Morphological status and acoustic realization:

Is there a difference between Bra[d] Pitt and a grille[d] cheese omelet, or between Kate Mo[s] and killer robot[s]?

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Traditional assumptions

- morphemes are represented at the phonological level
- no phonetic difference between different English /s/ or /d/ morphemes
- homophony of plural, genitive, genitive plural, 3rd sg, clitics of *has, is, us*
- homophony of past tense, past participle, adjectival *-ed*, clitics of *had, would, did*
- morphemic and non-morphemic sounds are the same in speech production

Suffix homophony in English: e.g. *-s*

Plural

"the allomorphs are /s/, /z/, and /ɪz/, where /ɪz/ occurs after sibilants, /s/ occurs after other voiceless consonants, and /z/ occurs elsewhere ... This allomorphy is easily understood in phonological terms (assimilation and epenthesis to break up illegal geminates), and is not controversial" (p. 15)

3rd person singular

"Verbs ending in a sibilant ... take the allomorph /ɪz/ or /əz/, all other bases take either /z/ or /s/, depending on the final segment of the base. If the base ends in a voiced segment the voiced allomorph /z/ is chosen, if not, the unvoiced allomorph /s/ is chosen" (p. 69)

Bauer, Lieber & Plag (2013) *The Oxford Reference Guide to English Morphology.*

Suffix homophony in English

- at the form level (= phonological level) the different */s/* morphemes are identical

- same holds true for past tense *-ed* and adjectival *-ed* with their allomorphs /t/, /d/ and /ɪd/

- current models do not have another form level ('post-lexical' phonology is not sensitive to morphology)

Is there another level of form where the different morphemes are not identical?

Lexeme homophony

Recent research on lexemes

- *time* and *thyme* are acoustically different (Gahl 2008)
- *like* (verb), *like* (particle) and *like* (quotative) are acoustically different (Drager 2010)
- stems are acoustically different when part of a complex word (e.g. Kemps et al. 2005)

Phonetics of English affixes

Early research on affixes

- morphemic /s/ (e.g. *hurts*) differs acoustically from non-morphemic /s/ (e.g. *Hertz*) (Walsh & Parker 1983)
- morphemic /t/ and /d/ differ acoustically from non-morphemic /t/ and /d/ (Losiewicz 1992)

Can these results be replicated with conversational speech?

Phonetics of English affixes

Recent research on affixes*:* /s/ morphemes

- Plag et al. (2015) investigated the duration of homophonous /s/ morphemes and non-morphemic /s/
- conversational data from the Buckeye Corpus (Pitt et al. 2007)
- significant differences in absolute and relative duration between different morphemes
- significant differences in absolute and relative duration between morphemic and non-morphemic segments
- duration (of voiceless) segments showed correlation with morphological boundary preceding it

