English auxiliary realization and the independence of morphology and phonetics

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The issue

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The architecture of the grammar:

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- **Modular**, feed-forward system with distinct levels of representations and processes?

(Chomsky & Halle 1968; Labov 1969)

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The architecture of the grammar:

- **Modular**, feed-forward system with distinct levels of representations and processes?

(Chomsky & Halle 1968; Labov 1969)

- Interactive, **exemplar-based**, all levels interdependent?

(Pierrehumbert 2002)

A test case

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Phonetic lenition

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Phonetic lenition

- Independent of morphology?

A test case

Phonetic lenition

- Independent of morphology?
- Contingent on “probabilistic relations between words”? (Jurafsky et al. 2001)

Our contribution

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Quantitative corpus study of phonetic **h-deletion** in function words

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- Another lenition process that affects multiple lexical items

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- A variable phenomenon that has been little studied empirically

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- A variable phenomenon that has been little studied empirically

Finding: no morphological sensitivity.

Setting the stage: Auxiliary variation

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English auxiliaries vary in phonological shape ("**contraction**")

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Today's talk:

had

has

Setting the stage: Auxiliary variation

3 phonological shapes

Setting the stage: Auxiliary variation

3 phonological shapes

had

has

Setting the stage: Auxiliary variation

3 phonological shapes

	CVC
had	[həd]
has	[həz]

Setting the stage: Auxiliary variation

3 phonological shapes

	CVC	VC
had	[həd]	[əd]
has	[həz]	[əz]

Setting the stage: Auxiliary variation

3 phonological shapes

	CVC	VC	C
had	[həd]	[əd]	[d]
has	[həz]	[əz]	[z]/[s]

Setting the stage: Auxiliary variation

3 phonological shapes,

contingent on host type

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Setting the stage: Auxiliary variation

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(MacKenzie in press)

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Analysis:

1. morphological

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Analysis:

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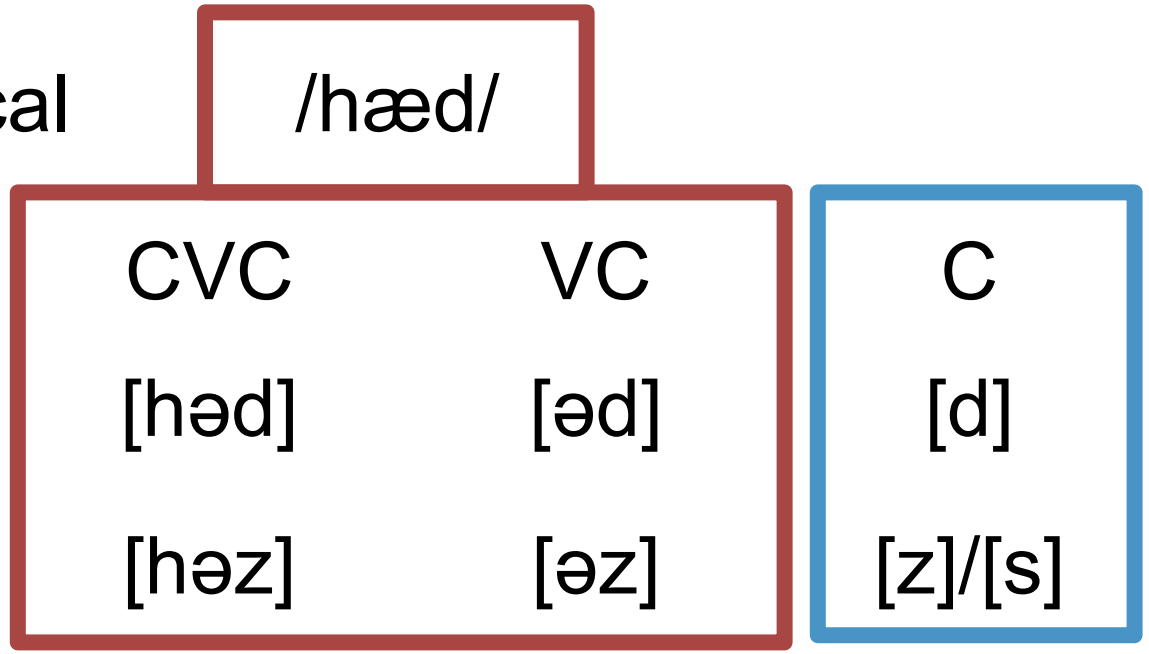

