Spanish in perception and production – some implications for teaching Spanish as a foreign language

Barcelona 2024

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Dialectal differences:

/s/ aspiration in pereption

(Jan Wołłejko)

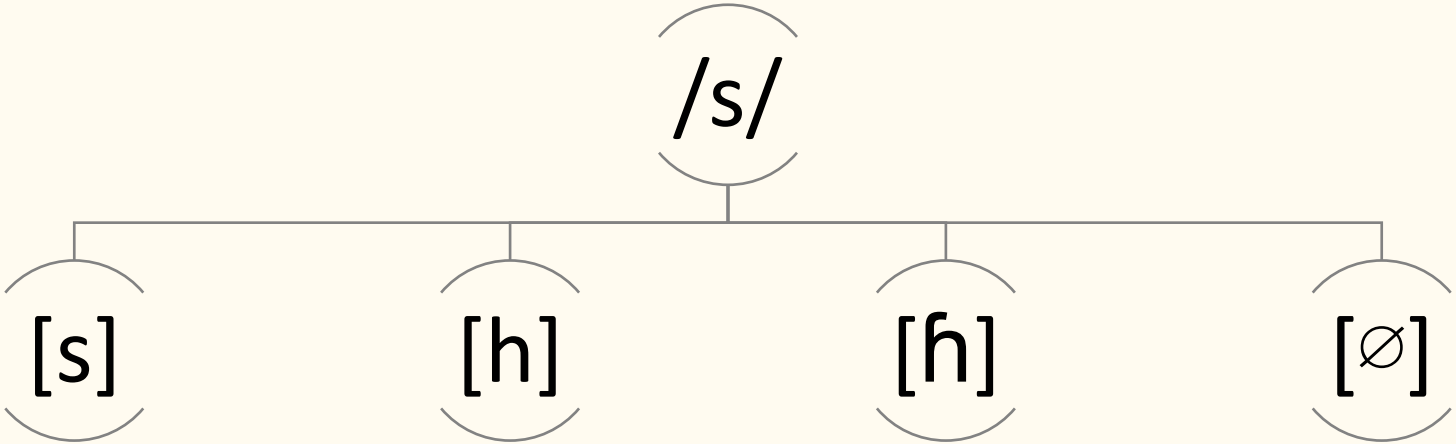
What types of /s/ aspiration dialects do we have?

What are the variants, dialectal groups?

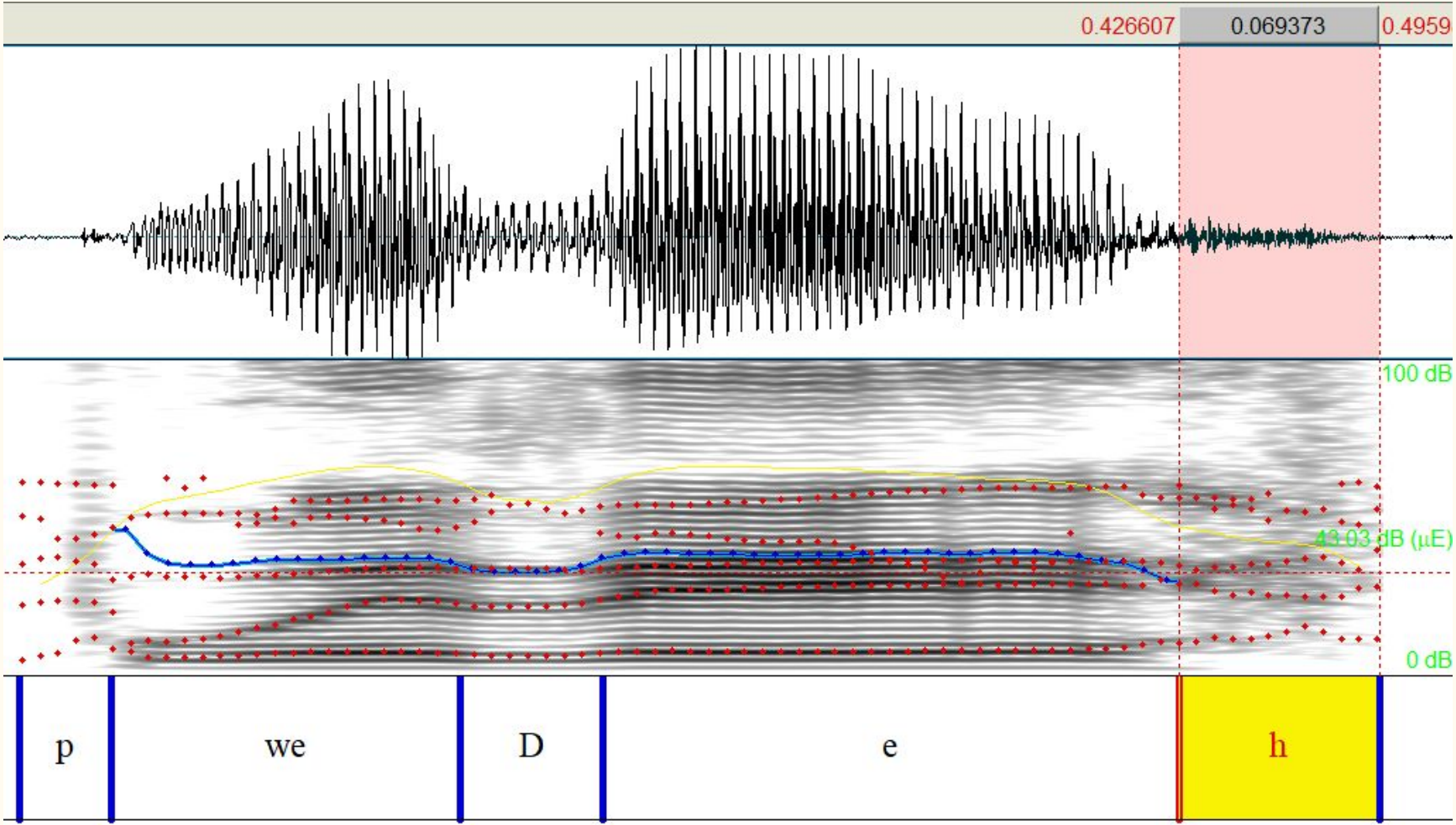
What are the factors that can influence these variants and the way we speak?

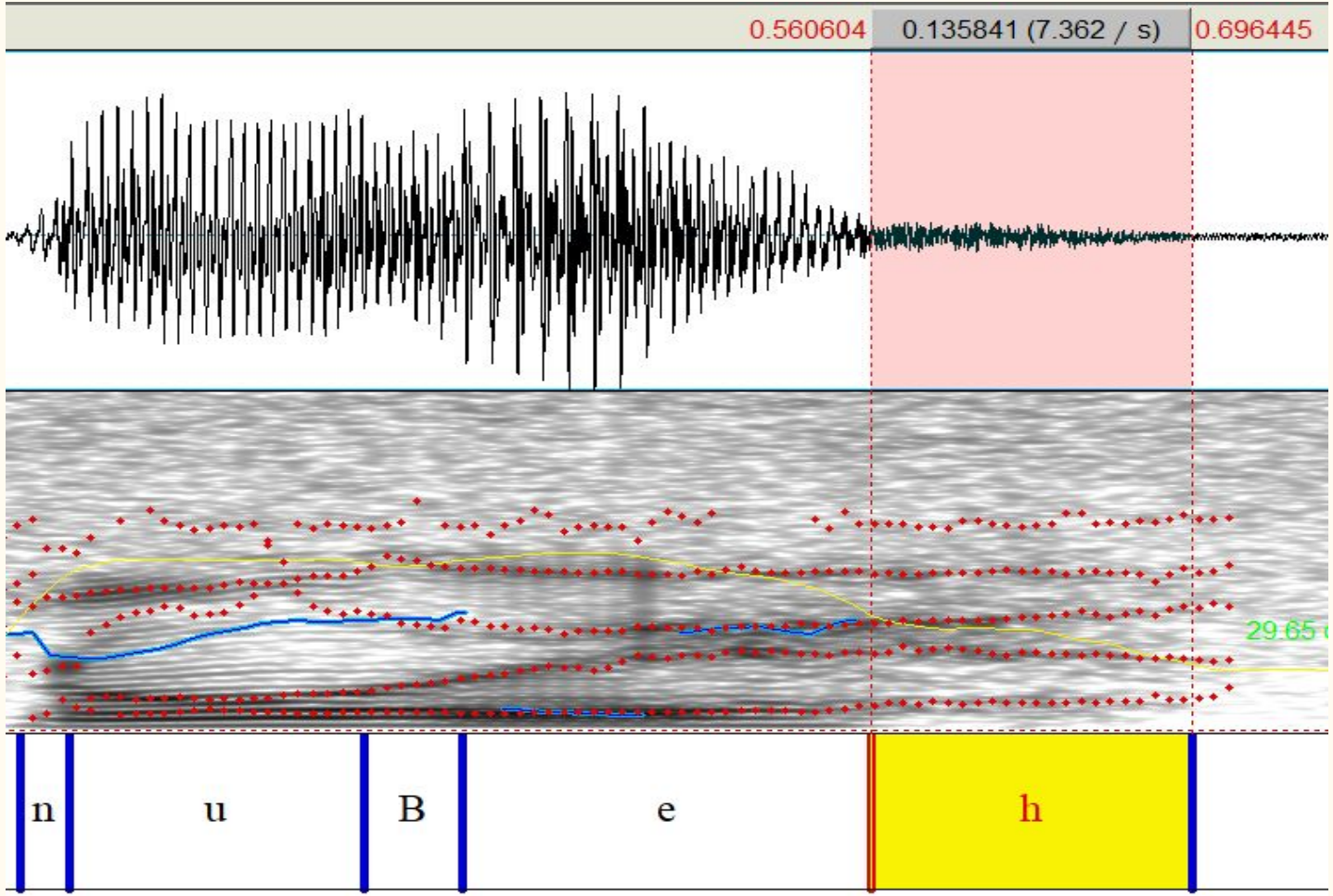
What are the cues we use in perception?

Canarian /s/ allophony



Aspiration differs in duration


0.426607
0.069373
0.4959
100 dB
43.03 dB (µE)
0 dB
p
we
D
e
h


0.560604
0.135841 (7.362 / s)
0.696445
29.65
n
u
B
e
h

Research questions

How long should aspiration be to be perceived as a morpheme/grammatical marker?

Are there any differences between Polish and Spanish people in the perception of aspirated /s/?

Which factors contribute to perception in this case?

Hypotheses

- Spaniards will detect the aspirated /s/ at a shorter duration; Poles will need a longer aspiration to recognise it as a plural marker
- Spanish natives representing varieties that have aspiration will perceive it more easily compared to others
- Canarians will be better at aspiration perception than all other groups

Stimuli and procedure

- **2 Canarian speakers:** male and female
- **4 words per speaker:**
  - female: *aceitunas*, *notas*, *perros*, *zapatos*
  - male: *aceitunas*, *notas*, *chocolates*, *postres*
- Each word is presented in 8 variants on a continuum of /s/ durations
- **Aspiration duration** differs from 105 ms to 0 by 15 ms (just noticeable difference), 0 ms x 2
- **180 auditory stimuli** presented in two blocks (randomised and counter-balanced)
- Participants had to decide whether they hear **a plural or a singular form** of the word

Bienvenid@ al experimento!

A continuación vas a escuchar algunas palabras españolas pronunciadas por un hablante nativo en varias versiones.

Las palabras pueden repetirse varias veces.

Tu objetivo es decidir si la palabra dada está en singular o en plural.

Ojo! Es un hablante de un dialecto en el cual la /s/ final suele pronunciarse como una jota floja.

Recuerda que se trata de tu percepción individual de las palabras.

Cada persona puede escuchar las palabras de manera diferente.

Aquí no hay respuestas erróneas.

