What a cluster!

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The difficulty of consonant clusters across languages and tasks

Background

- Linguistic attributes of stimuli influence performance on:
  - Phonological awareness (PA); Spelling; Reading
- Documented in various languages:
  - English; Spanish; Dutch; Hebrew; Arabic, etc.
- Locus of these effects remains somewhat elusive:
  - What attributes? Consistent effect across tasks?
- Why consonant clusters?
  - Pervasive (though not universal) → cross-language comparisons
  - Rule-bound (within a language) → testable hypotheses
  - Limited in number → representativeness of stimuli
  - More demanding than singletons → greater variability in outcomes

Research Questions

- Study 1: What variables explain item difficulty in **onset** segmentation?
- Study 2: What variables explain item difficulty in: (1) **first sound** segmentation; (2) word reading in decodable text (DT)?
- Overall: Across languages and tasks, are there patterns in the variables that influence the difficulty of clusters?

Methods

Study 1

Outcome of interest	Spanish Onset Segmentation	English Onset Segmentation
Participants	303 K-2	263 K-2
Items	Pool of 40 items (20 simple; 21 complex)	Pool of 46 items (24 simple; 24 complex)
Administration	• 8 anchor items • Untimed • ~14 responses per participant	• 8 anchor items • Untimed • ~20 responses per participant

Methods

Study 2

Outcome of interest	First Sound Segmentation	Word Correct (DT)
Participants	161,313 Kindergarteners	604 Kindergarteners
Items	53 items	545 distinct words across 40 passages
Administration	• Fixed forms • Timed (1 minute) • ~30 responses/participant	• 1 anchor passage and 3 randomized passages • Timed (1 minute) • ~66 responses/participant

Limitations

- Study 1
  - Small number of participants
  - Transcriber = scorer = modeler (first author)

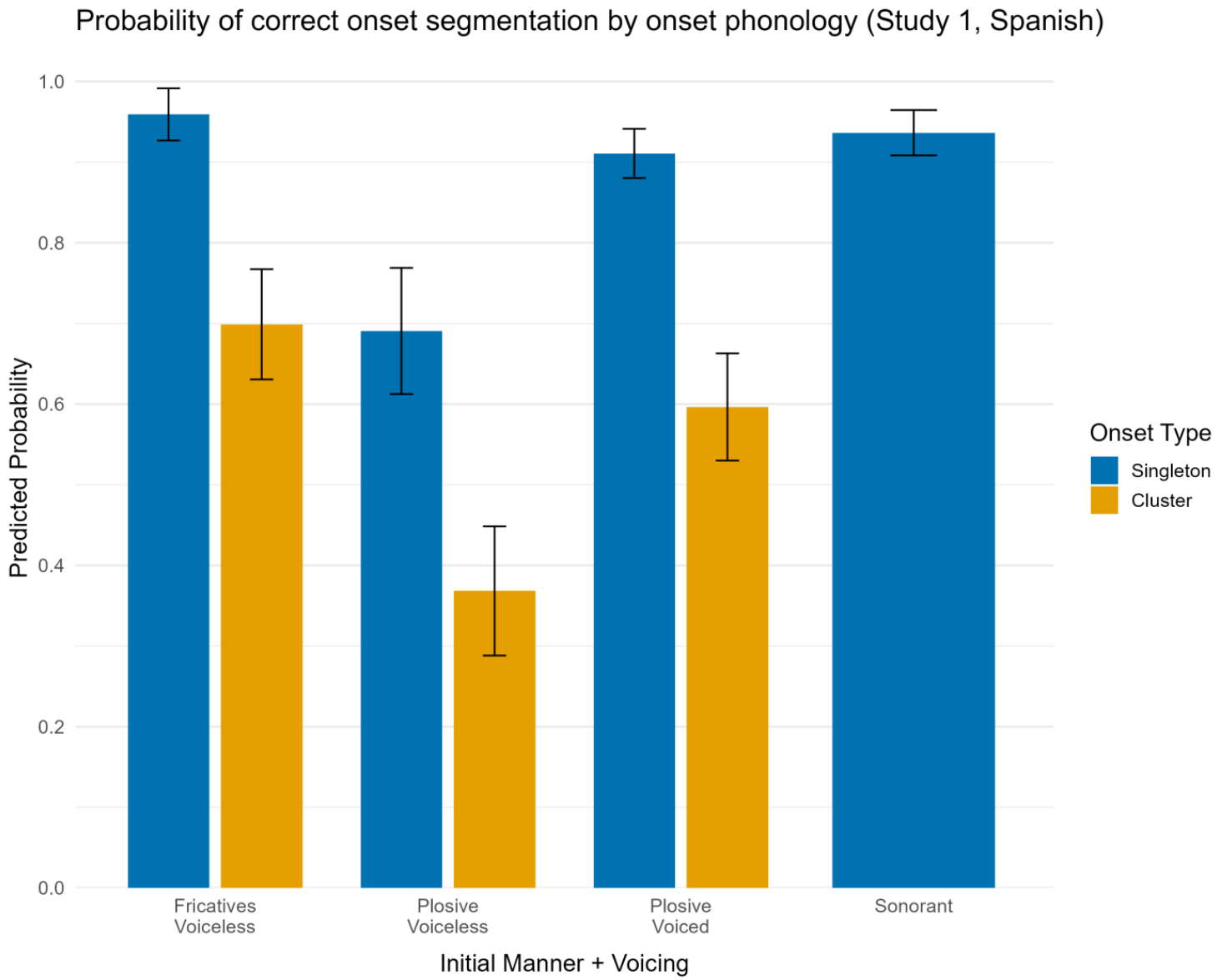
- Study 2
  - Few items per combination of covariates
  - Responses combined across two tasks (first sound fluency and phoneme segmentation fluency)
  - Timed tasks (1 minute)