(MacKenzie in press)

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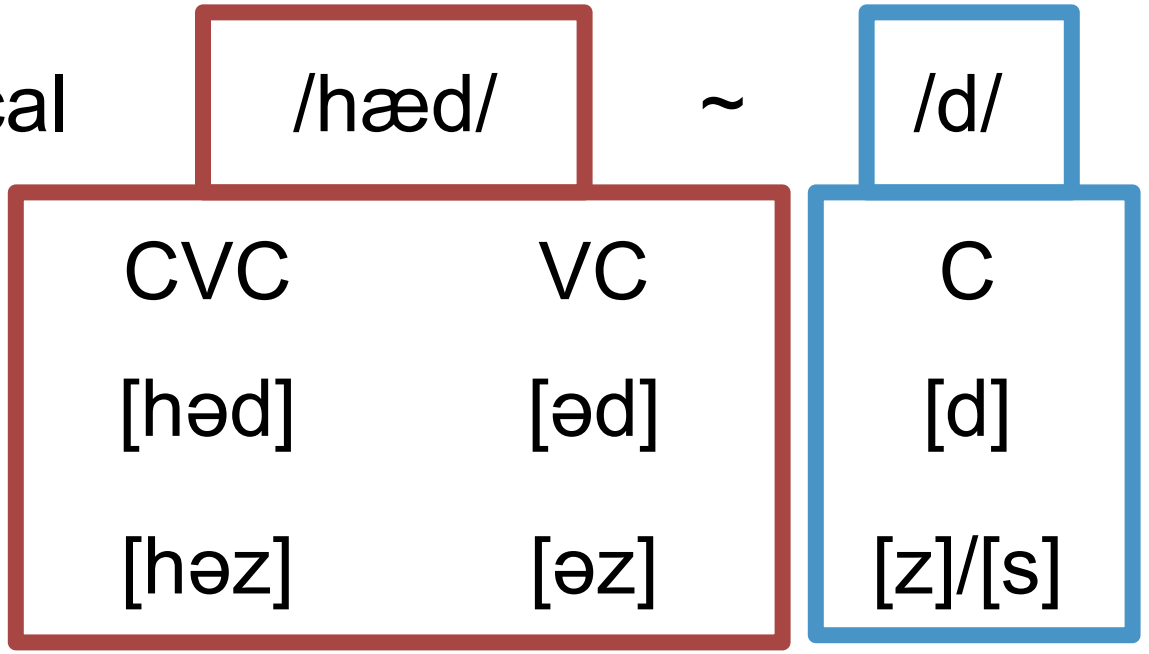

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Setting the stage: Auxiliary variation

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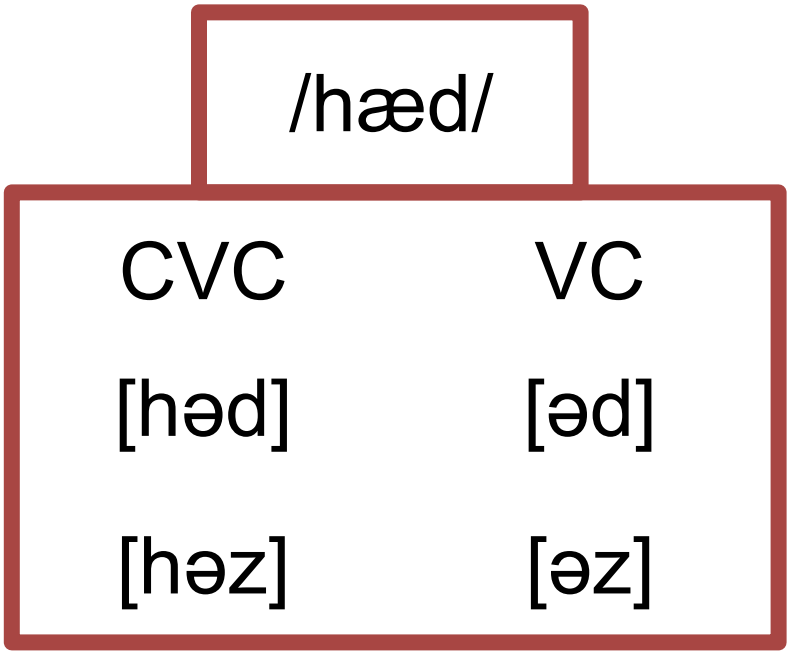

