Phonetic reduction in triconstituent compounds:

an investigation of acoustic constituent durations

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project: *Morphological embedding and phonetic reduction*

(associated to DFG Research Unit FOR 2373: *Spoken Morphology: Phonetics and Phonology of complex words)*

PI's: Gero Kunter, Ingo Plag

Today's talk

[health$_{N1}$ care$_{N2}$] law$_{N3}$ **corner$_{N1}$ [drug$_{N2}$ store$_{N3}$]**

Does the morphological structure of compounds have an effect on the acoustic durations of N1, N2 and N3?

Lexical Phonology (Kiparsky 1982)

Assumption:

strict division of

- the application of morphological and phonological rules to a lexical item → **lexical level**

- the embedding into a syntactic structure and the phonetic implementation of a lexical item → **post-lexical level**

Lexical Phonology (Kiparsky 1982)

Assumption:

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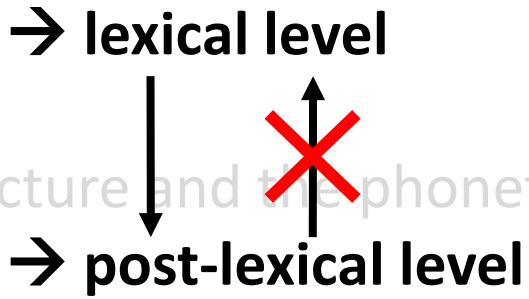
- the embedding into a syntactic structure and the phonetic implementation of a lexical item



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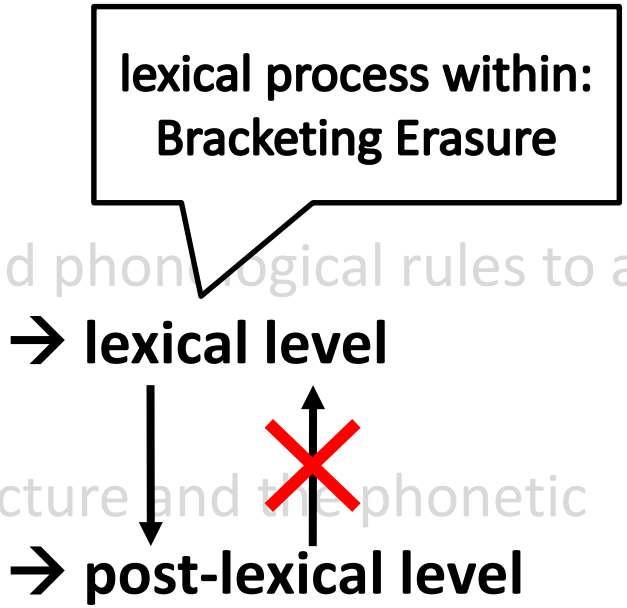


Bracketing Erasure

After each application of a morphological rule, the internal morphological brackets in the complex word are erased.

→ morphological structure is not visible
→ phonetic signal has no access to the morphological structure of the complex word
→ factors related to the morphological structure do not affect the phonetic signal

Bracketing Erasure

health$_{N1}$ care$_{N2}$ law$_{N3}$ **corner$_{N1}$ drug$_{N2}$ store$_{N3}$**

→ phonetic signal cannot reflect the morphological structure of the compound
→ relations (e.g. embeddedness) between constituents should be undetectable

Contrary assumption

The morphological structure is encoded in the phonetic signal.

Sproat & Fujimura (1993): gradient variation of /l/ realizations according to the morphological boundary they attach to

Hay (2007): *un*- shorter in words with weaker boundaries, and longer in words with stronger boundaries

phonetic realization of segments at a morphological boundary is sensitive to the degree of boundary strength

Contrary assumption

The morphological structure is encoded in the phonetic signal.

Hay & Plag (2004): in suffixed words, inner boundaries are weaker than outer boundaries; suffixes with weaker boundaries are closer to the base

[aim-less]-ness [king-dom]-ful

morphological embeddedness of affixes correlated with boundary strength

Contrary assumption

The morphological structure is encoded in the phonetic signal.

