The duration of word-final /s/ differs across morphological categories in English:

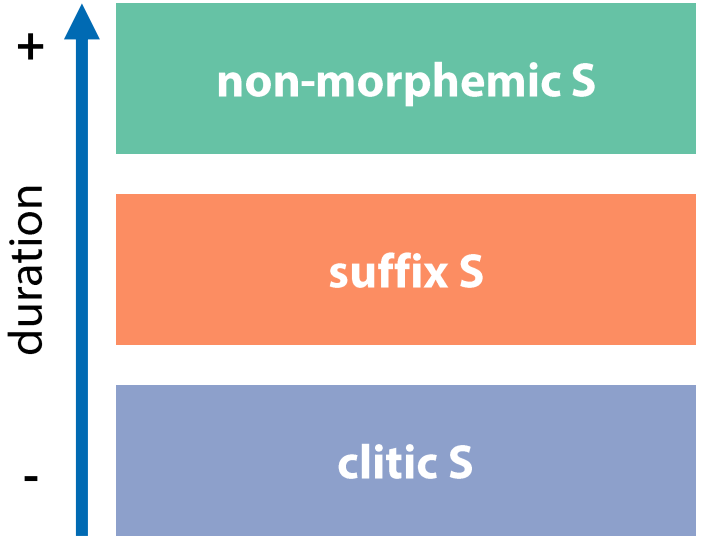
Evidence from pseudowords

Dominic Schmitz, Ingo Plag, Dinah Baer-Henney

Corpus findings

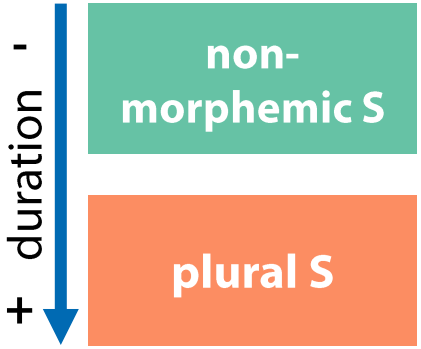
Zimmermann (2016), Plag et al. (2017), Tomaschek et al. (2019)

/s/ duration is longest in non-morphemic > suffixes > clitics



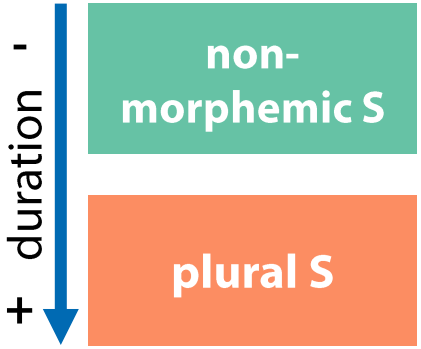
Experimental findings

Walsh & Parker (1983)



Experimental findings

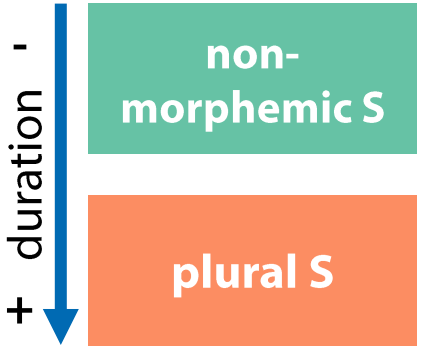
Walsh & Parker (1983)



- Very small data set, n=361

Experimental findings

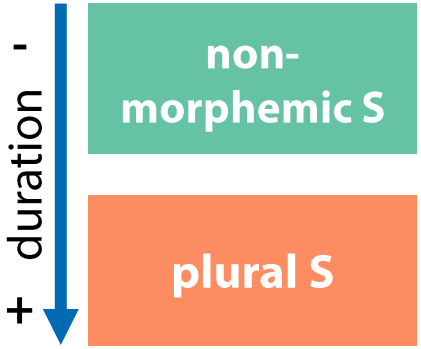
Walsh & Parker (1983)



- Very small data set, n=361
- Lack of inferential statistic analysis

Experimental findings

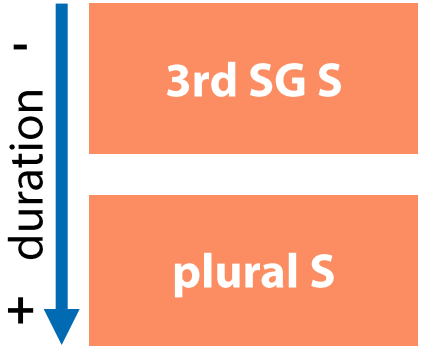
Walsh & Parker (1983)



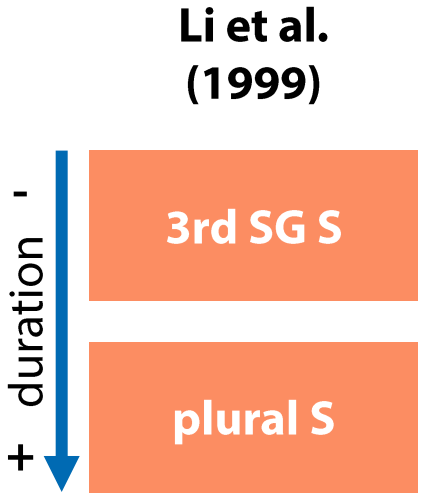
- Very small data set, n=361
- Lack of inferential statistic analysis
- No integration of phonetic covariates

Experimental findings

Li et al. (1999)

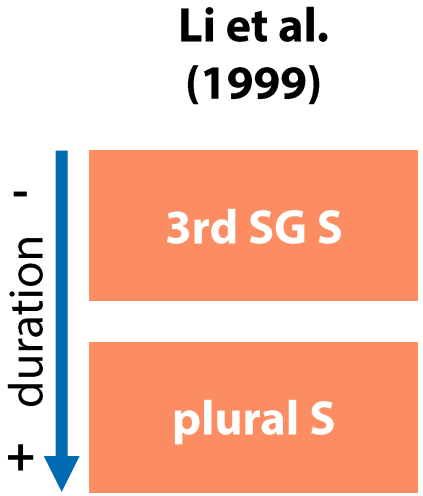


Experimental findings



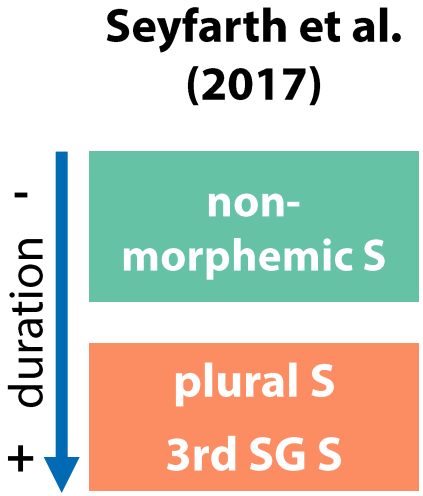
- Rather small data set, n=823

Experimental findings

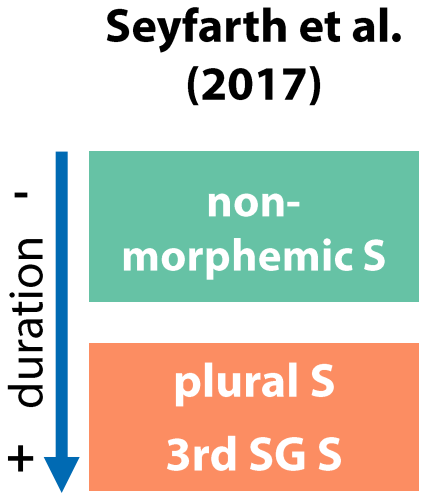


- Rather small data set, n=823
- Imbalance of sentence-medial and -final occurrences of word-final /s/

Experimental findings

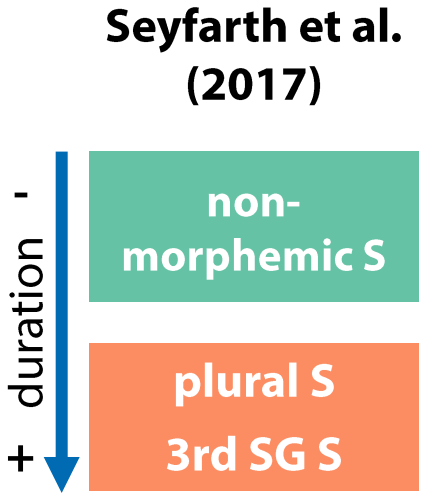


Experimental findings



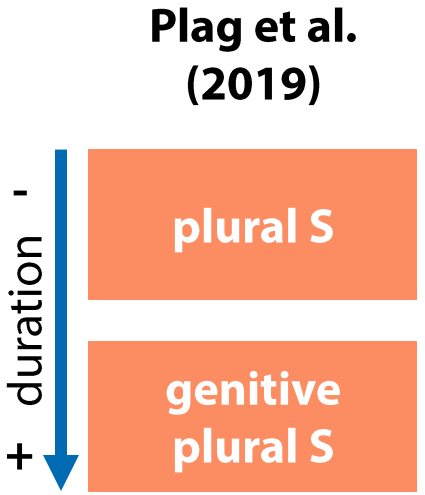
- No differentiation of /s/ and /z/ with a clear majority of /z/ items