plural

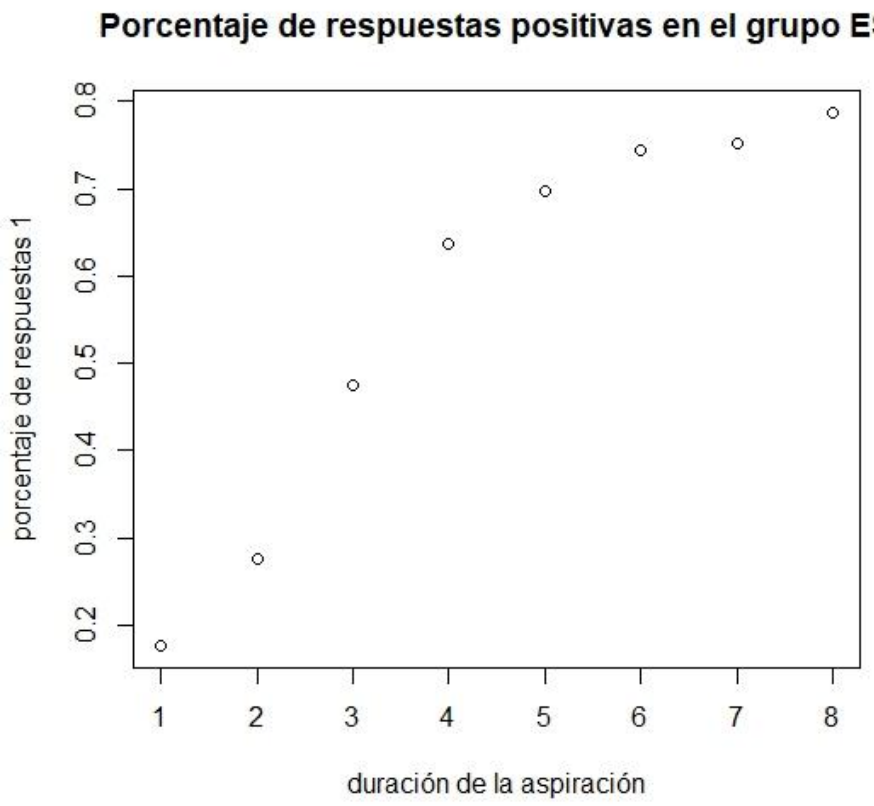
singular

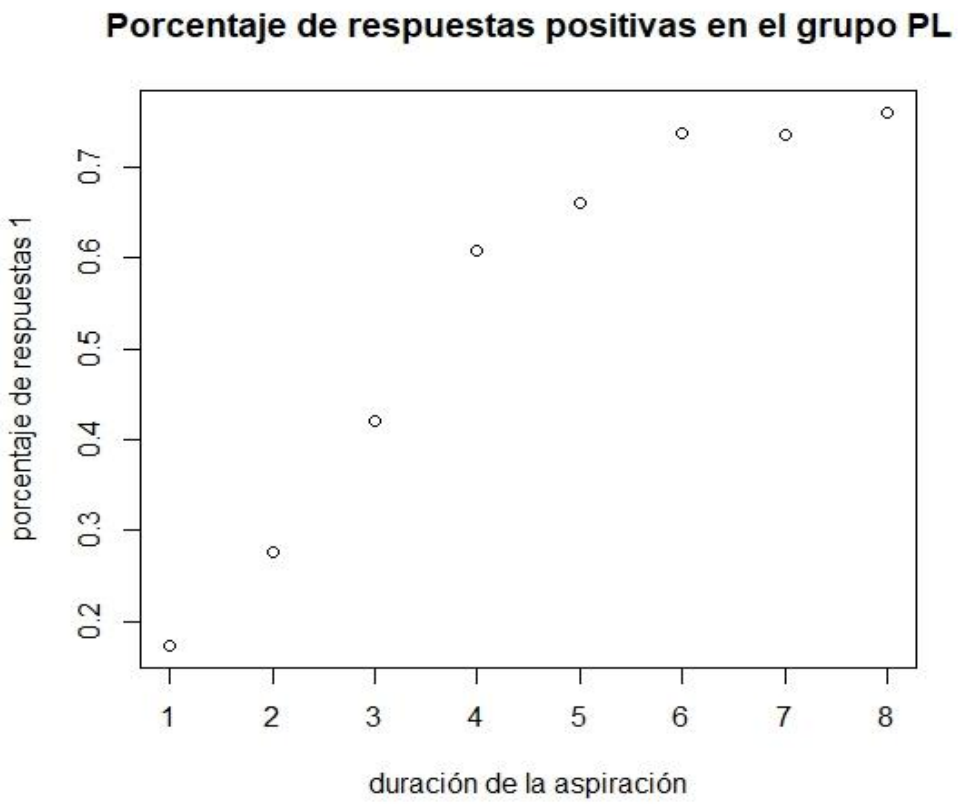
Participants

Polish (N=21) and Spanish (N=24) natives

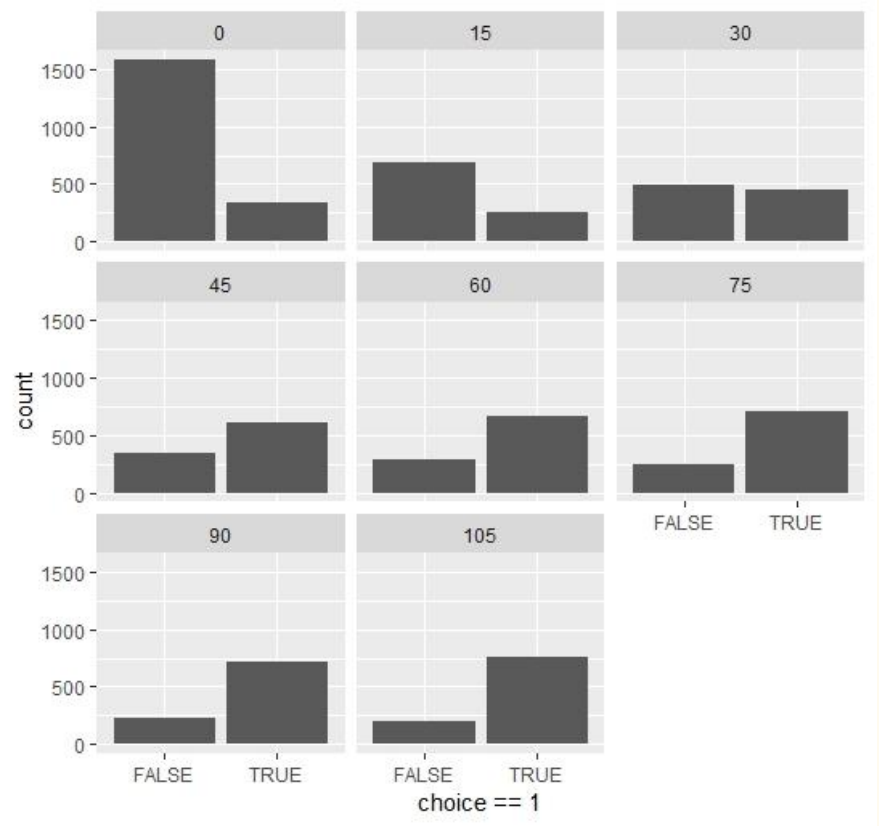
- PL: 4 males, 17 females, aged 20-34
  - C1-C2 level Spanish
- ES: 11 males, 13 females, aged 20-51
- Aspiration subgroup: 1 males, 8 females
- Canarian subgroup: 2 males, 2 females

How long does the /s/ have to be to be perceived as a plural morpheme?