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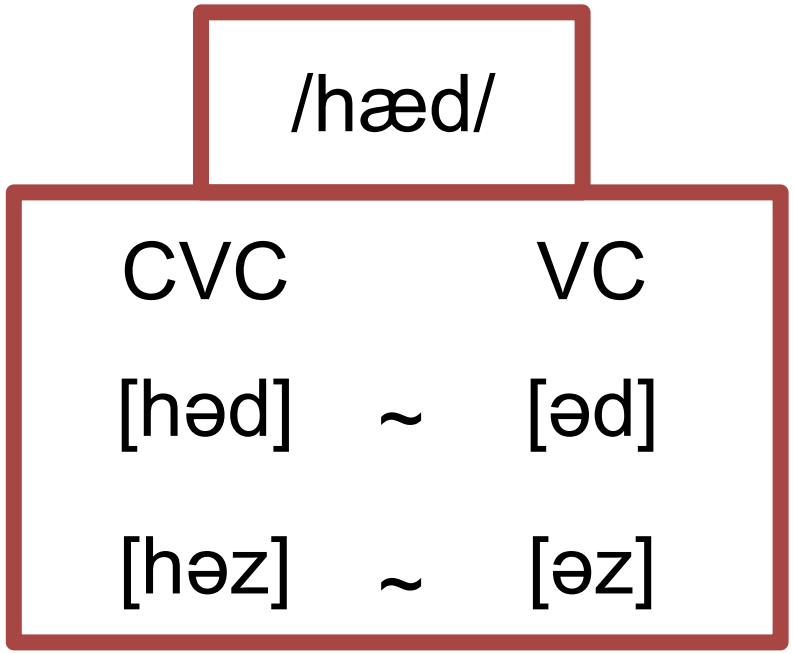
Setting the stage: Auxiliary variation

Analysis:

2. phonetic

   h-deletion



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[həd]	~	[əd]
[həz]	~	[əz]

(MacKenzie in press)

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Research question

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- Contingent on “probabilistic relations between words”? (Jurafsky et al. 2001)

Methodology

Corpus: Switchboard (Godfrey et al., 1992)

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Lexical items:

had

has

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Lexical items:		/h/	Ø
had	N=284	[həd]	[əd]
has	N=252	[həz]	[əz]

Methodology

Corpus: Switchboard (Godfrey et al., 1992)

Lexical items:		/h/	Ø
had	N=284	[həd]	[əd]
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he	N=273		

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-comp. *that*

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Mixed-effects modeling to obtain fitted rates

Findings

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		/h/	Ø	/h/-del.
had	N=284	[həd]	[əd]	**0.38**
has	N=252	[həz]	[əz]	**0.36**
he	N=273	[hi]	[i]	**0.33**

Findings

		/h/	Ø	/h/-del.
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No effect of lexical item

Interpretation

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Consistency of h-deletion across lexical items

	/h/-del.
had	**0.38**
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Interpretation

Consistency of h-deletion across lexical items

- Attributable to some other factor?

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Interpretation

Consistency of h-deletion across lexical items

- Attributable to some other factor?
  - Item frequency
  - Item predictability

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(Bybee 2002)

(Jurafsky et al. 2001)

Interpretation

Consistency of h-deletion across lexical items

- Attributable to some other factor?
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calculated in Switchboard

	/h/-del.
had	**0.38**
has	**0.36**
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(Bybee 2002)

(Jurafsky et al. 2001)

Item frequency

	freq.	/h/-del.
had	18366	**0.38**
has	7640	**0.36**
he	21854	**0.33**

Item frequency

	freq.	/h/-del.
had	18366	**0.38**
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✗

Predictability

	freq.	/h/-del.
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Predictability

= mean probability given previous word

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e.g. given ***she***, how likely is ***had*** to follow?

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Predictability

= mean probability given previous word

e.g. given ***she***, how likely is ***had*** to follow?

	pred.	freq.	/h/-del.
had	0.393	18366	**0.38**
has	0.650	7640	**0.36**
he	0.115	21854	**0.33**
		✗	

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Predictability - POS

= mean probability given previous part of speech

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had	0.393	18366	**0.38**
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Predictability - POS

= mean probability given previous part of speech

e.g. given ***pro***, how likely is ***had*** to follow?

	pred.	freq.	/h/-del.
had	0.393	18366	**0.38**
has	0.650	7640	**0.36**
he	0.115	21854	**0.33**
	✗	✗	

Predictability - POS

= mean probability given previous part of speech

e.g. given ***pro***, how likely is ***had*** to follow?