Experimental findings

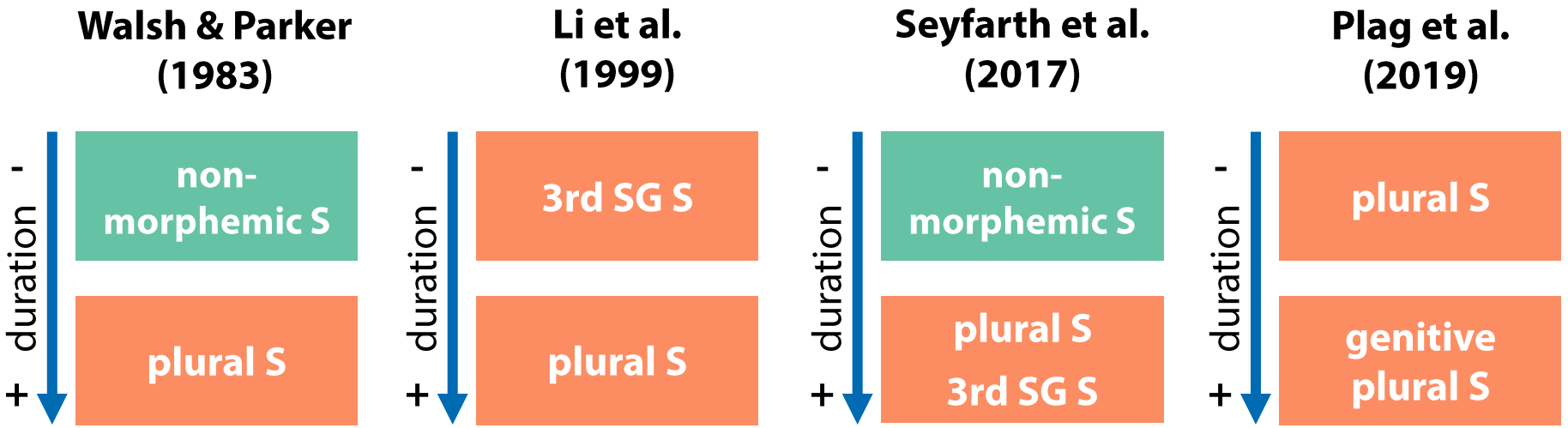


- No differentiation of /s/ and /z/ with a clear majority of /z/ items
- No reliable evidence for duration of /s/ due to lack of data

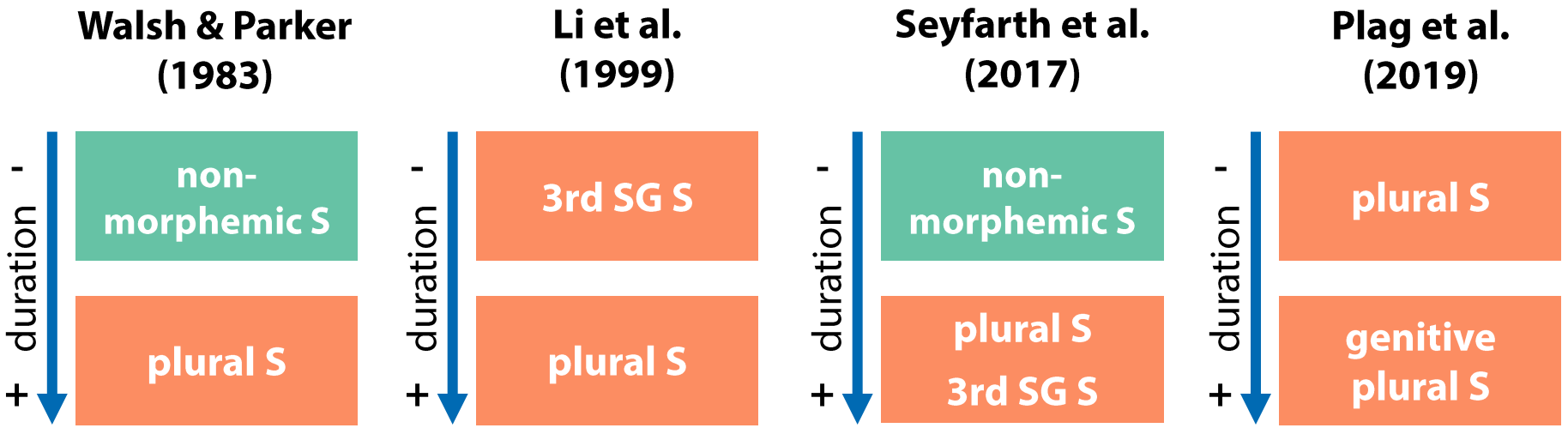
Experimental findings



Experimental findings



Experimental findings



? clitic S ?

Previous findings

Questions

Questions

1. Are durational differences between different types of word-final /s/ real?

Questions

1. Are durational differences between different types of word-final /s/ real?

2. Do speakers perceive durational differences in word-final /s/?

Questions

1. Are durational differences between different types of word-final /s/ real?
   - production study

2. Do speakers perceive durational differences in word-final /s/?
   - same-different task

Production Study

Question

- Are durational differences between different types of word-final /s/ real?

Question

- Are durational differences between different types of word-final /s/ real?

non-morphemic S

plural S

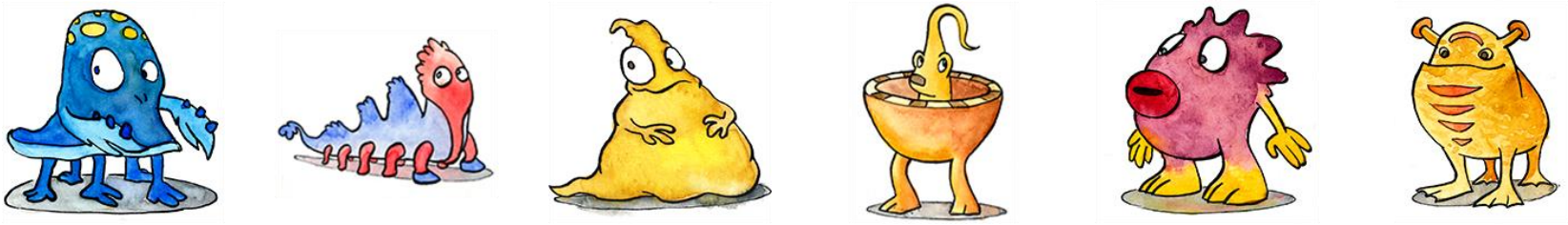
clitic S

Setup

- Balanced data
- Control of potentially intervening variables
- Data without potentially confounding effects of lexical and contextual properties, e.g. storage effects (Caselli et al. 2016)

Setup

- Balanced data
- Control of potentially intervening variables
- Data without potentially confounding effects of lexical and contextual properties, e.g. storage effects (Caselli et al. 2016)
- Adaption of Berko-Gleason's (1958) classic pseudoword ('wug') paradigm
- Stimuli corresponding to alien lifeforms represented by little images → pseudowords



Pseudowords

CC	V	C(C)
Stop + Approximant	/ɪ iː uː ʌ aʊ eɪ/	/p, t, k/ & /f/ /ps, ts, ks/ & /fs/

Pseudowords

CC	V	C(C)
Stop + Approximant	/ɪ iː uː ʌ aʊ eɪ/	/p, t, k/ & /f/ /ps, ts, ks/ & /fs/

ɪ	iː	uː	ʌ	aʊ	eɪ
glip	pleep	cloop	prup	bloup	glaip
glit	pleet	cloot	prut	blout	glait
glik	pleek	clook	pruk	blouk	glaik
glif	pleef	cloof	pruf	blouf	glaif

glips	pleeps	cloops	prups	bloups	glaips
glits	pleets	cloots	pruts	blouts	glaits
gliks	pleeks	clooks	pruks	blouks	glaiks
glifs	pleefs	cloofs	prufs	bloufs	glaifs

Procedure

- Items were embedded in contexts

Procedure

- Items were embedded in contexts
  - Introduction of the pseudoword

'This is a glip'

'This is another one'

Procedure

- Items were embedded in contexts
  - Introduction of the pseudoword

'This is a glip'

'This is another one'

  - Simple situation the respective aliens are in

'Last week, the glips listened to each other's songs'

Procedure

- Items were embedded in contexts
  - Introduction of the pseudoword

'This is a glip'

'This is another one'

  - Simple situation the respective aliens are in

'Last week, the glips listened to each other's songs'

  - Question to elicit the pertinent form of /s/

'What happened last week?'

Procedure

- Items were embedded in contexts
  - Introduction of the pseudoword

'This is a glip'

'This is another one'

  - Simple situation the respective aliens are in

'Last week, the glips listened to each other's songs'

  - Question to elicit the pertinent form of /s/

'What happened last week?'

  - Expected answer

*'The **glips** listened to each other's songs'*

Recordings

- 40 participants
  - 26 female, 14 male; average age 28.7 years
  - native speakers of Southern British English

Recordings

- 40 participants
  - 26 female, 14 male; average age 28.7 years
  - native speakers of Southern British English

