

What causes subphonemic differences between different types of /s/ in English? Evidence from pseudowords

FOR 2373 Spoken Morphology

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Motivation

- Recent research has shown that seemingly homophonous elements, e.g. **words** (e.g. [1], [2]), **stems** (e.g. [3], [4]), **prefixes** (e.g. [5], [6]), and **suffixes** (e.g. [7]) differ in their acoustic duration
- A prominent case for this is word-final /s/ in English; studies (e.g. [8], [9], [10], [11]) show that: **non-morphemic** > **suffixes** > **clitics**
- Such findings pose a challenge for **theories of speech production** (e.g. [12], [13]) as it is currently unclear how morphological information would come to influence articulation
- A recent alternative theory of comprehension and production is the discriminative lexicon ([14], [15], [16])
- We follow this approach to predict the duration of word-final non-morphemic and plural /s/ in pseudowords

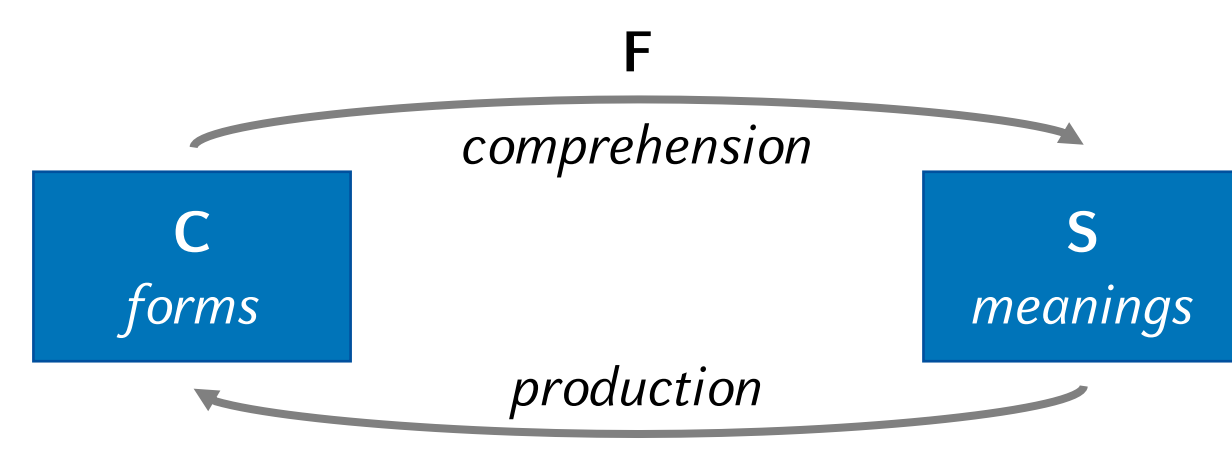


Figure 1. Schematic LDL network.

$$F = \begin{pmatrix} 0.5 & 1 \\ 0.1 & 0.2 \end{pmatrix}$$

$$C = \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 0 \end{pmatrix} \quad S = \begin{pmatrix} 0.5 & 1 \\ 0.1 & 0.2 \\ 0.9 & 0.7 \end{pmatrix}$$