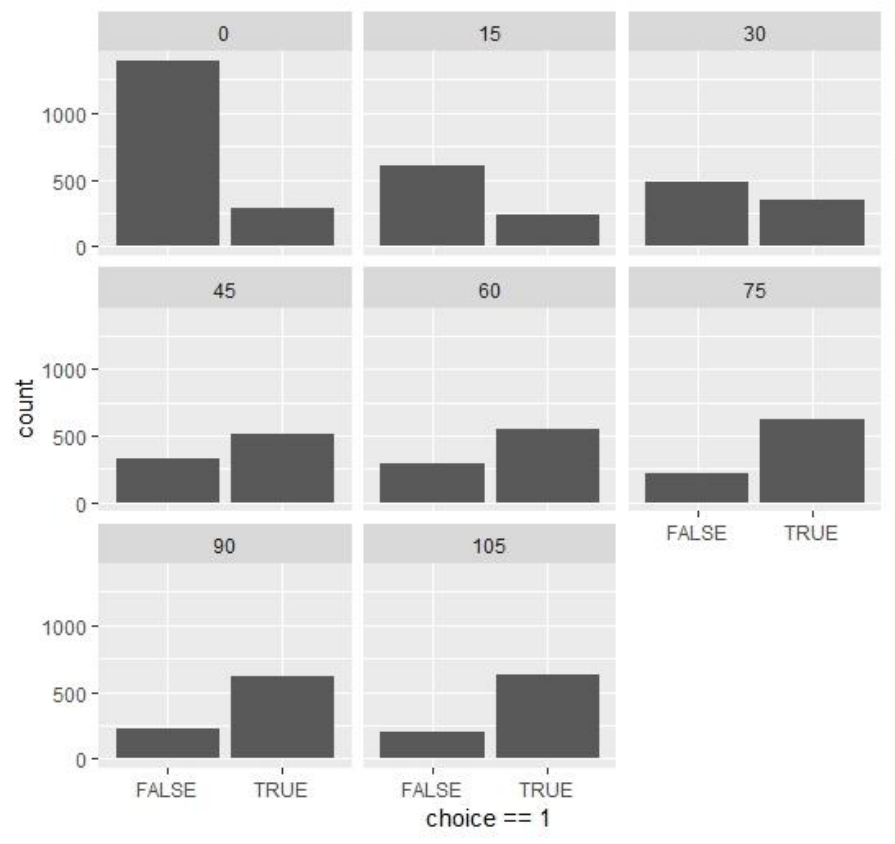


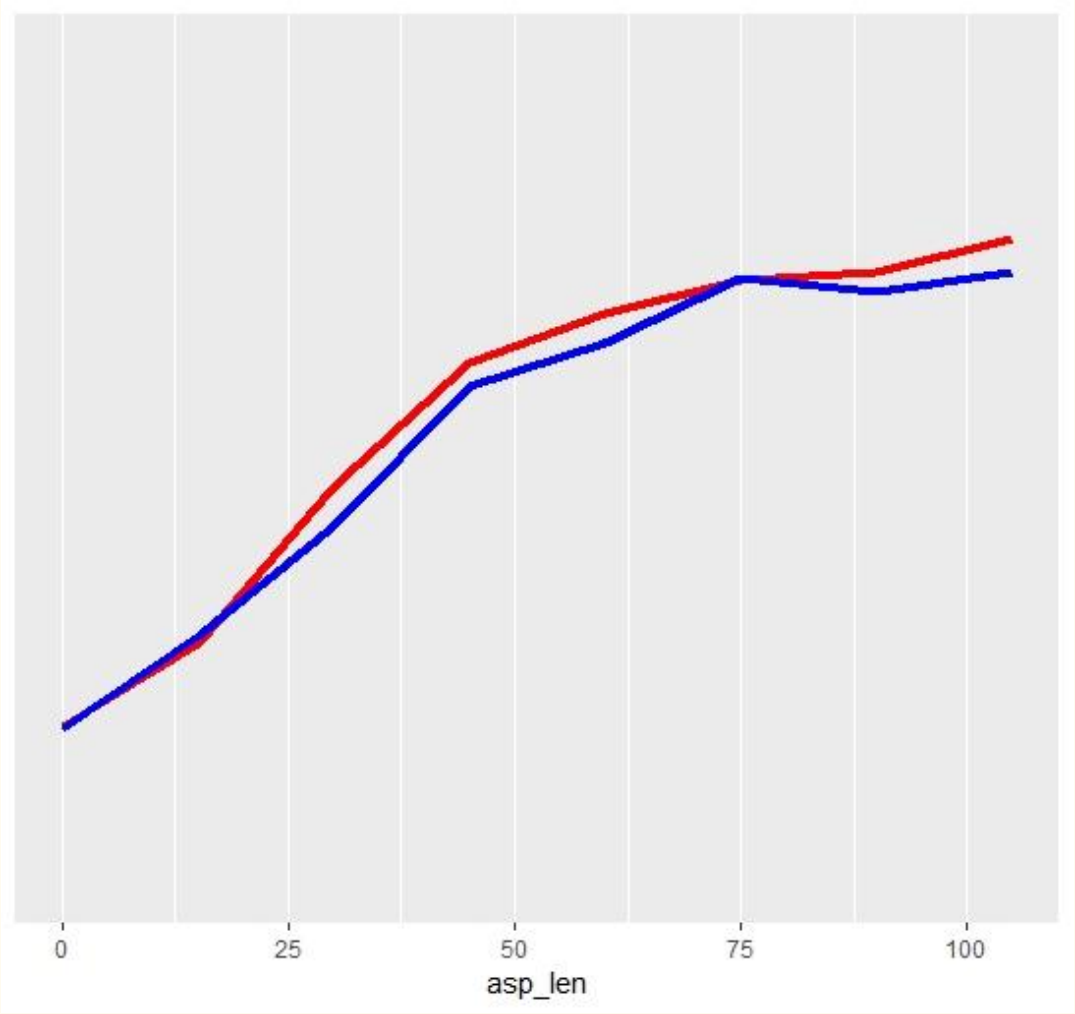


SPANISH PARTICIPANTS

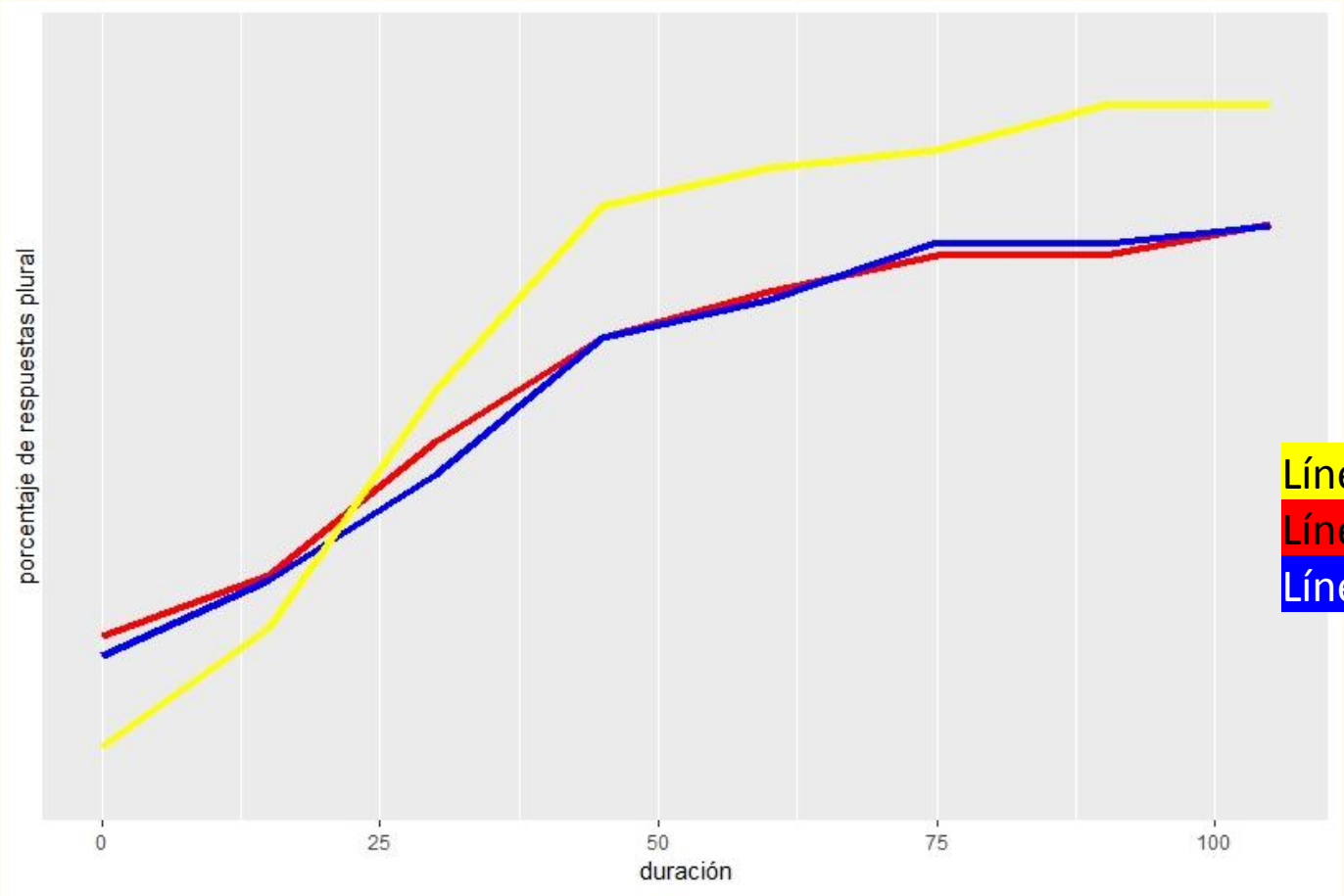


POLISH PARTICIPANTS

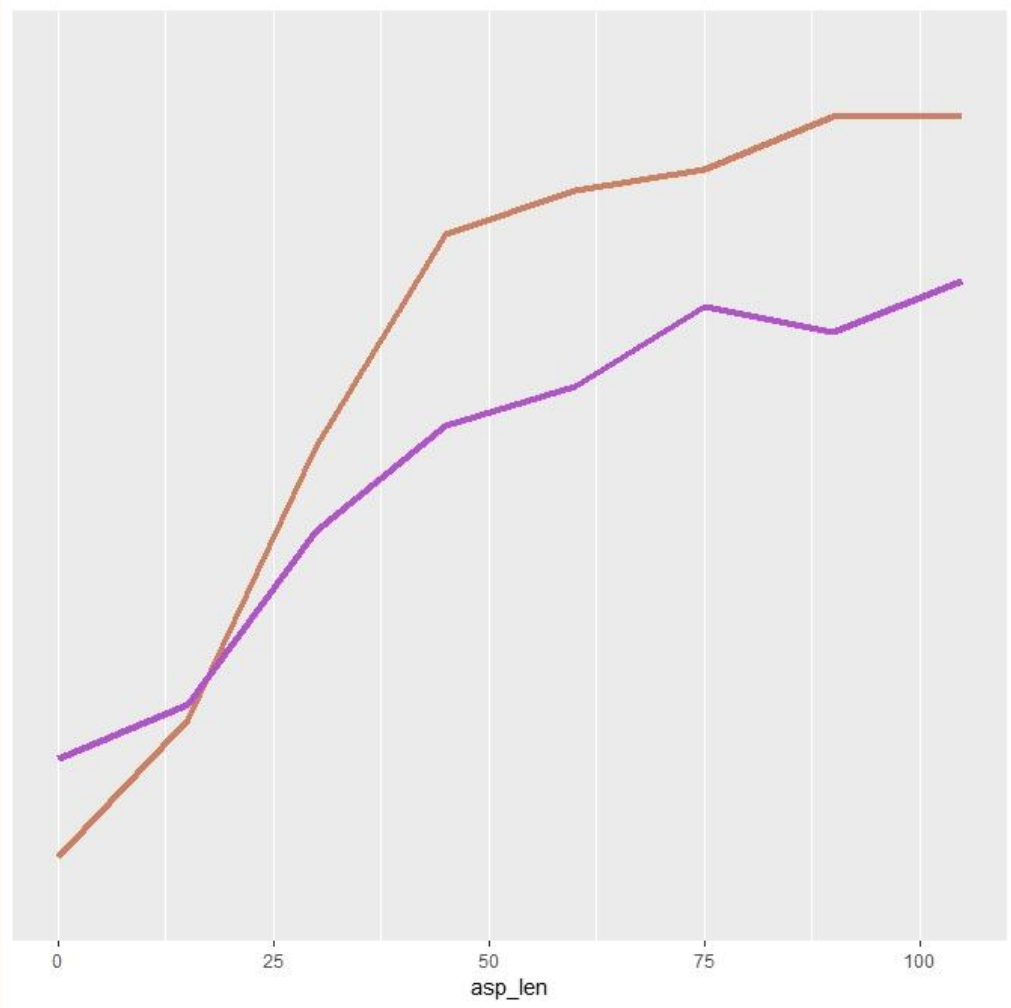




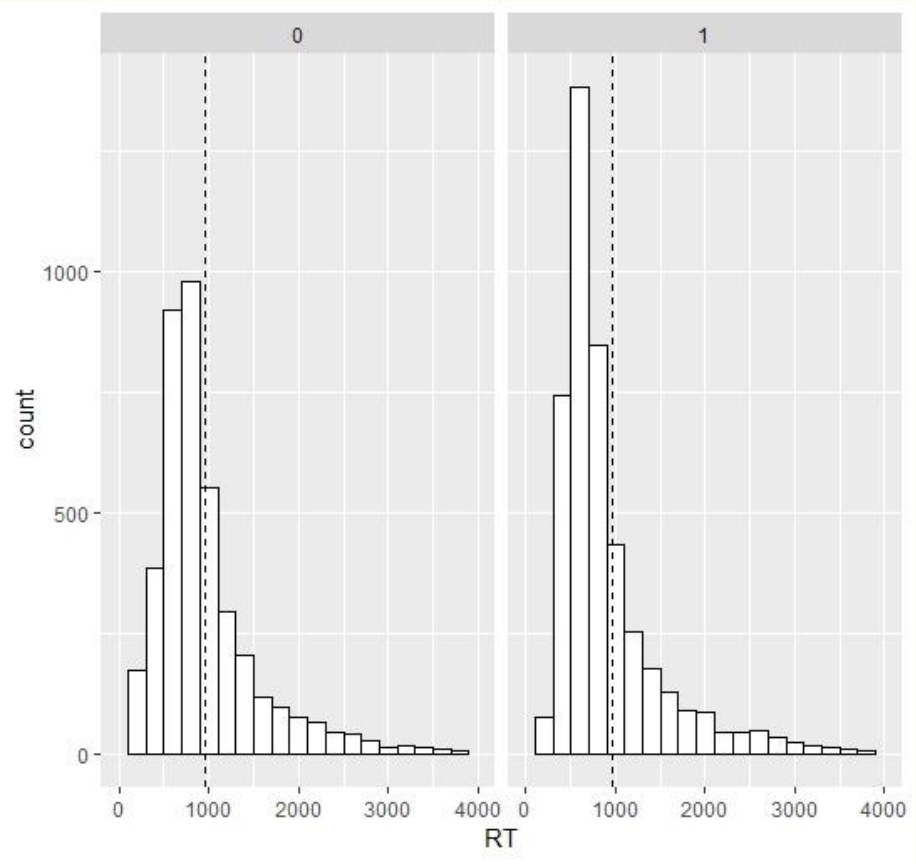
Línea roja: españoles
Línea azul: polacos



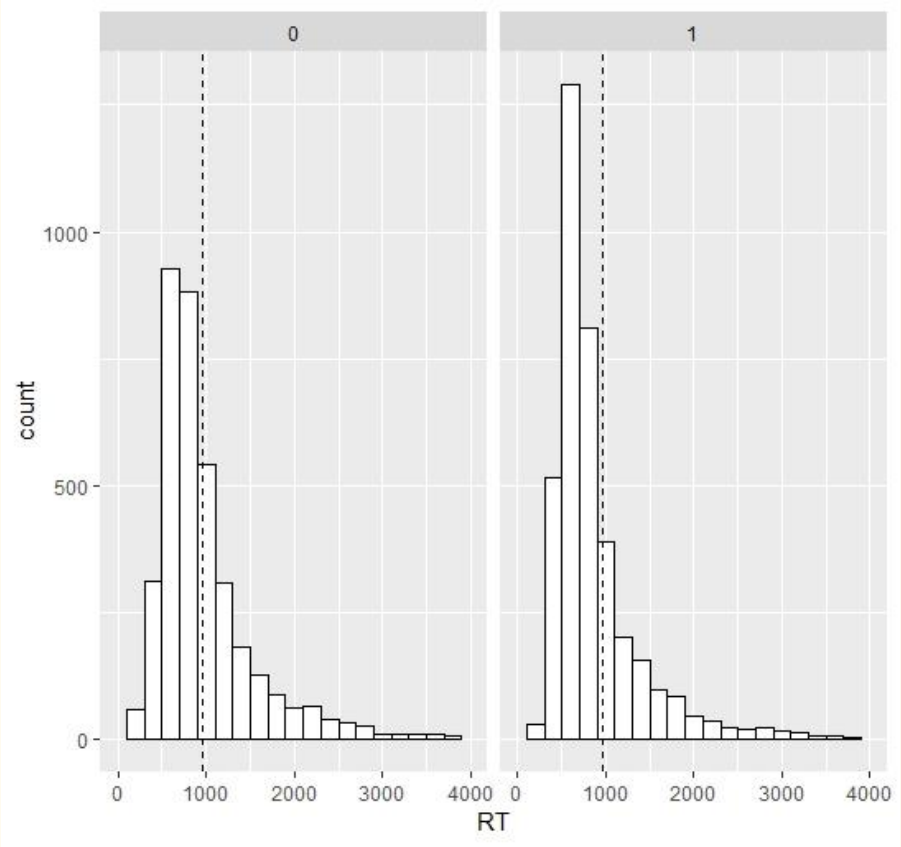
Línea amarilla: canarios
Línea roja: peninsulares
Línea azul: polacos



Línea marrón: canarios
Línea púrpura: españoles que aspiran



REACTION TIMES: SPANISH



REACTION TIMES: POLISH

Results summary

- In both groups, more than 30 ms is needed for the [h] to be perceived
- There are no significant differences between Polish people and Spaniards
- Canarian natives seem to be the best in perceiving aspiration compared to all others
- There are no group differences in reaction times
- The female voice and the vowel /a/ facilitate perception to some extent

Is there a remnant of the /s/ somewhere in the word?

Compensatory breathiness

/s/ weakening in Canary Islands Spanish

estás ‘you are’

[eh.ˈtas] [eh.ˈtah] [eh.ˈtaɦ] [eh.ˈta]

estás guapa ‘you look nice’

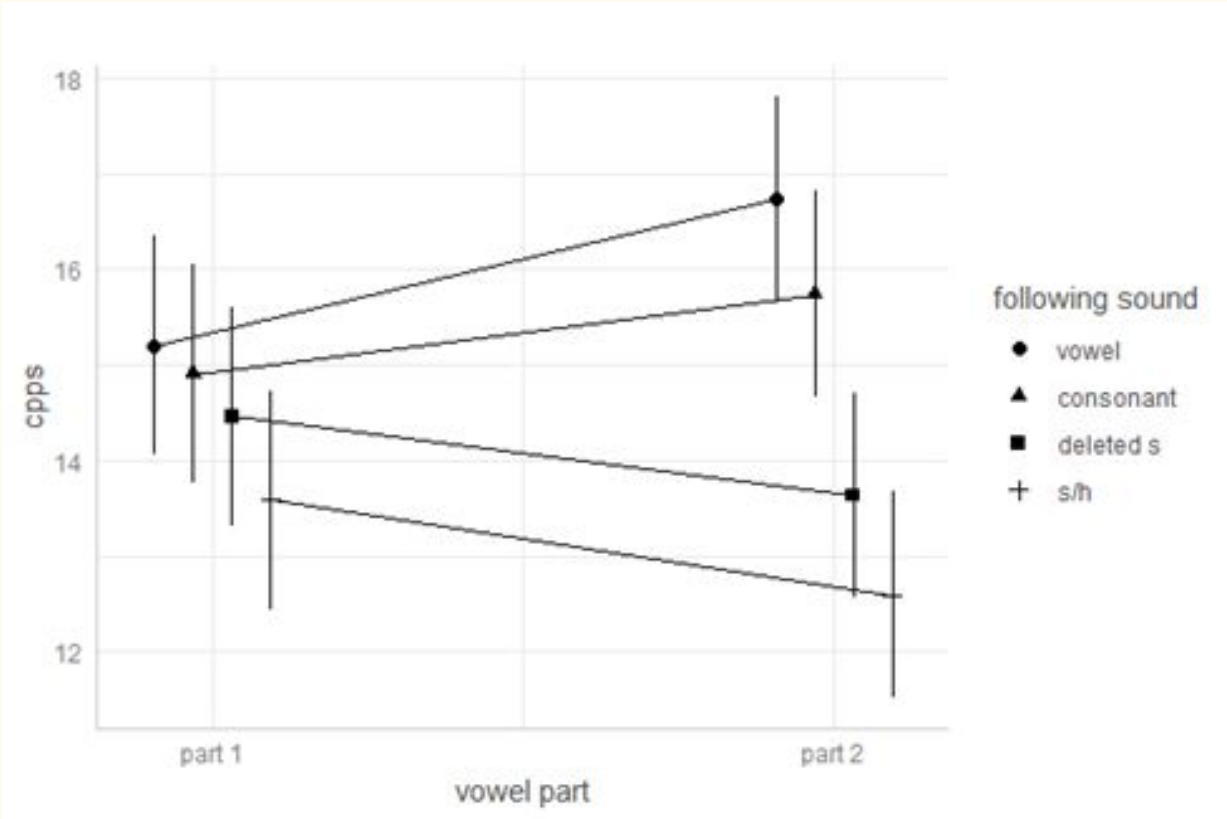
[eh.ˈtah.ˈgwa.pa] [eh.ˈtaɦ.ˈgwa.pa] [eh.ˈta.ˈgwa.pa]

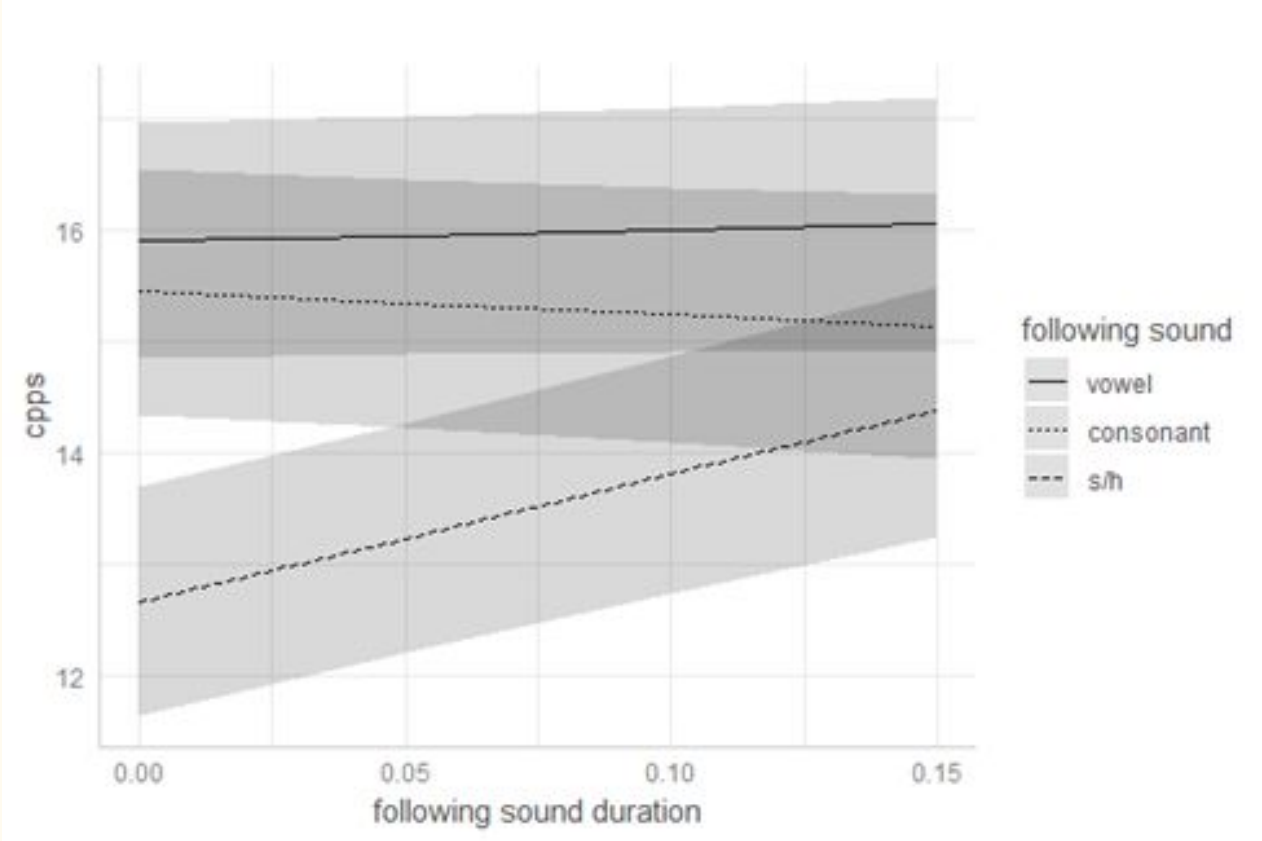
estás aquí ‘you are here’