- 1146 target items with word-final /s/ were produced

non-morphemic	plural	has	is
315	380	159	292

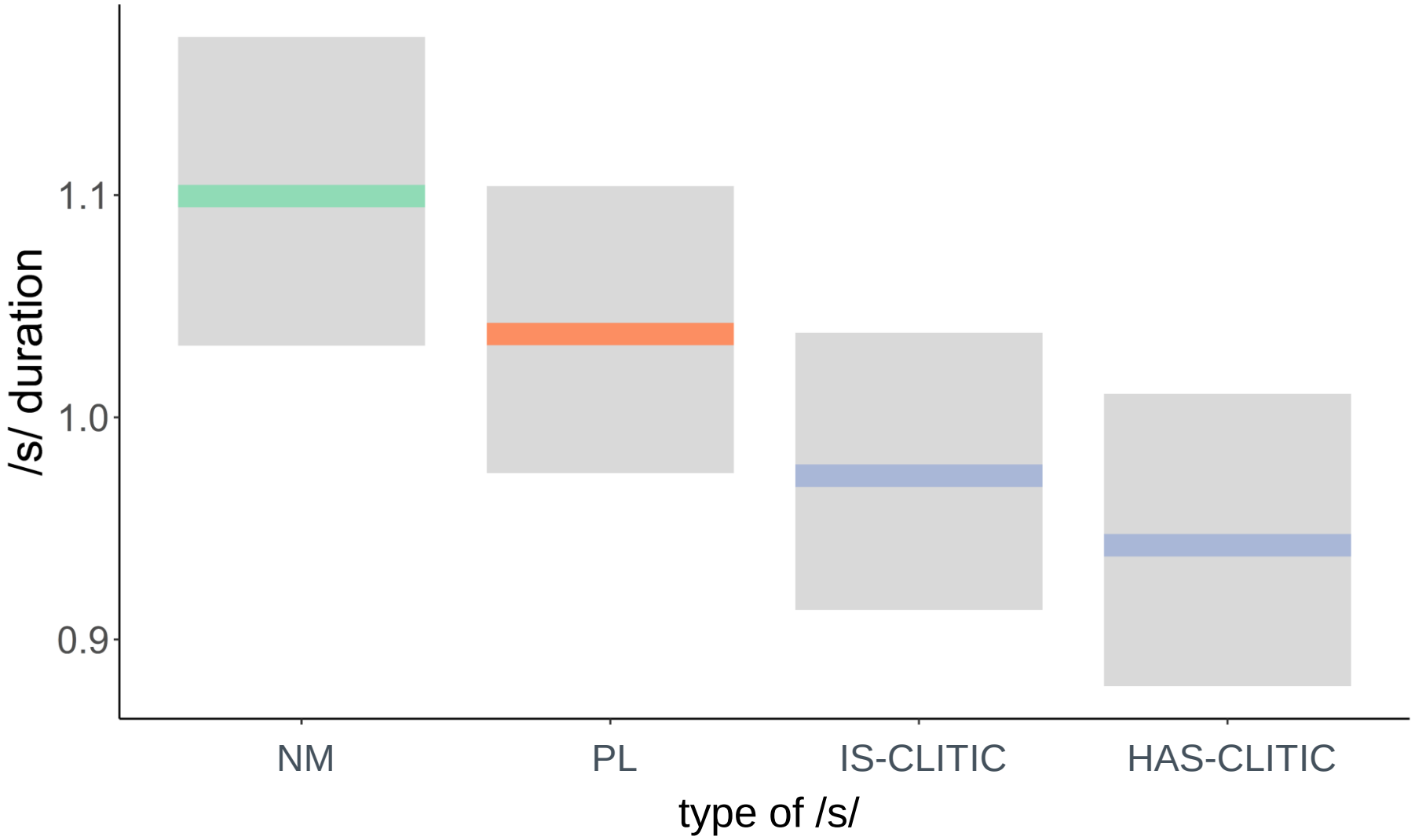
Statistical modelling

- Linear mixed effects regressions analysis using LME4 in R
- Response variable: /s/ duration
- Fixed effects:
  - Type of /s/
  - Type of following segment
  - Biphone Probability
  - Mono-/Multilinguality of speaker
  - Base duration
  - Pause following the /s/
  - Speaking rate
- Random effect:
  - Speaker

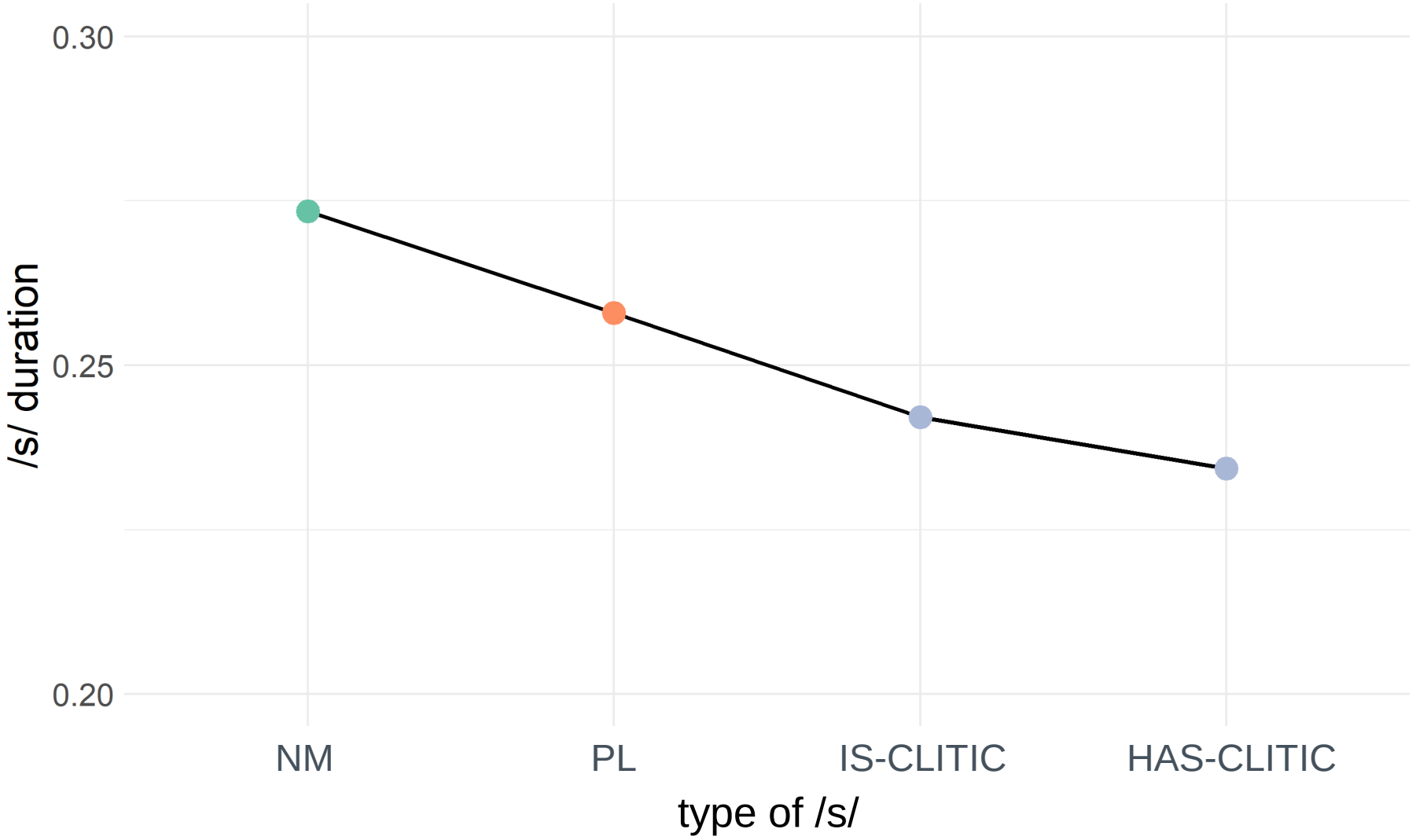
Statistical modelling

- Linear mixed effects regressions analysis using LME4 in R
- Response variable: /s/ DURATION
- Fixed effects:
  - TYPE OF /S/
  - TYPE OF FOLLOWING SEGMENT
  - BIPHONE PROBABILITY
  - MONO-/MULTILINGUALITY OF SPEAKER
  - BASE DURATION
  - PAUSE FOLLOWING THE /S/
  - SPEAKING RATE
- Random effect:
  - SPEAKER