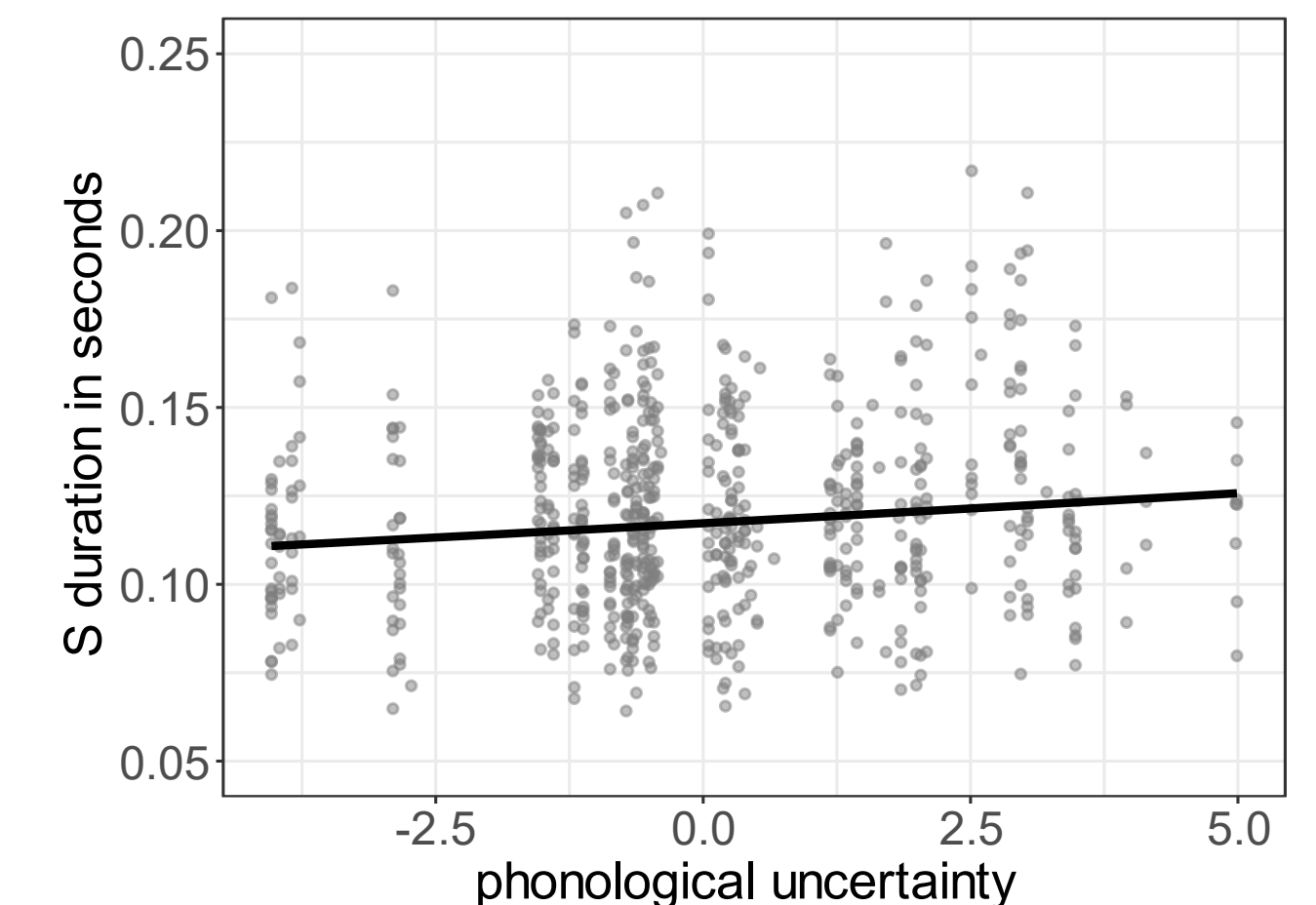
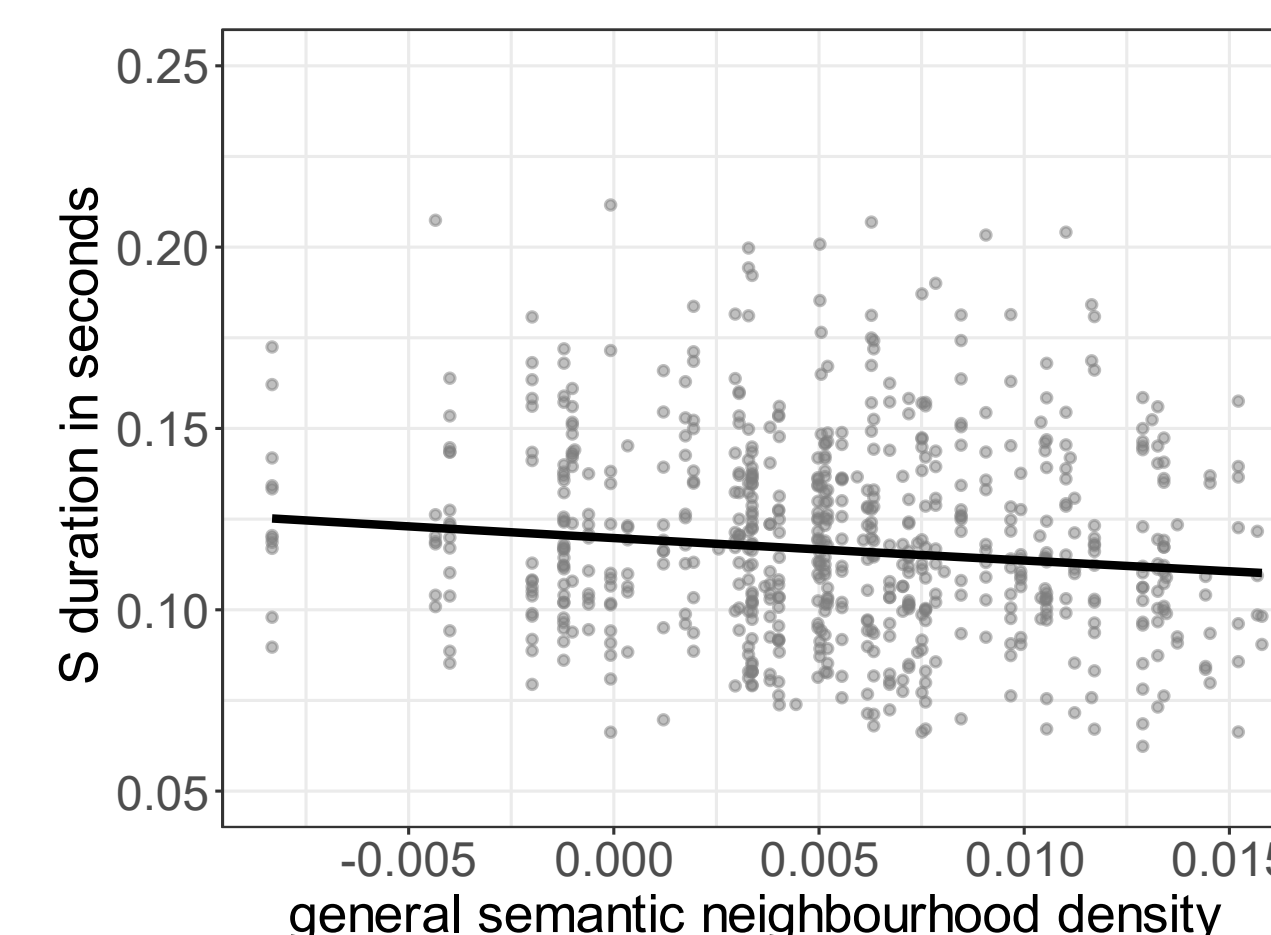