Phonetics of English affixes

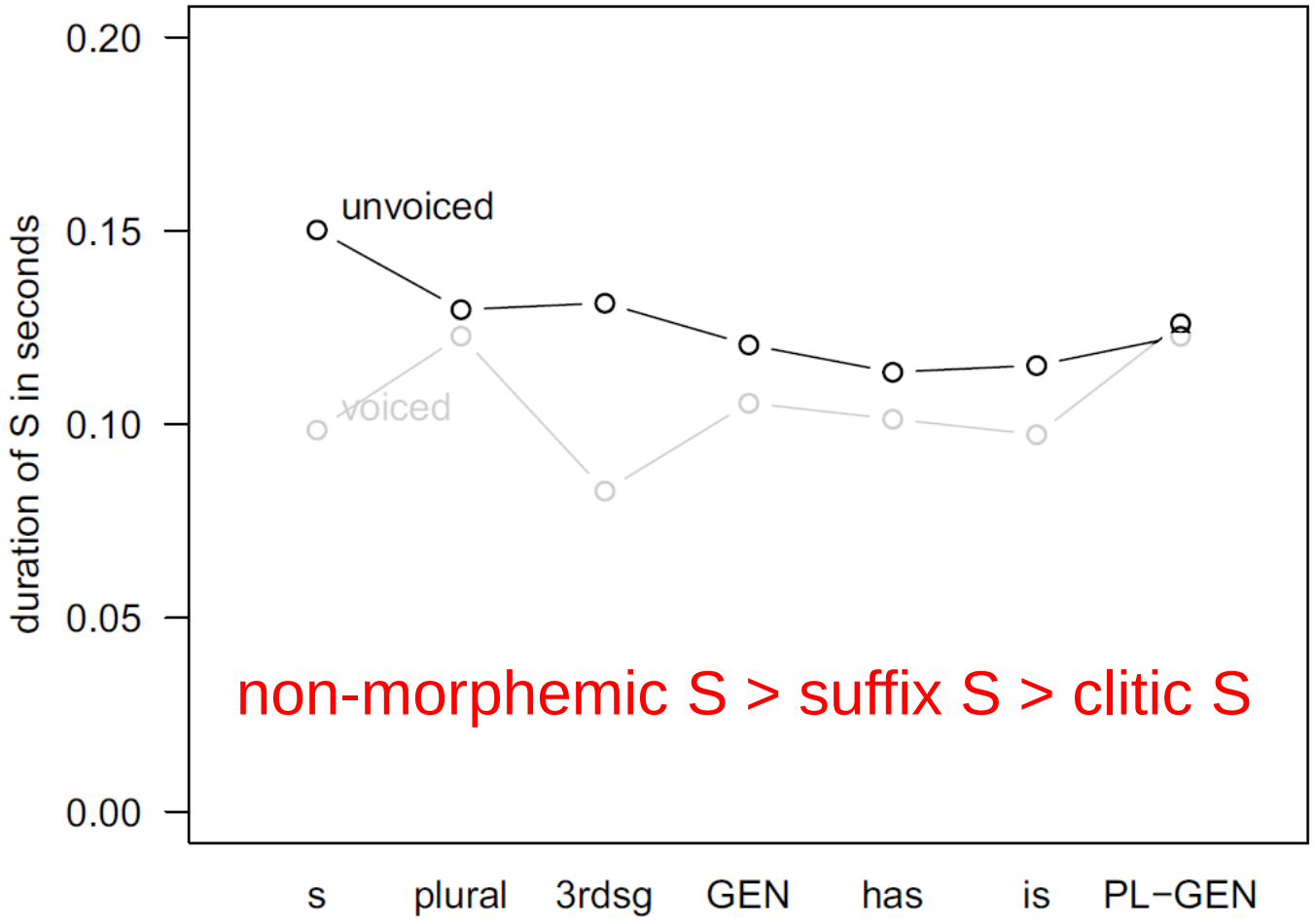


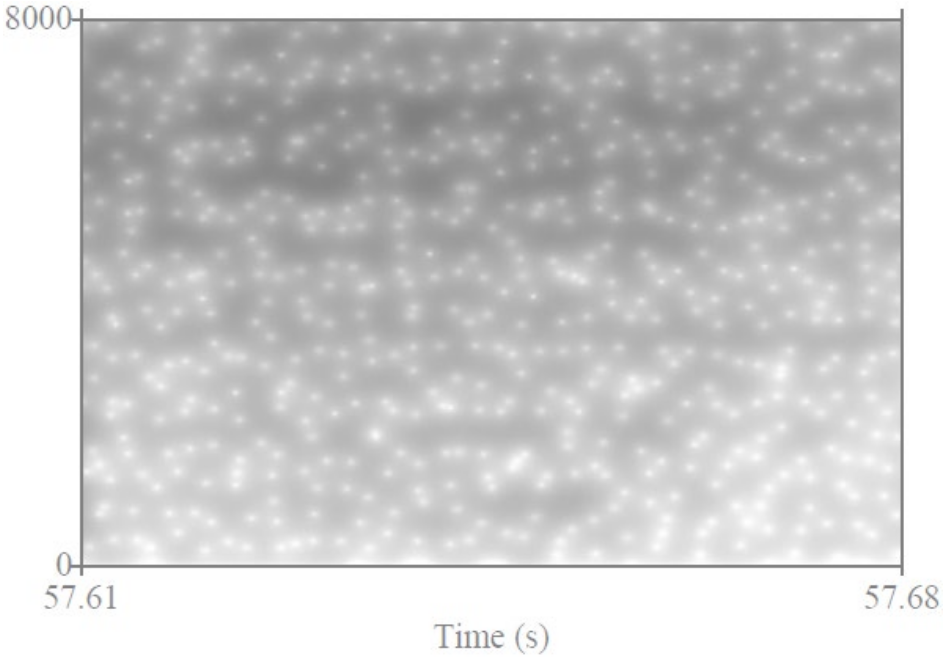
Figure 4
Interaction of type of S and voicing, Model 1 (Abbreviations: s = non-morphemic S, 3rdsg = 3rd person singular, GEN = genitive, PL-GEN = genitive-plural).