	POS-pred.	pred.	freq.	/h/-del.
had	0.063	0.393	18366	**0.38**
has	0.005	0.650	7640	**0.36**
he	0.014	0.115	21854	**0.33**
	✗	✗	✗	

Collocation with following word

Collocation with following word

Each item's most frequent successor:

Collocation with following word

Each item's most frequent successor:

had ***been***

Collocation with following word

Each item's most frequent successor:

had ***been***

has ***been***

Collocation with following word

Each item's most frequent successor:

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has ***been***

he ***had***

Collocation with following word

Each item's most frequent successor:

	/h/-del.
had ***been***	**0.37**
has ***been***	**0.28**
he ***had***	**0.29**

Collocation with following word

All other successors:

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had ¬***been***

Collocation with following word

All other successors:

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has ¬***been***

Collocation with following word

All other successors:

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has ¬***been***

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Collocation with following word

All other successors:

	/h/-del.
had ¬***been***	**0.33**
has ¬***been***	**0.41**
he ¬***had***	**0.39**

h-deletion by successor

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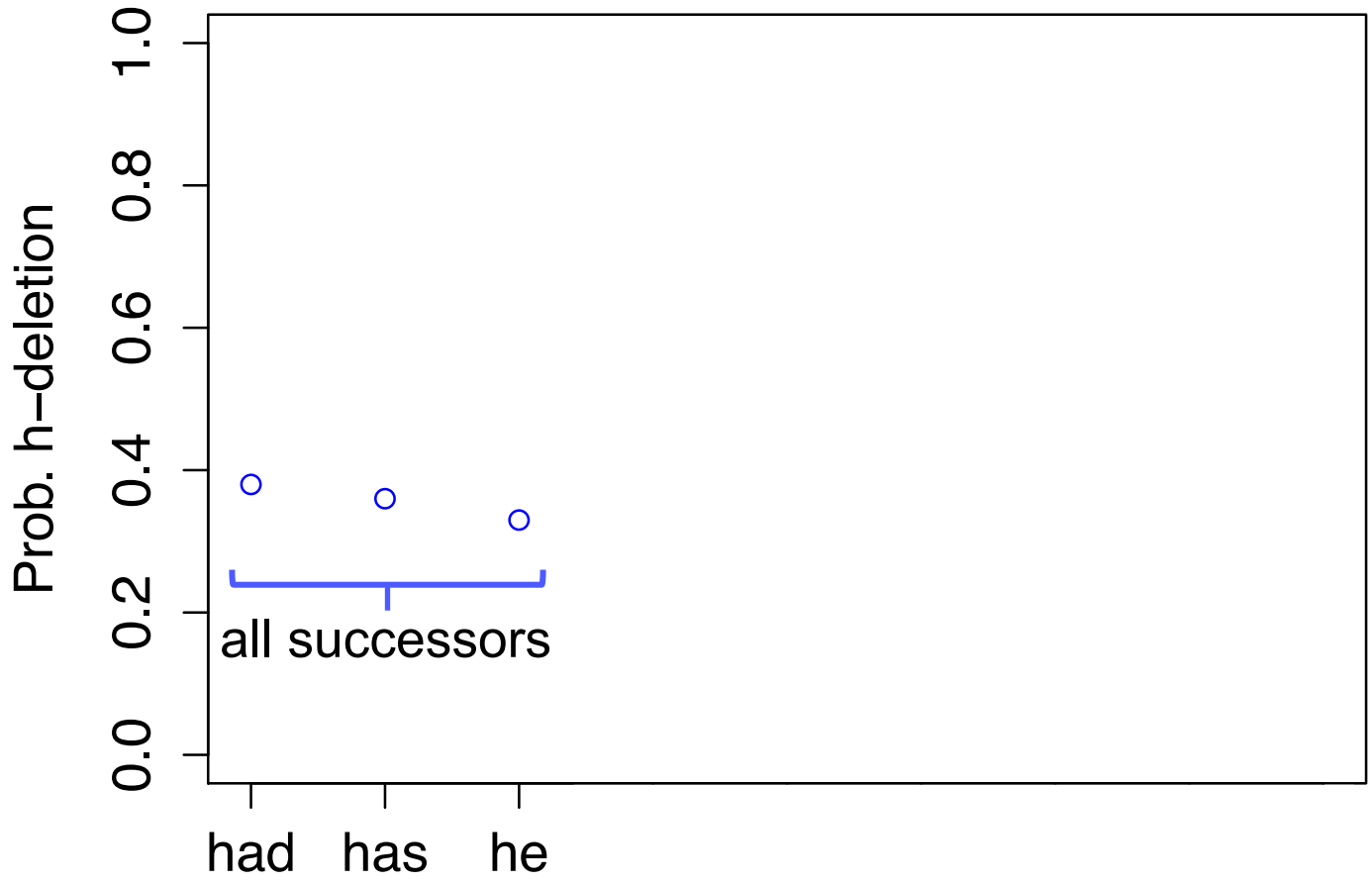