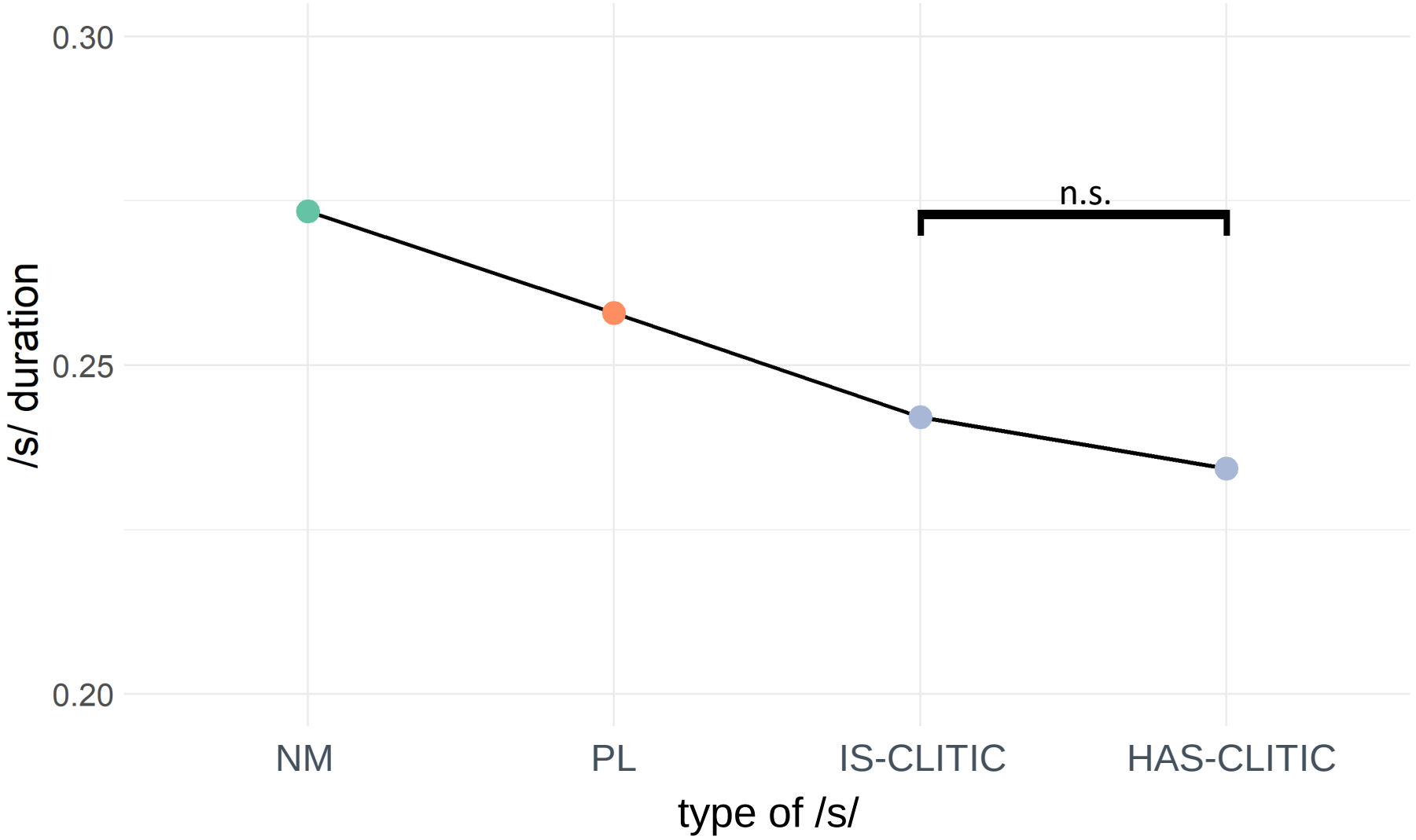
Effect of type of /s/



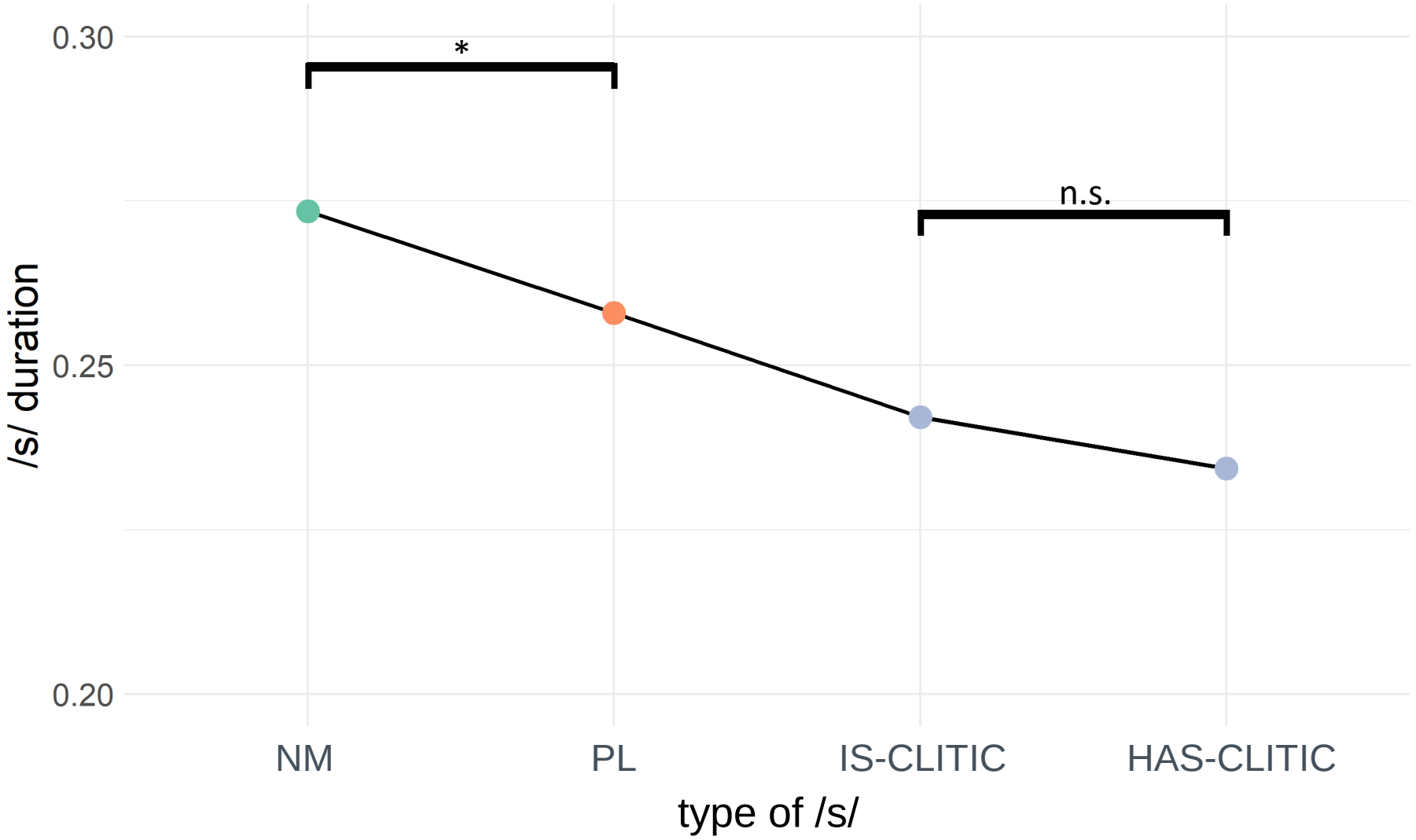
/s/ durations overall



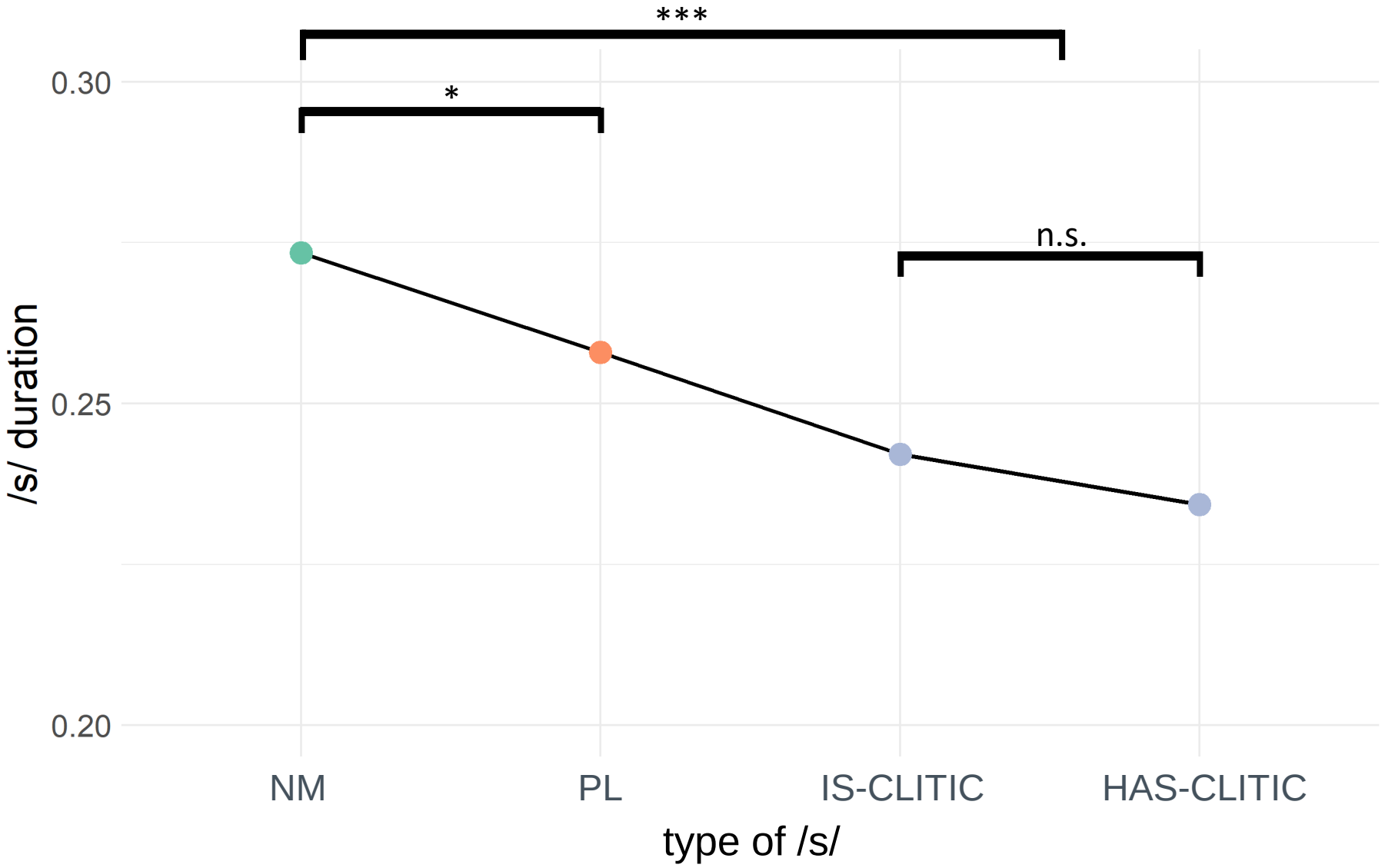
/s/ durations overall



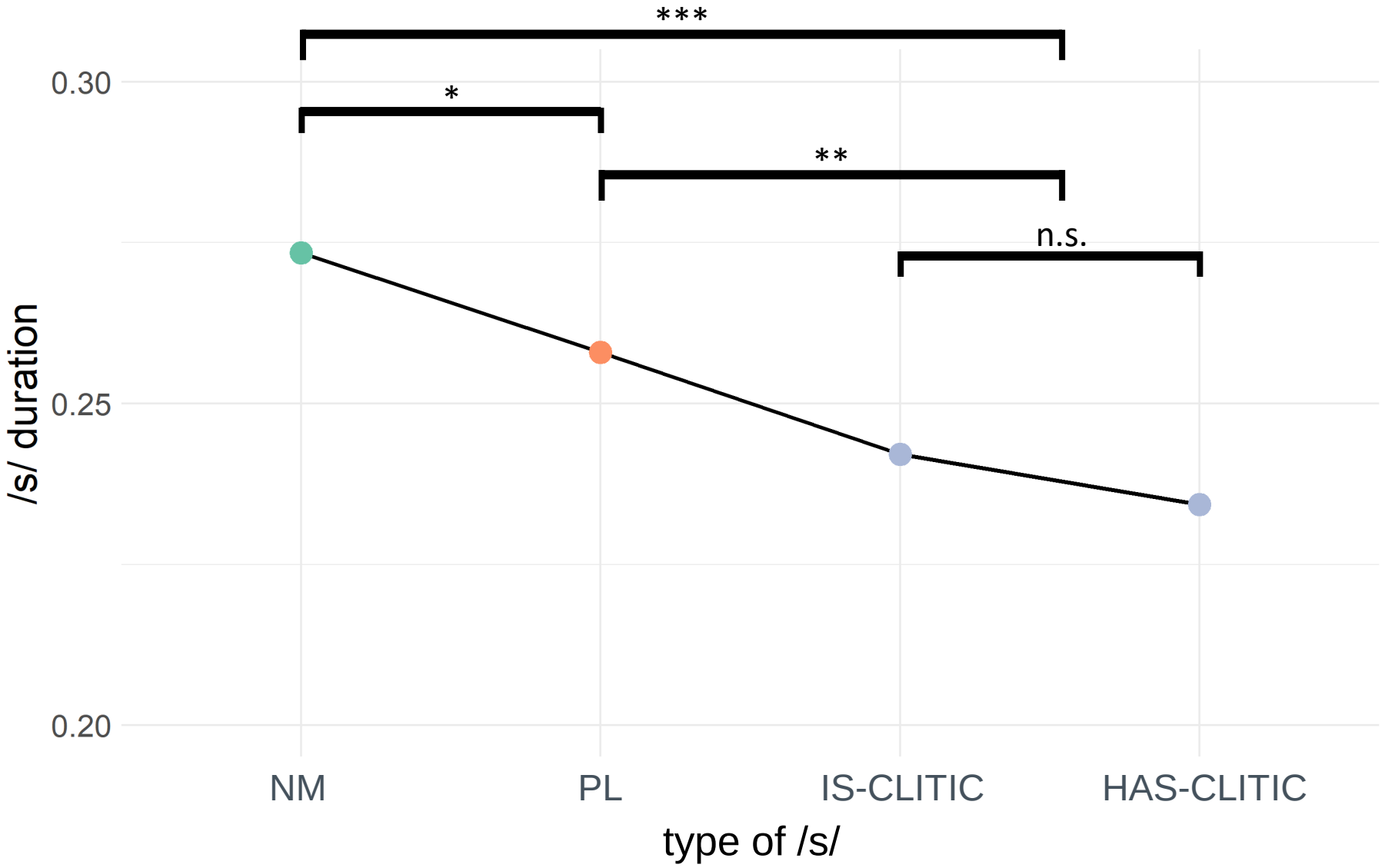
/s/ durations overall



/s/ durations overall



/s/ durations overall



Discussion

New Zealand English — non-morphemic > plural > clitics

Zimmermann 2016

North American English — non-morphemic > plural > clitics

Plag et al. 2017, Tomaschek et al. 2019

Southern British English — non-morphemic > plural > clitics

pseudowords

Perception Study

Question

- Do speakers perceive durational differences in word-final /s/?

