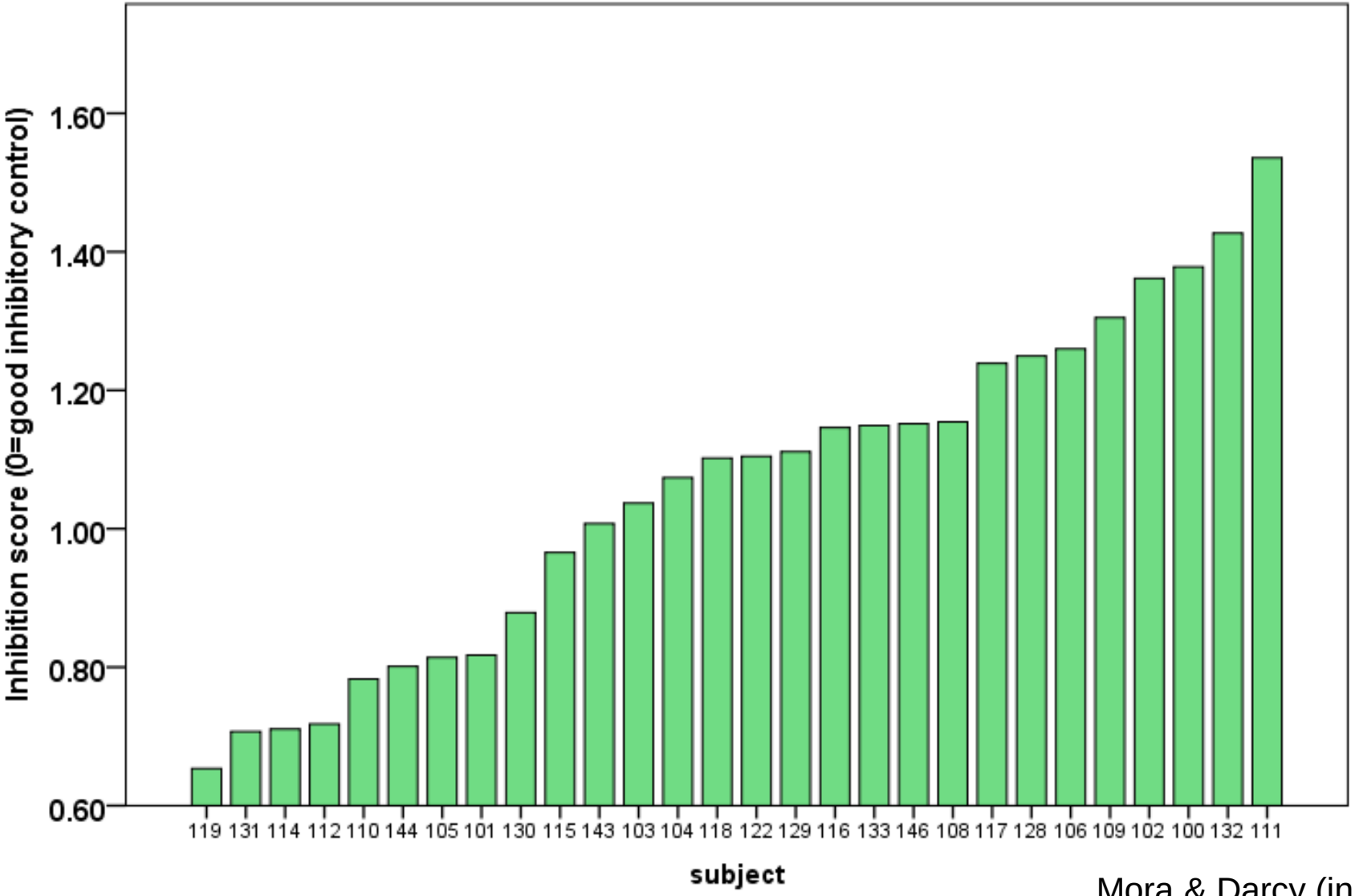
Results



Mora & Darcy (in prep.)