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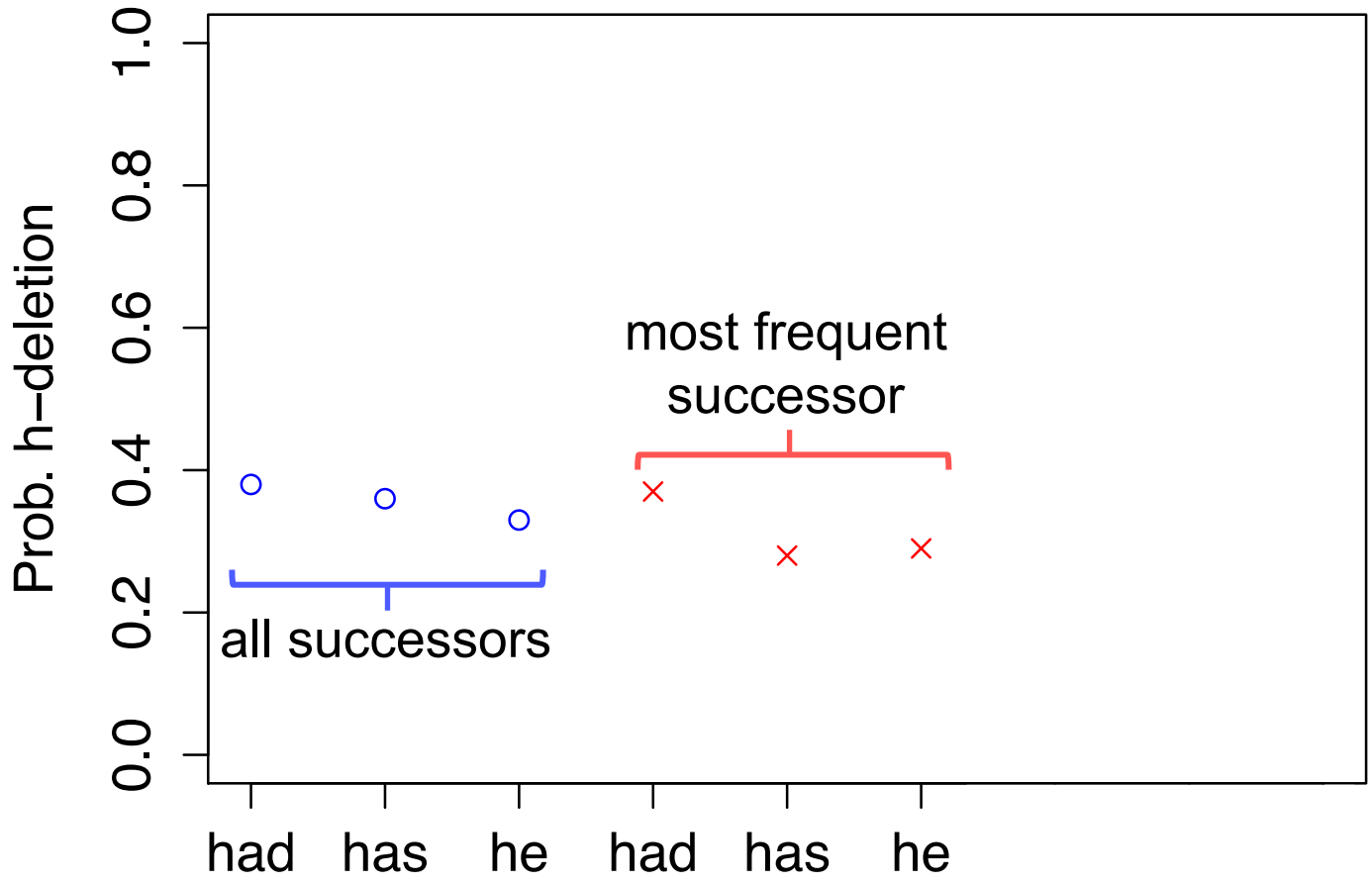