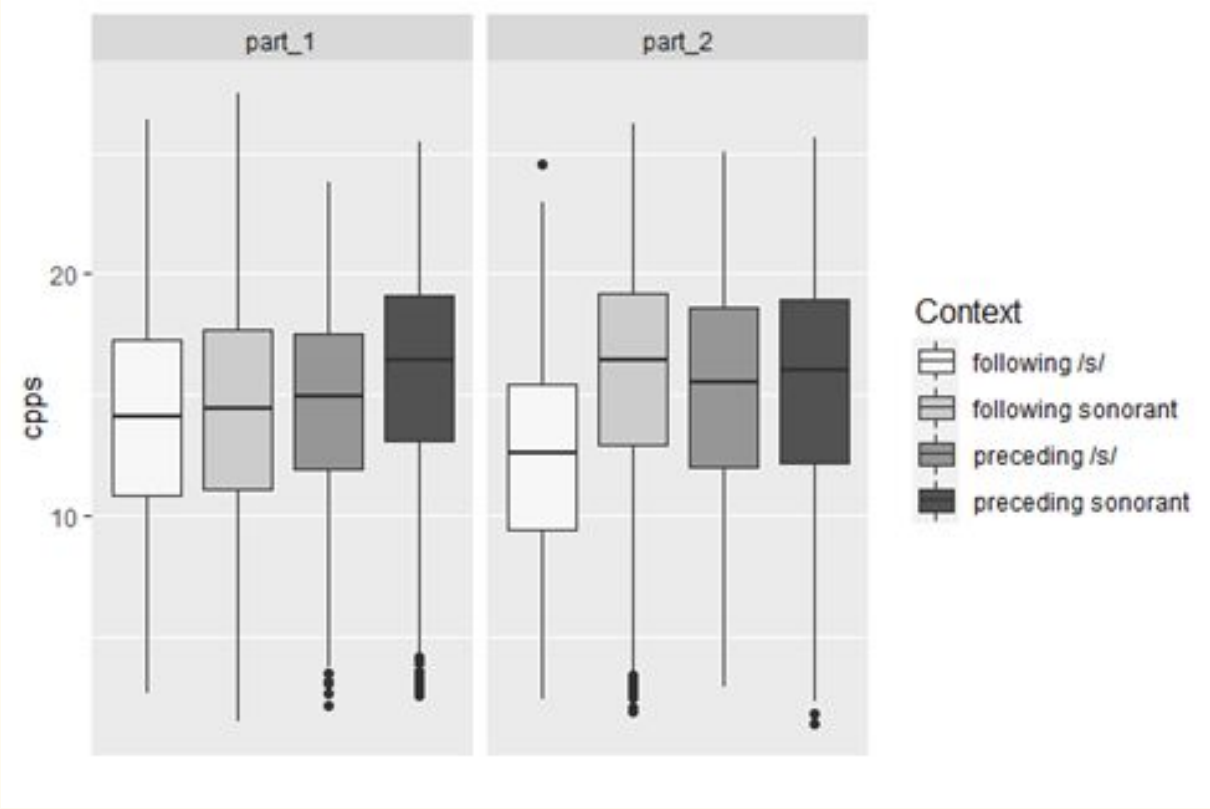
[eh.ˈta.sa.ˈki][eh.ˈta.ha.ˈki][eh.ˈta.ɦa.ˈki][eh.ˈta:.ˈki]

Hypotheses

- H1. CPP(S) is lower (more breathiness) in vowels followed by /s/ compared to vowels followed by other segments (lowest when there is no acoustic cue to the oral gesture of /s/, i.e. /s/ is deleted)
  - If Hypothesis 1 is supported, there is a compensatory effect of breathiness that comes from the deleted or aspirated segment
- H2. CPP(S) is lower (more breathiness) in the second half of the vowel compared to the first.
  - If Hypothesis 2 is supported, this confirms the subphonemic and compensatory nature of the change
- H3. CPP(S) is lower (more breathiness) with the decrease in duration of the following aspirated /s/
  - If there is a linear trend in the data as per Hypothesis 3, there is evidence for gradient change in the phonation of the vowel preceding the /s/


18
16
14
12
cpps
part 1
part 2
vowel part
following sound
vowel
consonant
deleted s
s/h


cpps
16
14
12
0.00
0.05
0.10
0.15
following sound duration
following sound
vowel
consonant
s/h


part_1
part_2
cpps
20
10
Context
following /s/
following sonorant
preceding /s/
preceding sonorant

Implications for teaching

Native speakers may have learned some phonetic cues that mark the plural even in the absence of the /s/ and this knowledge is gained by (native) experience – it may not be available to speakers of other languages and/or dialects

Designing class activities around such topics with a lot of practice might be a good idea

Context usually helps disambiguate words and meanings but this may be challenging for beginners

Dialectal differences:

subphonemic stop contrasts

Questions

- Stop weakening, lenition – what is it?
- What are the dialectal differences in this respect?
- How can we study them?

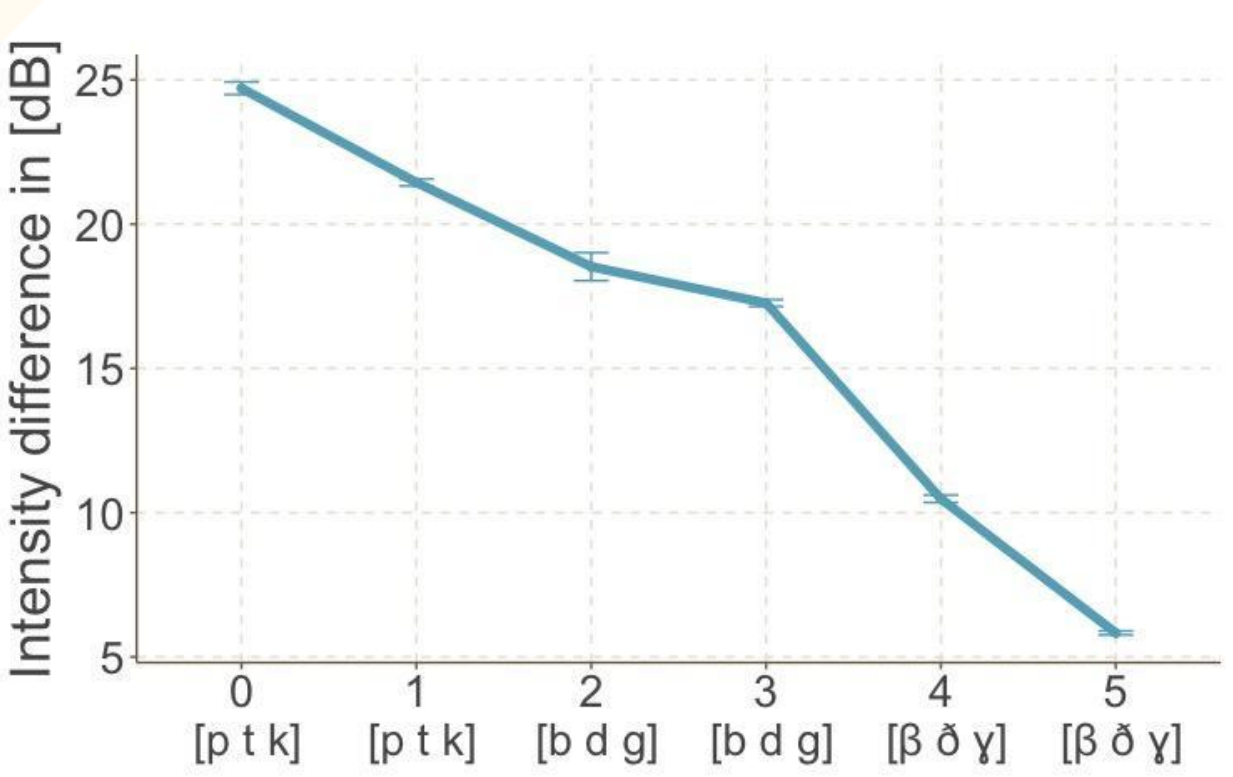

Puerto Nuevo
Sardina
Galdar
Puerto de Sardina
San Andres
Banaderos
Castillo de la Luz
Costa Ayala
San Isidro
Santa Maria
Trapiche
Cardones
Las Palmas de Gran Canaria
GC2
Moya
Arucas
Lance
Tenoya
Cueva de las Cruces
Juan XXIII
Santidad
Agaete
Firgas
Visvique
Tamaraceite
San Pedro
El Toscon
Lomo Blanco
Castillo de San Cristobal
Miraflor
S Lorenzo
Tafira Baja
Casas de Tamadaba
Suerte
Alta
Valleseco
Los Altos
Monte Lentiscal
Lanzarote
Teror
El Risco
Casa Quemada
Pino Santo
San Jose
Marzagan
Santa Brigida
Jinamar
Arinez
Utiaca
La Atalaya
La Garita
Puerto de la Aldea
Artenara
Las Lagunetas
La Lechuza
Vega de San Mateo
Telde
Playa del Hombre
San Nicolas de Tolentino
Las Marciegas
Tejeda
Tenteniguada
Valsequillo
Cueva Grande
Rincon
El Ceron
Las Huesas
Playa de Salinetas
La Culata
Tocodoman
El Goro
La Culata
Ayacata
Cazadores
Gando
Tasartico
Tasarte
Risco Blanco
Ingenio
Aeropuerto de Gran Canaria
San Bartolome de Tirajana
Santa Lucia
Las Casas de Veneguera
Soria
Agüimes
Carrizal
Temisas
Mogan
Fataga
Los Corralillos
Cruce de Arinaga
Playa de Tasarte
Los Navartos
El Cruce
El Estanco
Arinaga
Arteara
Sardina
Cercados de Espinos
Veneguera
Vecindario
Aldea Blanca
El Doctoral
Taurito
Pozo Izquierdo
Puerto de Mogan
Montana de Ladata
Juan Grande
Castillo del Romeral
Puerto Rico
El Tablero
Besudo
San Agustin
Patalavaca
Arguineguin
Playa del Ingles
Parchel
Maspalomas
GC1
GC2
810
811
812
813
814
815
816
817
520
4-6
18-11

Lenition in the Spanish of Gran Canaria

- Changes in voicing (p>b)
- Changes in constriction/openness (p>β, b>β)
- Changes between categories (p>b, p>β)
- Changes within categories (p>b̥ , b>β, b>β̞)
- Changes in one or more phonological features (voicing, continuancy, tenseness)
- 6 surface categories > aperture scale

Phonetics or phonology?

- **Two stages of lenition:**
  - ptk > bdg, bdg > β ð ɣ // ptk > β ð ɣ, bdg > ∅
  - examples: guapa ‚pretty' [gwa.ba] // [gwa.βa], boba ‚silly' [bo.βa] // [bo.a]
- **The process of lenition is sensitive to phonological structure**
  - *la pala* "the shovel" [la.ba.la], *las palas* [la.pa.la]
  - *la bala* "the bullet" [la. βa.la], *las balas* [la.ba.la]
- **The phonetic outputs of lenition are more nuanced:**
  - incomplete voicing, different degrees of opening and tenseness


Intensity difference in [dB]
25
20
15
10
5
0
[p t k]
1
[p t k]
2
[b d g]
3
[b d g]
4
[β ð ɣ]
5
[β ð ɣ]

PROBLEM

- Are the observed contrasts **perceptually salient?**
- Are the acoustic differences **sufficient cues** for auditory discrimination?
- Are the observed contrasts processed **phonologically** or merely at the **phonetic** level?
- Are **non-native speakers** able to distinguish sounds based on these differences?

Research question

How perceptible are these differences for learners of Spanish?

[aspiration vs true voice languages

continuant feature

voicing vs tenseness]

Cross-linguistic perception study

native speakers are usually sensitive only to the **contrasts** they are exposed to and that are **systemic**

some studies show native speaker sensitivity to **subphonemic differences** (e.g., underlying voicing in Polish or German)

Are variants confirmed in production salient enough to be reliably distinguished in perception?

4 groups of participants: Canarians, Peninsular Spaniards, Poles and Germans (N=110)

- Peninsular Spanish has fewer variants than Canarian given the lack of systematic /p t k/ weakening, which can affect perception
- like Spanish, Polish is a true voice language attending to the feature [voice].
- German is an aspirating language which uses [spread glottis] instead
- both German and Polish lack non-spirant approximants but use the feature [continuant] to contrast stops with fricatives

The tasks

1) a forced-choice AX task with disyllabic stimuli presented with a short ISI (300ms) aimed at tapping into acoustic perception and

2) an AXB task using trisyllabic stimuli with a longer (1 sec) ISI focused on phonological categorization

Stimuli

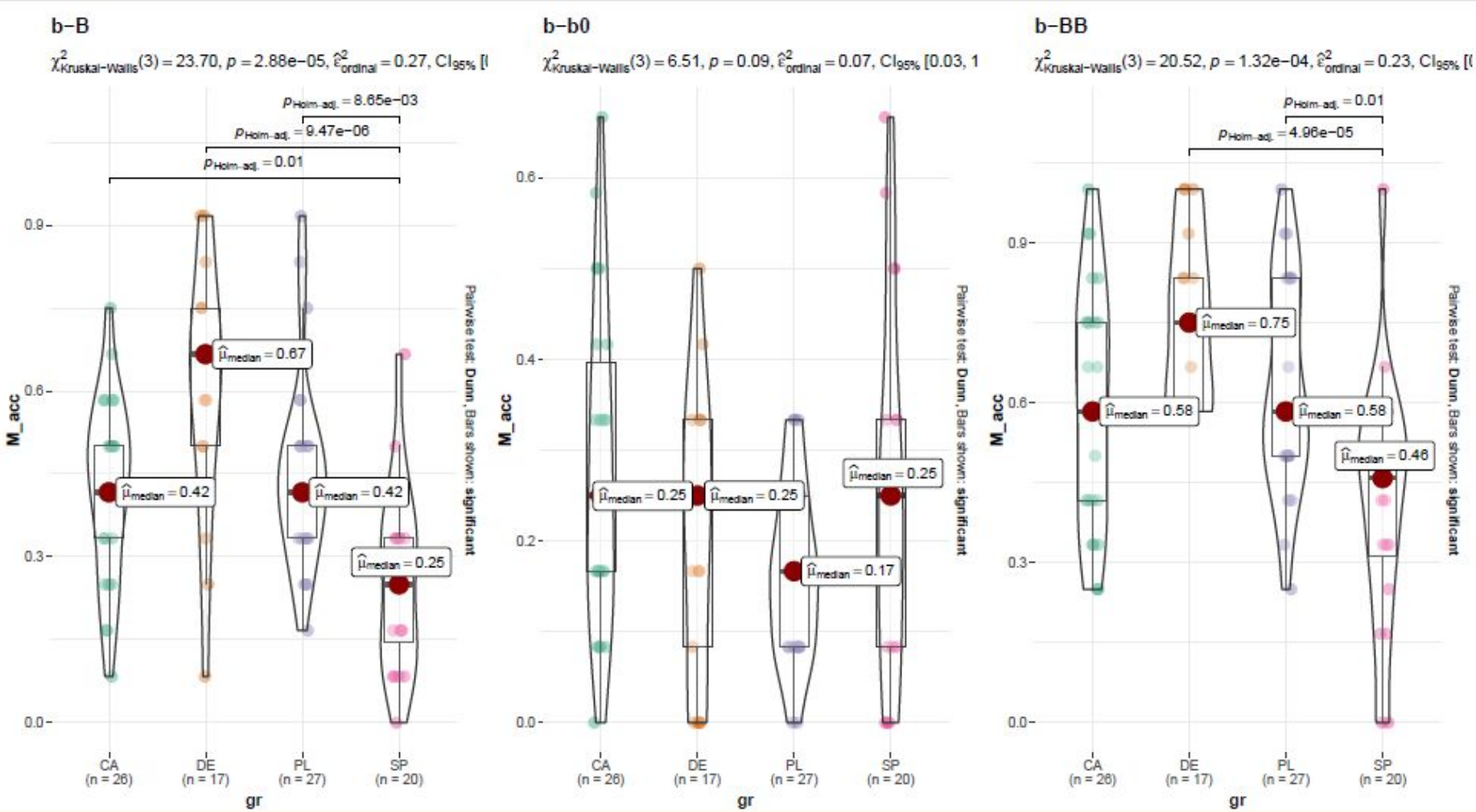
5 variants of obstruents: a voiceless stop [p], a partially voiced stop [b̥], a fully voiced stop [b], a closed approximant [β] and an open approximant [β̞]

