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)

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

i want to see how the season ends out it’s just ends

E n d z

322

end 3rdsg

2

Visible part 0.362245 seconds
Total duration 0.362245 seconds
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

- gender of speaker
- phonological voicing of S
- type of succeeding segment
- duration of S in seconds
- duration of base in seconds
- number of syllables in base
S: effect of covariates

- COG of S (absolute spectrum)
- Gender of S
- [-voice] vs. [+voice]
- Phonological voicing of S
- Duration of S in seconds
- Duration of base in seconds
- Number of syllables in base

Types of succeeding segment:
- PLO
- FRIC
- AFFR
- APPR
- NAS
- V
- Pause
S: effect of TYPE OF S

COG of S (absolute spectrum)

4000
4500
5000
5500

s  plural  3rdsg  GEN  has  is  PL-GEN

type of S
S: significant differences between the different TYPES OF S

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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

- 39 ms
- 52 ms
D: significant differences between the different TYPES OF D

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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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