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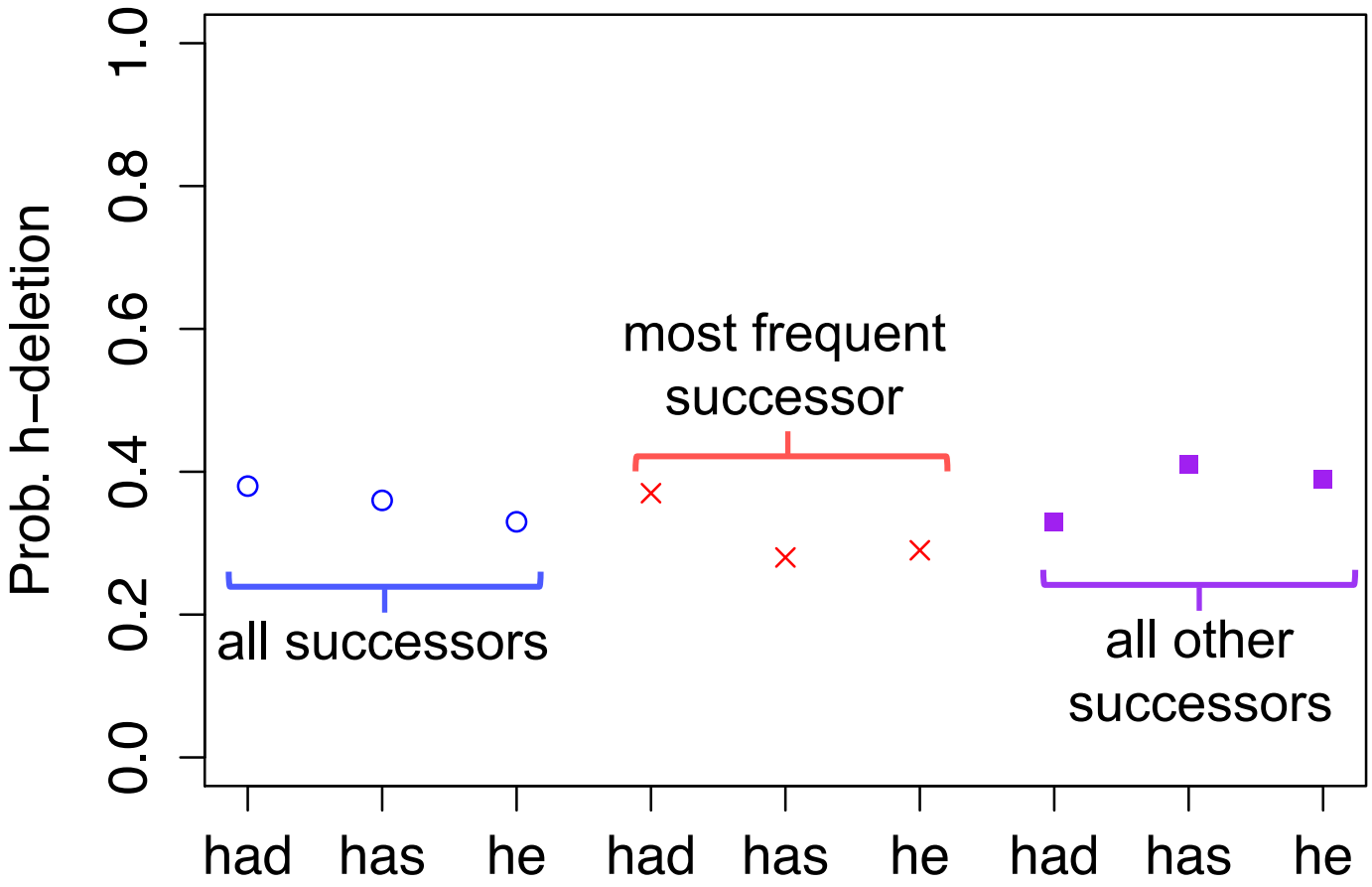