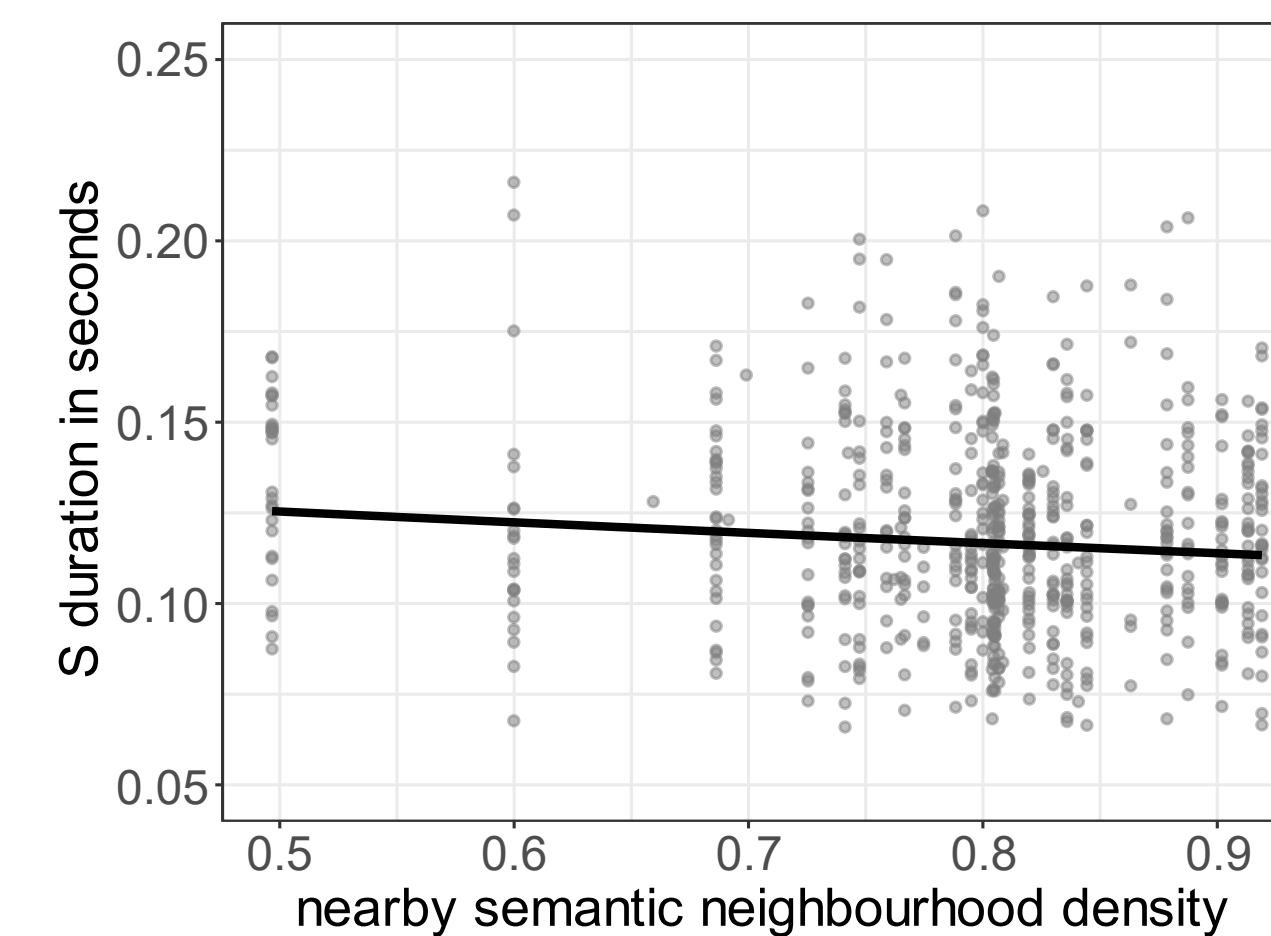
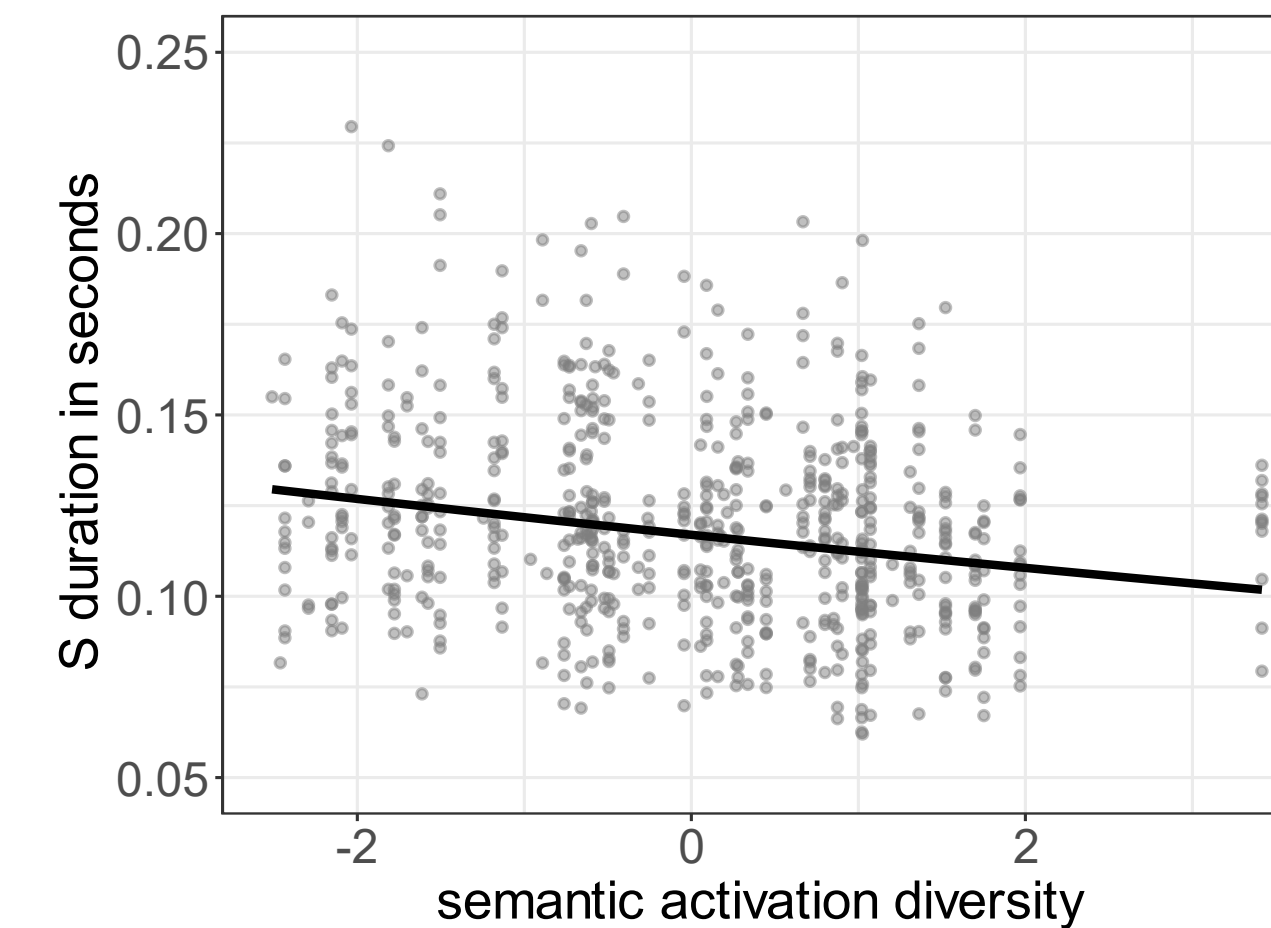
$$G = \begin{pmatrix} -1.22 & -0.24 \\ 1.57 & 0.31 \end{pmatrix}$$