Methods

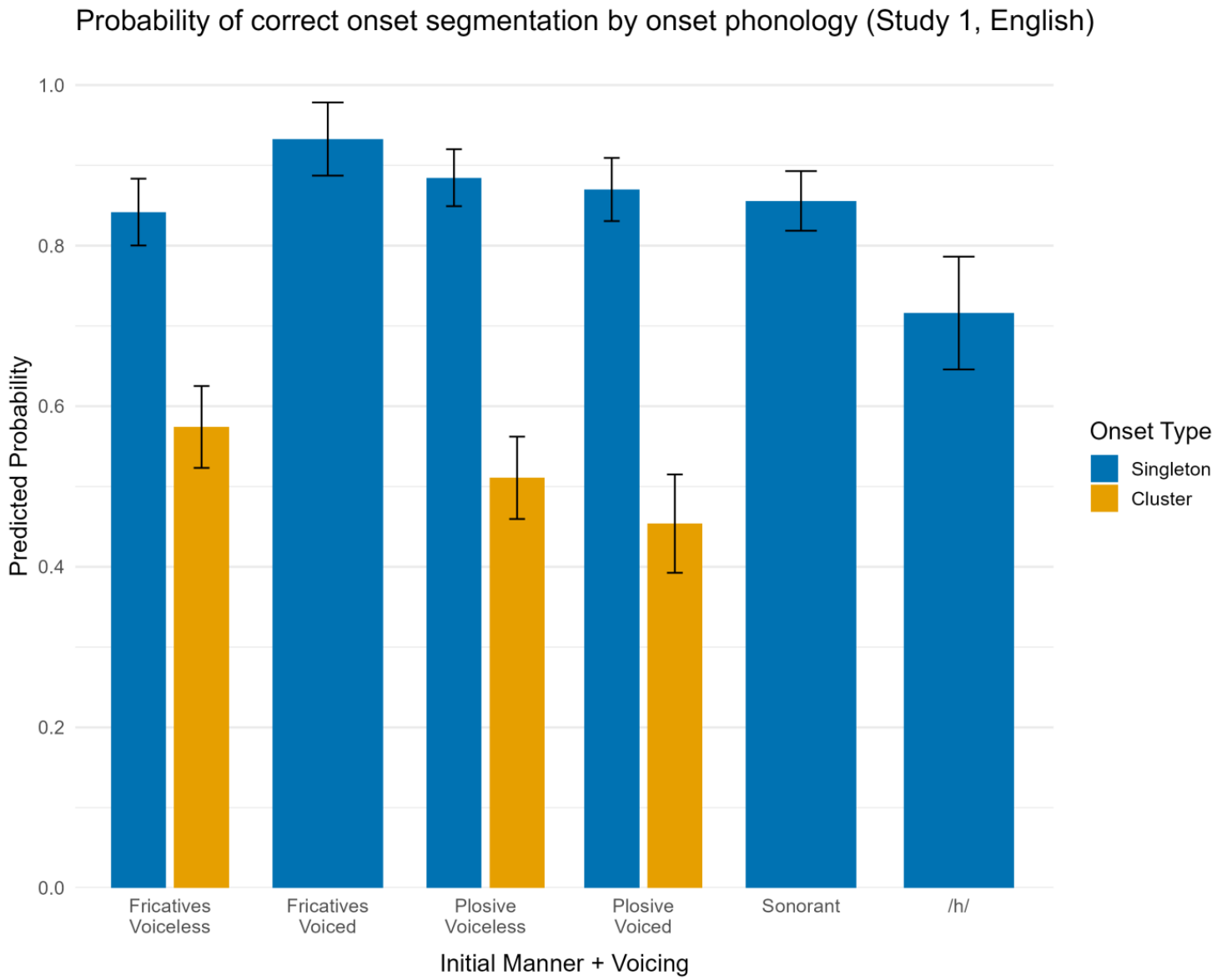
- Multilevel logistic regressions with (crossed) random effects for items, participants, and schools
- Variables of interest are on the item side—i.e., those explaining **between-item** variance:
  - onset type; manner of articulation; voicing
- Additional item-side and person-side control variables

```
glmer (response ~ 1 + onset_cluster * as.factor(initial_manner) * voiced +
coda_cluster + at2_phonemes + z2_tokenfreq + as.factor(grade) +
as.factor(prog_type) + eng_schooldays + (1 | personid) + (1 | classroom) + (1 | item),
data = eng_onsets,  family = binomial)
```

