



Durational differences among Japanese homophones as a function of their meanings

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DGfS2025, Mainz, 07.03.2025

Homophonous words

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- ▶ Their phonetic realizations should be the same (e.g., Levelt et al., 1999).
- ▶ They are however systematically different with respect to...
 - ▶ **Parts-of-speech** (Lohmann, 2018a).
 - ▶ **Morphological status** (Ben Hedia & Plag, 2017; Hay, 2007; Li et al., 2020; Plag & Ben Hedia, 2018; Plag et al., 2017; Schmitz, Baer-Henney, & Plag, 2021; Seyfarth et al., 2017; Smith et al., 2012; Song et al., 2013; Sproat & Fujimura, 1993; Strycharczuk & Scobbie, 2016; Sugahara & Turk, 2009; Walsh & Parker, 1983; Zimmermann, 2016; Zuraw et al., 2021)
 - ▶ **Frequency** (Gahl, 2008; Lohmann, 2018b)
 - ▶ **Semantics** (Baayen et al., 2019; Chuang & Baayen, 2021; Gahl & Baayen, 2024; Saito et al., 2021, 2024; Schmitz, Plag, et al., 2021)

Homophony of sublexical units

- ▶ **Morphemes** (Hay, 2007; Plag & Ben Hedia, 2018; Plag et al., 2017; Schmitz, Baer-Henney, & Plag, 2021; Seyfarth et al., 2017; Sproat & Fujimura, 1993; Sugahara & Turk, 2009).
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- ▶ **Segments** (Ben Hedia & Plag, 2017; Smith et al., 2012).
- ▶ **Can be explained by Discriminative Lexicon Model (DLM)** (Baayen et al., 2019).
 - ▶ It operates on sublexical levels.
 - ▶ Different semantics → different realizations.

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- ▶ Duration cannot be adjusted so easily in Japanese as in English.

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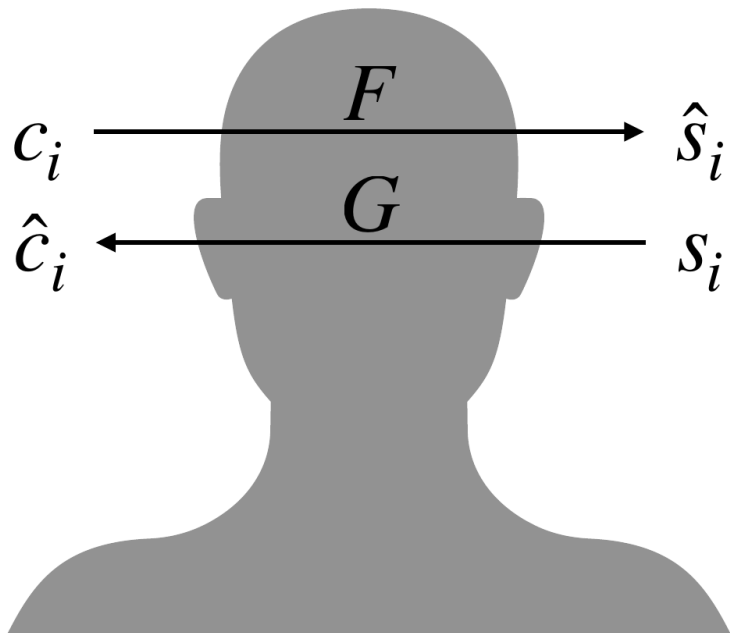


- ▶ The present study investigates both word-duration & mora-duration of homophonous words.

Possible outcomes

Outcome	WordDur	MoraDur	PredictedBy
H1	✓	✓	DLM
H2	✓		Neither
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Discriminative Lexicon Model (DLM)



Unconditional vs. conditional semantic support

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 - e.g., <PROG> → [-ɪŋ] ⇒ Greater semantic support
 - e.g., <PAST> → [-d], [-t], [-əd], [ɔ:t], ... ⇒ Less semantic support

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e.g., *encyclo... ..pedia*
- ▶ Conditional semantic support represents how well forms are discriminated based on meanings, given the sublexical forms preceding the sublexical form of interest.
e.g., *goggles* ⇒ -s is more predictable → Less semantic support for -s.
e.g., *suns* ⇒ -s is less predictable → more semantic support for -s.

