Preference for locality is affected by the prefix/suffix asymmetry: Evidence from artificial language learning

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Macro goals

- Addressing two larger issues in the artificial grammar learning (AGL) enterprise.
  - Replicability across labs and populations.
  - Influence of L1 biases (in addition to universal biases) on AGL results.

- Network of researchers across countries/L1s:
  - Dutch (Kager; Utrecht)
  - English (Nevins, White; UCL)
  - French (Linzen, Martin, Peperkamp; ENS)
  - German (van de Vijver; Düsseldorf)
  - Greek (Markopoulos, Topintzi; Aristotle U. of Thessaloniki)
  - Hungarian (Polgárdi; Hungarian Academy of Sciences)

Today's study

When learning novel vowel co-occurrence restrictions…

1. To what extent are learners biased towards local restrictions vs. non-local ones?

2. How is the preference for locality influenced by prosodic structure?
   - Word structure (prefix-suffix asymmetry)
   - Stress / prominence

Background

Locality

- Robust bias towards locality when learning co-occurrence restrictions. (Finley 2011, 2015; McMullin & Hansson 2014; McMullin 2016)
- True even when learning consonant harmony, which is often non-local in natural languages (McMullin & Hansson 2014; Finley 2015; McMullin 2016)
- McMullin & Hansson 2014:

$$CV\overbrace{S_x VCV\text{-}S_x}V \Rightarrow CVCV\overbrace{S_x V\text{-}S_x}V,\ \overbrace{S_x VCVCV\text{-}S_x}V$$

$$CVCV\overbrace{S_x V\text{-}S_x}V \not\Rightarrow CV\overbrace{S_x VCV\text{-}S_x}V,\ \overbrace{S_x VCVCV\text{-}S_x}V$$

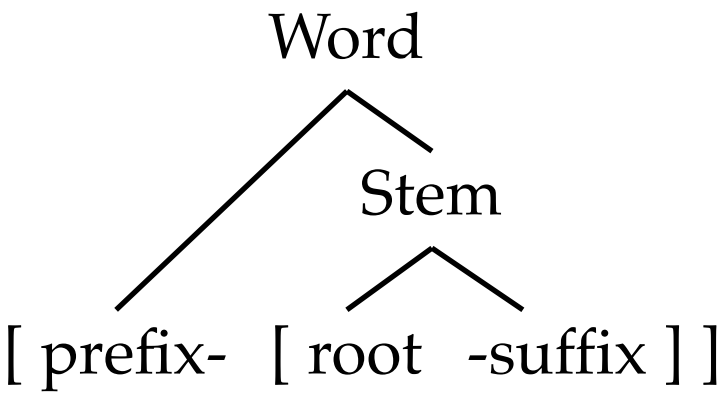
Edge effects

- However, non-local co-occurrence restrictions may be favoured when adjacent to salient prosodic edges.

- Endress & Mehler 2010:
  - Adults better at learning restrictions between C_1 and C_2 in **C_1VccVC_2** than in **cVC_1C_2Vc**.
  - Attributed to advantage from coding edge positions during learning:
    - e.g. "beginning" must be *x* and "end" must be *y*.

Prefix-suffix asymmetry

- Previous research arguing for structure in which root + suffix forms a domain to the exclusion of prefixes. (Nespor & Vogel 1986, Peperkamp 1997; Zuraw et al. 2014)



- Suffixes more likely than prefixes to participate in vowel harmony cross-linguistically. (Bakovic 2000, Hyman 2002, Krämer 2002, Finley & Badecker 2009)