Question

- Do speakers perceive durational differences in word-final /s/?

non-morphemic S

plural S

Items

- pseudowords

ɪ	iː	uː	ʌ	aʊ	eɪ
glips	pleeps	cloops	prups	bloups	glaips
glits	pleets	cloots	pruts	blouts	glaits
gliks	pleeks	clooks	pruks	blouks	glaiks
glifs	pleefs	cloofs	prufs	bloufs	glaifs

Items

- pseudowords
- real words
  - monomorphemic singulars ending in /s/

singulars
mix
box
tax
coax
hoax
corpse

Items

- pseudowords
- real words
  - monomorphemic singulars ending in /s/
  - bimorphemic plurals ending in /s/

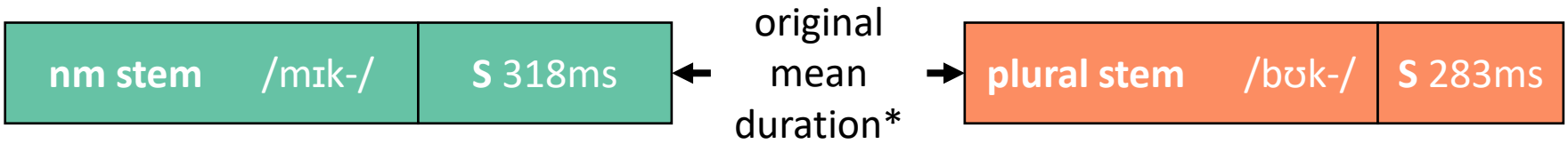
singulars	plurals
mix	books
box	steps
tax	rights
coax	points
hoax	groups
corpse	parts

Items

- pseudowords
- real words
  - monomorphemic singulars ending in /s/
  - bimorphemic plurals ending in /s/
- filler words
  - monomorphemic singulars ending in /f/, e.g. *hoof*
  - monomorphemic singulars ending in /θ/, e.g. *death*

Stimuli

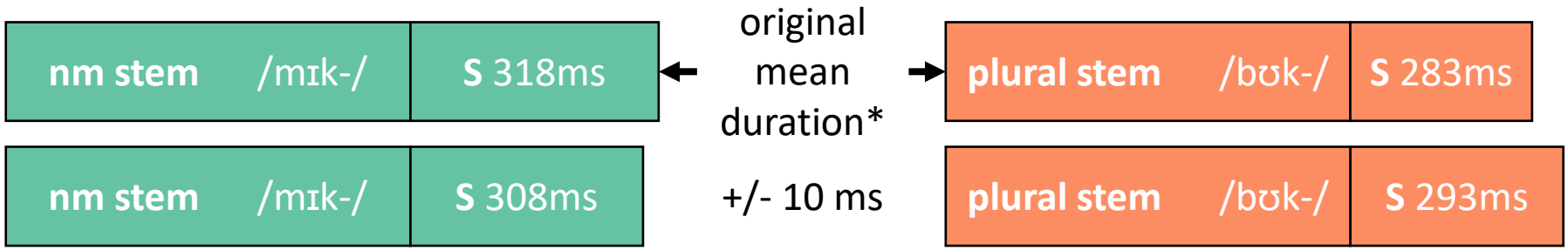
- word-final fricative durations are manipulated



*as in Plag et al., 2017

Stimuli

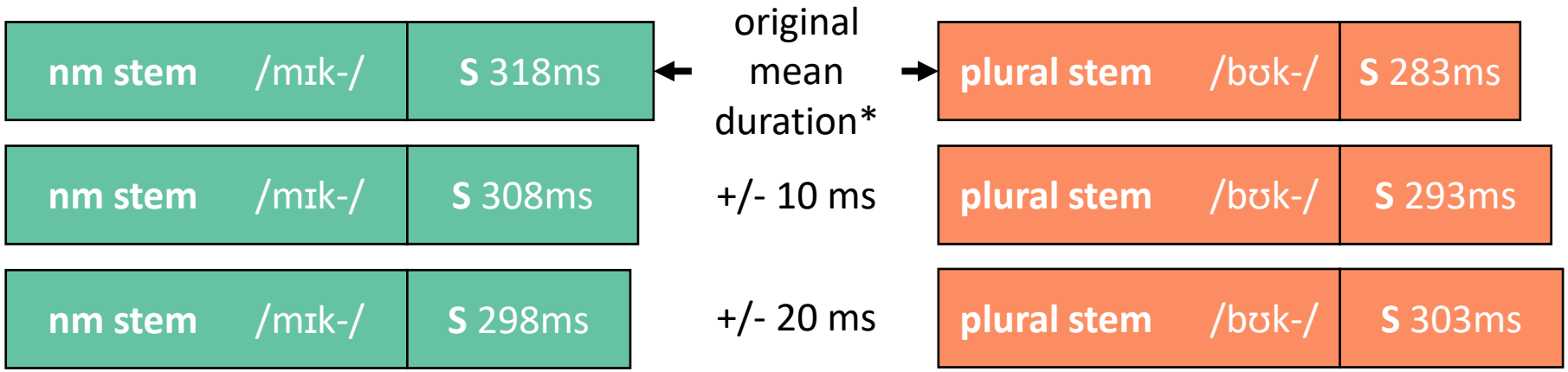
- word-final fricative durations are manipulated



*as in Plag et al., 2017

Stimuli

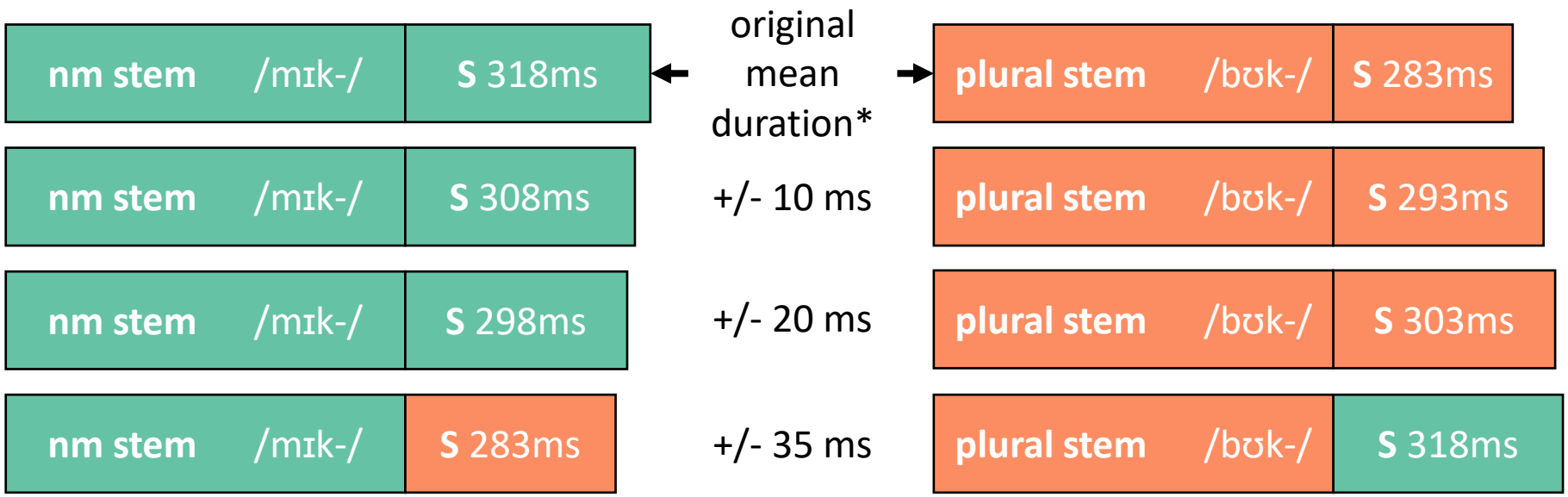
- word-final fricative durations are manipulated