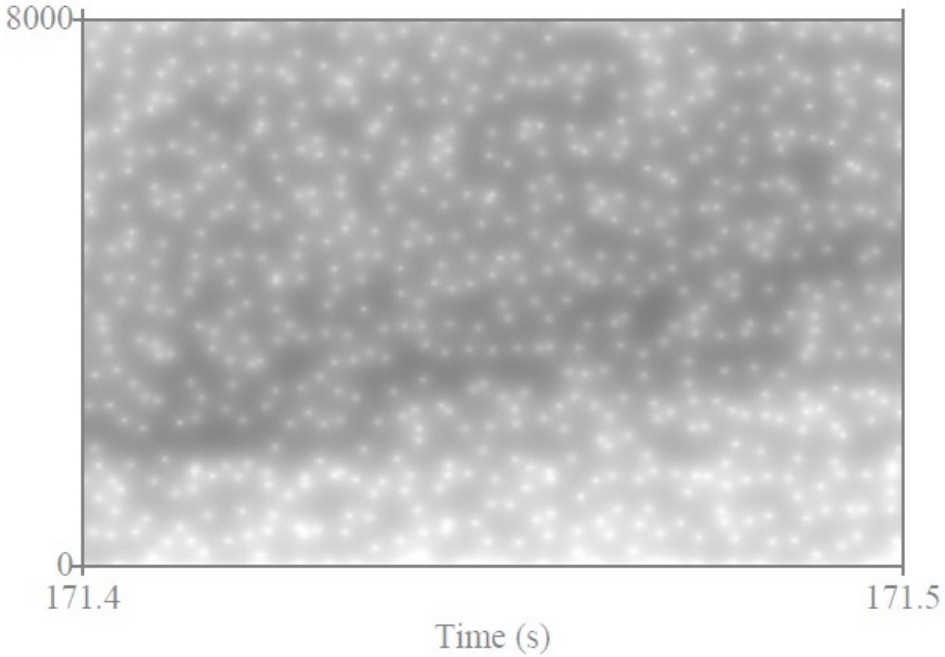
(Plag et al. 2015:21)

Phonetics of English affixes

Is there also a difference between…

- **other acoustic aspects** of the different morphemic *–s,* e.g. their centers of gravity*?*
- the duration of different **morphemic *–d***?





spectrograms of a [s] (left) and a [ʃ] (right)

Hypotheses

-s:

- Null hypothesis 1: No difference in center of gravity between morphemic and non-morphemic segments
- Null hypothesis 2: No difference in center of gravity between different homophonous morphemes

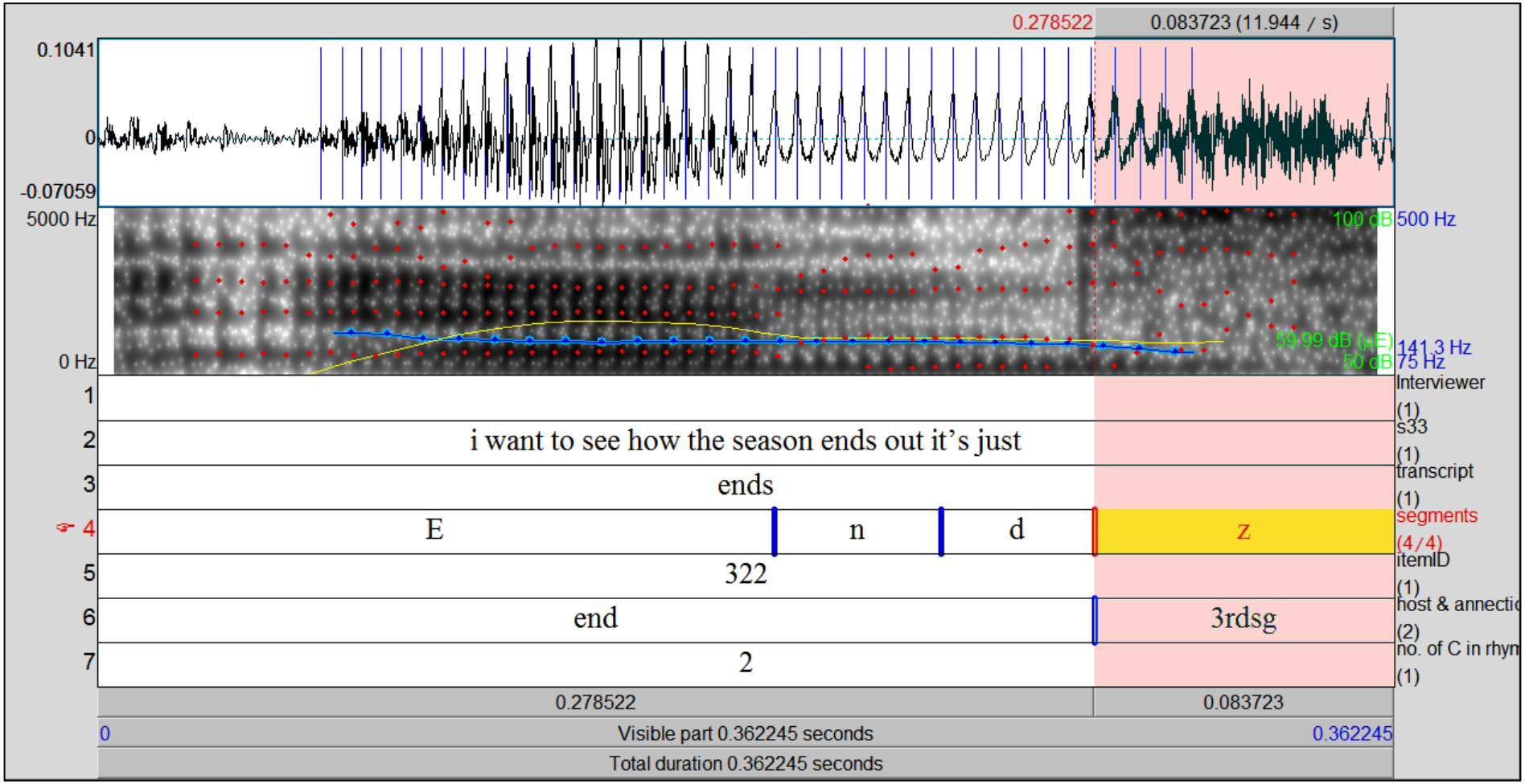
-d:

- Null hypothesis 3: No difference in duration between morphemic and non-morphemic segments
- Null hypothesis 4: No difference in duration between different homophonous morphemes

S: methodology

- /z/ and /s/ (henceforth ‘S’)
- plural, genitive, genitive plural, 3sg, clitics of *has*, *is*
- Buckeye Corpus, acoustic analysis (data from Plag et al. 2015)
- natural conversations, North American English
- morphemic S: N = 448, up to 100 per category
- non-morphemic S: N = 199
- statistical analysis: center of gravity by morpheme type, LMER
- data illustration: *ends* (3SG)

S: data illustration



S: analysis

- predict center of gravity of S on the basis of type of morpheme
- LMER:
  - dependent variable: **center of gravity of S** (weighted by absolute spectrum)
  - independent variable of interest: **type of S**
  - **covariates** (selection)

    voicing

    frequency

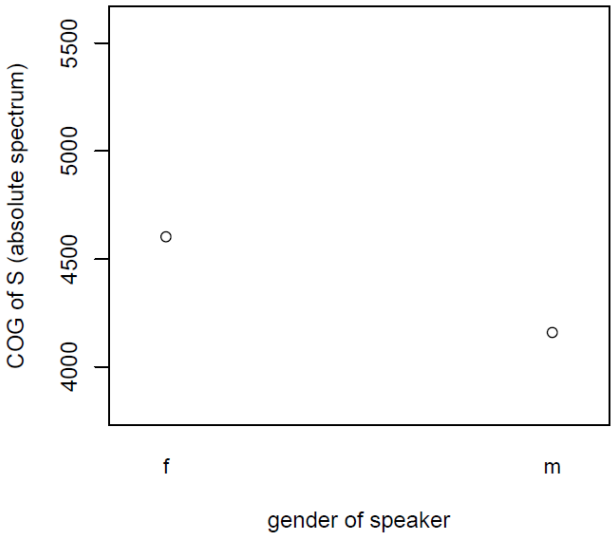
    speech rate (local, non-local)