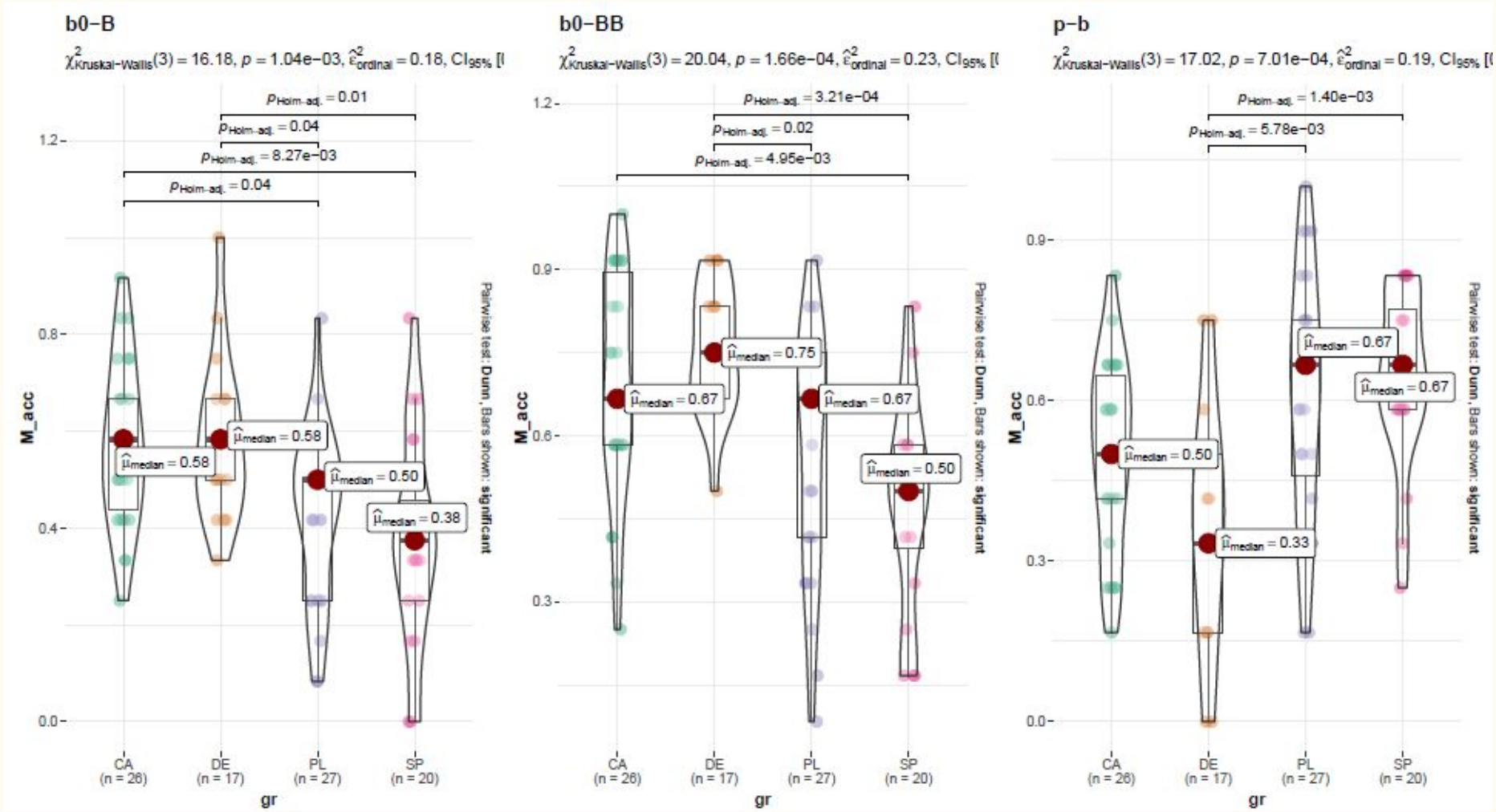
This gave us **10 pairs of sound contrasts** embedded in **pseudowords**:

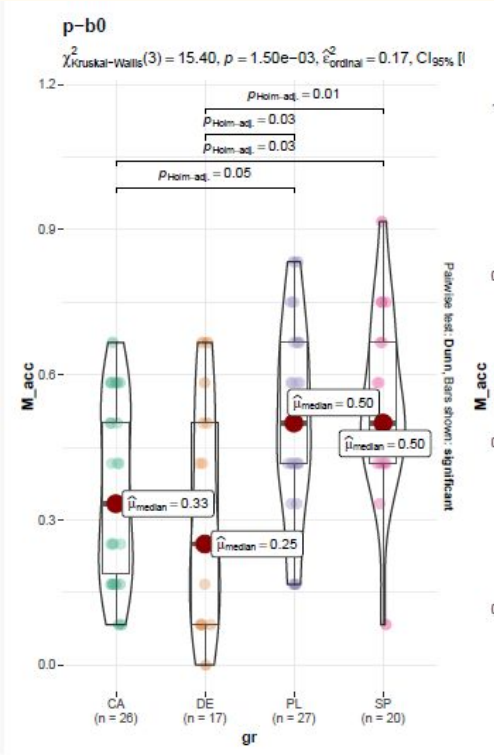
[gapa], [repe], [supu], [lapafa], [depeha], [nupula]

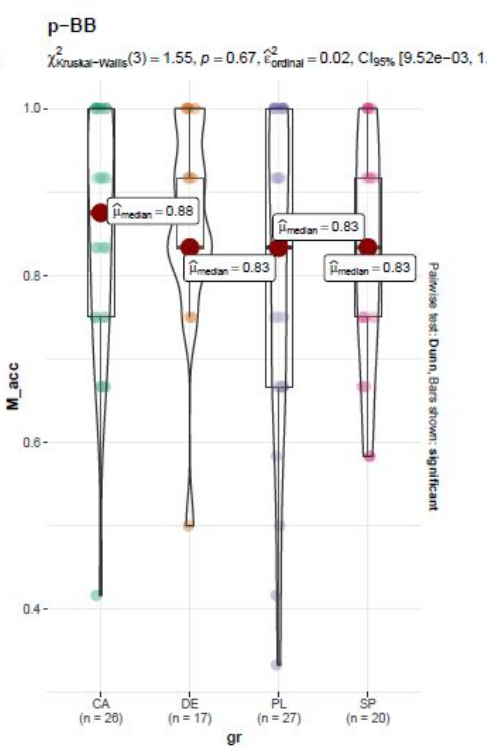
Results – AX task

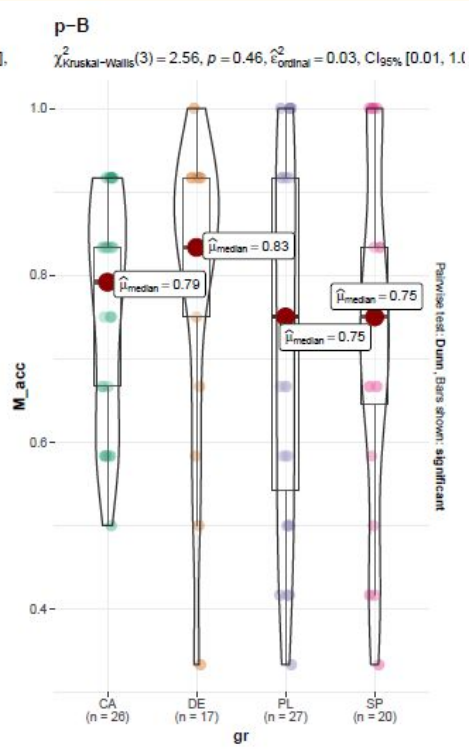
- contrasts are recognized by participants based on **phonological categories**
- **allophonic distinctions** and minor phonetic details are treated **as intra-category**
- Spaniards had serious difficulties with most of the tested contrasts; Poles and Germans fared statistically better: **approximants** probably **reinterpreted as /v/**
- Poles above chance in **voicing contrasts**, as opposed to Germans (33%)
- in most cases it takes a difference of **more than one phonological feature** for sounds to be reliably distinguished
- the **/p/ - /b/ contrast** may be **in decline** in the Canary Islands: Canarians recognized it at random (50%) while other Spaniards at a 67% accuracy level

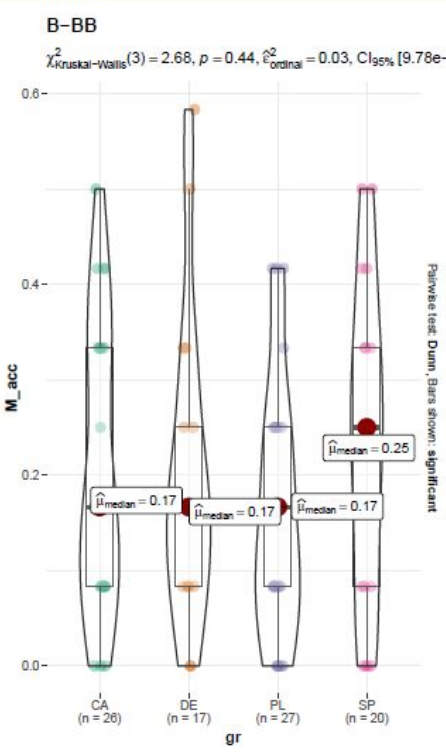

b–B
$\chi^2_{Kruskal-Wallis}(3) = 23.70$, $p = 2.88e{-}05$, $\hat{\varepsilon}^2_{ordinal} = 0.27$, $CI_{95\%}$ [
$p_{Holm-adj.} = 8.65e{-}03$
$p_{Holm-adj.} = 9.47e{-}06$
$p_{Holm-adj.} = 0.01$
$\hat{\mu}_{median} = 0.67$
$\hat{\mu}_{median} = 0.42$
$\hat{\mu}_{median} = 0.42$
$\hat{\mu}_{median} = 0.25$
M_acc
0.0
0.3
0.6
0.9
CA (n = 26)
DE (n = 17)
PL (n = 27)
SP (n = 20)
gr
Pairwise test: Dunn, Bars shown: significant
b–b0
$\chi^2_{Kruskal-Wallis}(3) = 6.51$, $p = 0.09$, $\hat{\varepsilon}^2_{ordinal} = 0.07$, $CI_{95\%}$ [0.03, 1
$\hat{\mu}_{median} = 0.25$
$\hat{\mu}_{median} = 0.25$
$\hat{\mu}_{median} = 0.17$
$\hat{\mu}_{median} = 0.25$
M_acc
0.0
0.2
0.4
0.6
CA (n = 26)
DE (n = 17)
PL (n = 27)
SP (n = 20)
gr
Pairwise test: Dunn, Bars shown: significant
b–BB
$\chi^2_{Kruskal-Wallis}(3) = 20.52$, $p = 1.32e{-}04$, $\hat{\varepsilon}^2_{ordinal} = 0.23$, $CI_{95\%}$ [
$p_{Holm-adj.} = 0.01$
$p_{Holm-adj.} = 4.96e{-}05$
$\hat{\mu}_{median} = 0.58$
$\hat{\mu}_{median} = 0.75$
$\hat{\mu}_{median} = 0.58$
$\hat{\mu}_{median} = 0.46$
M_acc
0.0
0.3
0.6
0.9
CA (n = 26)
DE (n = 17)
PL (n = 27)
SP (n = 20)
gr
Pairwise test: Dunn, Bars shown: significant


b0−B
$\chi^2_{Kruskal-Wallis}(3) = 16.18$, $p = 1.04e{-}03$, $\hat{\varepsilon}^2_{ordinal} = 0.18$, $CI_{95\%}$ [
$p_{Holm-adj.} = 0.01$
$p_{Holm-adj.} = 0.04$
$p_{Holm-adj.} = 8.27e{-}03$
$p_{Holm-adj.} = 0.04$
$\hat{\mu}_{median} = 0.58$
$\hat{\mu}_{median} = 0.58$
$\hat{\mu}_{median} = 0.50$
$\hat{\mu}_{median} = 0.38$
M_acc
gr
CA (n = 26)
DE (n = 17)
PL (n = 27)
SP (n = 20)
Pairwise test: Dunn, Bars shown: significant
b0−BB
$\chi^2_{Kruskal-Wallis}(3) = 20.04$, $p = 1.66e{-}04$, $\hat{\varepsilon}^2_{ordinal} = 0.23$, $CI_{95\%}$ [
$p_{Holm-adj.} = 3.21e{-}04$
$p_{Holm-adj.} = 0.02$
$p_{Holm-adj.} = 4.95e{-}03$
$\hat{\mu}_{median} = 0.67$
$\hat{\mu}_{median} = 0.75$
$\hat{\mu}_{median} = 0.67$
$\hat{\mu}_{median} = 0.50$
M_acc
gr
CA (n = 26)
DE (n = 17)
PL (n = 27)
SP (n = 20)
Pairwise test: Dunn, Bars shown: significant
p−b
$\chi^2_{Kruskal-Wallis}(3) = 17.02$, $p = 7.01e{-}04$, $\hat{\varepsilon}^2_{ordinal} = 0.19$, $CI_{95\%}$ [
$p_{Holm-adj.} = 1.40e{-}03$
$p_{Holm-adj.} = 5.78e{-}03$
$\hat{\mu}_{median} = 0.67$
$\hat{\mu}_{median} = 0.67$
$\hat{\mu}_{median} = 0.50$
$\hat{\mu}_{median} = 0.33$
M_acc
gr
CA (n = 26)
DE (n = 17)
PL (n = 27)
SP (n = 20)
Pairwise test: Dunn, Bars shown: significant


p−b0
$\chi^2_{Kruskal-Wallis}(3) = 15.40$, $p = 1.50e{-}03$, $\hat{\varepsilon}^2_{ordinal} = 0.17$, $CI_{95\%}$ [
$p_{Holm-adj.} = 0.01$
$p_{Holm-adj.} = 0.03$
$p_{Holm-adj.} = 0.03$
$p_{Holm-adj.} = 0.05$
$\hat{\mu}_{median} = 0.33$
$\hat{\mu}_{median} = 0.25$
$\hat{\mu}_{median} = 0.50$
$\hat{\mu}_{median} = 0.50$
M_acc
gr
CA (n = 26)
DE (n = 17)
PL (n = 27)
SP (n = 20)
Pairwise test: Dunn, Bars shown: significant