Corpus

- ▶ The “core” section of Corpus of Spontaneous Japanese (CSJ) (The National Institute for Japanese Language, 2006).
 - ▶ Approximately 500,000 words.
 - ▶ 44 hours of speech.
 - ▶ Formal monologues of spontaneous speech by 177 speakers.
 - ▶ Formal dialogues of spontaneous speech by 18 speakers.
 - ▶ Read-aloud speech of books by 6 speakers.
 - ▶ Forced alignment manually checked/corrected by two phoneticians.

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e.g., 書く [kaku] ‘write’ and 掻く [kaku] ‘scratch’

- ▶ 310,574 homophonous tokens in CSJ
- ▶ 20,971 homophonous types in CSJ

Setup and train DLM

- ▶ Form-matrix:

- ▶ Tri-mora representations

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- ▶ Words made of only one mora were excluded.

- e.g., に [ni] “to”

- ▶ Because most of them are function words such as particles.

- ▶ Because a one-mora word is made of only one trimora.

- It would make it difficult to tease apart word-level and mora-level phenomena.

Data

- ▶ 1,586 word types in orthography
- ▶ 1,200 word types in phonetic transcriptions
- ▶ 99,776 word tokens
- ▶ 213,399 mora tokens

Analysis

- ▶ GAMMs (Wood, 2017)
- ▶ Dependent variables:
 - ▶ Log word duration (i.e., WordDur)
 - ▶ Log mora duration (i.e., MoraDur)
- ▶ Predictors:
 - ▶ Unconditional or conditional semantic support
 - ▶ Speech rate
 - ▶ Utterance-initial
 - ▶ Utterance-final
 - ▶ Word frequency
 - ▶ Bimora frequency
 - ▶ Part-of-speech
 - ▶ Gender
 - ▶ Speaker

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Model 3: MoraDur \sim s(uSemSup, k=3) + Covariates

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Model 4: MoraDur \sim s(cSemSup, k=3) + Covariates

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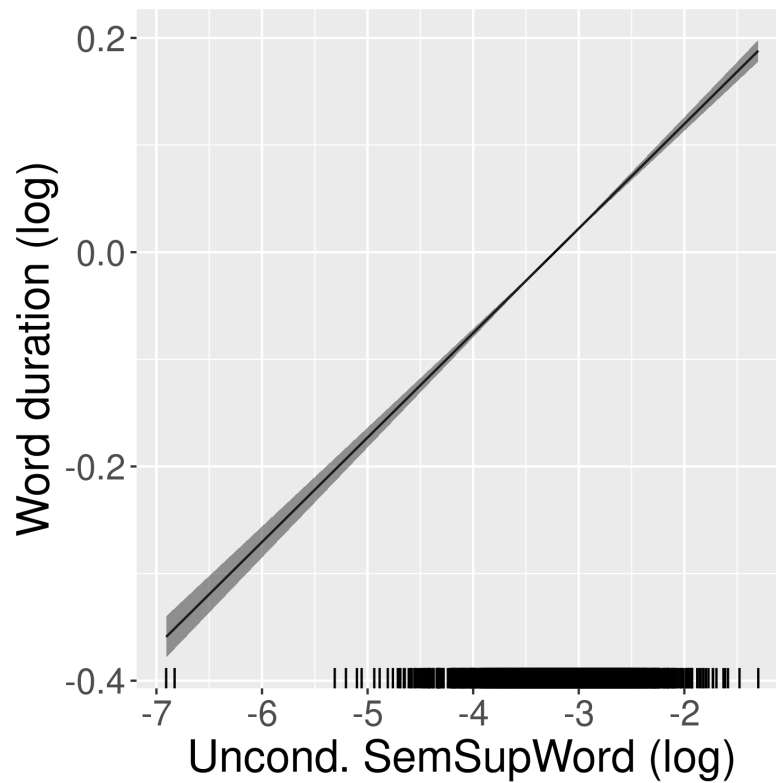
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$\Delta\text{AIC} = 1079.090$