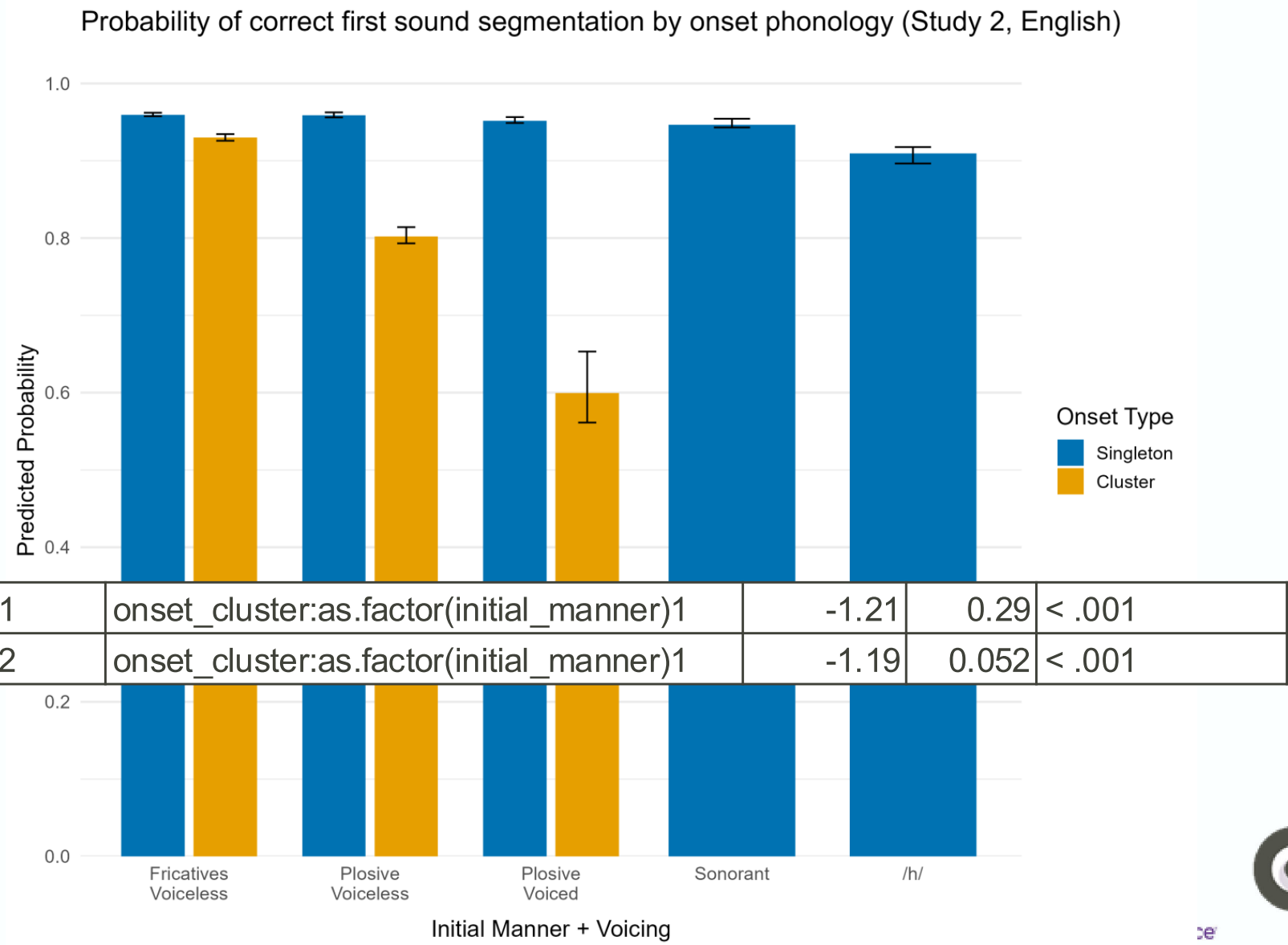
Results:


Probability of correct onset segmentation by onset phonology (Study 1, Spanish)
Predicted Probability
1.0
0.8
0.6
0.4
0.2
0.0
Fricatives Voiceless
Plosive Voiceless
Plosive Voiced
Sonorant
Initial Manner + Voicing
Onset Type
Singleton
Cluster

Results:

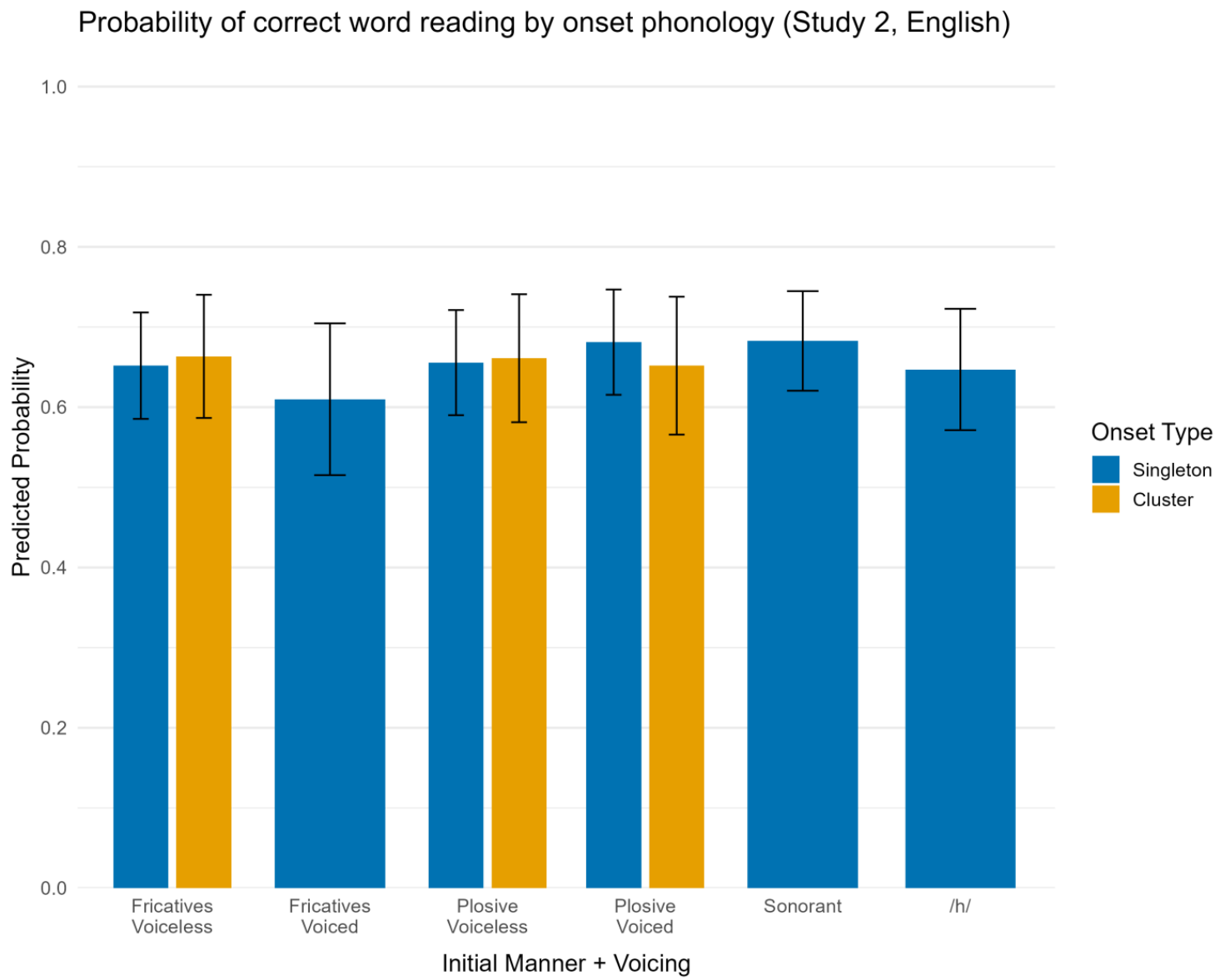

Probability of correct onset segmentation by onset phonology (Study 1, English)
Predicted Probability
1.0
0.8
0.6
0.4
0.2
0.0
Fricatives Voiceless
Fricatives Voiced
Plosive Voiceless
Plosive Voiced
Sonorant
/h/
Initial Manner + Voicing
Onset Type
Singleton
Cluster

Results:

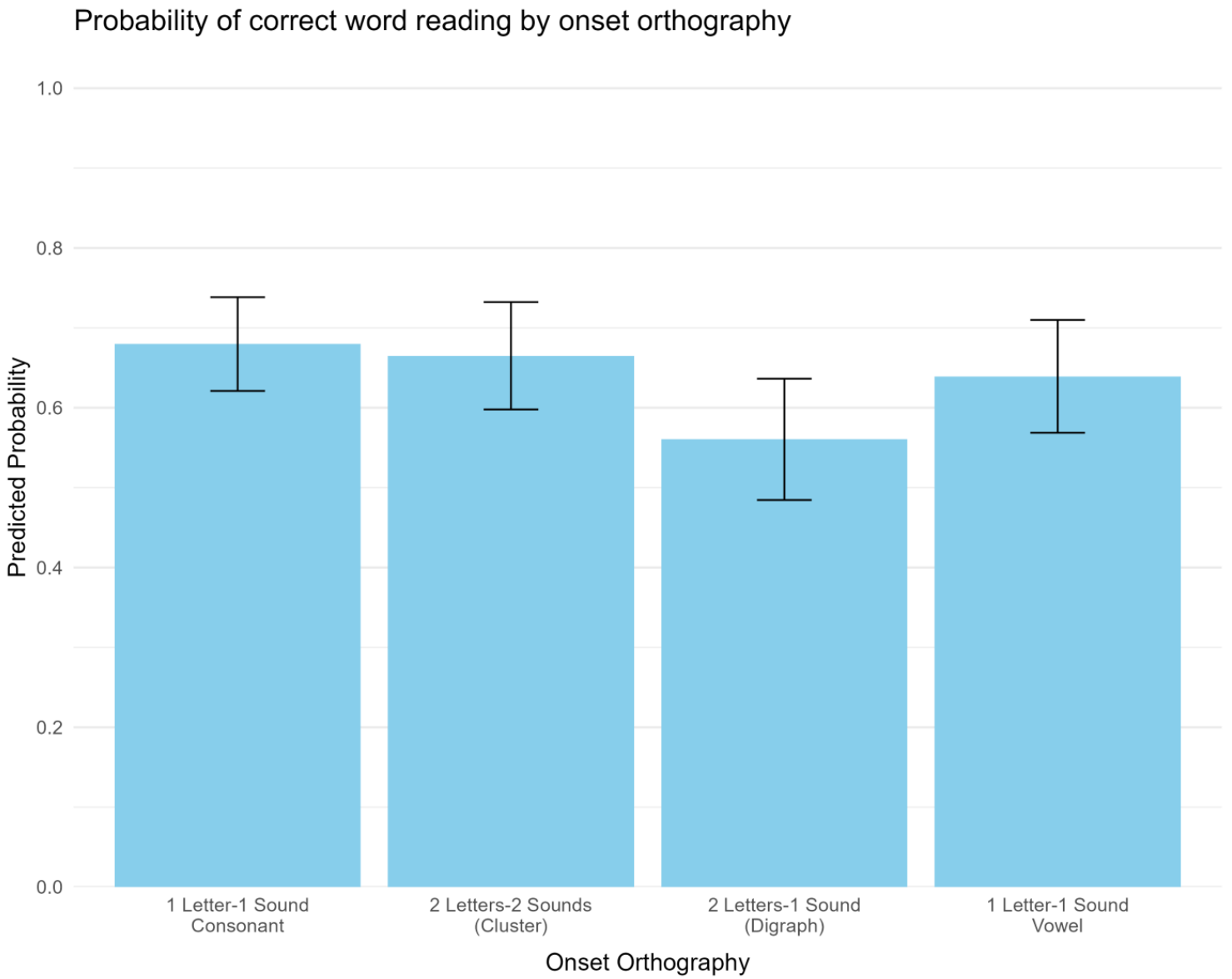


Study 1	onset_cluster:as.factor(initial_manner)1	-1.21	0.29	< .001
Study 2	onset_cluster:as.factor(initial_manner)1	-1.19	0.052	< .001