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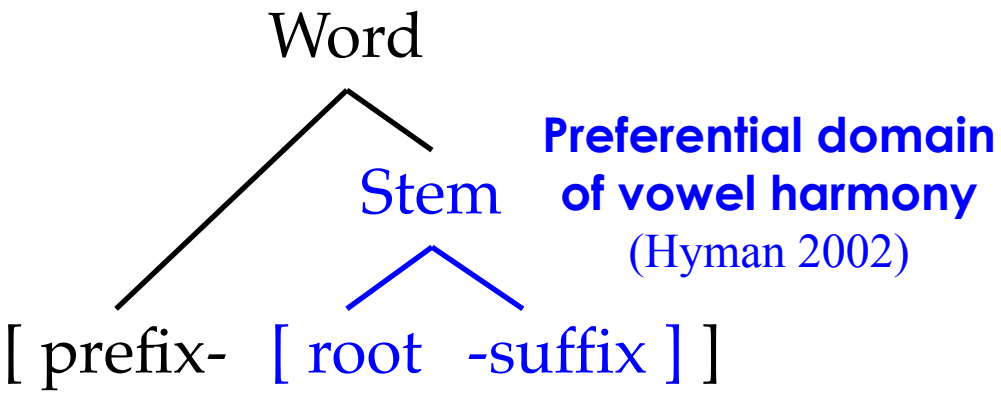

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Stress and vowel harmony

- Vowels in strong positions (e.g. stressed syllable of the root) might be preferred triggers for vowel harmony. (Hyman 2002)
  - E.g. Height harmony spreads leftward from a stressed syllable in Pasiego Spanish. (Penny 1969, Hualde 1991, Kaisse 2016)

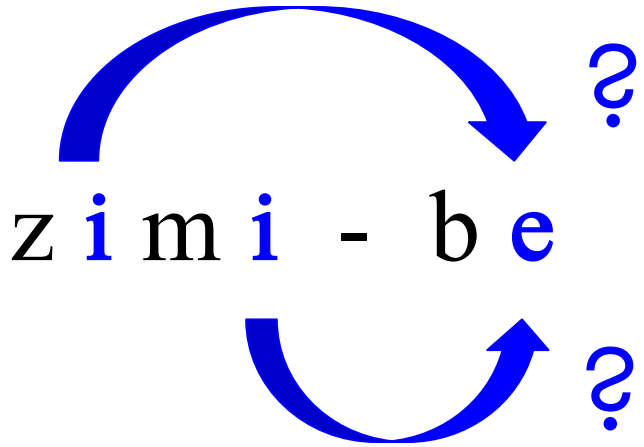
- Metaphony-type systems: co-occurrence restriction between stressed syllable and a following vowel, often an affix. (Walker 2005)
  - In some varieties, target and trigger can even be non-local. (Walker 2004)

Experiment

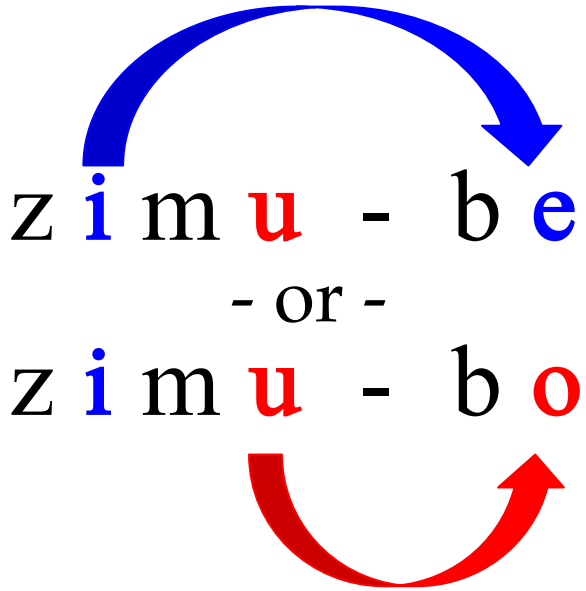
Experiment Overview

- AGL paradigm
- 'Poverty of the stimulus' design (Wilson 2006)

Training:
Harmonic stems only



Test:
Disharmonic stems



Design

- Stem vowels:
  - Front [i, e]
  - Back [u, o]

Stem types

C i C i	C e C i	C u C i	C o C i
C i C e	C e C e	C u C e	C o C e
C i C u	C e C u	C u C u	C o C u
C i C o	C e C o	C u C o	C o C o

- Stem consonants:
  - [z, n, g] any position; [m, l, d] as C_2 only.
  - No repeated consonants.