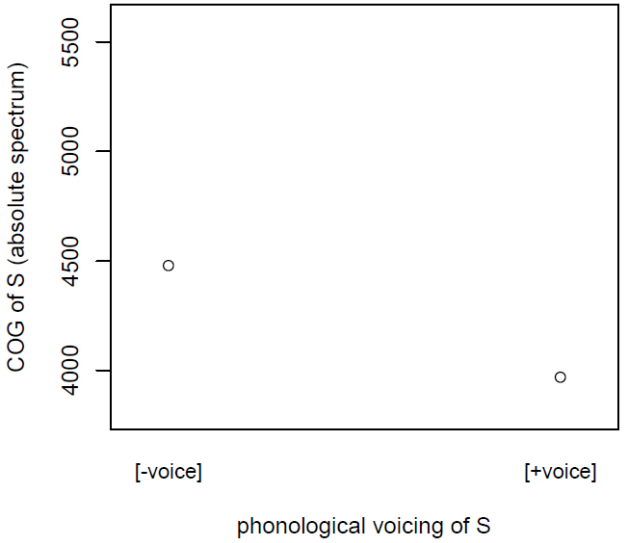
    N-gram frequency

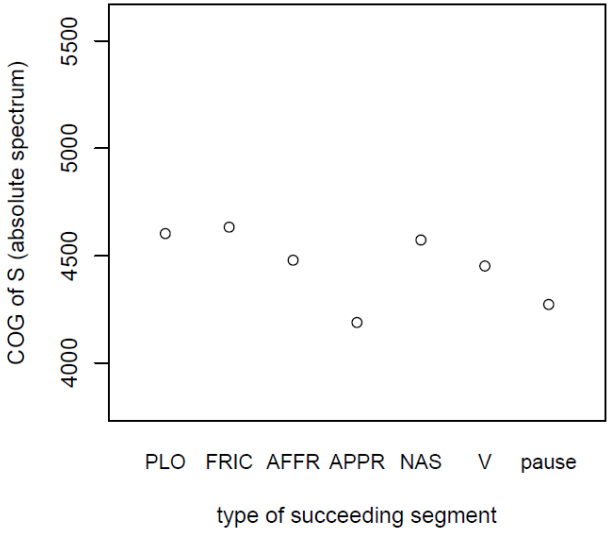
    phonetic environment

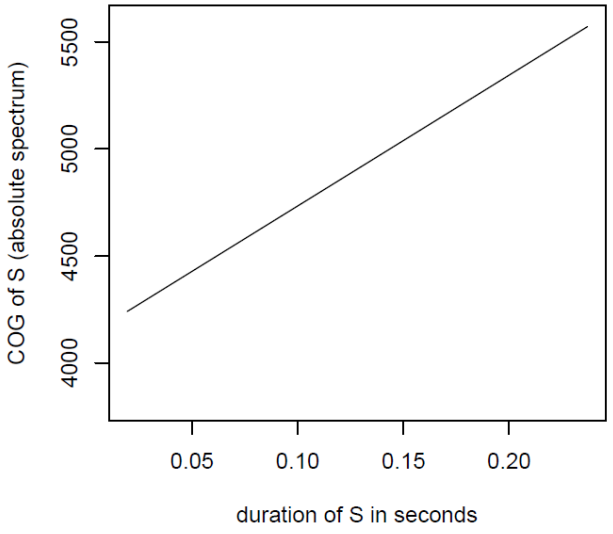
    gender of speaker

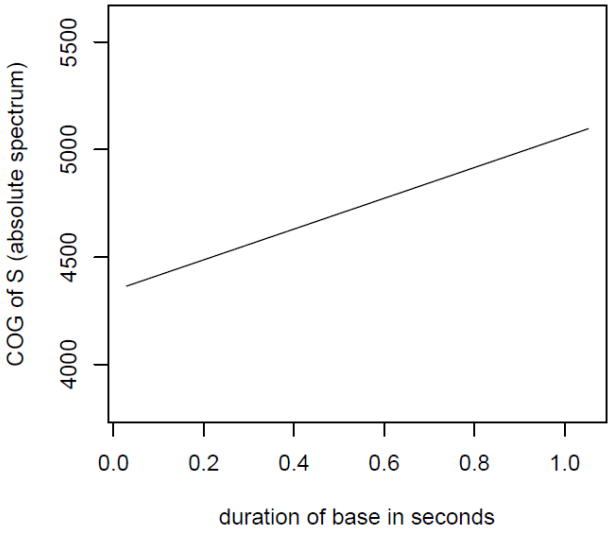