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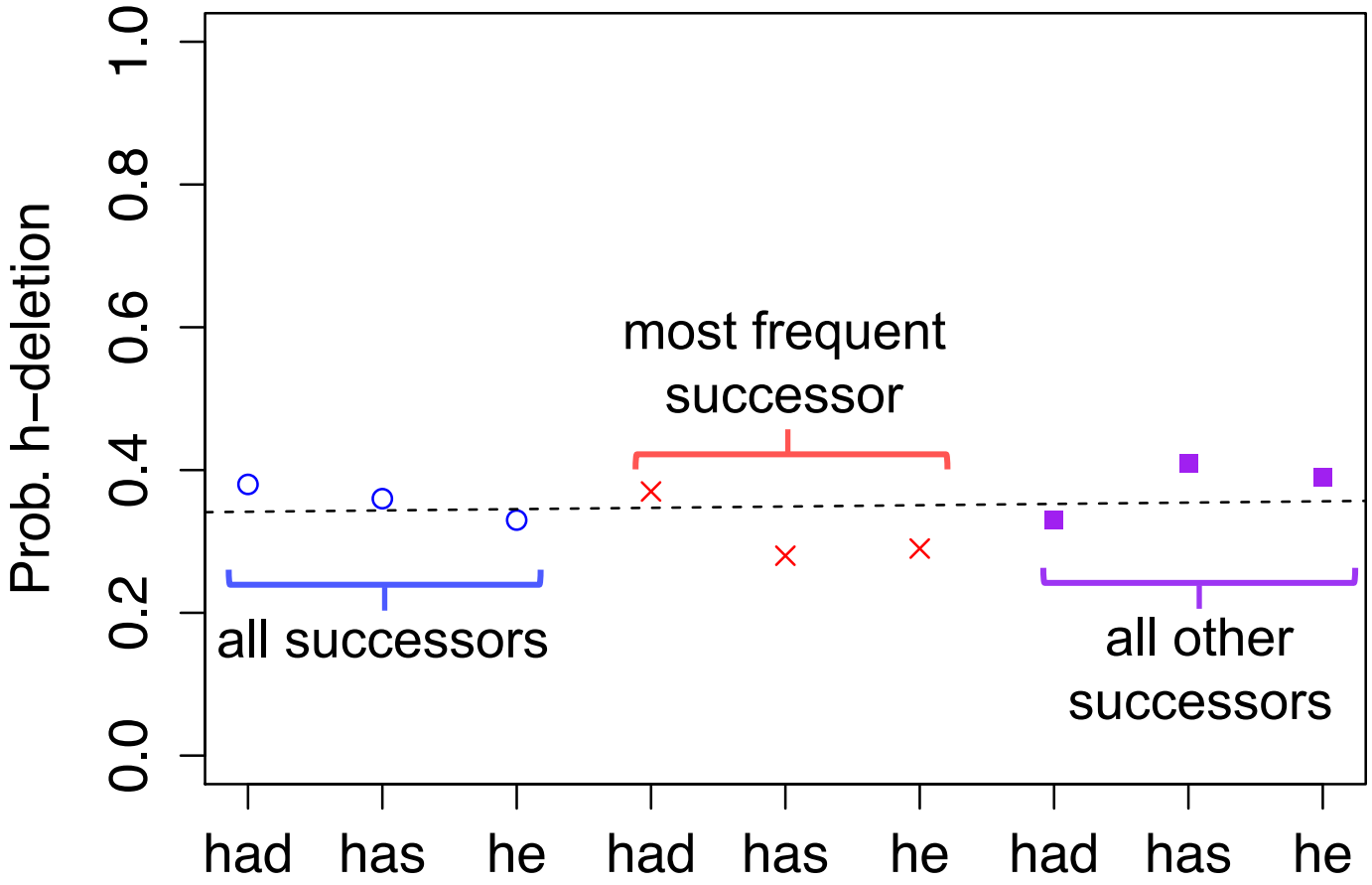