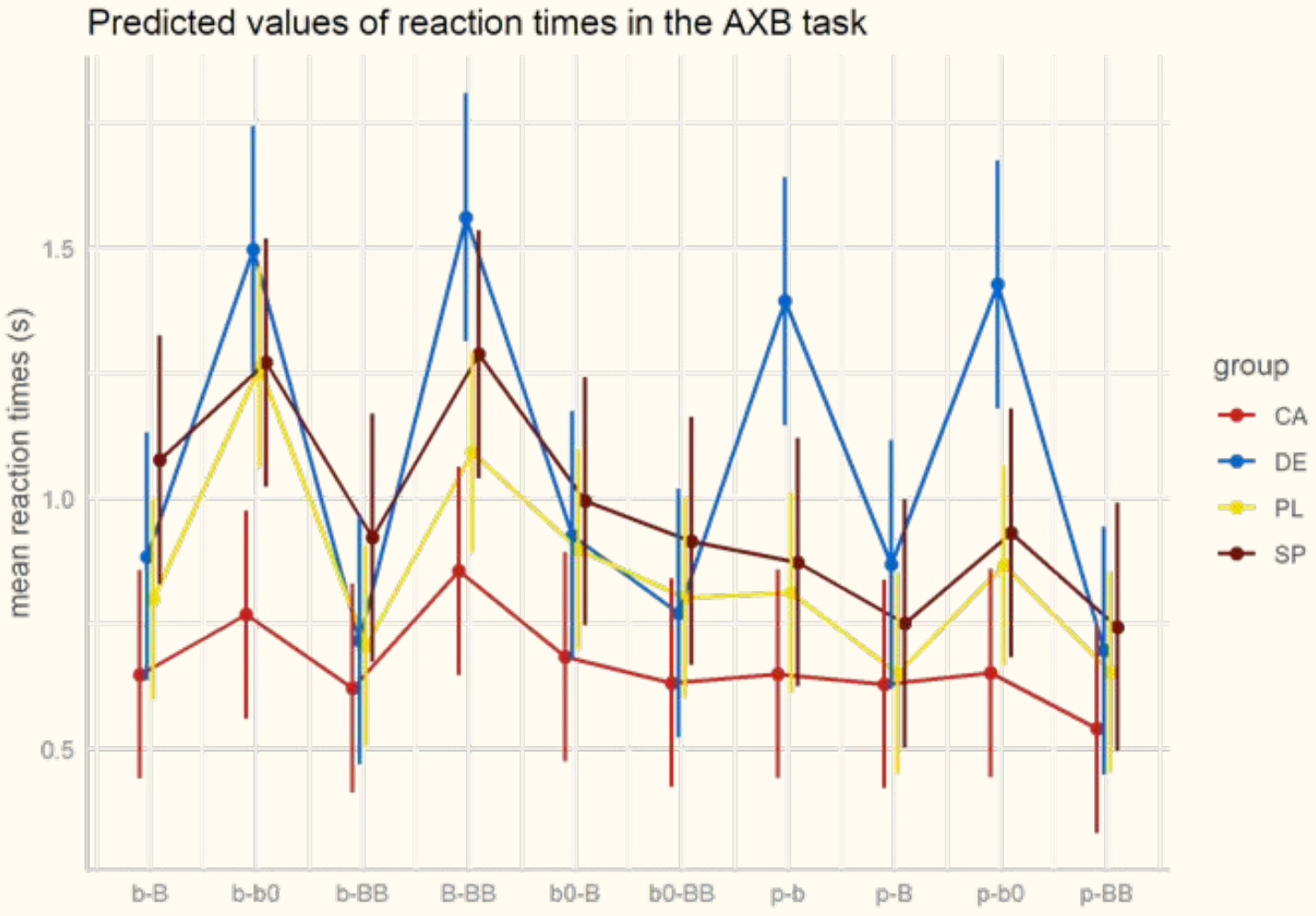

p−BB
$\chi^2_{Kruskal-Wallis}(3) = 1.55$, $p = 0.67$, $\hat{\varepsilon}^2_{ordinal} = 0.02$, $CI_{95\%}$ [9.52e−03, 1.00],
$\hat{\mu}_{median} = 0.88$
$\hat{\mu}_{median} = 0.83$
$\hat{\mu}_{median} = 0.83$
$\hat{\mu}_{median} = 0.83$
M_acc
gr
CA (n = 26)
DE (n = 17)
PL (n = 27)
SP (n = 20)
Pairwise test: Dunn, Bars shown: significant

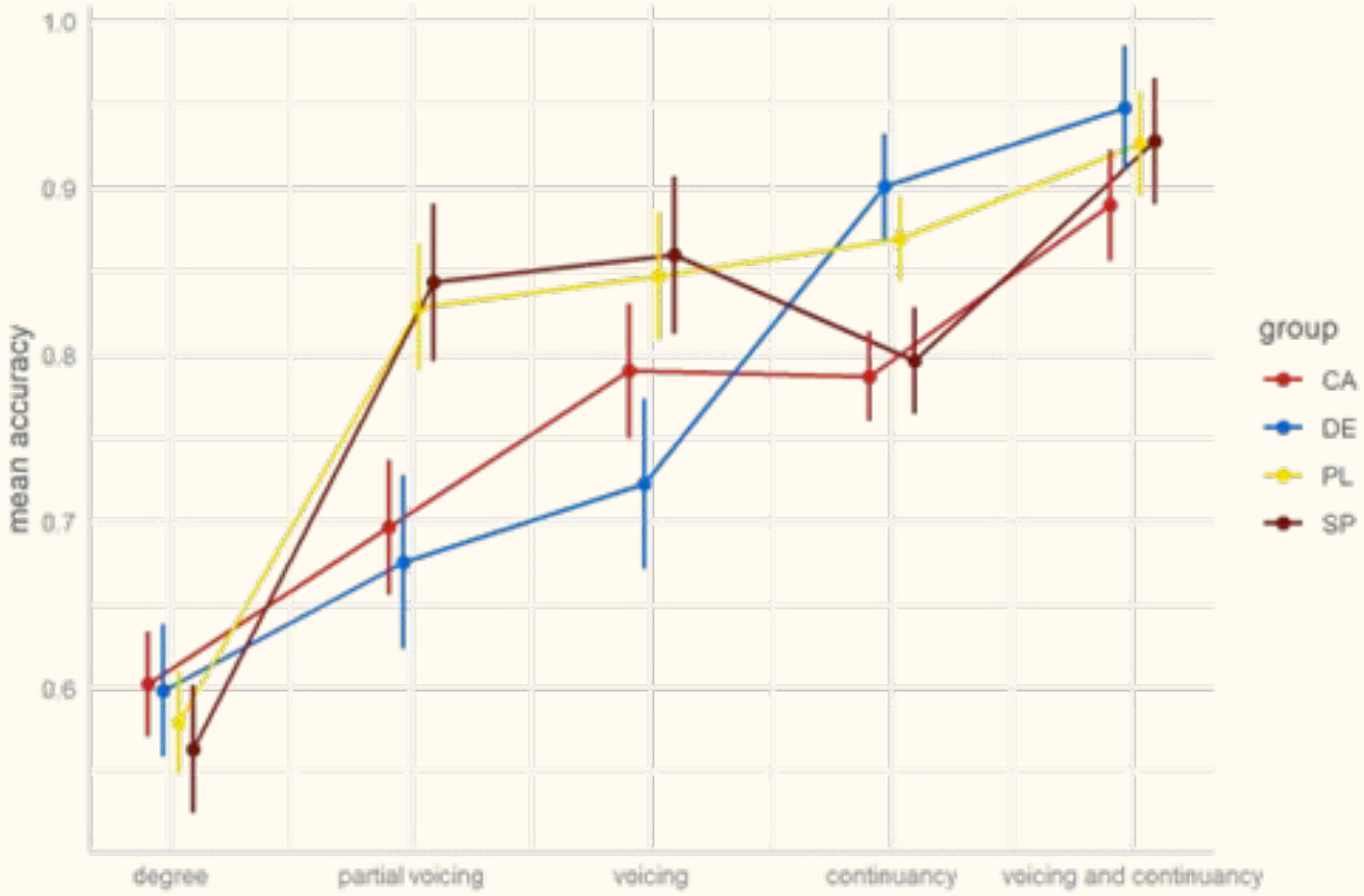

p−B
$\chi^2_{Kruskal-Wallis}(3) = 2.56$, $p = 0.46$, $\hat{\varepsilon}^2_{ordinal} = 0.03$, $CI_{95\%}$ [0.01, 1.0
$\hat{\mu}_{median} = 0.79$
$\hat{\mu}_{median} = 0.83$
$\hat{\mu}_{median} = 0.75$
$\hat{\mu}_{median} = 0.75$
M_acc
gr
CA (n = 26)
DE (n = 17)
PL (n = 27)
SP (n = 20)
Pairwise test: Dunn, Bars shown: significant

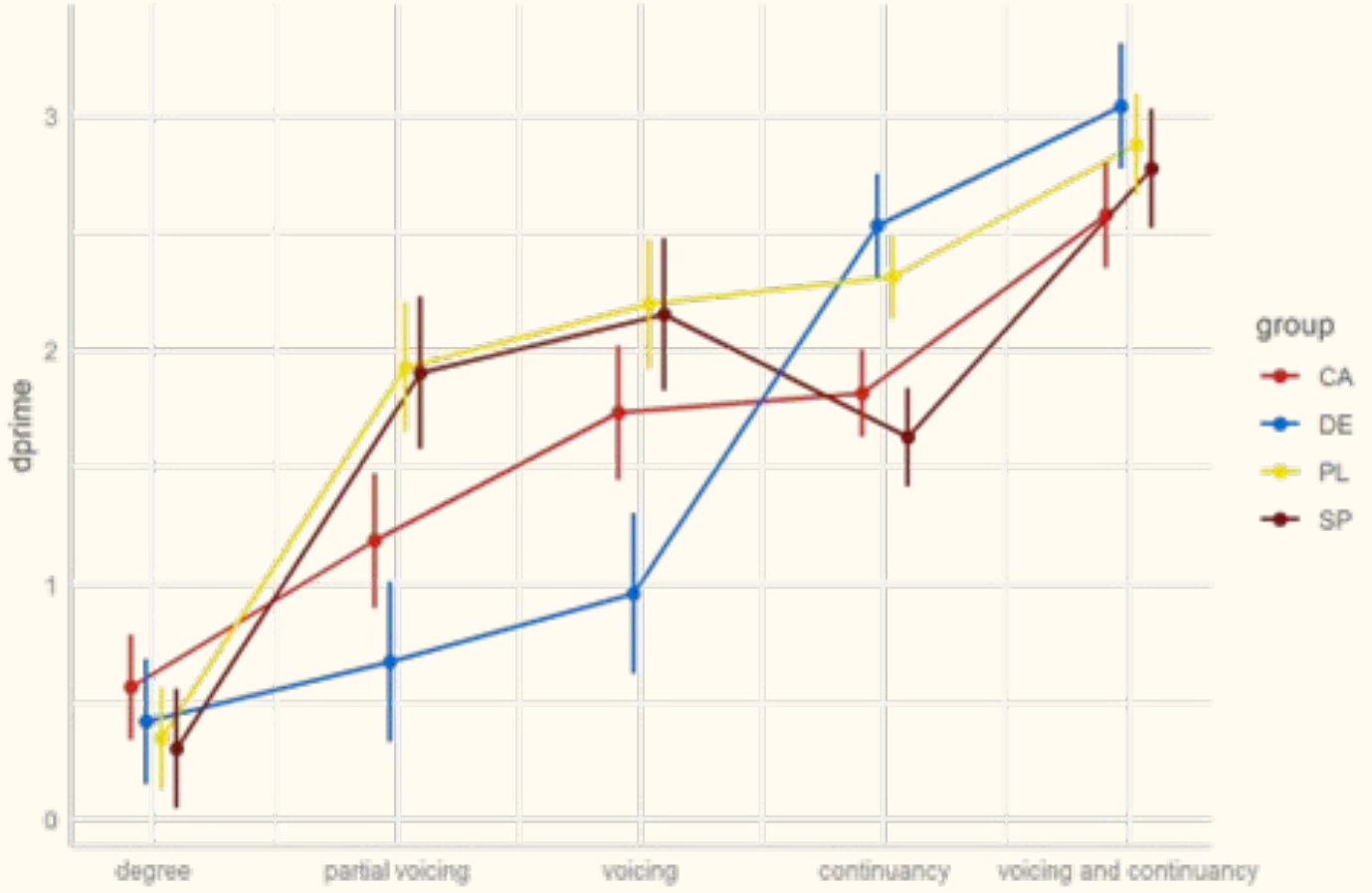

B−BB
$\chi^2_{Kruskal-Wallis}(3) = 2.68$, $p = 0.44$, $\hat{\varepsilon}^2_{ordinal} = 0.03$, $CI_{95\%}$ [9.78e−
$\hat{\mu}_{median} = 0.17$
$\hat{\mu}_{median} = 0.17$
$\hat{\mu}_{median} = 0.17$
$\hat{\mu}_{median} = 0.25$
M_acc
gr
CA (n = 26)
DE (n = 17)
PL (n = 27)
SP (n = 20)
Pairwise test: Dunn, Bars shown: significant

Results – AXB task

- **all participants did much better**, except for Germans (voicing)
- general tendency for all **Spaniards** to be **worse** than Poles and Germans in **discriminating between stops and approximants** (~80% vs. 90% accuracy, $<$ 2 vs $>$ 2 in d')
- Canarians are the only group that treats the **voiceless-partially voiced contrast differently than voiceless-voiced**, which is in line with the production data
- **Canarians responded** systematically **faster** than all other groups by an average of 300-500ms: despite comparable accuracy, they were significantly more confident in their answers


Predicted values of reaction times in the AXB task
mean reaction times (s)
1.5
1.0
0.5
b-B
b-b0
b-BB
B-BB
b0-B
b0-BB
p-b
p-B
p-b0
p-BB
group
CA
DE
PL
SP


1.0
0.9
0.8
0.7
0.6
mean accuracy
degree
partial voicing
voicing
continuancy
voicing and continuancy
group
CA
DE
PL
SP


dprime
3
2
1
0
degree
partial voicing
voicing
continuancy
voicing and continuancy
group
CA
DE
PL
SP

Conclusions

- although some phonetic sensitivity to consonantal contrasts is observed in perception in native speakers, there is **no evidence for (near-)categoricity**
- **native phonological categories prevail in non-natives** in guiding both acoustic perception and categorisation