Results (word-level): GAMM partial effects



Results (mora-level): Model comparison

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Model 4: MoraDur \sim s(cSemSup, k=3) + Covariates

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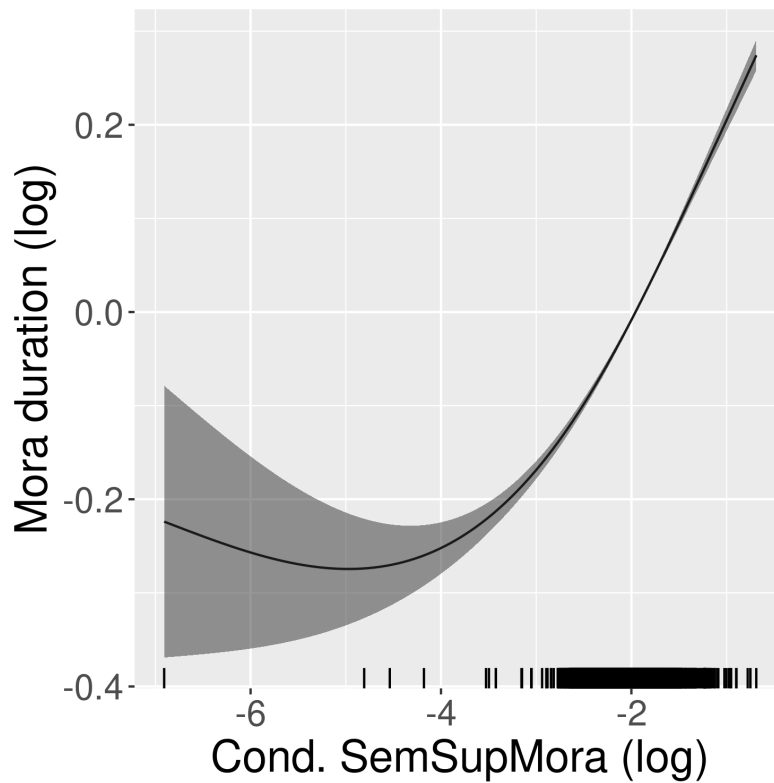
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WIN! \rightarrow **Model 4:** MoraDur \sim s(cSemSup, k=3) + Covariates

Covariates: s(SpRate, k=3) + s(Freq, k=3) + s(BimroraFreq, k=3)
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Δ AIC = 203.691

Results (mora-level): GAMM partial effects



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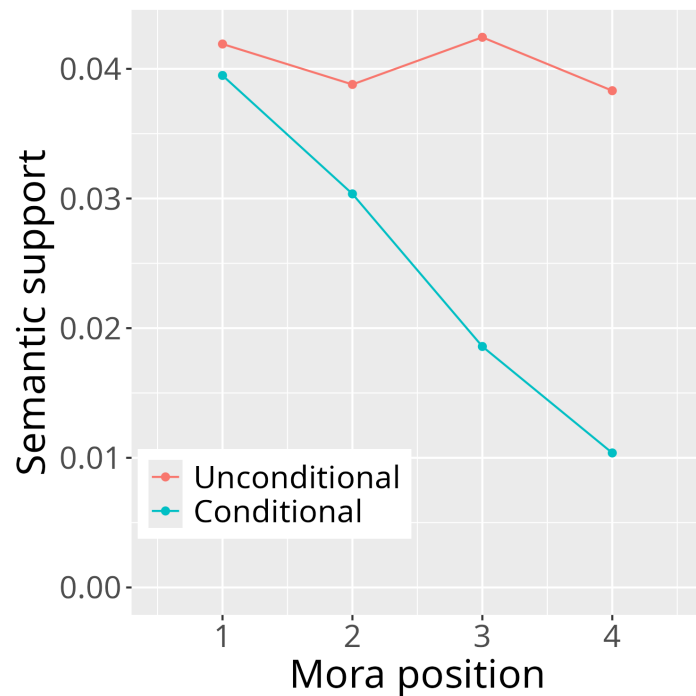
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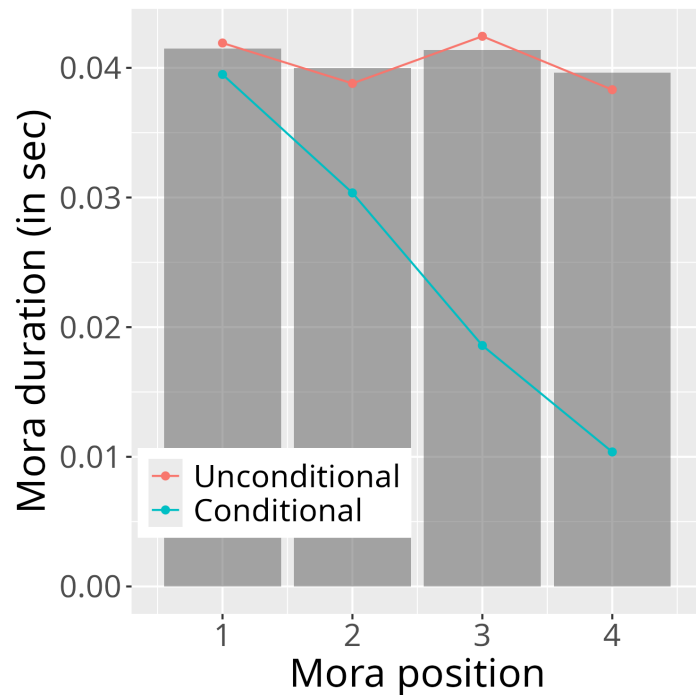
A. Conditional semantic support captured degrees of decreasing duration within each word well.