[health$_{N1}$ care$_{N2}$] law$_{N3}$ **corner$_{N1}$ [drug$_{N2}$ store$_{N3}$]**

→ the phonetic implementation of the three constituents should be different due to the different boundary strengths

Contrary assumption

Kunter & Plag (2016) present the **Embedded Reduction Hypothesis**

In a complex word with more than two constituents, the embedded constituents are acoustically shorter than constituents at higher derivational levels.

Contrary assumption

[health$_{N1}$ care$_{N2}$] law$_{N3}$ **corner$_{N1}$ [drug$_{N2}$ store$_{N3}$]**

Predictions:
a. The embedded constituents are relatively short.

Contrary assumption

[health$_{N1}$ care$_{N2}$] law$_{N3}$ corner$_{N1}$ **[drug$_{N2}$ store$_{N3}$]**

Predictions:
a. The embedded constituents are relatively short.
b. The free constituent is relatively long.

Contrary assumption

[health$_{N1}$ care$_{N2}$] law$_{N3}$ **corner$_{N1}$ [drug$_{N2}$ store$_{N3}$]**

Predictions:
a. The embedded constituents are relatively short.
b. The free constituent is relatively long.
c. This effect is independent from the branching direction.

→ interaction between constituents and branching direction of the compound needed

Kunter & Plag (2016)

[health$_{N1}$ care$_{N2}$] law$_{N3}$ **corner$_{N1}$ [drug$_{N2}$ store$_{N3}$]**

- data set: experimental data (Kösling 2013, Kösling et al. 2013)
- 477 English triconstituent NNN compounds

- statistical analysis: lmer modelling
- next slides: results from interaction with embedded constituents

left-branching: [N1 N2] N3

N1N2 bigram frequency (=embedded constituent):

N1 is relatively short regardless of N1N2 freq.
N2 is relatively short regardless of N1N2 freq.
N3 is relatively long regardless of N1N2 freq.

left-branching: [N1 N2] N3

N1N2 bigram frequency (=embedded constituent):

N1 is relatively short regardless of N1N2 freq. EXPECTED
N2 is relatively short regardless of N1N2 freq. EXPECTED
N3 is relatively long regardless of N1N2 freq. EXPECTED

right-branching: N1 [N2 N3]

N2N3 bigram frequency (=embedded constituent):

N1 is relatively long with higher N2N3 freq.
N2 is relatively short with higher N2N3 freq.
N3 is relatively short regardless of N2N3 freq.

right-branching: N1 [N2 N3]

N2N3 bigram frequency (=embedded constituent):

N1 is relatively long with higher N2N3 freq.	EXPECTED
N2 is relatively short with higher N2N3 freq.	EXPECTED
N3 is relatively short regardless of N2N3 freq.	EXPECTED

Corpus Study

Corpus Study

[health$_{N1}$ care$_{N2}$] law$_{N3}$ **corner$_{N1}$ [drug$_{N2}$ store$_{N3}$]**

-data from BURSC (data set by Kösling & Plag 2009)
-451 English triconstituent NNN compounds

Corpus study

[health$_{N1}$ care$_{N2}$] law$_{N3}$ **corner$_{N1}$ [drug$_{N2}$ store$_{N3}$]**

Predictions:
a. The embedded constituents are relatively short.
b. The free constituent is relatively long.
c. This effect is independent from the branching direction.

Corpus study

- statistical analysis: lmer modelling

dependent variable	constituent duration
predictors	constituent number branching frequencies of each constituent bigram frequency N1N2 and bigram frequency N2N3 trigram frequency N1N2N3 pitch range phonological length
random effect	speaker
central interactions	constituent number * branching * bigramFreqN1N2 constituent number * branching * bigramFreqN2N3

left-branching: [N1 N2] N3

significant three-way interaction constituent number * branching * bigramFreqN1N2

N1N2 bigram frequency (=embedded constituent):

N1 is relatively short
N2 is relatively short
N3 is relatively long

left-branching: [N1 N2] N3

significant three-way interaction constituent number * branching * bigramFreqN1N2

N1N2 bigram frequency (=embedded constituent):

N1 is relatively short	EXPECTED
N2 is relatively short	EXPECTED
N3 is relatively long	EXPECTED

right-branching: N1 [N2 N3]

significant interaction constituent number * bigramFreqN2N3

N2N3 bigram frequency (=embedded constituent):