*as in Plag et al., 2017

Stimuli

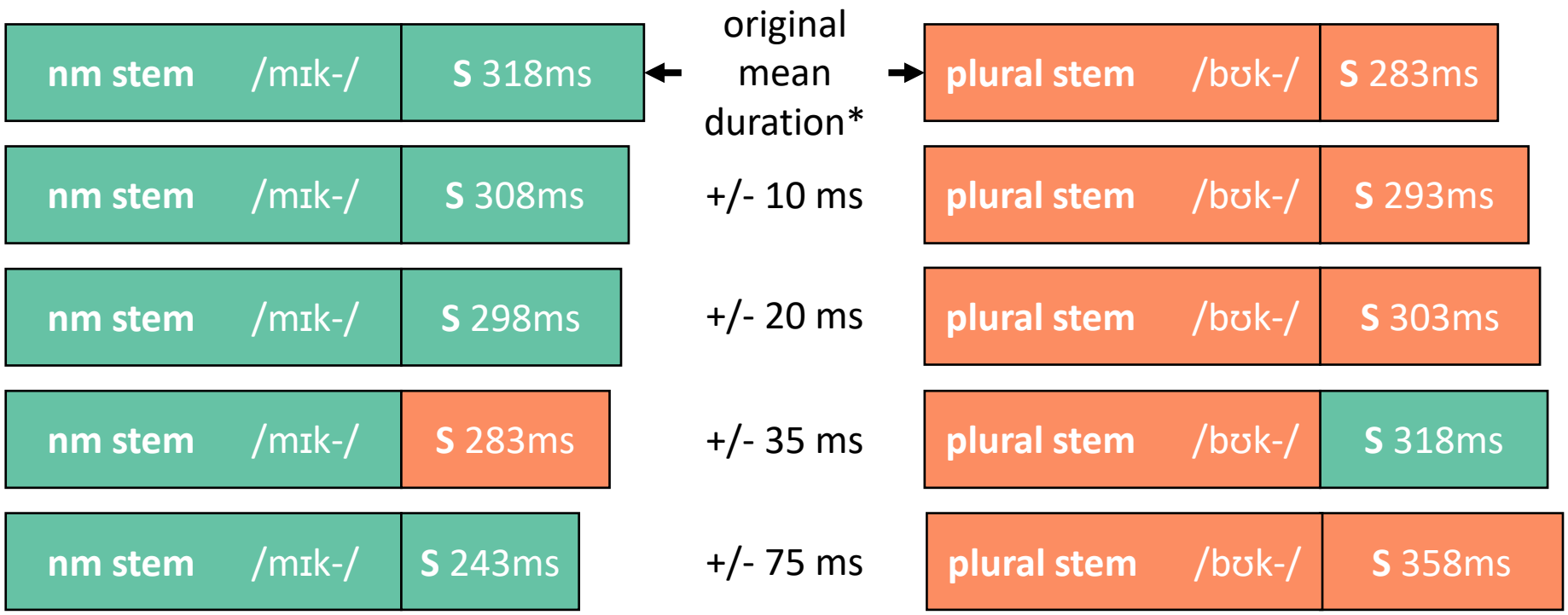
- word-final fricative durations are manipulated



*as in Plag et al., 2017

Stimuli

- word-final fricative durations are manipulated



*as in Plag et al., 2017

Procedure

- same-different task
  - participants listen to two stimuli
  - indicate whether the two stimuli sounded different via button-press

Procedure

- same-different task
  - participants listen to two stimuli
  - indicate whether the two stimuli sounded different via button-press
- 3435 data points by 39 participants
  - 32 female, 7 male; average age 23 years
  - native speakers of New Zealand English

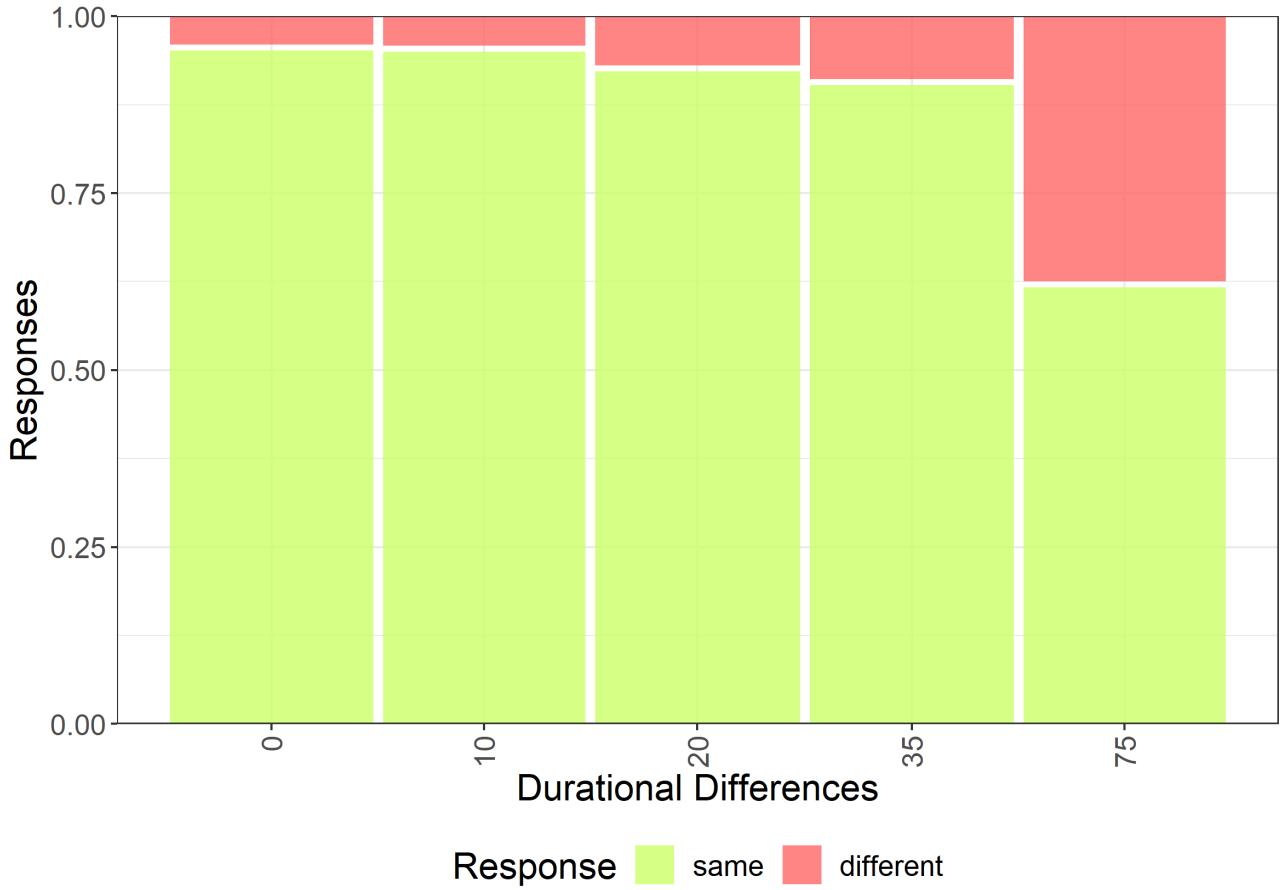
Statistical modelling

- General linear mixed effects regressions analysis using LME4 in R
- Response variable: SAME_OR_DIFFERENT
- Fixed effects:
  - DURATIONAL_DIFFERENCE
  - MUSICAL_INTRUMENT
- Random effect:
  - SPEAKER
  - ITEM

Statistical modelling

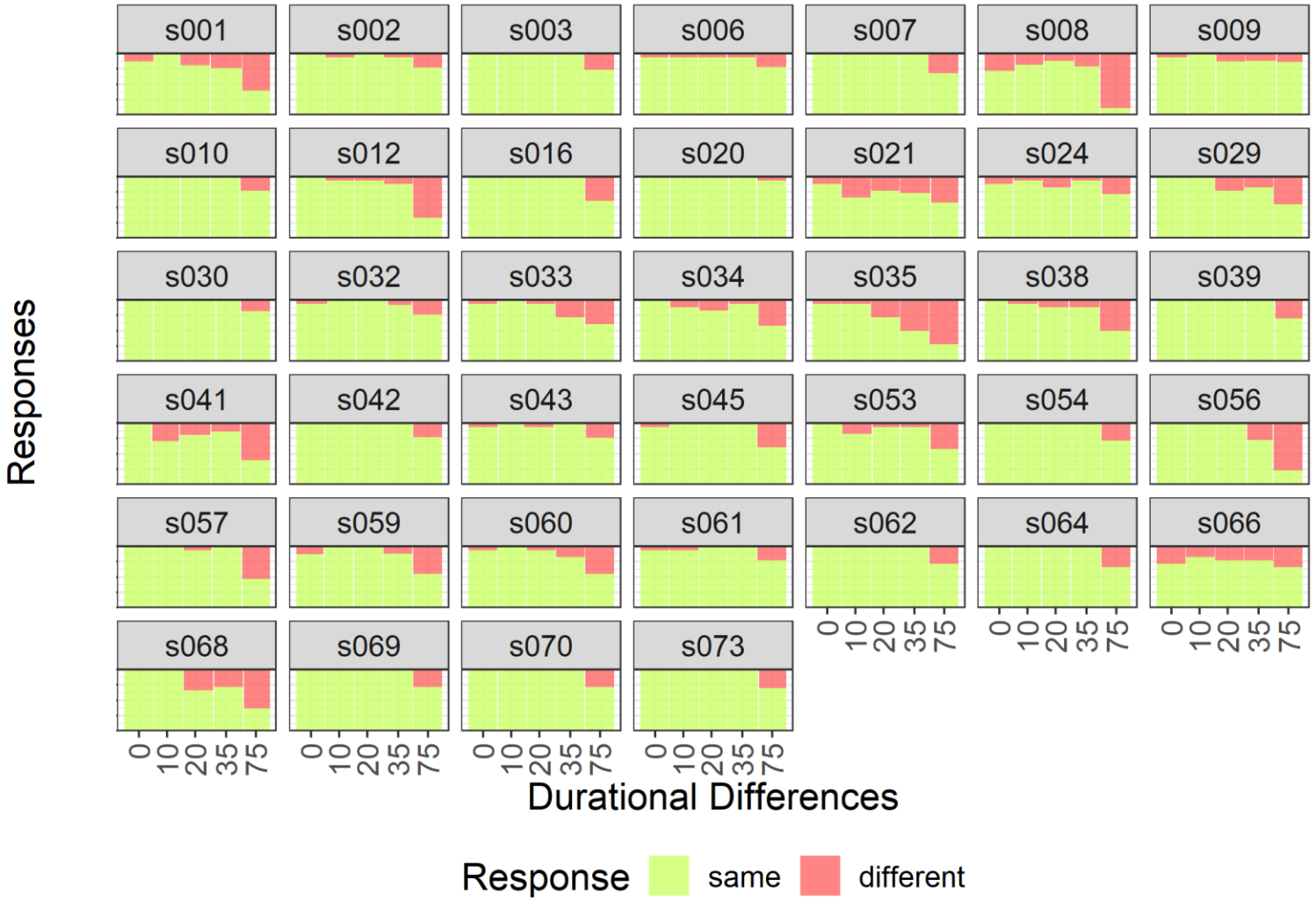
- General linear mixed effects regressions analysis using LME4 in R
- Response variable: SAME_OR_DIFFERENT
- Fixed effects:
  - DURATIONAL_DIFFERENCE
  - MUSICAL_INTRUMENT
- Random effect:
  - SPEAKER
  - ITEM