S: effect of covariates

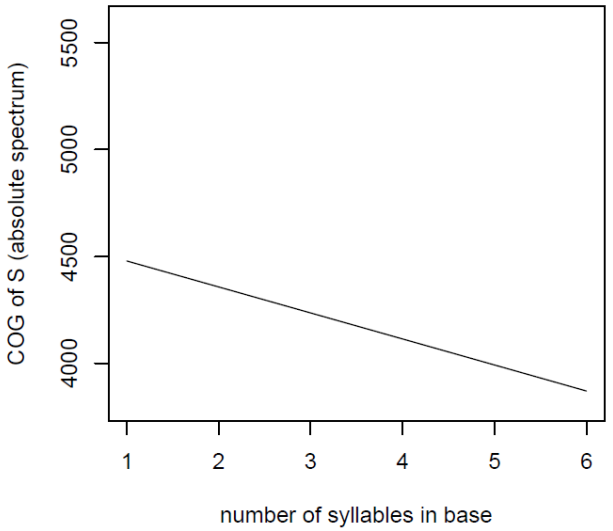




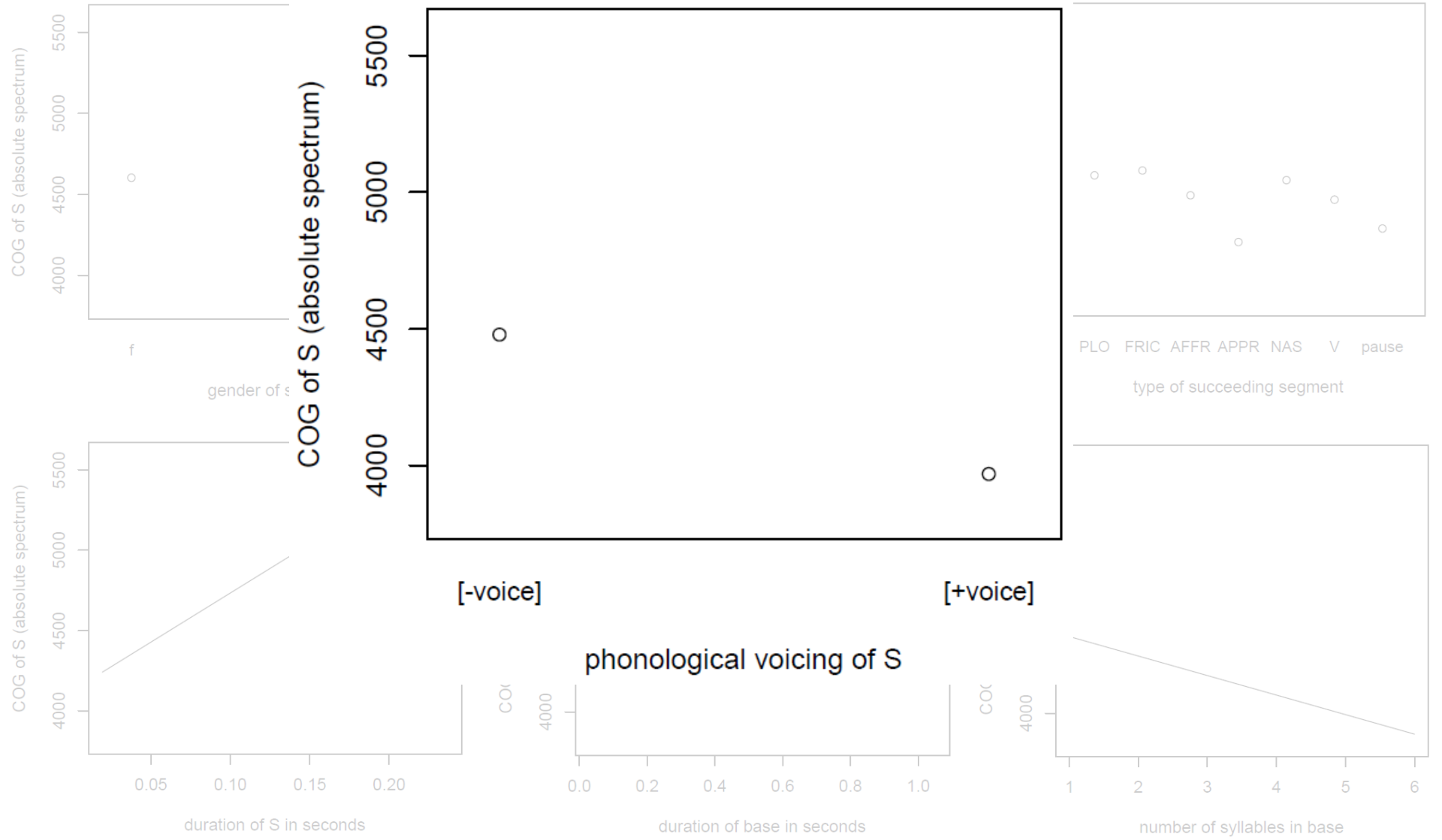




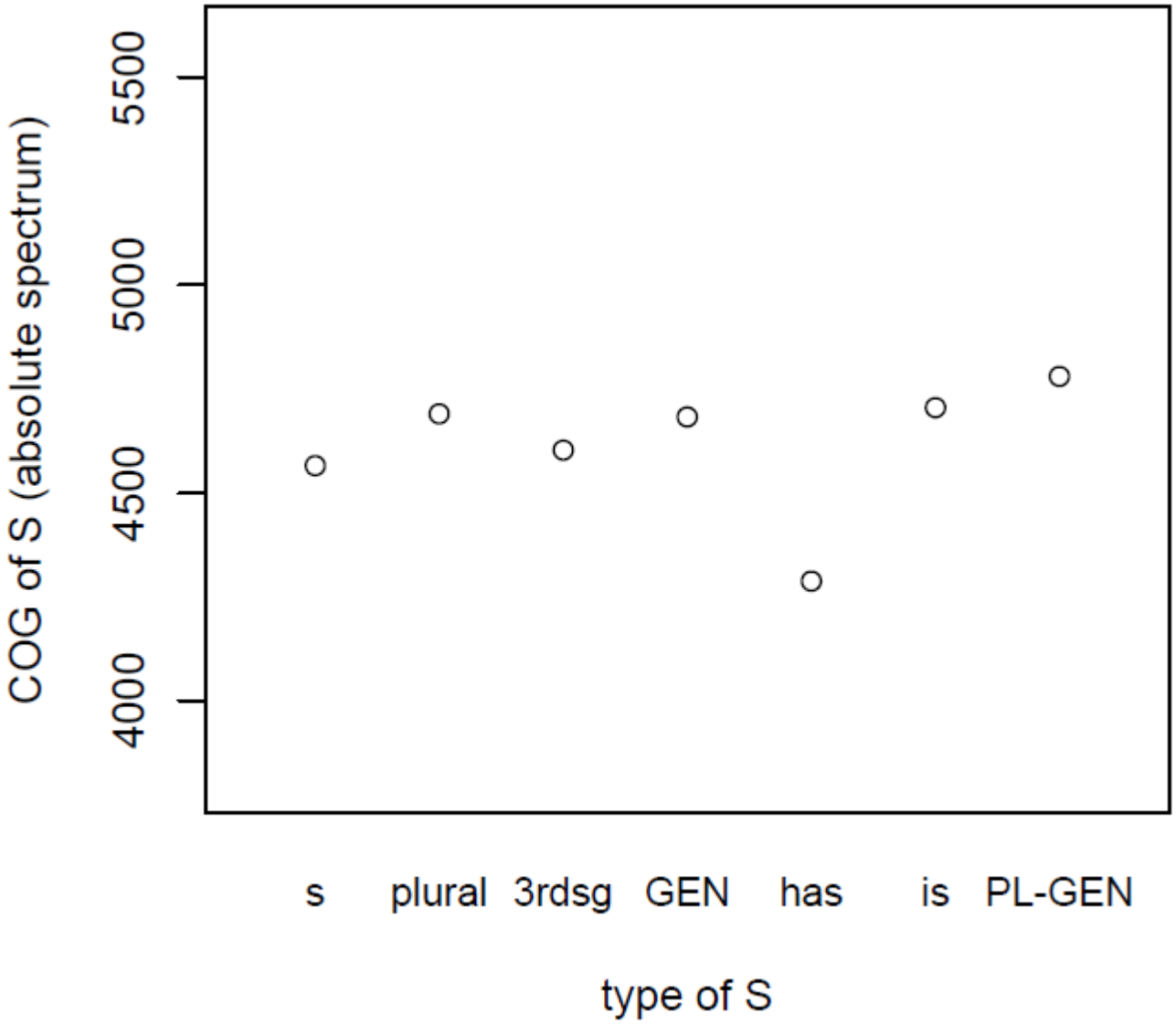




S: effect of covariates



S: effect of TYPE OF S



S: significant differences between the different TYPES OF S

	HAS	3RDSG	PL-GEN	IS	GEN	PL	non-morph
HAS		(0.0632)	0.0114	0.0154	0.024	0.0213	(0.0802)
3RDSG	(0.0632)						
PL-GEN	0.0114						
IS	0.0154						
GEN	0.024						
PL	0.0213						
non-morph	(0.0802)						