Unconditional semantic support captured overall word-specific durational targets well.

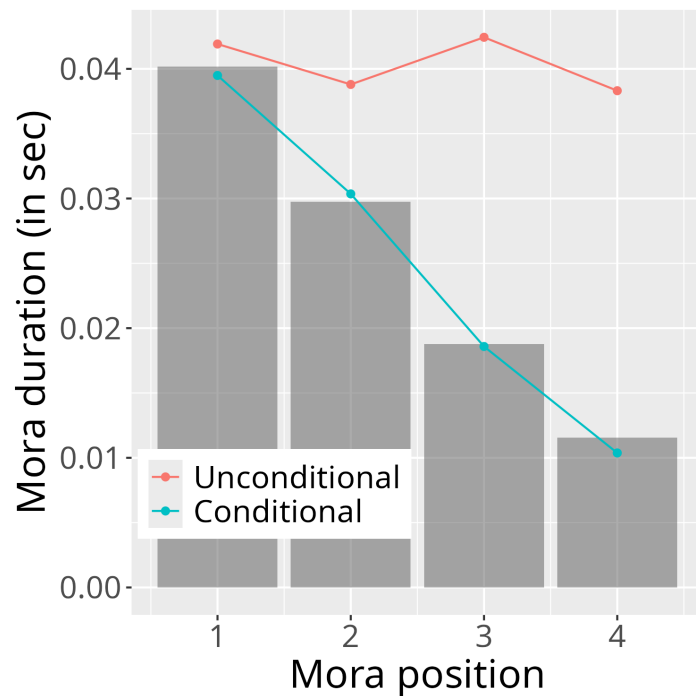
Differences between uSemSup and cSemSup