N1 is longer than N2, but shorter than N3
N2 is relatively short
N3 is relatively long

right-branching: N1 [N2 N3]

significant interaction constituent number * bigramFreqN2N3

N2N3 bigram frequency (=embedded constituent):

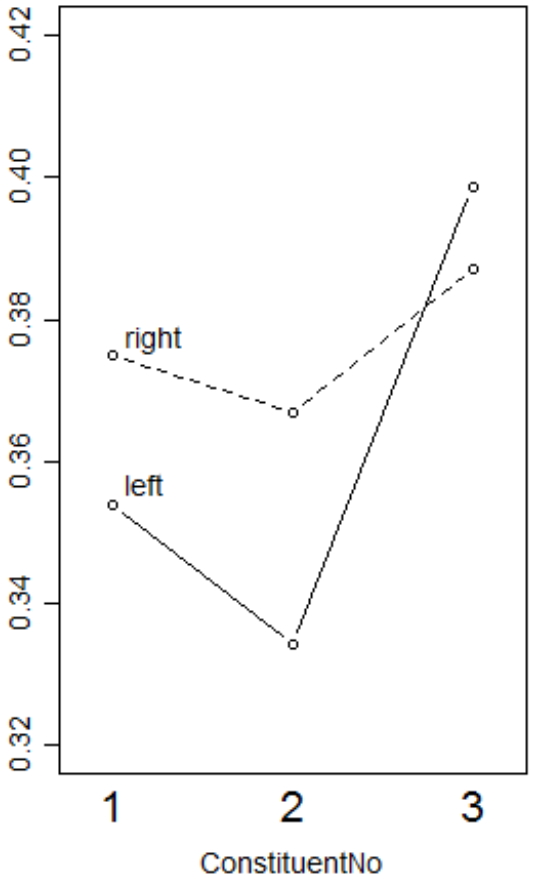
N1 is longer than N2, but shorter than N3	?
N2 is relatively short	EXPECTED
N3 is relatively long	UNEXPECTED

difference to Kunter & Plag (2016) analysis:

3-way interaction *constituent number * branching * bigramFreq N2N3* not significant

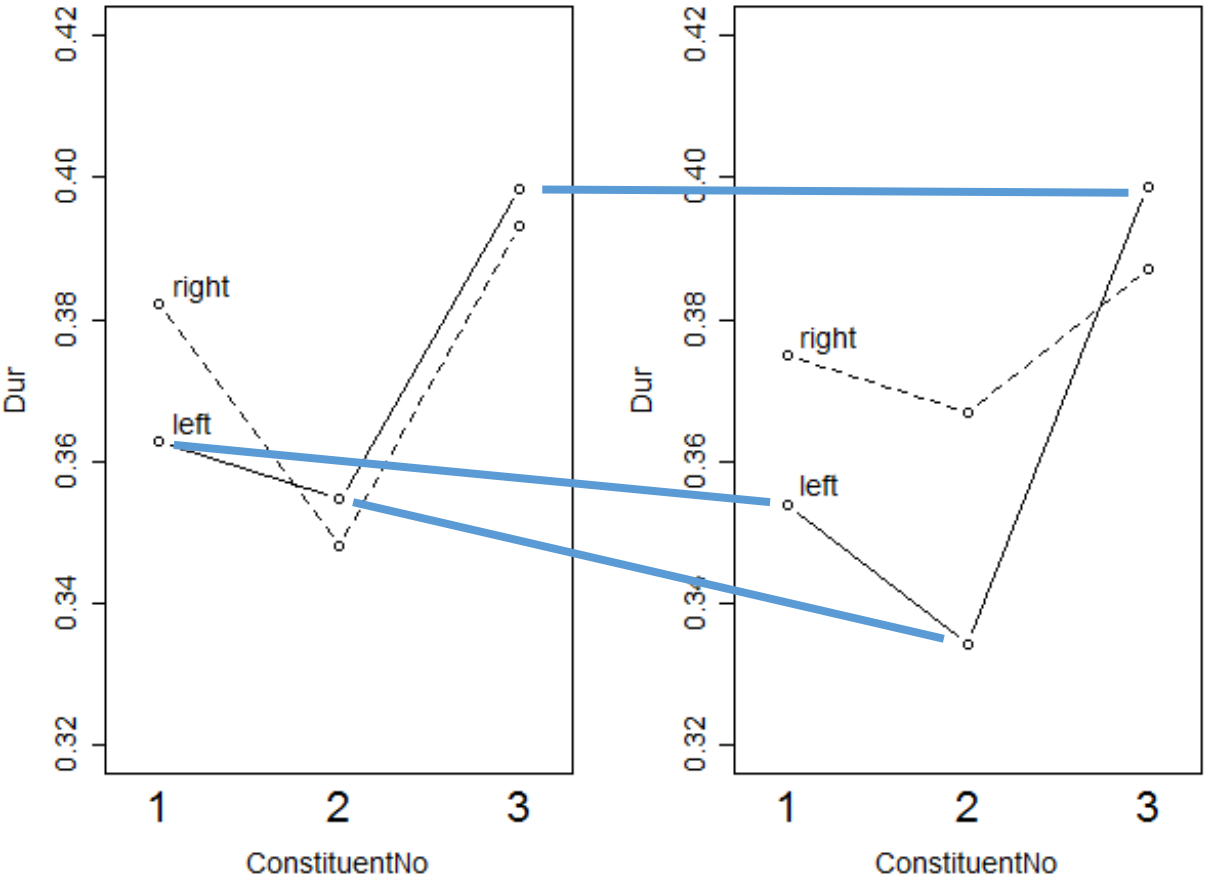
→ effect of N2N3 similar for left-branching