S: summary

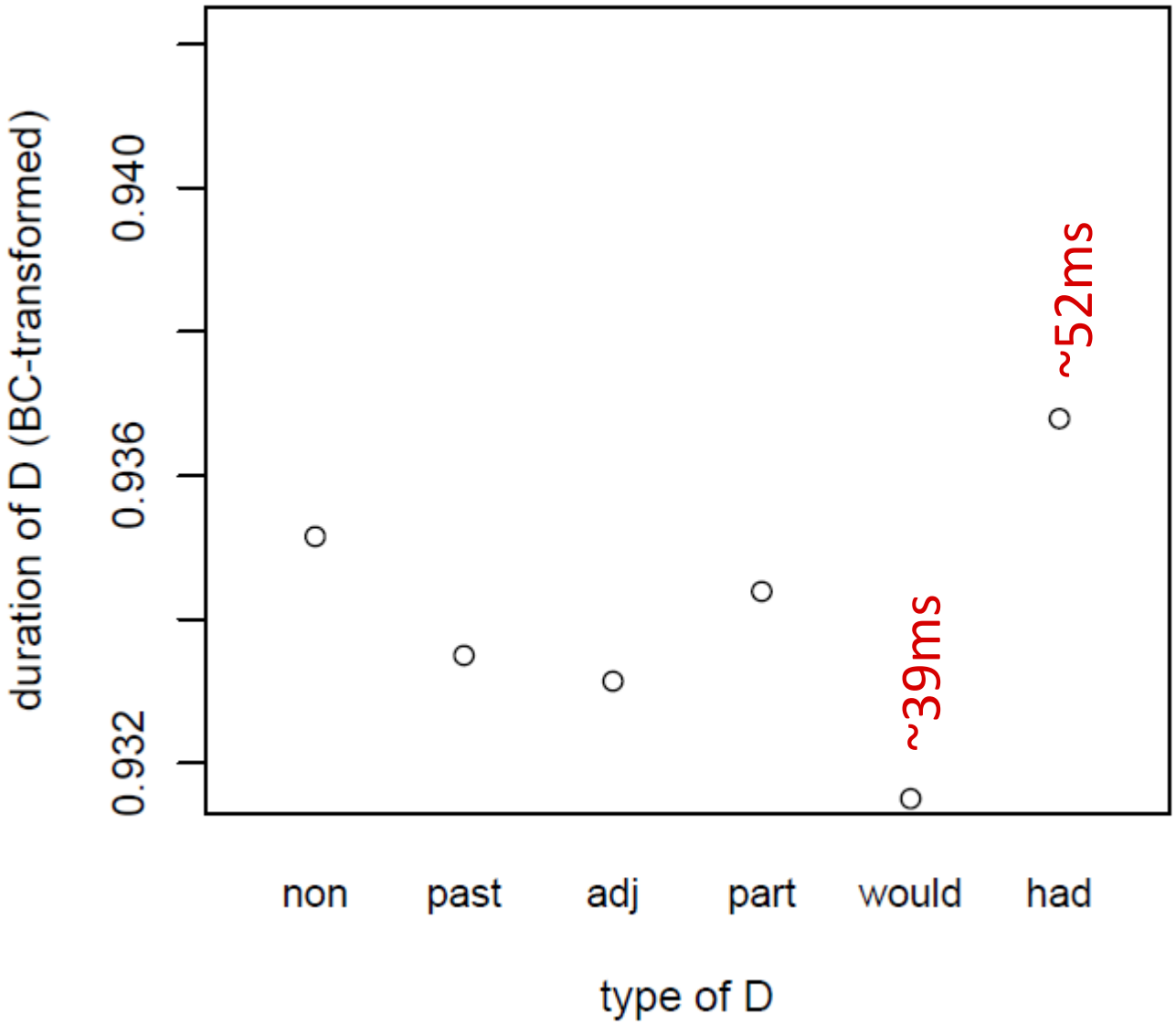
- Null hypothesis 1: accepted. Non-morphemic S don‘t differ in their centers of gravity from morphemic S.
- Null hypothesis 2: rejected. Some homophonous S affixes differ in their centers of gravity amongst each other.

- This effect is robust in natural speech, and holds also if we control for other phonetic influences.

D: data & analysis

- Null hypothesis 3: No difference in duration between morphemic and non-morphemic D
- Null hypothesis 4: No difference in duration between the different D morphemes
- /t/ and /d/ (henceforth ‘D‘)
- Buckeye Corpus (Pitt et al. 2007)
- past tense *-ed*, participial *-ed*, adjectival *-ed*, clitics of *had, would*, non-morphemic *-d*; N = 359, 40-120 per category
- **absolute closure duration** of D as dependent variable (LMER)
- **type of D** and **covariates** as independent variables

D: effect of TYPE OF D



D: significant differences between the different TYPES OF D

	WOULD	ADJ	VERB	HAD	non-morph
WOULD				0.0072	0.039
ADJ				(0.0567)	
VERB					
HAD	0.0072	(0.0567)			
non-morph	0.039				

D: summary

- Null hypothesis 3: rejected. Non-morphemic D's differ in duration from some morphemic D's.
- Null hypothesis 4: rejected. Some homophonous D affixes differ in duration amongst each other.

- These effects are robust in natural speech, and hold also if we control for other phonetic influences.

S & D: discussion

- traditional analyses of English S morphemes and D morphemes do not cover or predict the acoustic differences found between the affixes
- acoustic differences cannot be accounted for by purely phonetic processes – covariates are controlled
- implications for linguistic and psycholinguistic models

Implications

Phonetic detail reflects morphological structure.

Lexical Phonology (à la Kiparsky 1982, or other)

- different S and D suffixes are treated in the same way
- phonetic detail does not play a role

Existing models of speech production (Levelt et al. 1999)

- 'post-lexical' phonology has no access to morphological information

Future research

- replicate the observed production effects (ONZE corpus)
- test the differences experimentally
- test the differences in perception
- develop new models of phonology-morphology interaction

Thank you very much for your attention!

Acknowledgements

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