Inhibition: Retrieval-induced forgetting

Results



Mora & Darcy (in prep.)

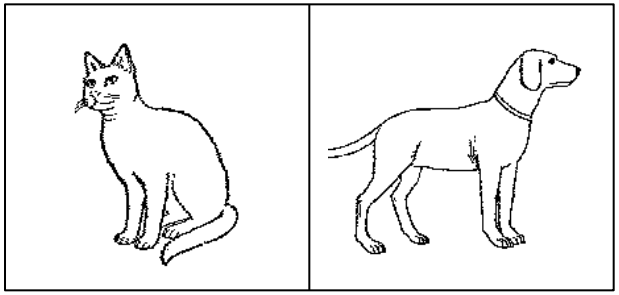
Inhibition: Auditory Inhibition

Bilingual sentence comprehension task involving auditory INH

L1	*el gat persegueix el gos*	*el gos es perseguit pel gat*
L2	*the cat is chasing the dog*	*the dog is chased by the cat*
L2-L1	*the cat is chasing the dog*	*el gos es perseguit pel gat*
	male voice / female voice	male voice / female voice

Who is doing the “bad” action?

- Simultaneous presentation of:



Test: Active-Passive

Male-Female voice

L1-L2

Attend to M / F voice

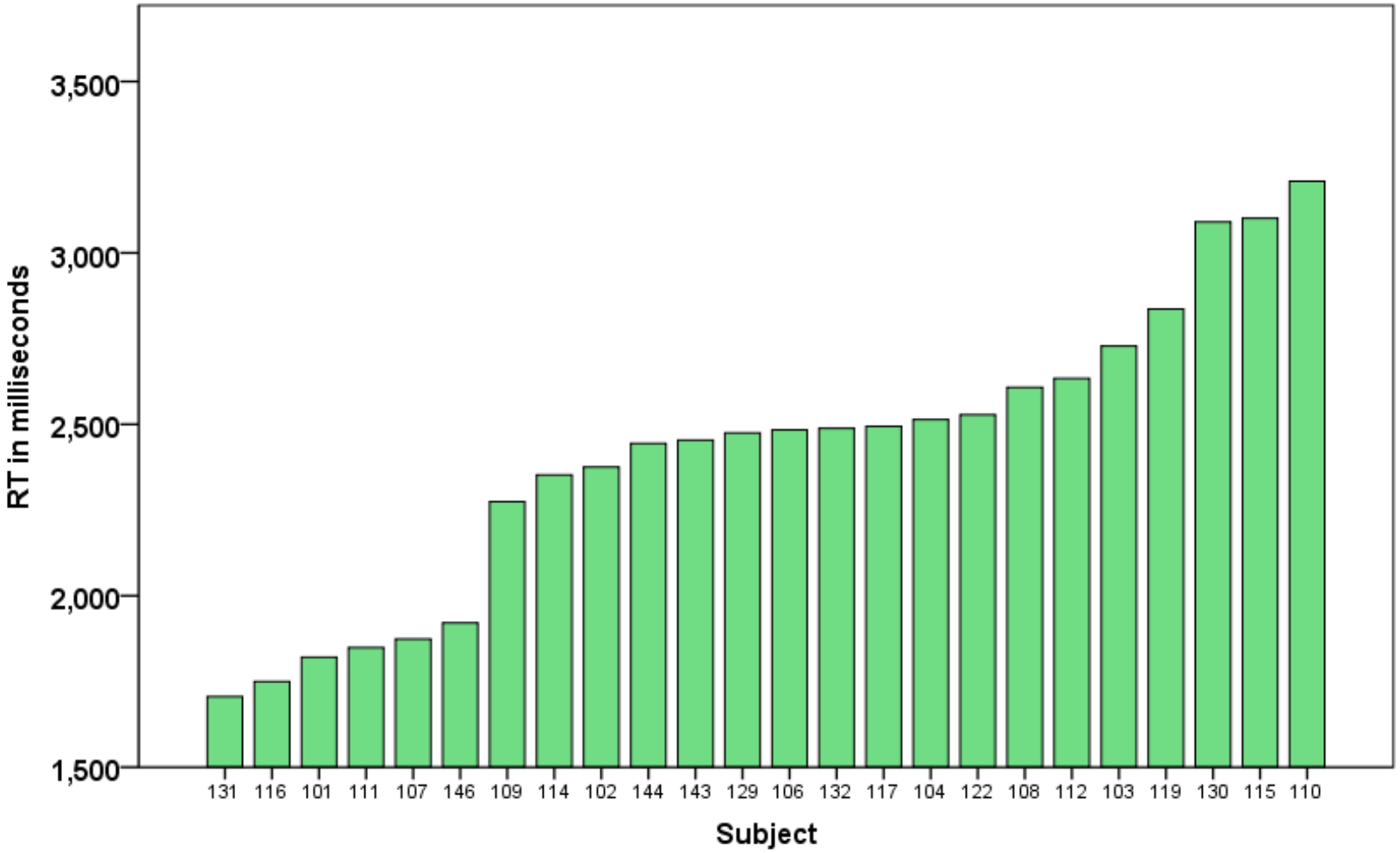
Control: Act-Act / Pass-Pass

L1-L1 / L2-L2

Based on Filippi et al. 2012, 2014

Inhibition: Auditory Inhibition

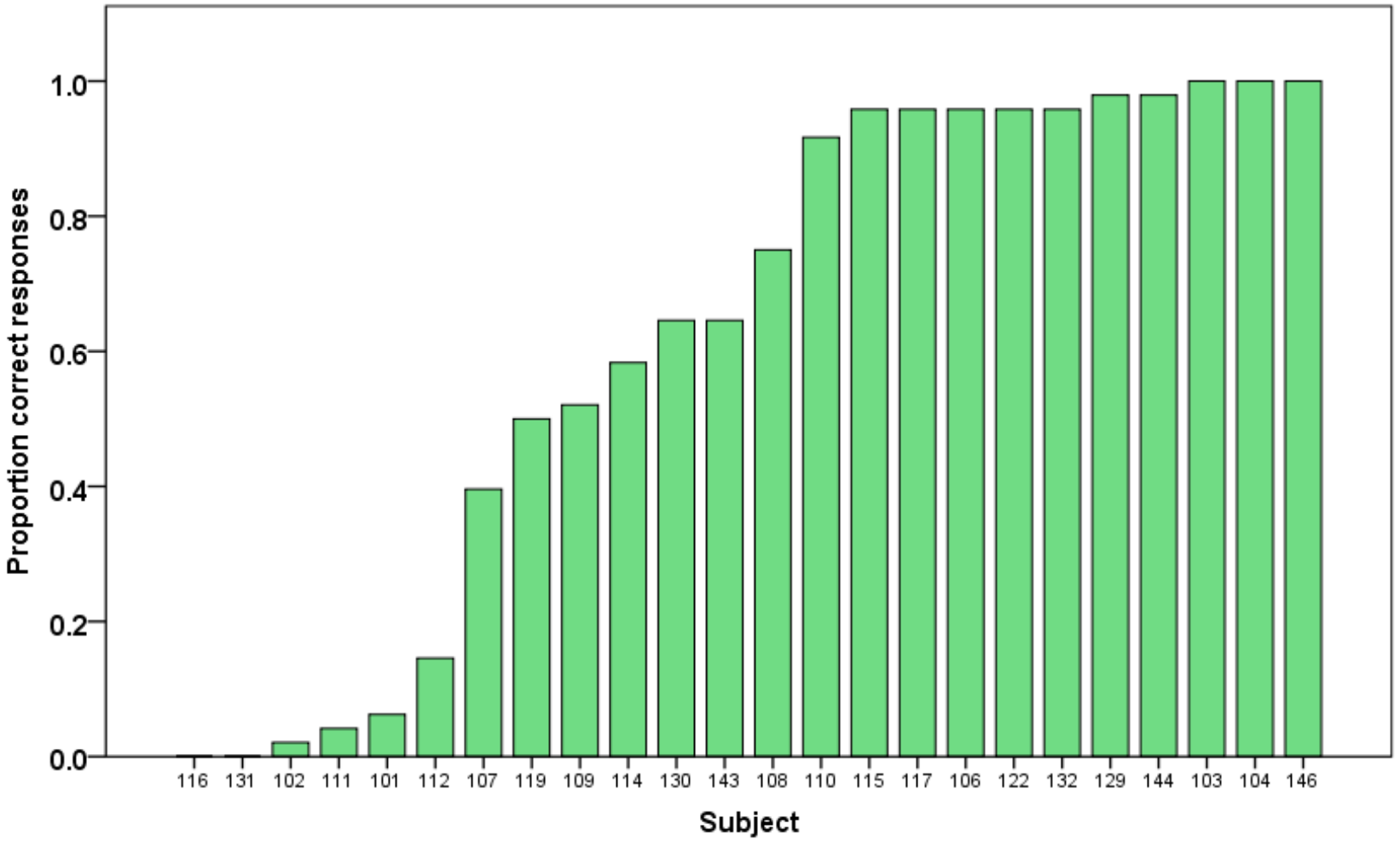
Results



Mora & Darcy (in prep.)

Inhibition: Auditory Inhibition

Results



Mora & Darcy (in prep.)

Results and discussion

What did we find?

L3 Phonology
/iː/-/ɪ/; /æ/-/ʌ/
VOT

Perception
- ABX discrimination
- Lexical Decision

Production