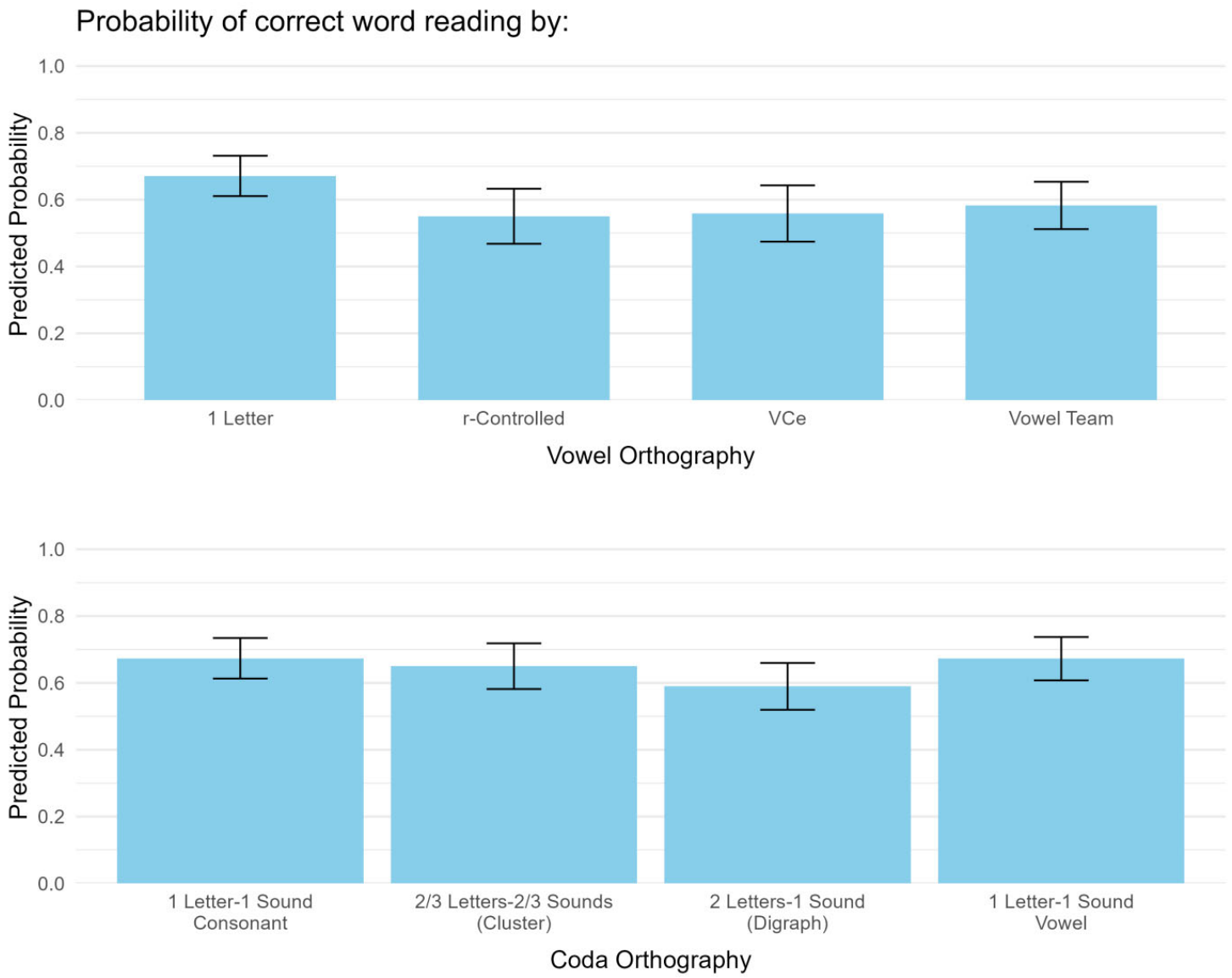
Results:


Probability of correct word reading by onset phonology (Study 2, English)
Predicted Probability
1.0
0.8
0.6
0.4
0.2
0.0
Fricatives Voiceless
Fricatives Voiced
Plosive Voiceless
Plosive Voiced
Sonorant
/h/
Initial Manner + Voicing
Onset Type
Singleton
Cluster