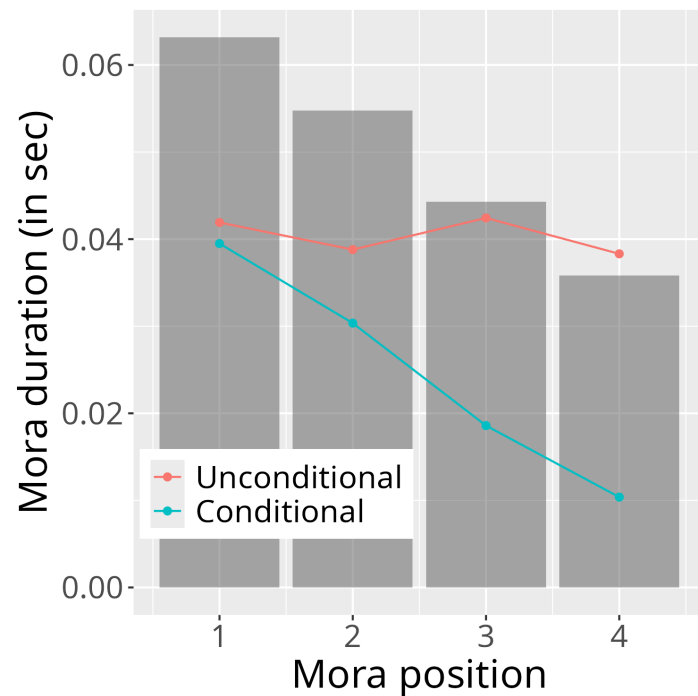
When *unconditional* SemSup should win



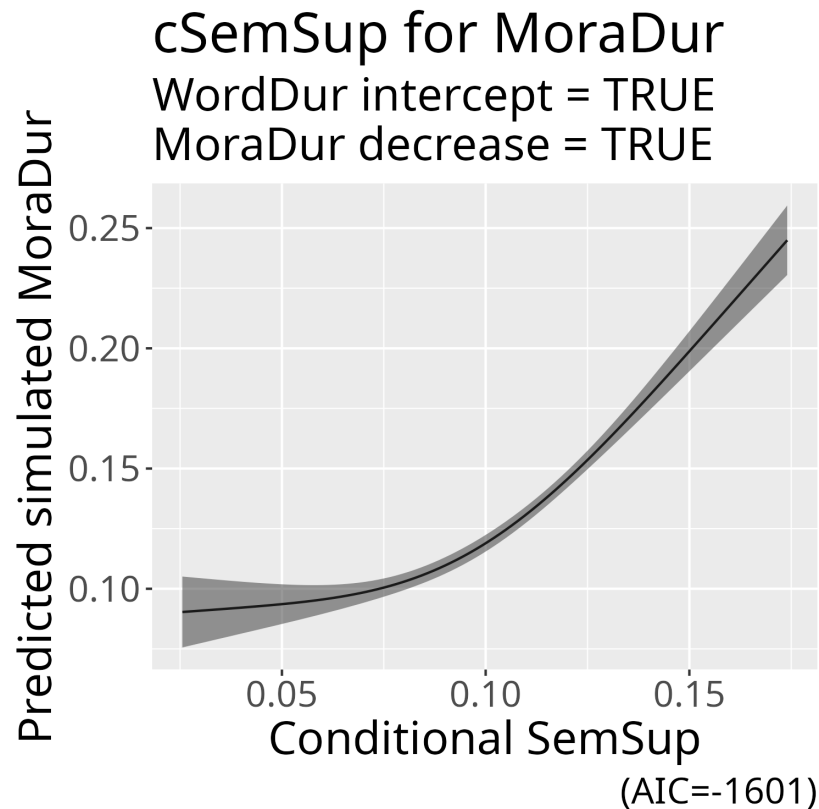
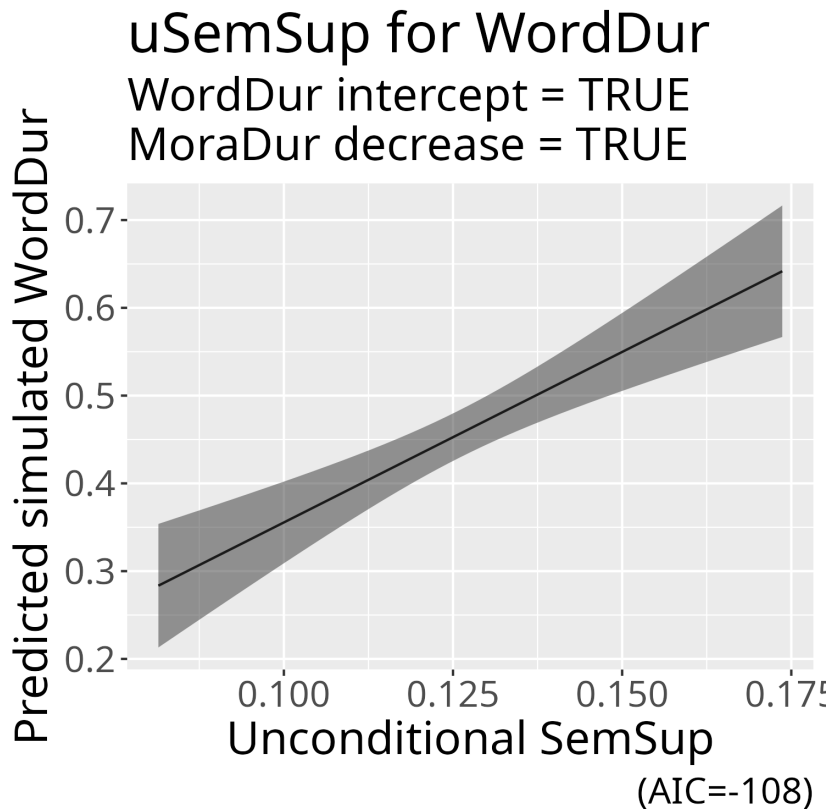
When *conditional* SemSup should win