- VOT in picture naming

Dominance!

Attention

Domain-general
- Flanker

Linguistic
- Auditory stroop

Inhibition

Domain-general
- Simon

Linguistic
- Retrieval-ind. forgetting
- Auditory inhibition

Mora & Darcy (in prep.)

Results and discussion

Results revealed an interplay between **inhibition** and **phonological** measures in processing speed (not accuracy):

ABX RTs	←→	Auditory Stroop	r=.389, p=.045
	←→	Auditory Inhibition	r=.499, p=.018

Stronger inhibitors were faster at discriminating the target vowels in the ABX test condition.

Results and discussion

Results show that **inhibition** and **dominance** have an effect on phonetic CLI in language switching tasks:

Inhibition

Auditory Inhibition	←→	VOT at En Switch	r=.398, p=.060
	←→	VOT at Cat Switch	r=.516, p=.012
Auditory stroop	←→	VOT En Switch cost	r=.417, p=.027

The slower participants were at inhibiting their L1 (poorer inhibitory control) in the auditory language inhibition task (perception switching), the longer (i.e. the more English-like) their VOT was on English and Spanish trials after a switch in the Picture Naming Task.

Results and discussion

Results show that **inhibition** and **dominance** have an effect on phonetic L1>L2 CLI in language switching tasks:

Dominance

% Cat use	←→	VOT at Cat Switch	*r*= -.452, *p*=.035
	←→	VOT En Switch cost	*r*= .385, *p*=.077

The more dominant participants were in Catalan...
- the more Catalan-like (shorter) their VOT was in Cat at switch trials (i.e. Less CLI from English)
- the larger the L1>L2 CLI on English VOT at switch

The magnitude of phonetic L1>L2 CLI was smaller the more dominant participants were in Catalan.

Conclusion

Potential of language switching tasks as testing ground for L3 (phonetic) CLI patterns, as regards:

- the role of dominance

- the role of IDs in inhibition on CLI

- maybe also for hypotheses from L3 acquisition models

Dziękuję!

Collaborators in this work:

Isabelle Darcy (IU)

Danielle Daidone (IU)

Elena Safronova (UB)

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