Morphological Status and Acoustic Realization: English S & D Morphemes

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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)

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 2011)

• 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?

- study I: duration and center of gravity of S
- study II: duration of obstruction of D
Study I (S): Hypotheses

**Duration:**
- Null hypothesis 1: No difference in duration between morphemic and non-morphemic segments
- Null hypothesis 2: No difference in duration between different homophonous morphemes

**Center of gravity:**
- Null hypothesis 3: No difference in center of gravity between morphemic and non-morphemic segments
- Null hypothesis 4: No difference in center of gravity 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: duration / COG by morpheme type, LMER
- data illustration: ends (3SG)
i want to see how the season ends out it’s just ends

322 3rdsg

end 2
S: analysis 1

• predict duration of S on the basis of type of morpheme

• LMER:
  • dependent variable: duration of S
  • 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 TYPE OF S * VOICING

non-morphemic S > suffix S > clitic S
/s/: significant differences between the different (unvoiced) TYPES OF /S/
S analysis 1: summary

• Null hypothesis 3: rejected. Non-morphemic S differ in their durations from morphemic S.

• Null hypothesis 4: rejected. Some homophonous S affixes differ in their durations amongst each other.

• This effect is robust in natural speech, and holds also if we control for other phonetic influences.
S: analysis 2

• predict center of gravity of S on the basis of type of morpheme
• LMER:
  • dependent variable: center of gravity of S
  • 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 on COG

- **Gender of Speaker**
  - f
  - m

- **Phonological Voicing of S**
  - [-voice]
  - [+voice]

- **Type of Succeeding Segment**
  - PLO
  - FRIC
  - AFFR
  - APPR
  - NAS
  - V
  - Pause

- **Duration of S in Seconds**

- **Duration of Base in Seconds**

- **Number of Syllables in Base**
S: effect of covariates on COG
S: effect of TYPE OF S on COG

- Type of S: s, plural, 3rdsg, GEN, has, is, PL-GEN
- COG of S (absolute spectrum)
**S: significant differences in COG between the different TYPES OF S**

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S analysis 2: summary

• Null hypothesis 3: **accepted**. Non-morphemic S don’t differ in their centers of gravity from morphemic S.

• Null hypothesis 4: **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.
Study II (D): Hypotheses

*Duration*:

- Null hypothesis 5: No difference in duration of the obstruction between morphemic and non-morphemic segments

- Null hypothesis 6: No difference in duration of the obstruction between different homophonous morphemes
D: data & analysis

• /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
• covariates
  • as in study I
  • presence of release & aspiration
D: effect of TYPE OF D

- Non: ~39ms
- Past: ~39ms
- Adj: ~39ms
- Part: ~39ms
- Would: ~52ms
- Had: ~52ms

(duration of D (BC-transformed))
D: significant differences between the different TYPES OF D

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D: summary

- Null hypothesis 5: rejected. Non-morphemic D's differ in duration from some morphemic D's.
- Null hypothesis 6: rejected. Some homophonous D's 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 (QuakeBox 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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