left-branching & right-branching



average bigramFreq N1N2

left-branching & right-branching



low bigramFreq N1N2

average bigramFreq N1N2

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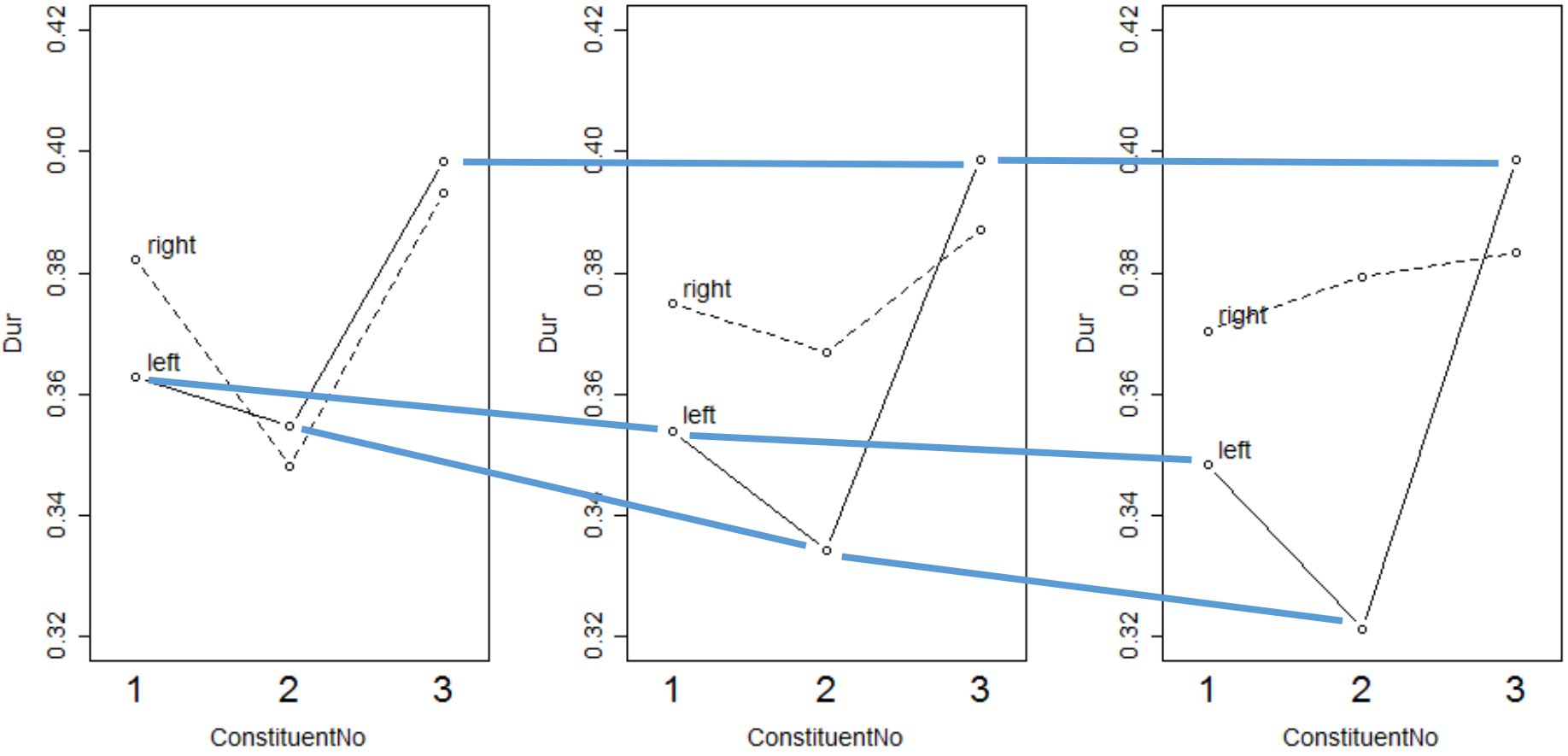