- Two alternating affixes: [fi]~[fu] and [be]~[bo]
  - One plural, one diminutive (counterbalanced).

- Stimuli recorded by native Hebrew speaker.

Design

- **Manipulated**: Affix Type and Stress between-subjects.

- Four groups:
  - Suffixes, Local stress: [nupó] … [nupó-fu]
  - Suffixes, Nonlocal stress: [núpo] … [núpo-fu]
  - Prefixes, Local stress: [núpo] … [fu-núpo]
  - Prefixes, Nonlocal stress: [nupó] … [fu-nupó]

- **Measured**: Proportion of test trials participants chose harmony with local vowel.

Hypotheses

1. **Locality**: Overall preference for agreement with local vowel vs. non-local vowel.

 # CVCV – CV #

 # CVCV – CV #

Hypotheses

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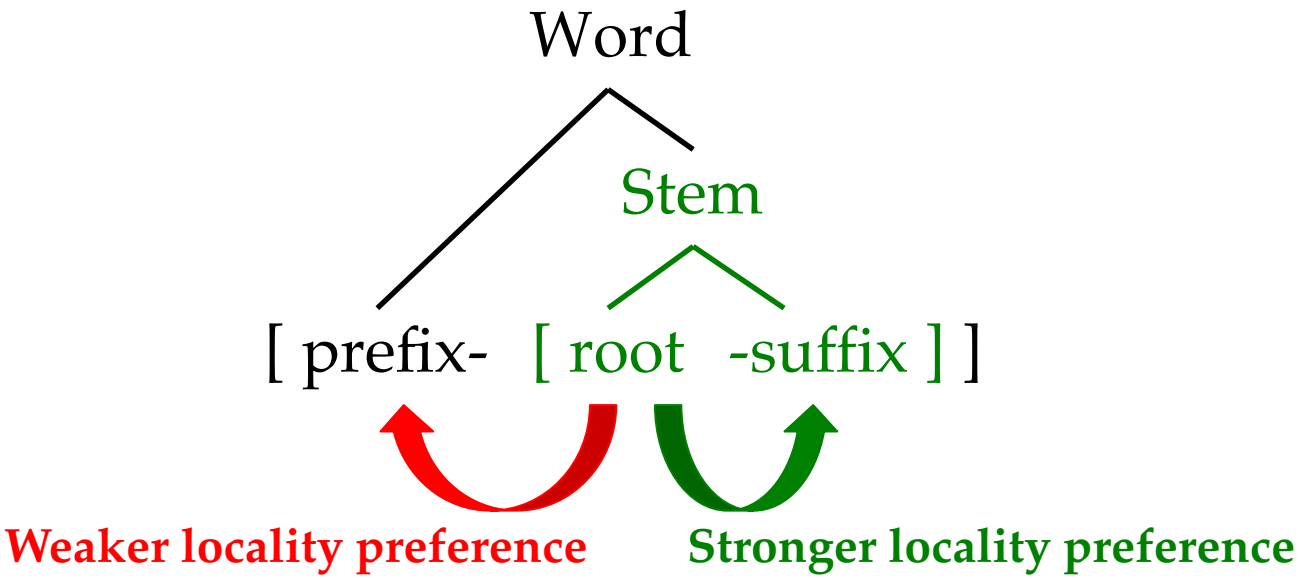
   ↑ # CVCV – CV # ↓ # CVCV – CV #

2. **Affix Type**: Greater locality preference for suffixes than for prefixes.



Hypotheses

1. **Locality**: Overall preference for agreement with local vowel vs. non-local vowel.

 # CVCV – CV #

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2. **Affix Type**: Greater locality preference for suffixes than for prefixes.

[[CVCV – CV]] vs. [[CVCV – CV]]

Greater locality preference

[CV-[CVCV]] vs. [CV-[CVCV]]

Weaker locality preference

Hypotheses

1. **Locality**: Overall preference for agreement with local vowel vs. non-local vowel.