Figure 2. LDL network toy example.

Method

- Linear Discriminative Learning (LDL) networks are very simple two-layer networks and are linguistically transparent and interpretable
- LDL makes use of five high-dimensional numeric matrices, each of which represents a different subsystem
- For the current implementation, the **semantic** and the **form matrix** are most important
 - The **semantic matrix S** contains semantic vectors of words
 - The **form matrix C** contains triphone cues of words
- The LDL implementation predicts
 - meaning from forms → **comprehension**
 - form from meaning → **production**
- Making use of real word comprehension and its mathematical implementation, we can **estimate pseudoword semantics**
- A **combined implementation** for real words and pseudowords then enables us to extract a variety of measures that reflect various dimensions of associations in the lexicon
- Such **measures** describe, for example, phonological and semantic neighbourhood densities, phonological certainty, and semantic activation diversity
- These measures are used as **predictors** in linear mixed-effects regression models to analyse /s/ durations
- We took an existing data set on durations of non-morphemic and plural /s/ durations in pseudowords from a previous production study [11]

Results



Discussion

- LDL measures are predictive of word-final /s/ durations**
 - Higher **semantic activation diversity** leads to **shorter** word-final /s/ durations
 - Higher **phonological uncertainty** leads to **longer** word-final /s/ durations
- In contrast, for **traditional predictor variables** such as lexical frequencies, bigram frequencies, etc., it is **unclear** why they would manifest themselves in a particular morphological effect in speech production
- In **LDL** such effects can emerge through the mapping of form and meaning in a **clearly defined process** of discriminative learning
- We showed that durational differences emerge from the pseudoword's resonance with the lexicon
- It remains to be shown whether the same measures are predictive for /s/ durations in real words