Perception of /s/ durations



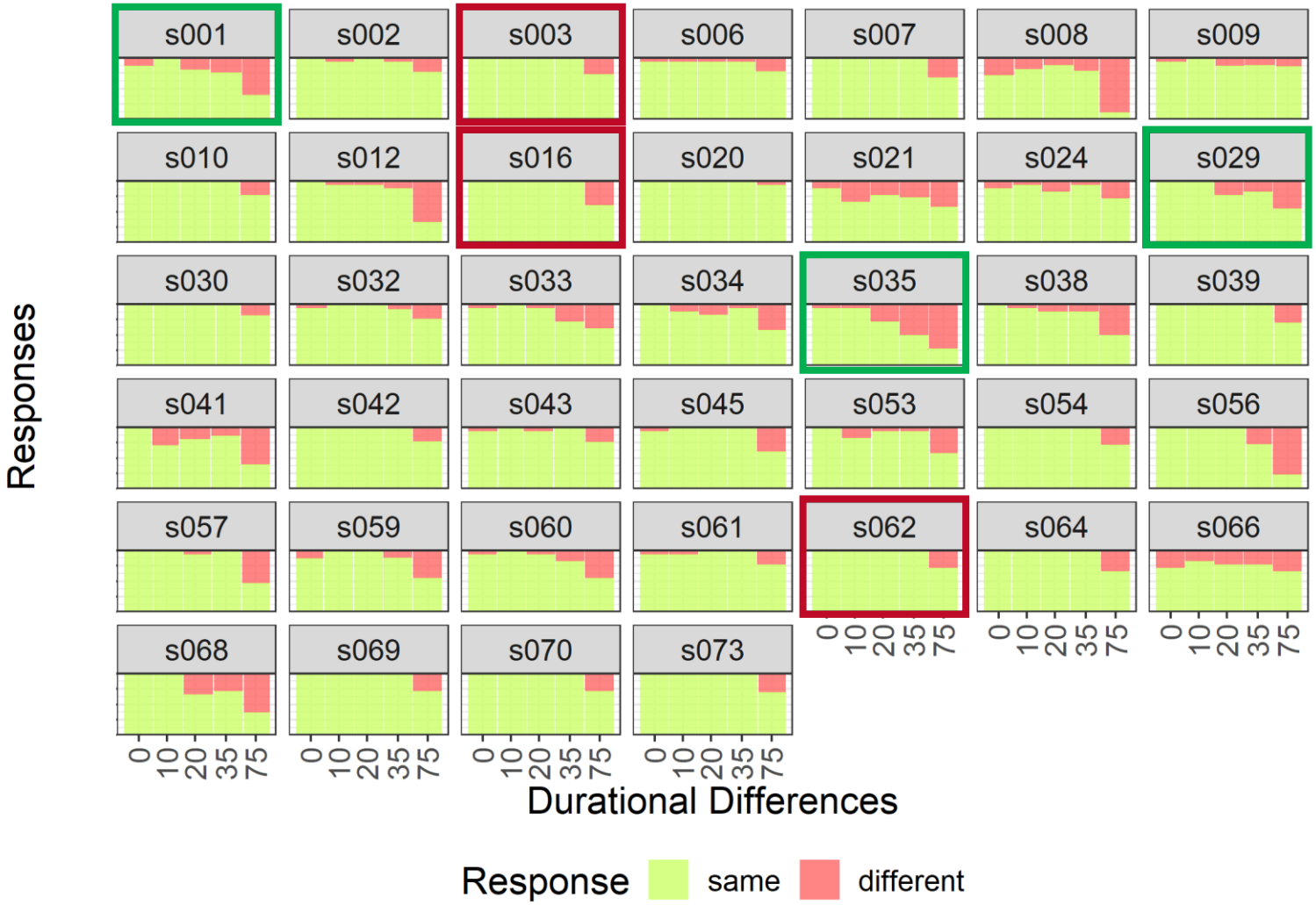
difference	p-value
10 ms	0.86
20 ms	0.01
35 ms	< 0.01
75 ms	< 0.001

Perception of /s/ durations

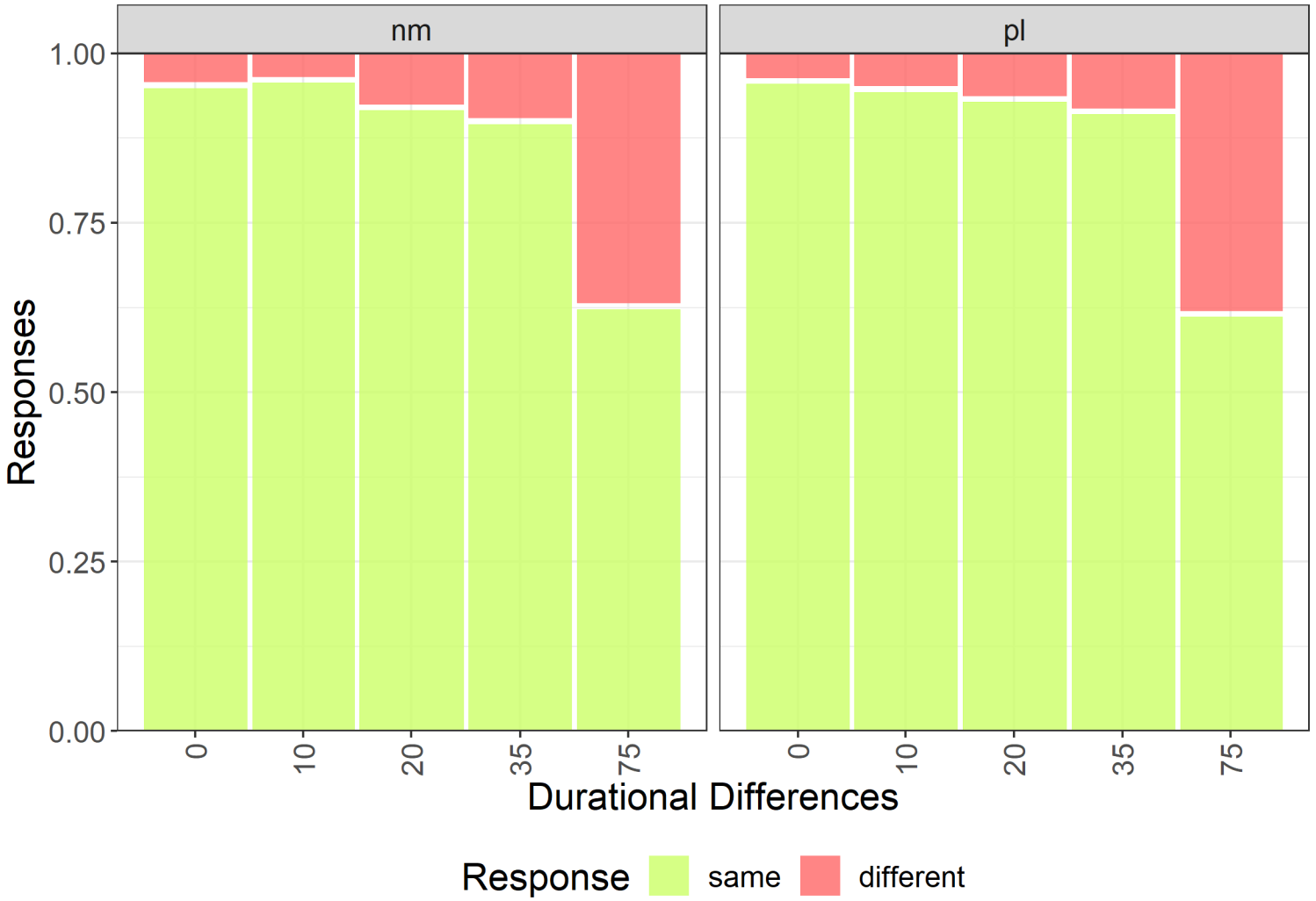


Perception of /s/ durations

Perception of /s/ durations



Perception of /s/ durations



Conclusion

- **Perception Study:**

  Speakers can perceive durational differences in word-final /s/ - some better than others

Conclusion

- **Perception Study:**

  Speakers can perceive durational differences in word-final /s/ - some better than others

- **Production Study:**

  First study to use pseudowords to examine durational differences of different types of /s/

  - non-morphemic > plural > clitic /s/

Conclusion

- **Perception Study:**

  Speakers can perceive durational differences in word-final /s/ - some better than others

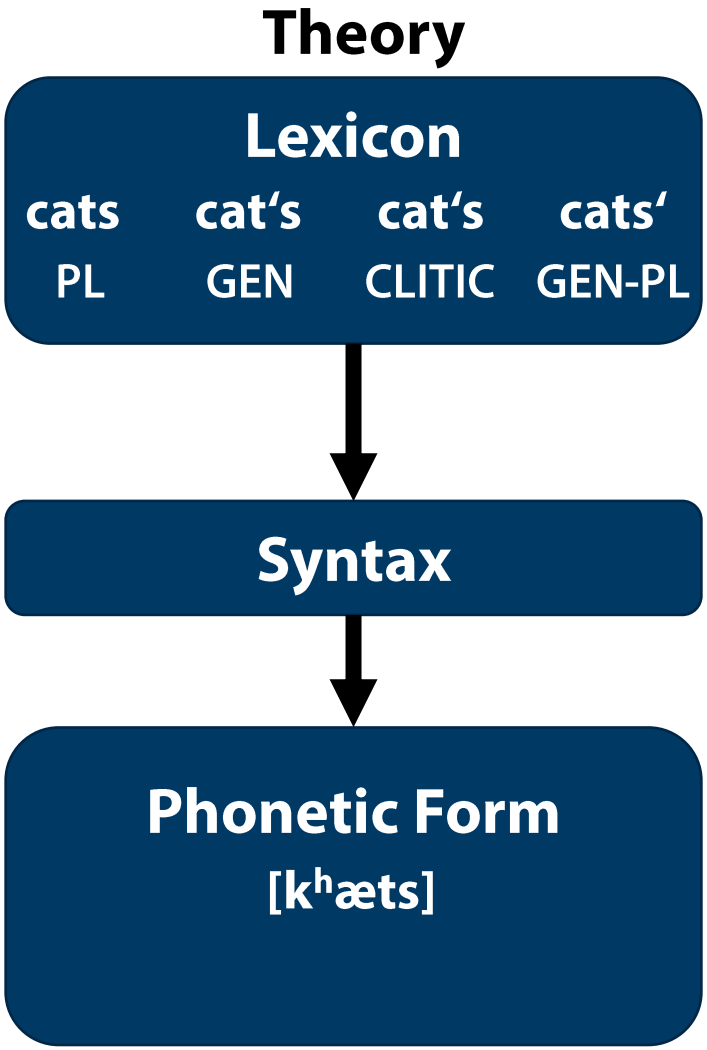
- **Production Study:**

  First study to use pseudowords to examine durational differences of different types of /s/