 # CVCV – CV #

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2. **Affix Type**: Greater locality preference for suffixes than for prefixes.

[[CVCV – CV]] vs. [[CVCV – CV]]

Greater locality preference

[CV-[CVCV]] vs. [CV-[CVCV]]

Weaker locality preference

3. **Stress**: Greater locality preference when local vowel is stressed.

CVCV́ – CV vs. CVCV́ – CV

Greater locality preference

CV́CV – CV vs. CV́CV – CV

Weaker locality preference

Participants

- **Total: 356**
  - L1 Dutch: 77
  - L1 English: 76 (33 from pilot)
  - L1 French: 38
  - L1 German: 90 (54 from pilot)
  - L1 Greek: 75

- Mostly university students.

Method

1. **Training phase** (harmonic stems only)

 [núpo] … [núpofu]

(Later trial…)

 [núpo] … [núpobo]

Method

1. **Training phase** (harmonic stems only)

[núpo] … [núpofu]

- 16 trials in training phase:
  - 8 CVCV stems x 2 affixes, [fi~fu] and [be~bo].
    - One stem for each possible V_1V_2 combination.

Method

1. **Training phase** (harmonic stems only)

 [núpo] … [núpofu]

2. **Verification phase** (harmonic stems only)

 [gódo] … [gódofi] … [gódofu] ?

- 16 Verification trials :
  - 8 novel CVCV stems x 2 affixes, [fi~fu] and [be~bo].
    - One stem for each possible V_1V_2 combination.

Method

1. **Training phase** (harmonic stems only)

[núpo] … [núpofu]

2. **Verification phase** (harmonic stems only)

[gódo] … [gódofi] … [gódofu] ?

80% correct? → **No**

Yes

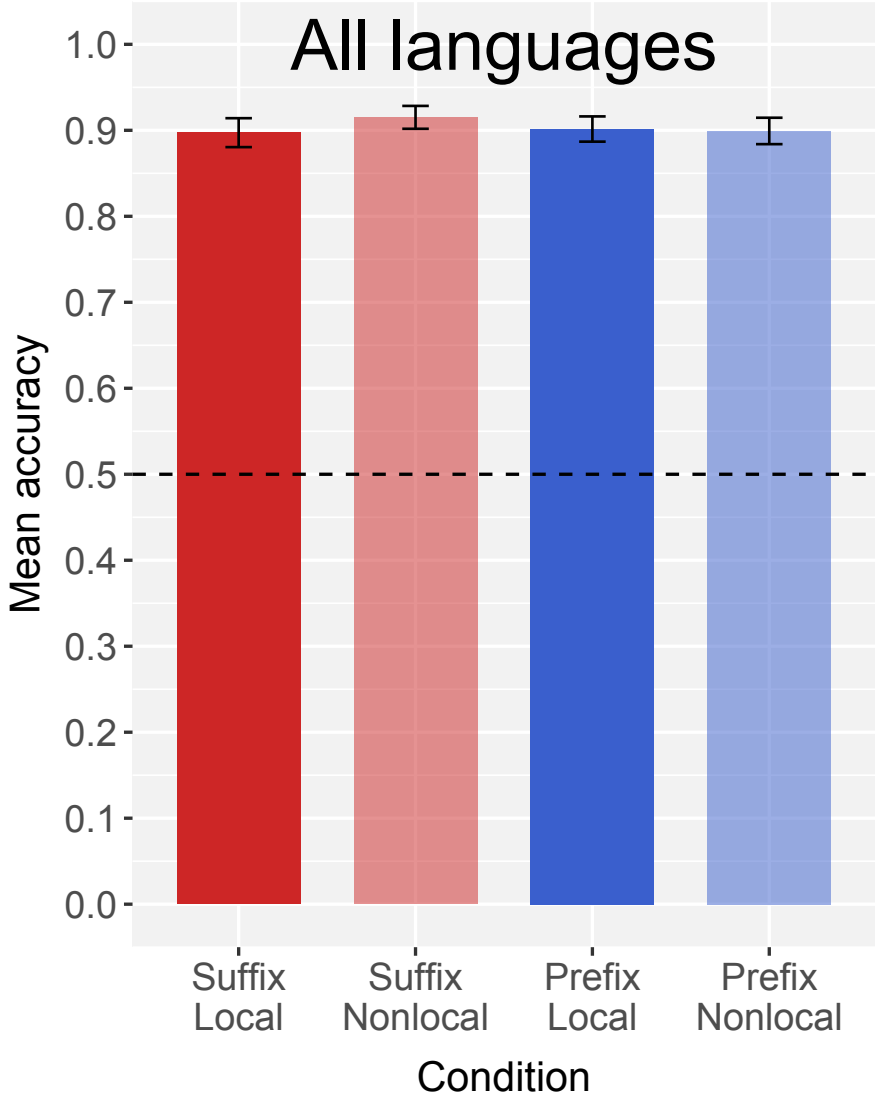
3. **Generalization phase** (harmonic and disharmonic stems)