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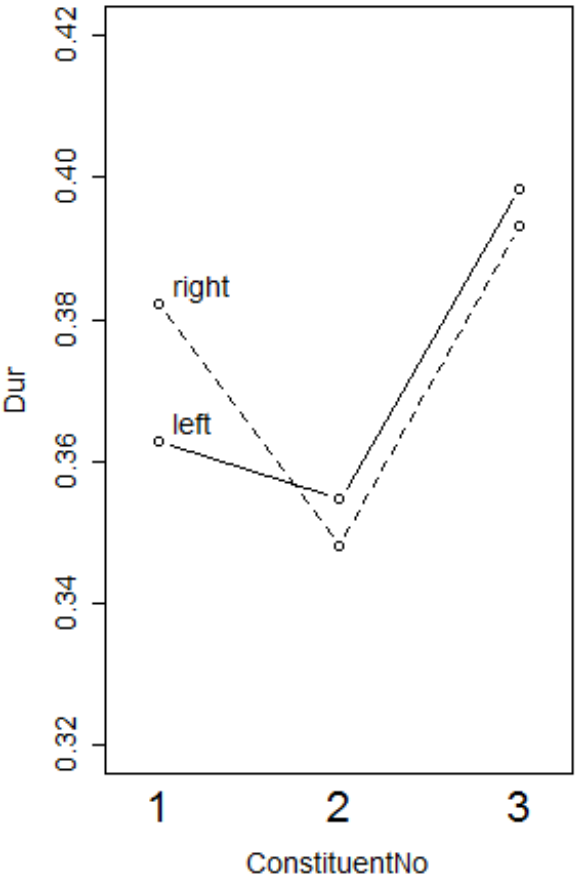

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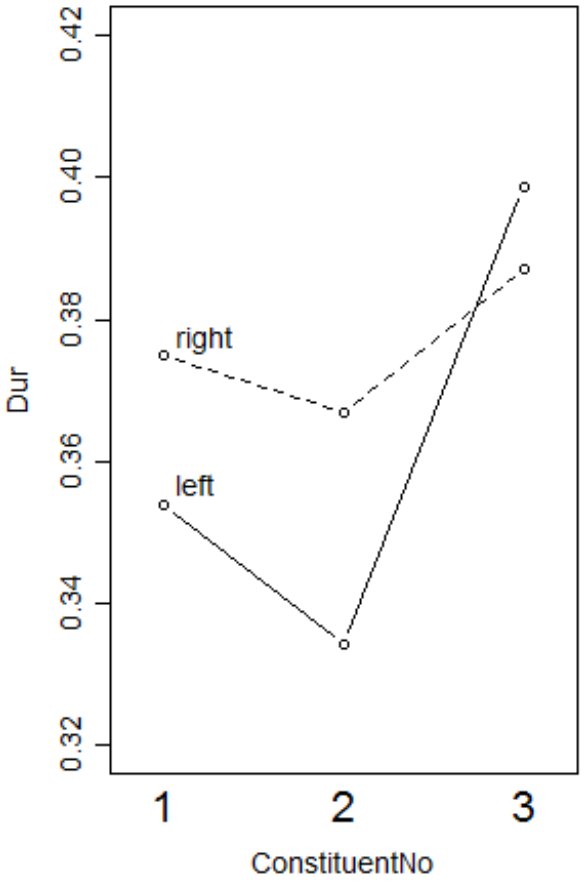