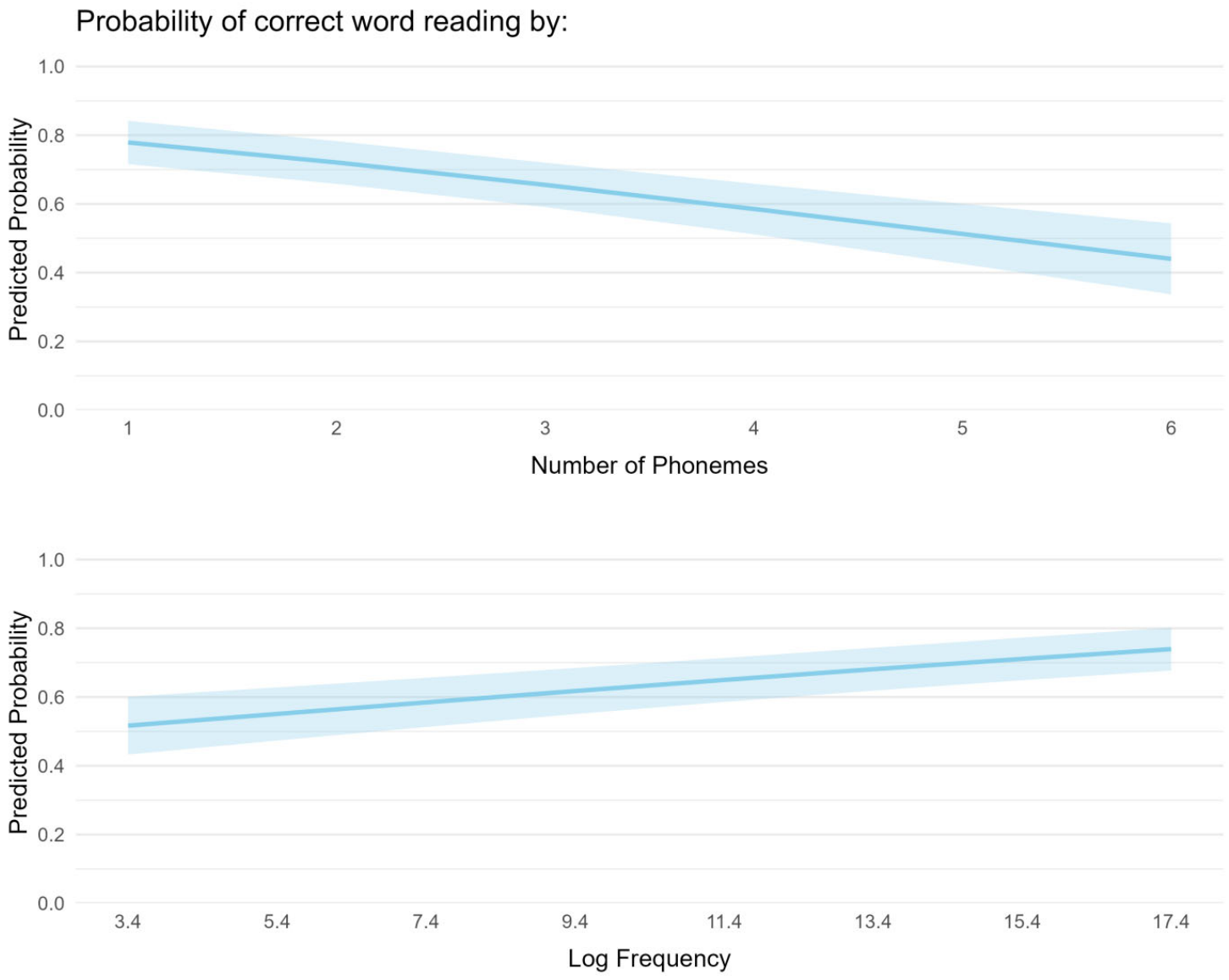
Results:


Probability of correct word reading by onset orthography
Predicted Probability
1.0
0.8
0.6
0.4
0.2
0.0
1 Letter-1 Sound
Consonant
2 Letters-2 Sounds
(Cluster)
2 Letters-1 Sound
(Digraph)
1 Letter-1 Sound
Vowel
Onset Orthography

Results:


Probability of correct word reading by:
Predicted Probability
1.0
0.8
0.6
0.4
0.2
0.0
1 Letter
r-Controlled
VCe
Vowel Team
Vowel Orthography
Predicted Probability
1.0
0.8
0.6
0.4
0.2
0.0
1 Letter-1 Sound Consonant
2/3 Letters-2/3 Sounds (Cluster)
2 Letters-1 Sound (Digraph)
1 Letter-1 Sound Vowel
Coda Orthography

Results:


Probability of correct word reading by:
Predicted Probability
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
Number of Phonemes
Predicted Probability
1.0
0.8
0.6
0.4
0.2
0.0
3.4
5.4
7.4
9.4
11.4
13.4
15.4
17.4
Log Frequency

Discussion

- Difficulty of clusters affected by:
  - Composition?
  - Language?
  - Task?

- What does this tell us about the processes at play?

- Research → ? → Practice
  Practice → ? → Research

Thank you!

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