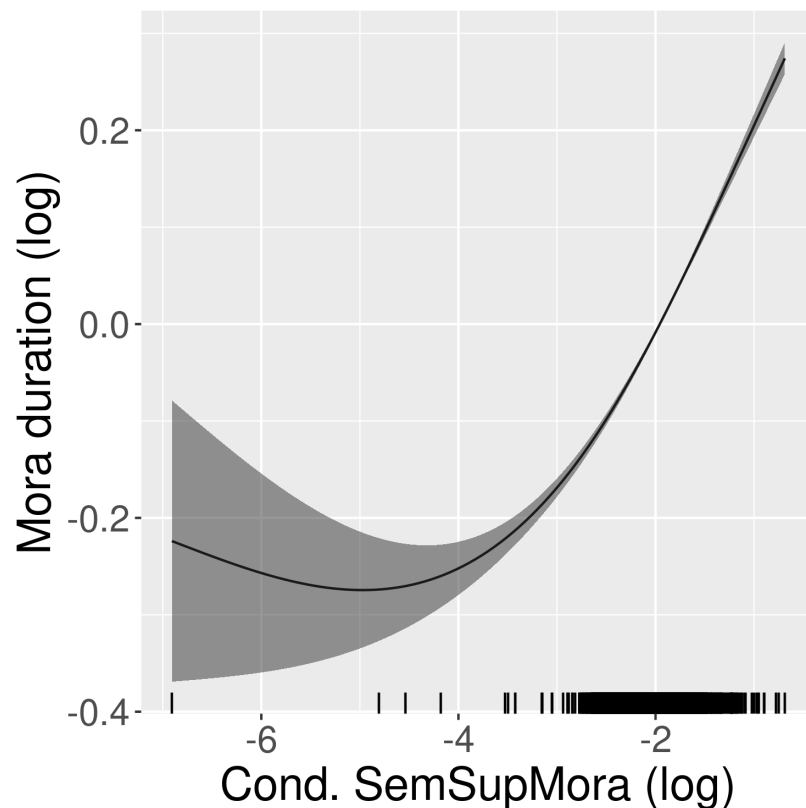
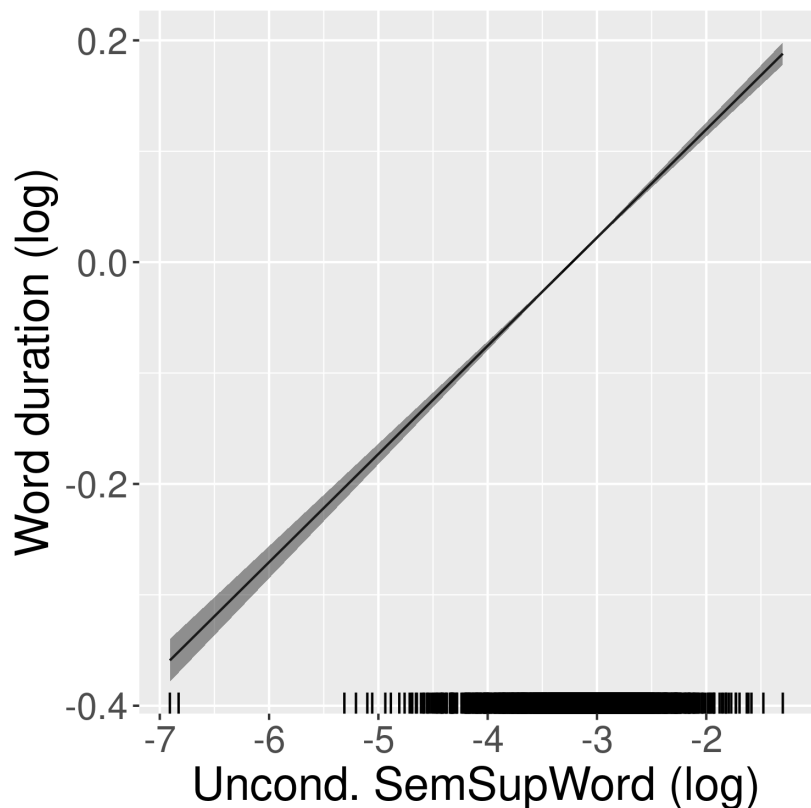
When both SemSups perform well