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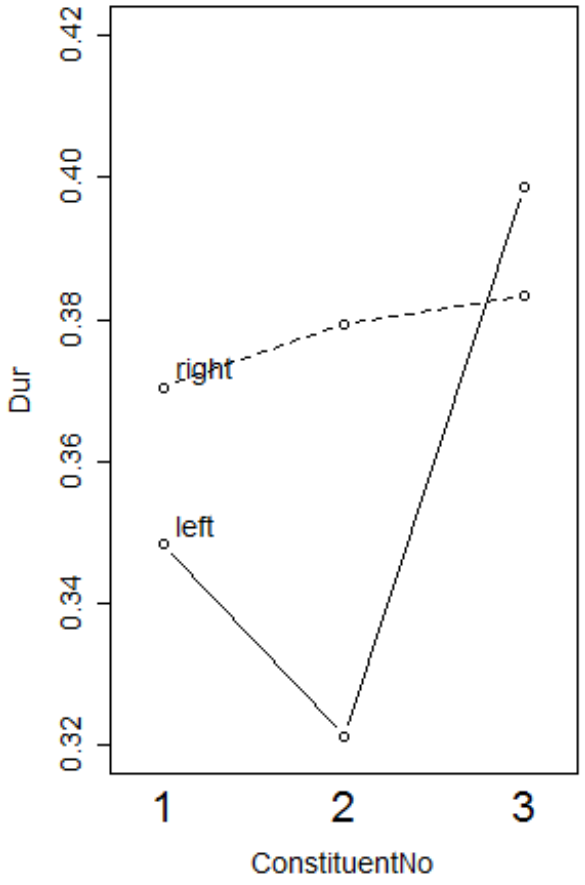

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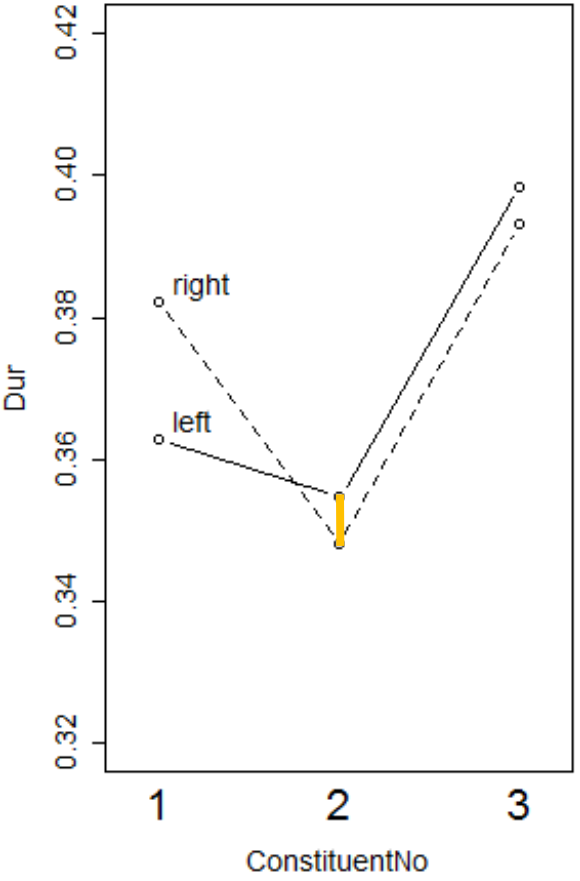