[púdi] … [púdifu] … [púdifi] ?

Method

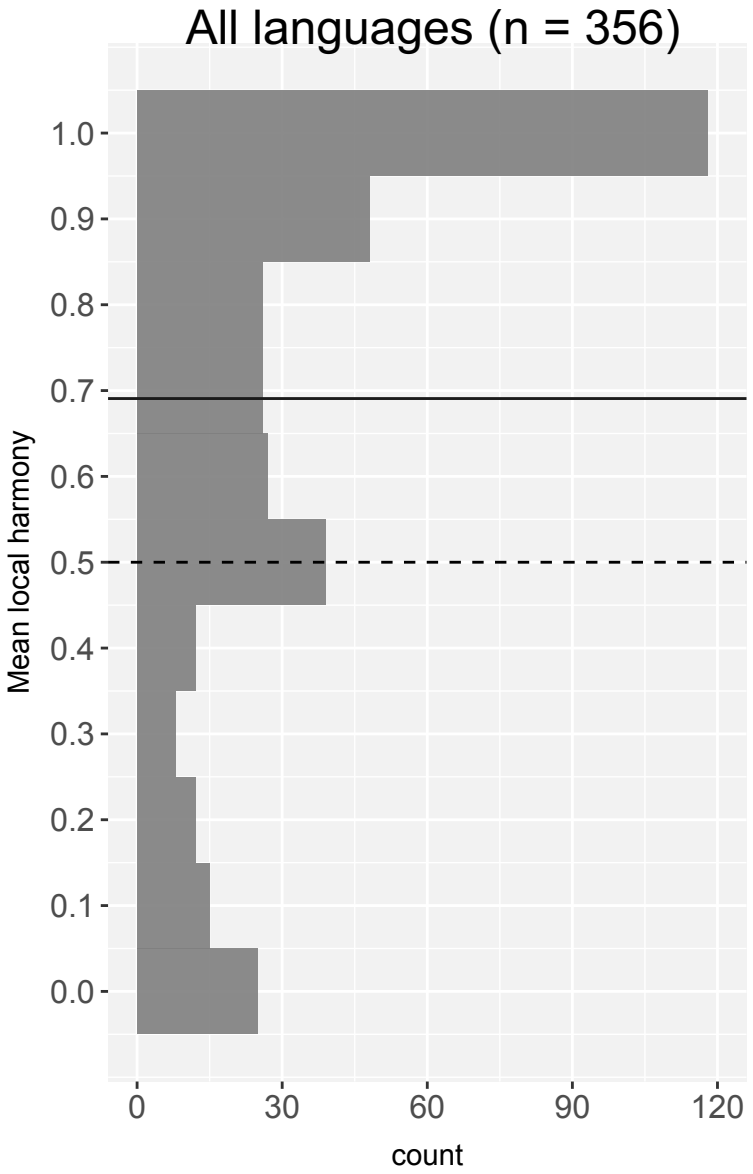
- 80 total Generalization phase trials:
  - 16 harmonic stem trials.
    - 8 novel harmonic stems x 2 affixes.
    - Similar to those in training.
  - 64 disharmonic stem trials.
    - 32 disharmonic stems x 2 affixes.
    - Never encountered stems of this type before.
  - All trials mixed together; order randomized.