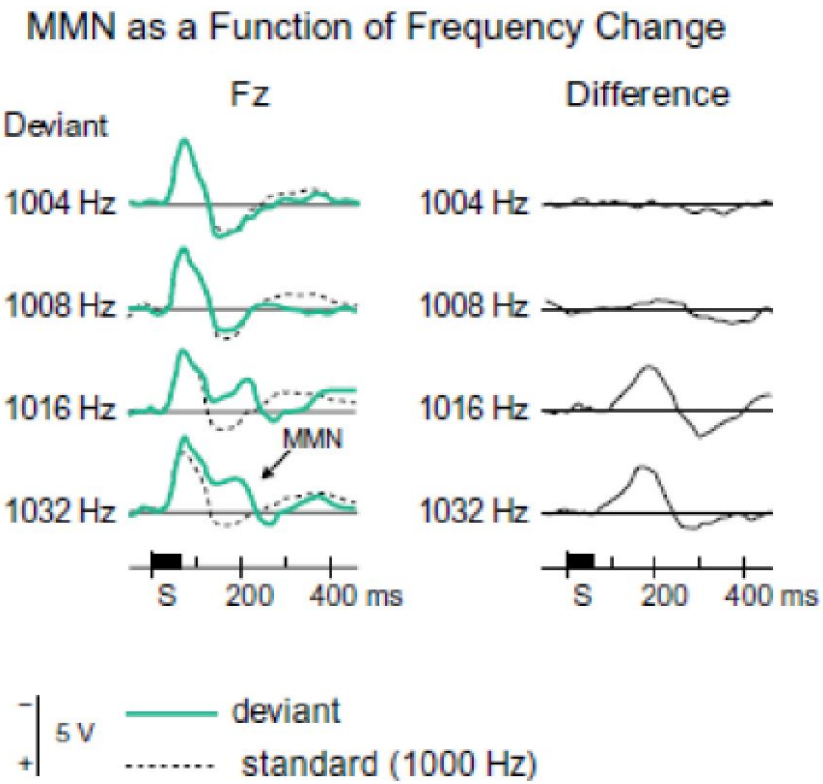
Implications for teaching

- Non-native speakers will use their native contrasts and sound inventories (at least at first) when learning a foreign language
- This may be good in perception, but not necessarily in production
- Focus on the differences between such allophones and phonemic differences is necessary

EEG exploration

MMN experiment

- passive oddball paradigm
- two experimental groups (Spanish, French)
- 15-18 participants per group
- two blocks with a change in standard vs. deviants following Honbolygó & Csépe (2013)



Background

Honbolygó & Csépe argue that there is a difference between purely acoustic processing based on physical differences

- (short-term representation matching) and phonological processing
- (long-term representation matching) in stress processing

I expect the same effects in the case of **phonemic vs. phonetic differences** between individual consonants

Background

Honbolygó & Csépe refer to the **familiar context hypothesis:**

- when the standard sounds of an oddball sequence are familiar, this creates a regularity representation or context that makes the processing of deviant features more elaborate
- familiar stimuli > richer representation (learning, exposure, long-term traces)
- In the study, the MMNs were determined by the status of the standard stimuli: when the deviant was presented in a familiar context (legal standard), no MMN in the unfamiliar context (illegal standard)
- I expect similar effects in the case of familiar sounds as context (existent phonemes or allophones) vs. unfamiliar ones (inexistent phones)

Background

Adapting the results to the purposes of this study:

- If the standard is a legal (existing, contrastive) sound and the deviant is not, there is a mismatch caused by a grammatical violation and hence an MMN is expected.
- This applies to both: the case in which the deviant is a non-existent sound in the language (French), and a sound not matching the context (Spanish)
- If the standard is an illegal or inexistent pattern/sound, and the deviant is legal/existing, there should be no MMN or there should be no MMN effect when comparing a given word in the deviant vs. standard condition (cross-comparison between blocks)

Experimental procedure

Block 1

video:
sand on glass

[babá]

(standard)
probability: **72%**

N=1030

[bapá] voiceless

[babə́] partially voiced

[baβá] closed approximant

[baβ̞á] open approximant

deviants
probability: 7%
N=100x4

ITI: 500-600 ms

Block 2

video:
sand on glass

[baβá]

(standard)
probability: **72%**

N=1030

[bapá] voiceless

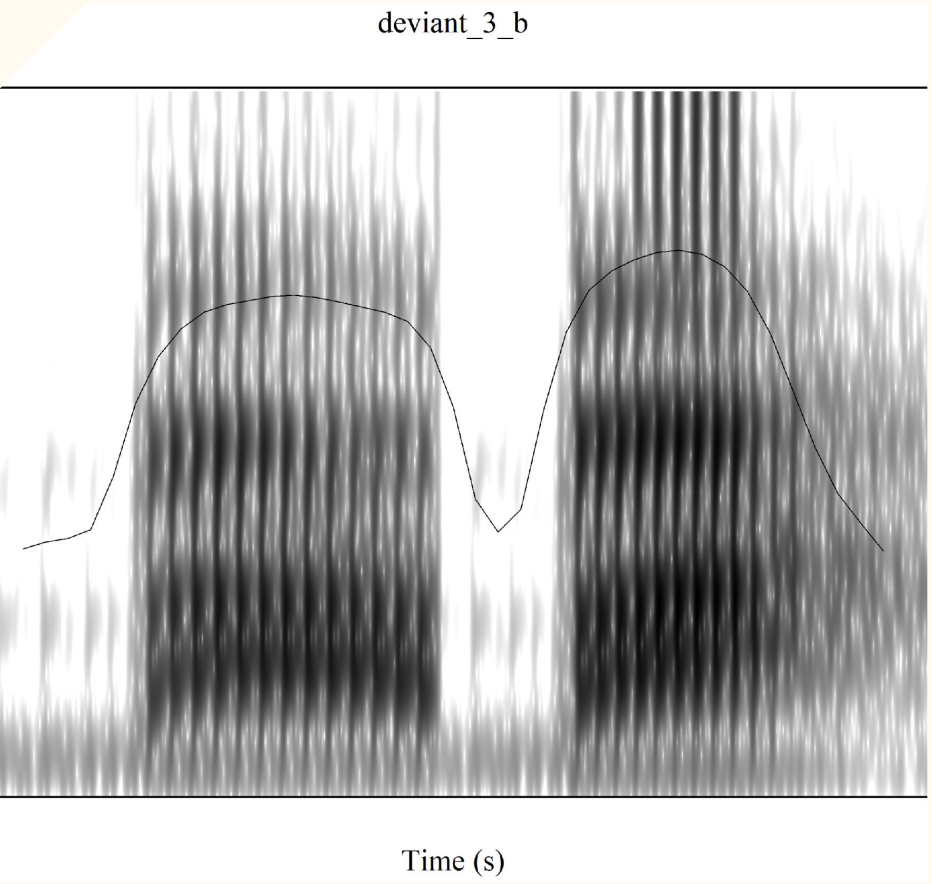
[babə́] partially voiced

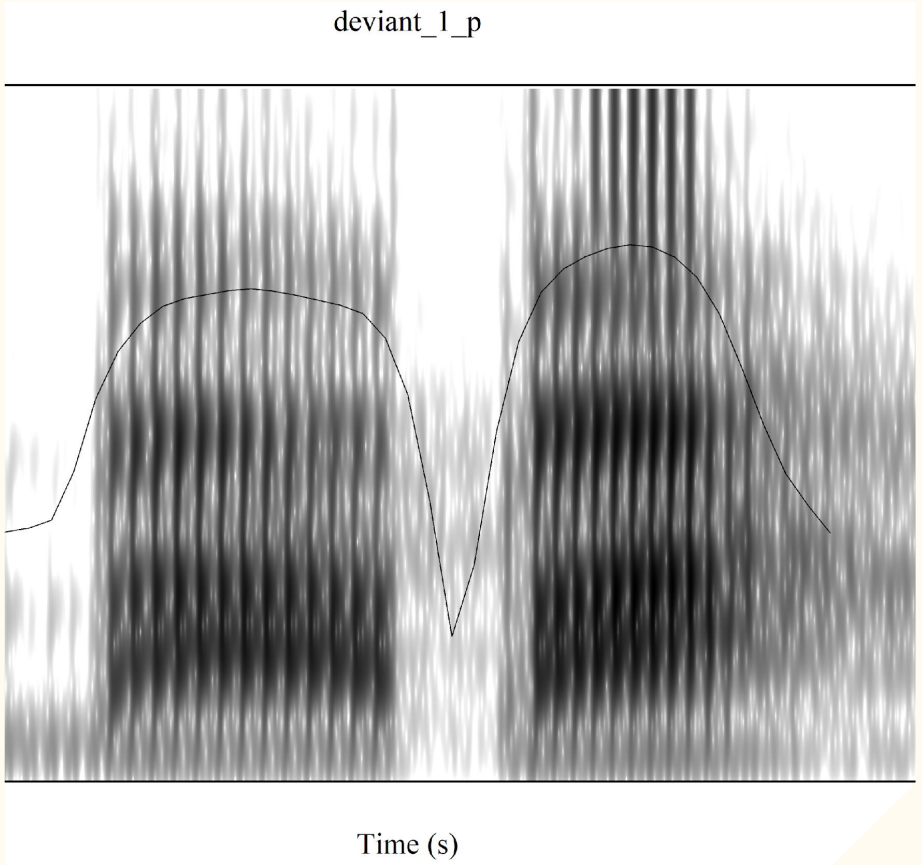
[babá] voiced

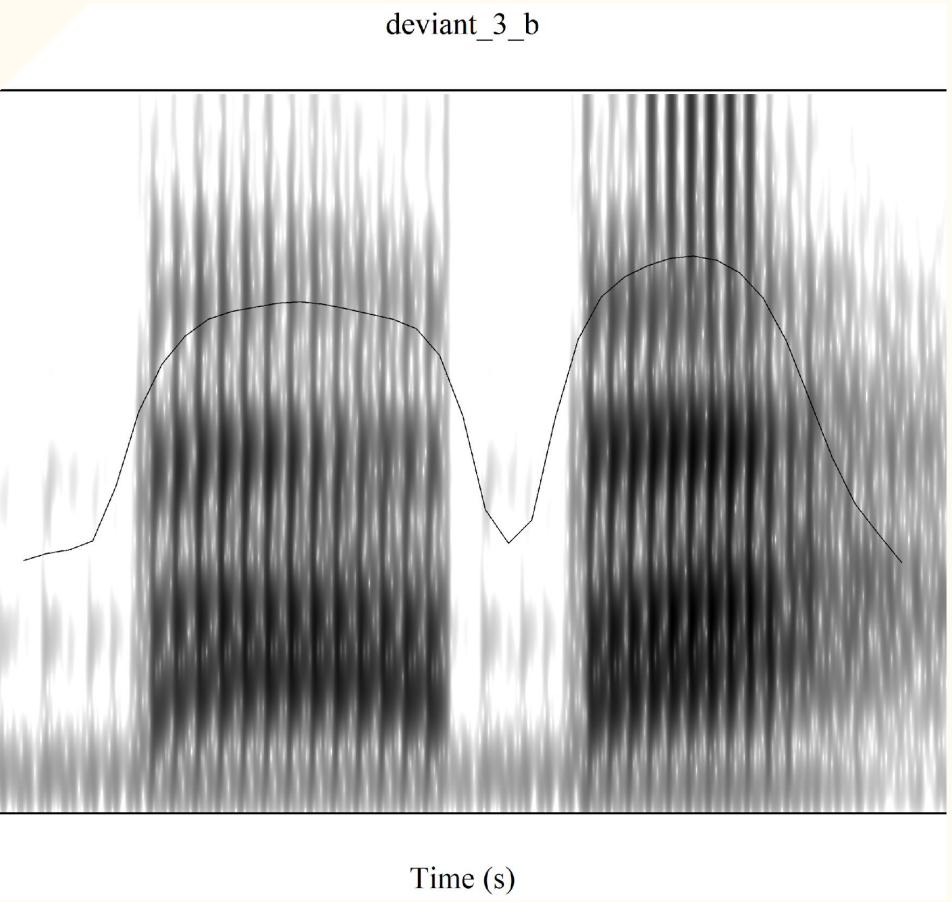
[baβ̞á] open approximant

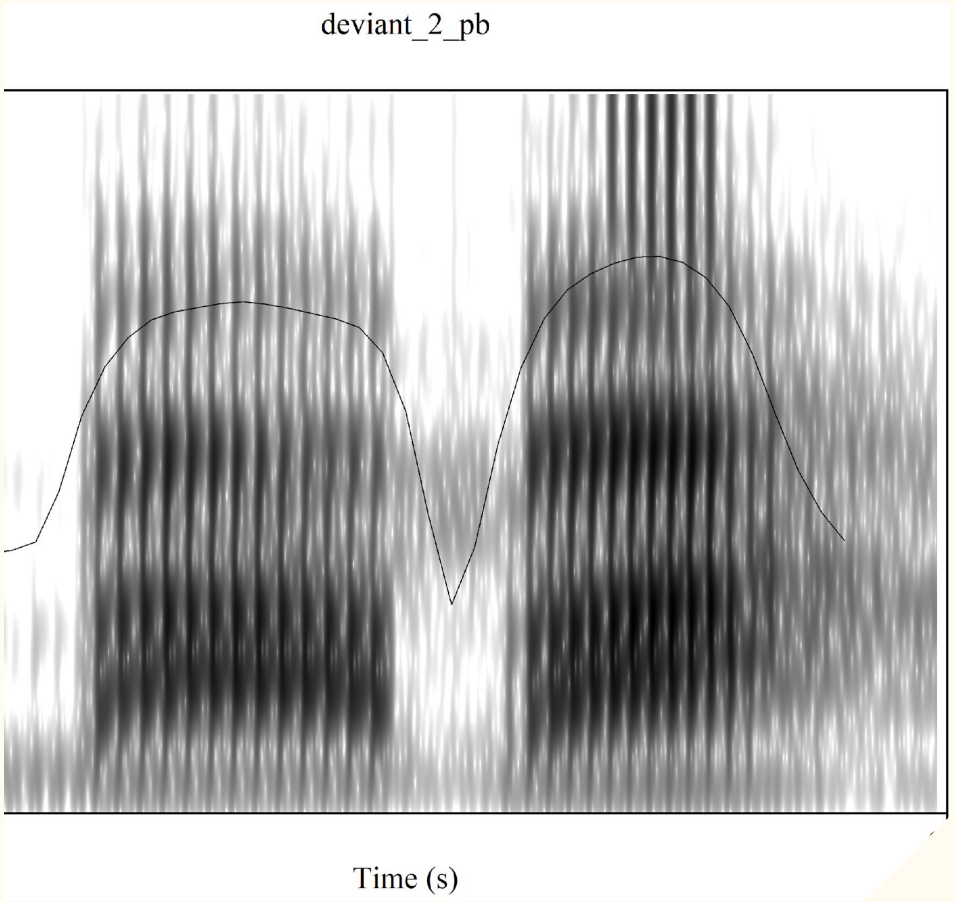
deviants
probability: 7%
N=100x4

ITI: 500-600 ms

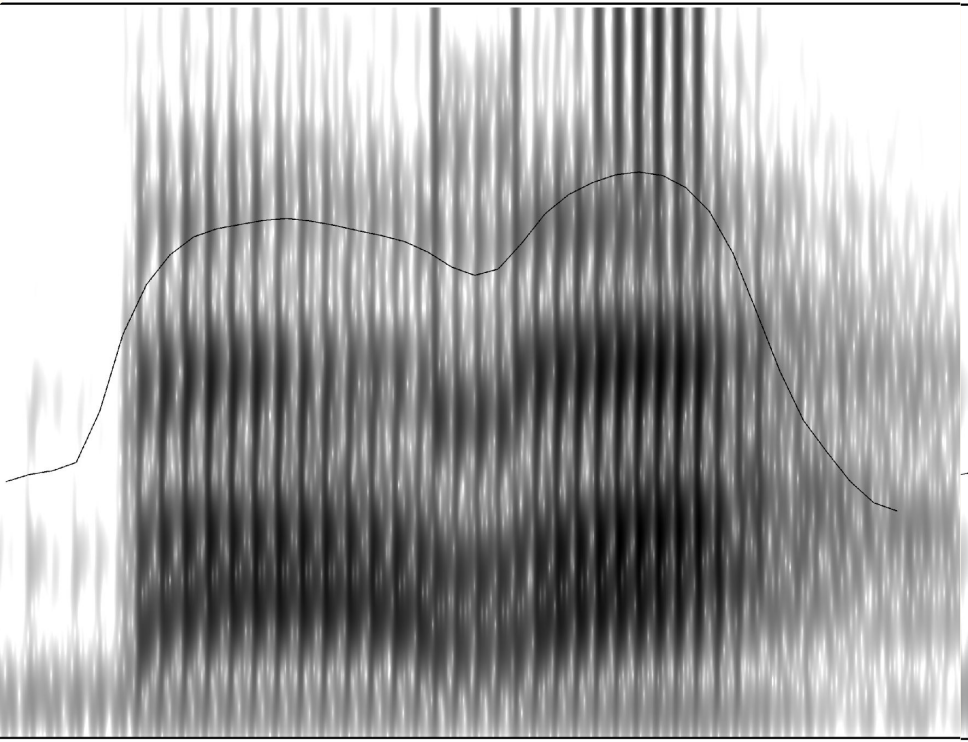

deviant_3_b
Time (s)


deviant_1_p
Time (s)


deviant_3_b
Time (s)