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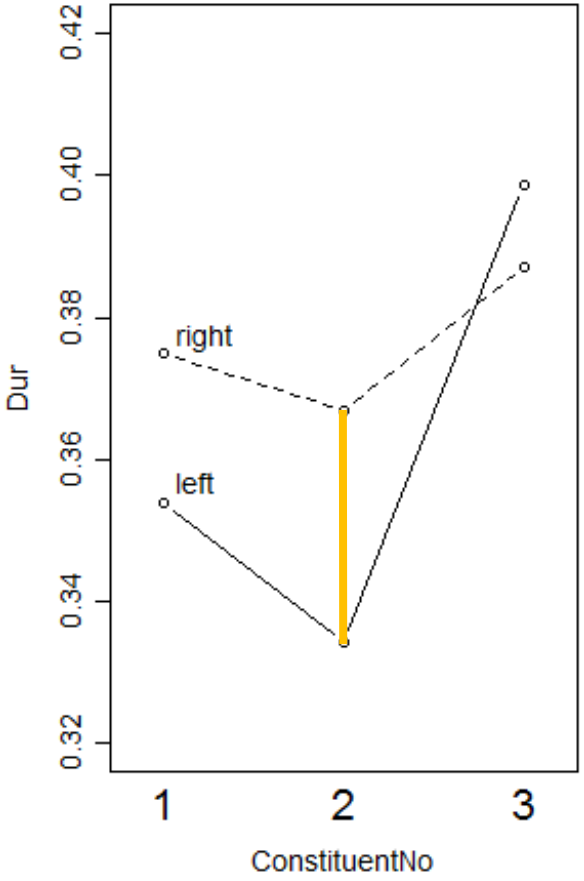

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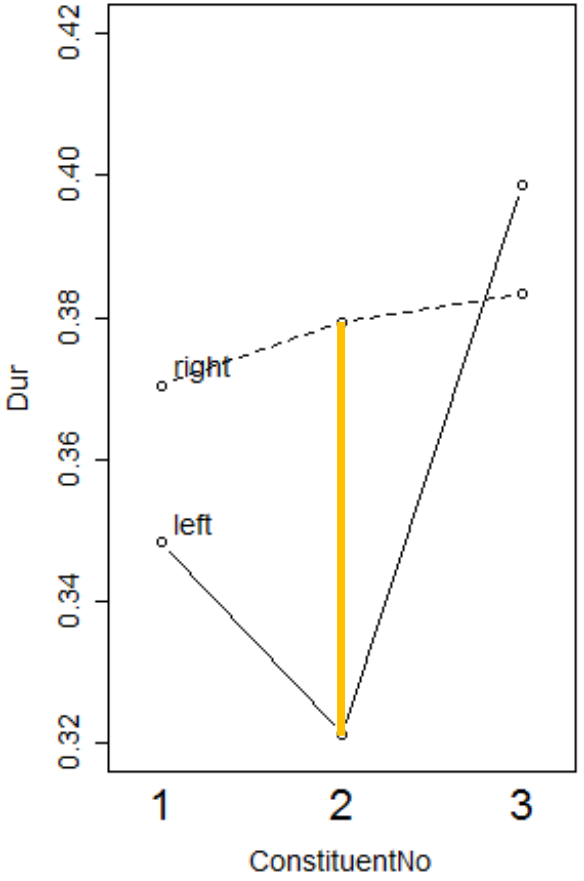

high bigramFreq N1N2

Kunter & Plag (2016) & corpus study

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		Kunter & Plag (2016)	**corpus study**
embedded constituent frequency	left-branching (N1N2)	N1 short N2 short N3 long	N1 short N2 short N3 long
	right-branching (N2N3)	N1 long N2 short N3 short	N1 short N2 short N3 long

Contrasting Bracketing Erasure and ERH

Bracketing Erasure claims

- no difference in acoustic durations among all constituents of a complex word
- no effect of branching direction on the acoustic duration of constituents

Embedded Reduction Hypothesis claims

- differences in acoustic durations among constituents of a complex word
- shorter durations with embedded constituents, longer durations with free constituents

Contrasting Bracketing Erasure and ERH

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across-boundary frequency	left-branching (N2N3)	N1 short N2 long N3 short	N1 short N2 short N3 long
	right-branching (N1N2)	N1 short N2 short N3 long	N1 short N2 short N3 long

Results predicted by Bracketing Erasure

Contrasting Bracketing Erasure and ERH

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Results predicted by Embedded Reduction Hypothesis

Contrasting ERH and Bracketing Erasure

Bracketing Erasure

cannot explain the effects found in both studies.

Embedded Reduction Hypothesis

cannot explain all the effects, either.

More research needed:

What is going on with N3?
Is there phonetic reduction going on?
What happens when frequencies are controlled for?

Thank you…

…for your attention!

…for having me here!

…for letting me use your resources!

…for being so helpful!

Kunter & Plag (2016) & corpus study

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