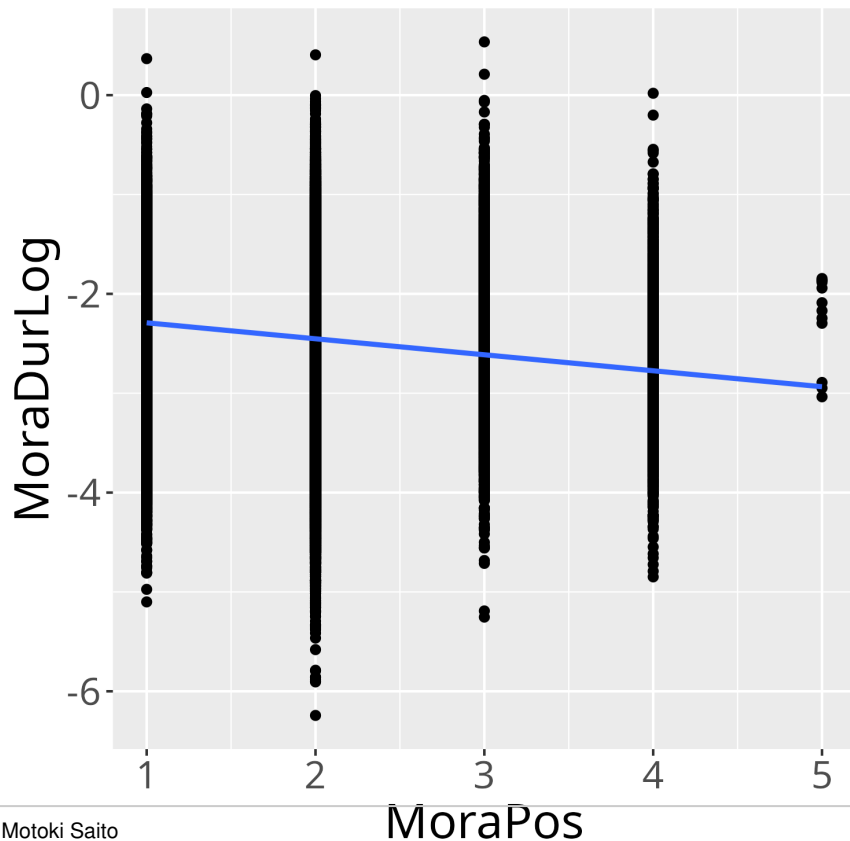
Simulated effects (intercept=T, decreasing=T)



Observed effects



Decreasing mora duration



- ▶ In fact, mora duration was found to decrease towards the end of the word in the current data.
- ▶ $\beta = -0.161, p < 0.001$

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→ Clearer relationships between semantics and forms.



- ▶ The present results echo with the studies that found the positive association between certainty and duration.
 - ▶ Higher certainty → Longer duration & careful articulation (Cohen, 2014; Kuperman et al., 2007; Tomaschek et al., 2019, 2021; Tucker et al., 2019)

Discussion (3)

- ▶ Adds to the literature that found direct relationships between forms and meanings (Baayen et al., 2019; Chuang et al., 2020; Gahl & Baayen, 2024).