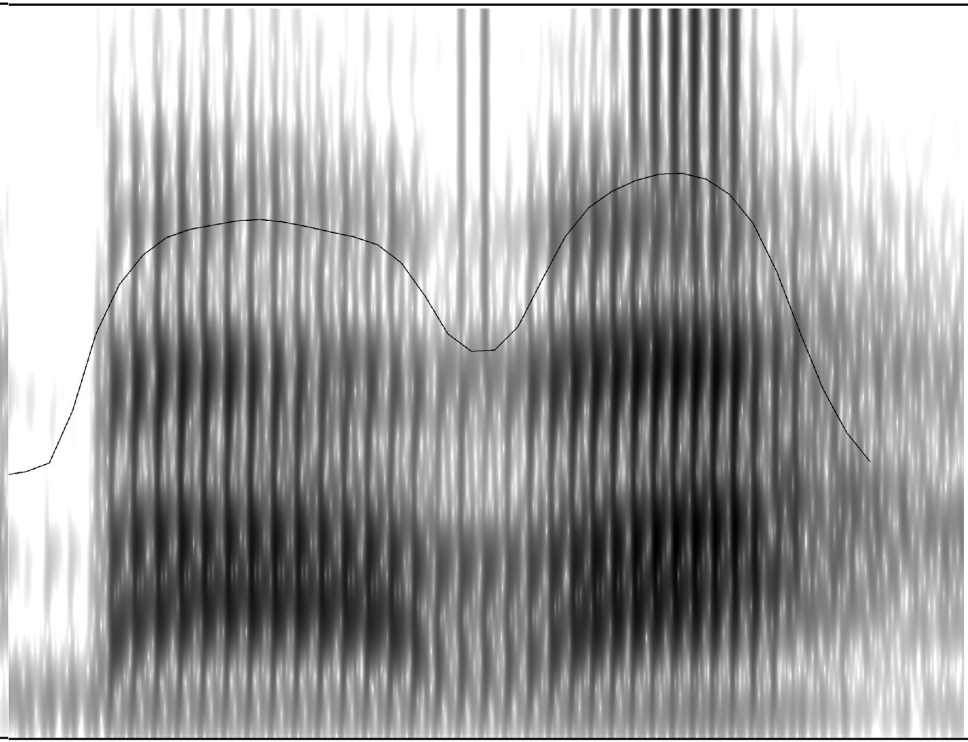

deviant_2_pb
Time (s)

deviant_4_bb



Time (s)

deviant_3_b0



Time (s)

Cross-comparisons

[baba] > [baβa]

[baβa] > [baba]

[baba] > [bapa], [baba] > [baḇa], [baba] > [baβ̰a]

[baβa] > [bapa], [baβa] > [baḇa], [baβa] > [baβ̰a]

FR <> ES

French participants

- voicing contrast exists, [baba] > [bapa] should elicit negativity that is different compared to [baba] in the deviant condition
- difference between [baba] > [baβa] and [baβa] > [baba]
- partially voiced deviant might be subject to phonetic sensitivity and elicit an MMN
- the approximant deviants should elicit negativity typical of phonetic/acoustic and not phonological processing
- possibly feature-based differences in the elicited MMNs

Spanish participants

- all contrasts exist and should therefore elicit MMNs corresponding to phonetic sensitivity
- there may be differences in the amplitude and/or latency of the MMN depending on the type of contrast (or number of features involved)
- difference between [baba] > [baβ/pa] and [baβa] > [bab/pa] due to the legality contrast
- latency difference in the observed negativities marking phonological vs. phonetic processing (PMN?)

Stress cues and stress perception: Spanish speakers and foreigners

Research on stress?

1. Stress as a bundle of features

pitch vowel reduction duration intensity spectral tilt

2. Stress as an abstract category

morphophonology syllable/metrical structure lexical properties

What are the cues to Spanish stress?

Ortega-Llebaria

Navarro Tomás

Pilar Prieto

What are the cues to Spanish stress?

Llisterii et al. (2003) – F0 contour alone is not enough to allow the identification of the stressed syllable of a word. In combination with duration, intensity or both, F0 is a relevant acoustic cue.

P. Prieto, M. Ortega-Llebaria (2006) – syllable duration, vowel quality, and spectral tilt are reliable acoustic correlates of stress. Accentual differences are acoustically marked by overall intensity cues

What are the cues to Spanish stress?

Ortega-Llebaria, M. & Prieto, P. (2007) – stress contrast in Spanish is maintained by differences in duration and spectral tilt in de-accented contexts

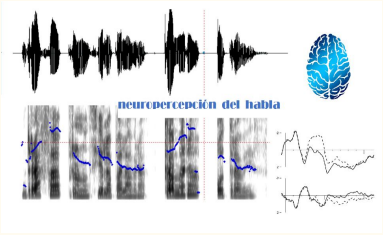
Ortega-Llebaria, M. & Prieto, P. (2009) – duration and general intensity are cues to stress, not spectral tilt

Torreira, F., Simonet, M., & Hualde, J.I. (2014) – durational and intensity cues in production, used by listeners above chance level Phonetic overlap between stress categories, numerous errors in the identification In the absence of intonational cues, Spanish speakers must rely on context

What do we know so far?

Peperkamp and Dupoux

stress deafness

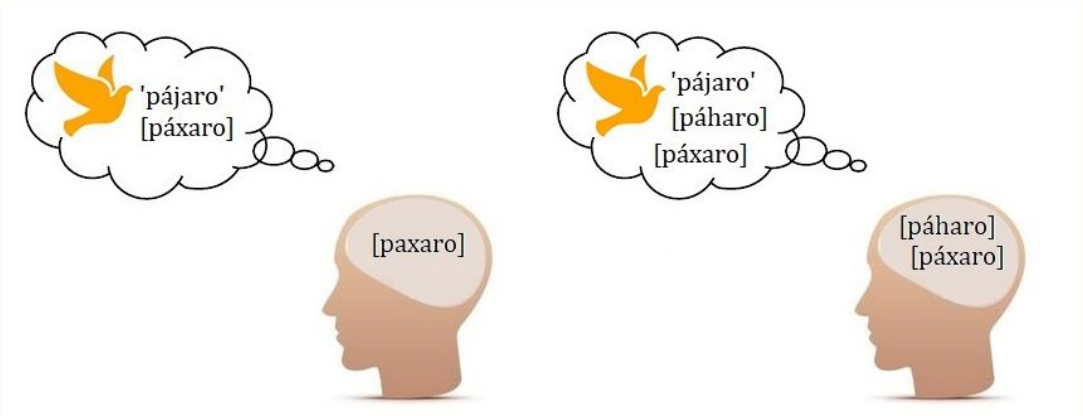


Spanish Stress Perception -- an ERP analysis

Karolina Broś, Martin Meyer, Volker Dellwo

Universität Zürich[UZH]

1. What kind of phonological information do speakers store in long-term memory?



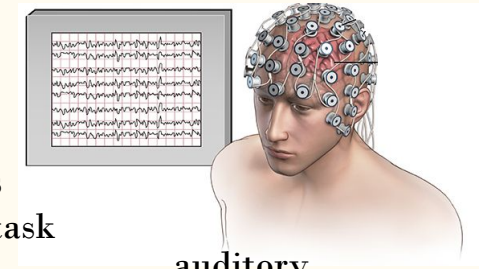
2. Is stress learned as an abstract category?

3. Do changes in stress cause lexical inhibition?

EEG

2 stress patterns

Spanish



correctness judgment task

auditory stimuli

Spanish

- a language with variable stress
- prevalence of one stress pattern over the others: partial stress predictability
- over 64% (78.9%) of all Spanish words are stressed on the penultimate syllable (Morales-Front 2014, Quilis 1981)
- antepenults constitute merely 8% (or 2.76%): exceptional

So: default penult pattern derivable by rules, with lexical exceptions

Spanish

Is the default penultimate stress pattern processed differently than the exceptional antepenult?

Is the exceptional stress stored to facilitate word retrieval, as opposed to the default?

EEG stimuli

4 conditions:

seMAna (PUs – standard)

PAjaro (APUs – standard)

SEmana (PUd – deviant)

paJAro (APUd – deviant)

EEG stimuli

Pedro pronunció la palabra [target word] otra vez

Pablo pronunció la palabra [target word] otra vez

Dani pronunció la palabra [target word] otra vez

Lupe pronunció la palabra [target word] otra vez

Marta pronunció la palabra [target word] otra vez

Laura pronunció la palabra [target word] otra vez

Sonia pronunció la palabra [target word] otra vez

Procedure

Hypotheses

Incorrect stress will invoke a more robust negativity around 400 ms from the onset of the stimulus – response to a **semantic violation**

A significant difference between the two stress patterns

Results – accuracy scores

threshold was 75% (ensure comprehension, SNR)

average of 9 misses in the experiment

significant effect of condition ($p = 0.0235$) but not stress pattern

Bonferroni-corrected: significant difference between APUd and both APUs and PUs ($p = 0.002055$, $p = 0.000894$)

APUd condition is especially difficult and caused most errors in stress correctness detection

Results – RTs

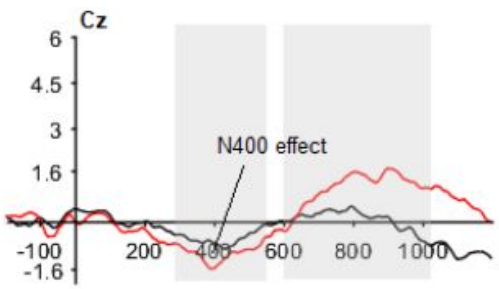
Mean RTs: 504 ms for APUs, 636 ms for APUd, 514 ms for PUs and 559 ms for PUd

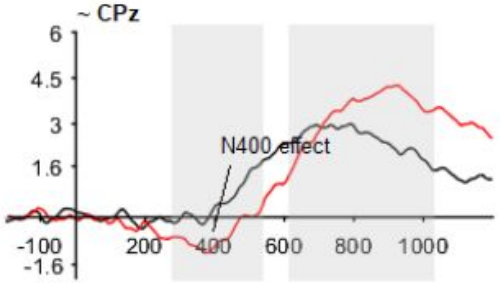
difference in RTs (between standard and deviant) much greater in the case of the exceptional APU (132 ms) than in the case of the default PU (45 ms)

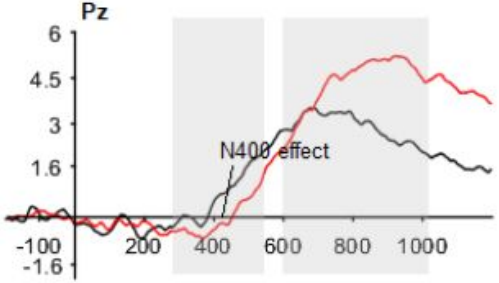
significant difference in responses to deviants depending on the stress pattern

RT results match those of accuracy scores

Results – EEG





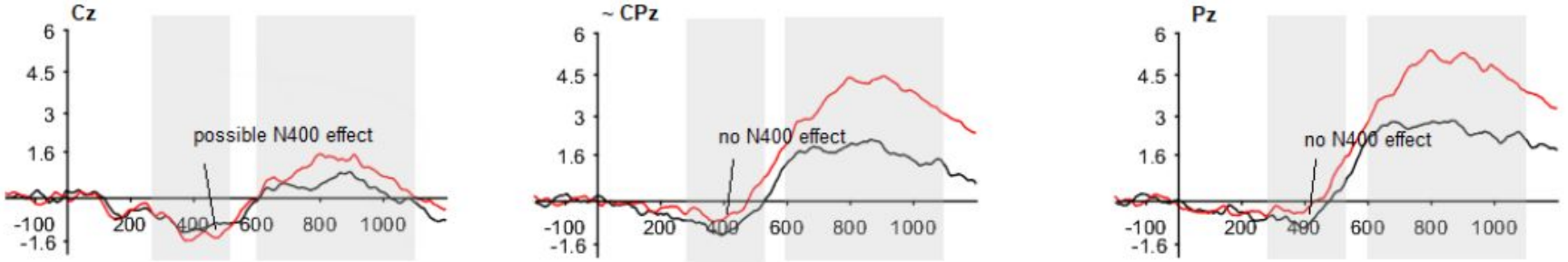


correctly stressed antepenults followed by correct response

incorrectly stressed antepenults followed by correct response

ANOVA results: main effect of condition (correct/incorrect) for the antepenults in the range of 350-600 ms from word onset ($F(1,26) = 20.38$, $p < 0.001$)

Results – EEG



ANOVA results: no N400 effect was confirmed for the penults ($F(1,26) = 1.562$, $p = 0.222$). The hypothetical effect in the Cz electrode region was not confirmed statistically. In other regions, an opposite effect is seen instead: incorrect stress causes a less negative inflection in the 350-600 ms windows than correct stress (cf. antepenults).

General conclusions

THANK YOU!

UPDATES ON MY PROJECTS ARE AVAILABLE AT WWW.KAROLINABROS.EU