  - non-morphemic > plural > clitic /s/

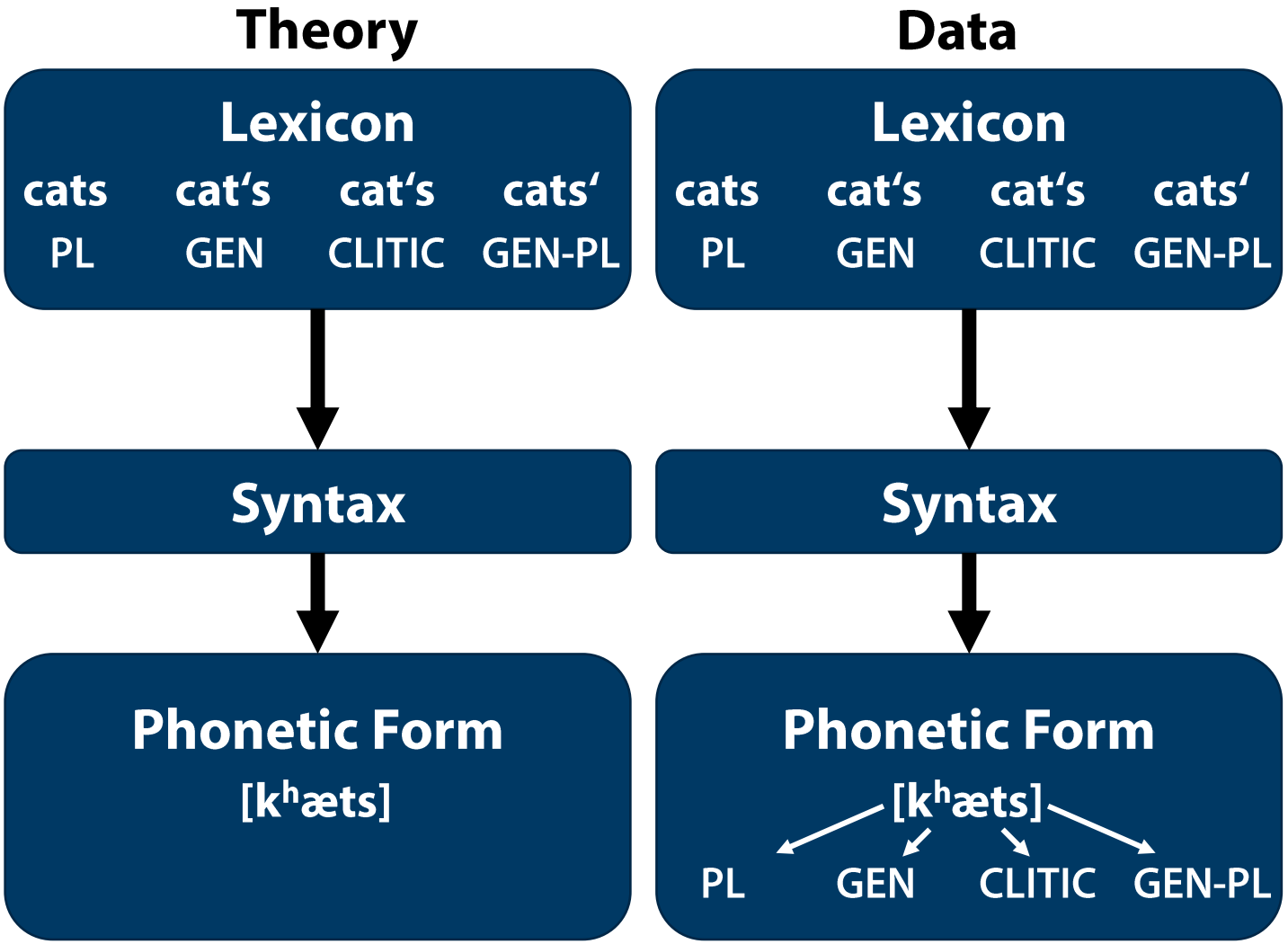
- Durational differences appear to be of a robust morphological nature rather than a simple by-product of e.g. potential storage effects

Conclusion



e.g. Kiparsky (1982)

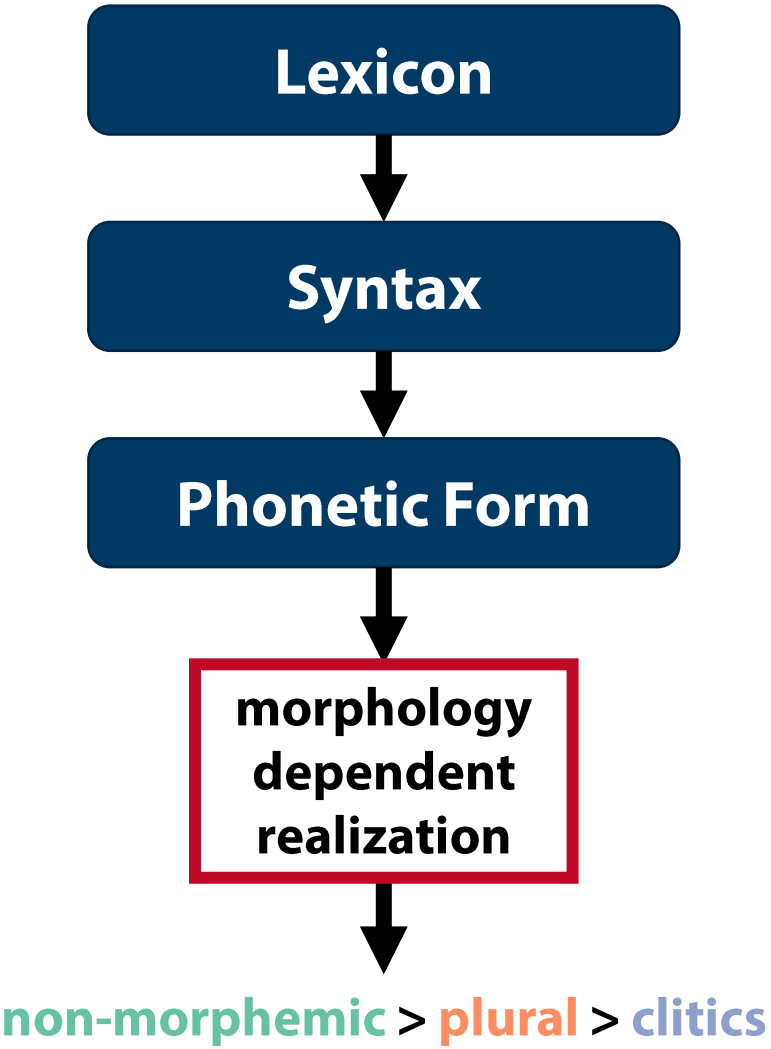
Conclusion



e.g. Kiparsky (1982)

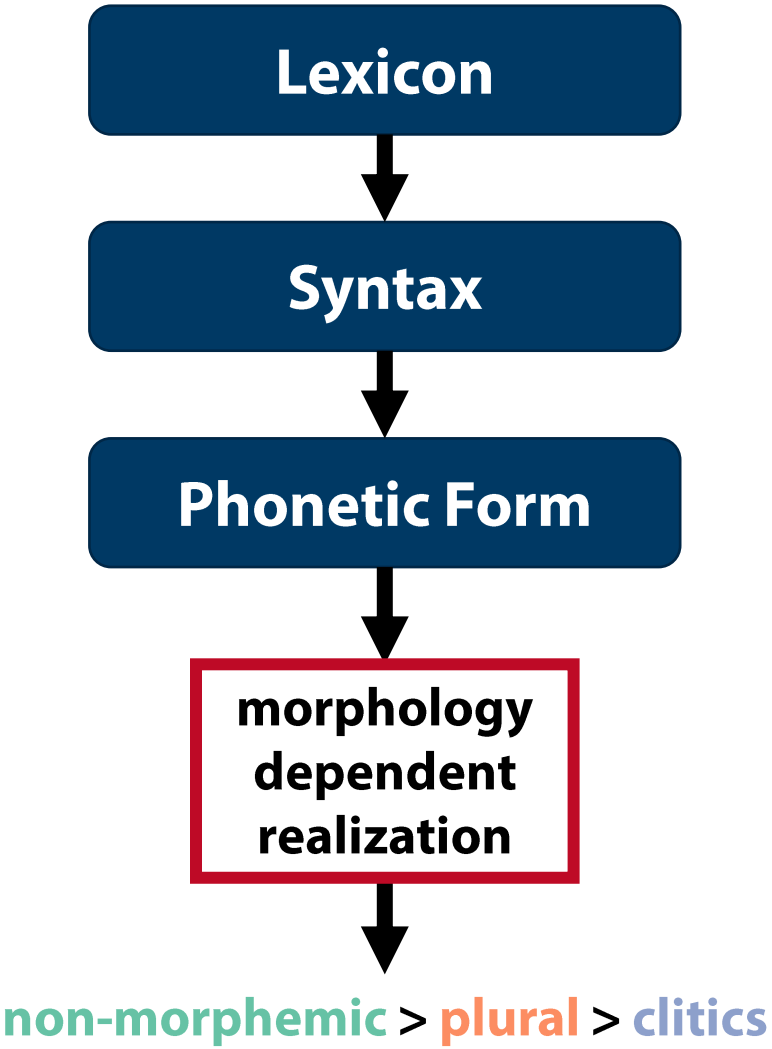
Conclusion

- This calls into question the morphology independent realization of segments, which predicts homophony for all types of /s/



Conclusion

- This calls into question the morphology independent realization of segments, which predicts homophony for all types of /s/
- Remaining question: Do listeners make use of the perceived differences?




Thank you!