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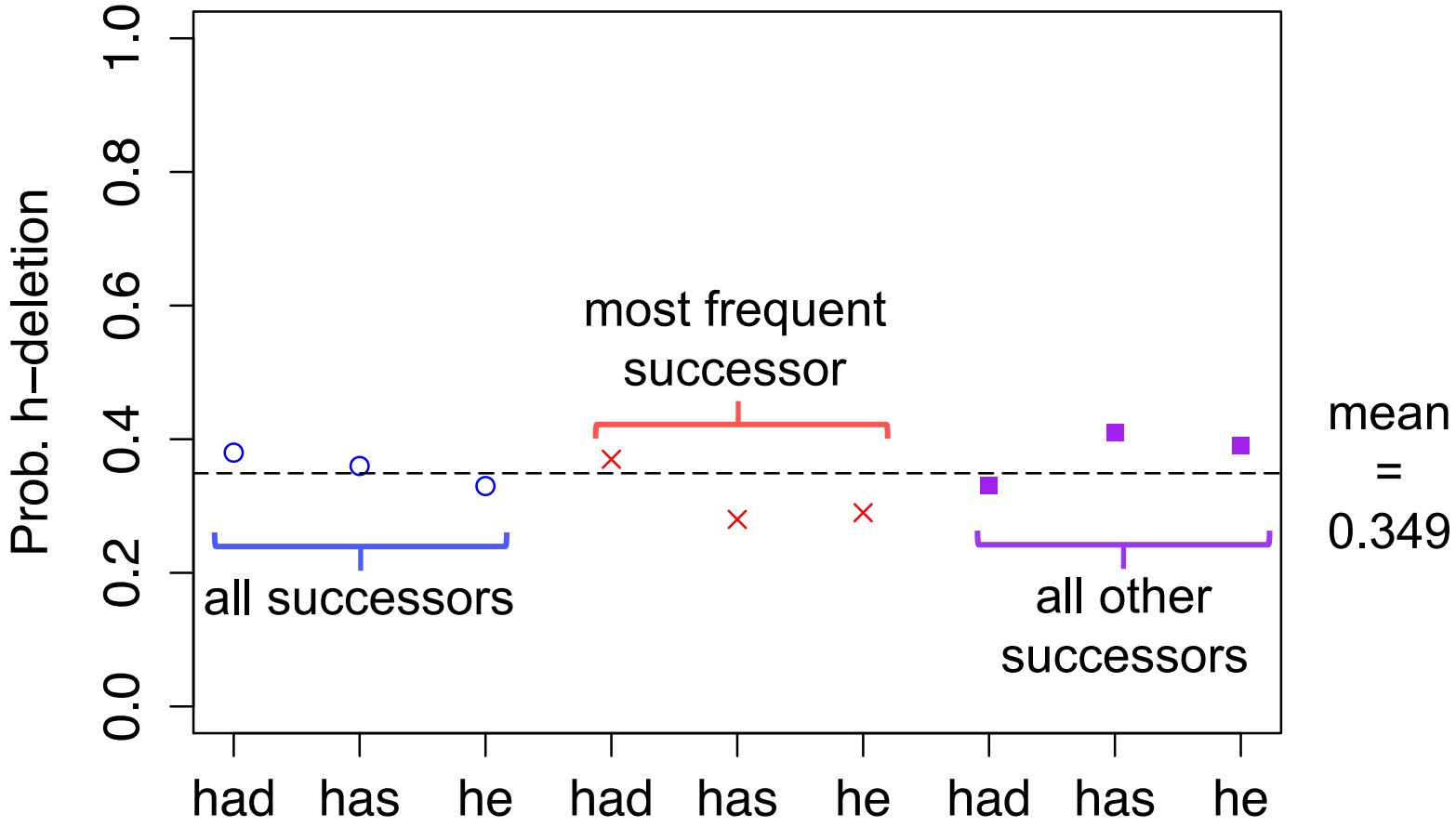

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h-deletion applies at a consistent rate, irrespective of

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- Predictability of following word given item

Implications

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- A fast-speech lenition process that makes no reference to morphology
- Modular separation of morphology/phonetics
- Challenges for exemplar-based models which predict increased lenition with greater frequency/predictability

Future work

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  - Flapping / glottalization

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- Connections between /h/-del. & other processes
  - Flapping / glottalization
  - Linking /r/ (Ogden 1999)

Thank you!

- Acoustic measures of /h/ (Pierrehumbert & Talkin 1992)

Raw frequency of *has/had*

Calculated by searching for item followed by participle, with zero or one words intervening (covers negation/adverbs)

Predictability from preceding POS

- *had:* most likely to follow pronouns & nouns
- *has:* most likely to follow pronouns & nouns
- *he:* most likely to follow conjunctions & prepositions

Successor frequency given h-word

- *had:*
  - #1: *been* (16%)
  - #2: *done* (6%)
- *has*:
  - #1: *been* (30%)
  - #2: *gone* (8%)