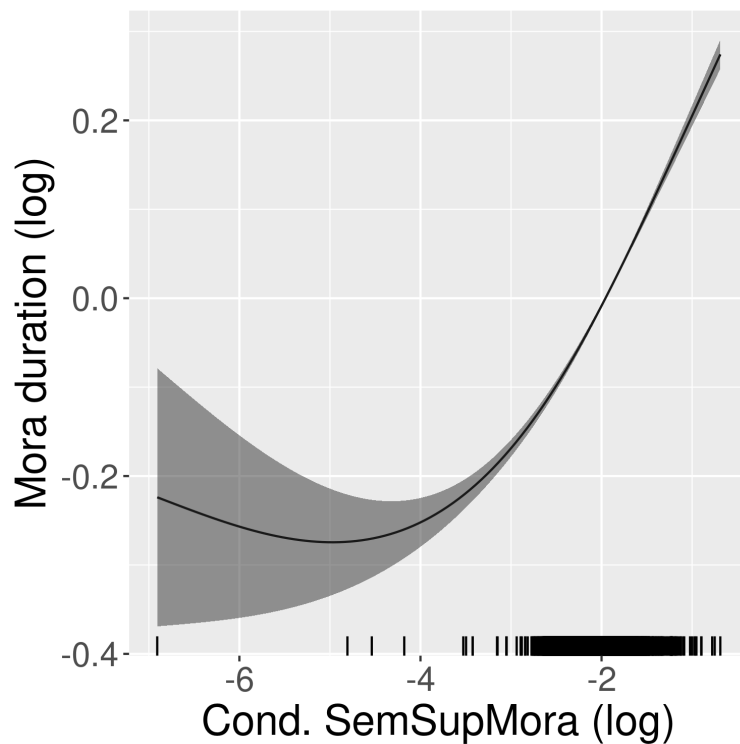
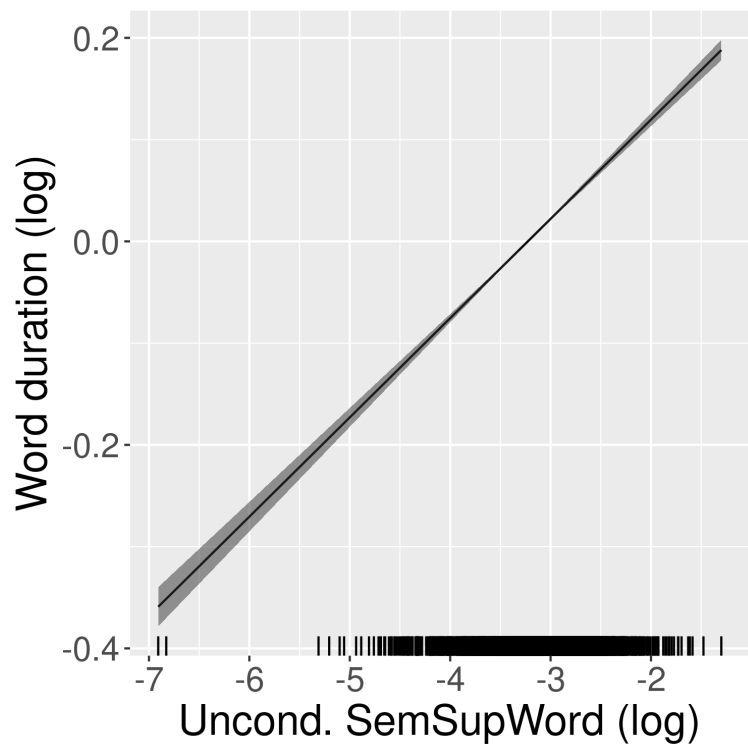
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- ▶ Dovetails well also with the literature on sound symbolism and iconicity (Dingemanse & Thompson, 2020; Dingemanse et al., 2016)
- ▶ Challenges the traditional view of speech production, where semantic effects on phonetic realizations are absent or limited.

Thanks for listening! ありがとう!



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