Results – Harmonic stems

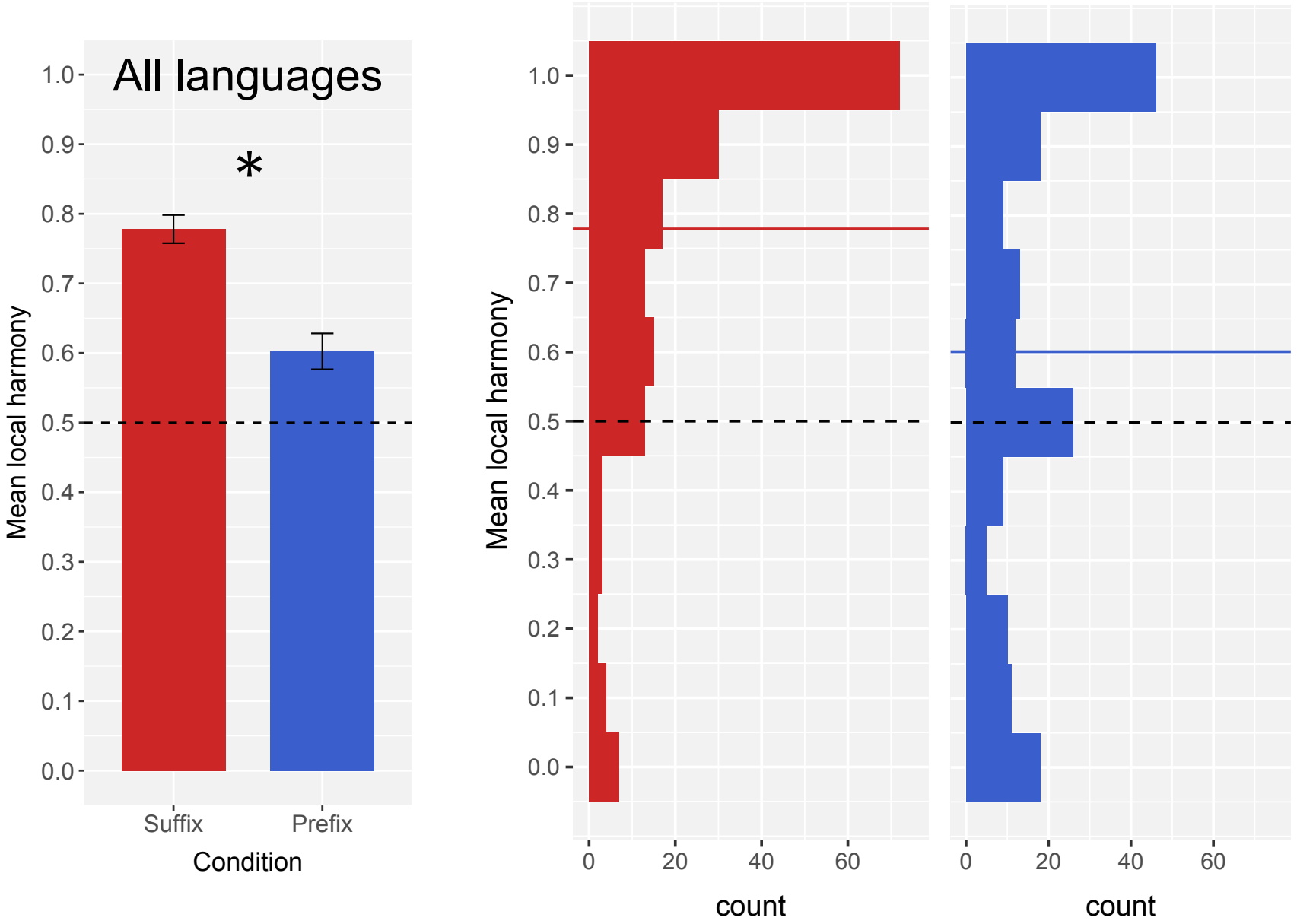


Results – disharmonic stems

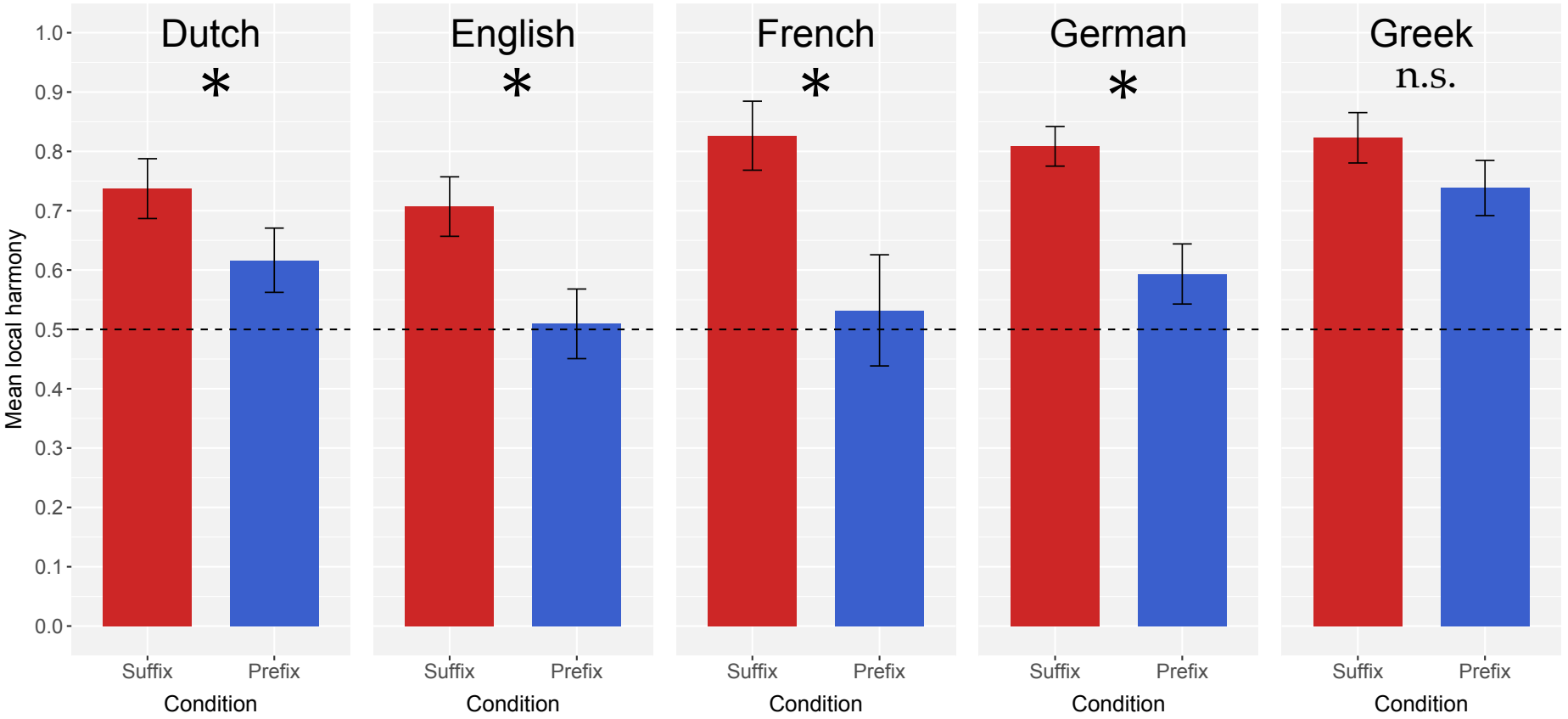
Overall locality preference



Affix Type


All languages
*
Mean local harmony
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Suffix
Prefix
Condition
0
20
40
60
count
0
20
40
60
count

Affix Type


Dutch
*
English
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French
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German
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Greek
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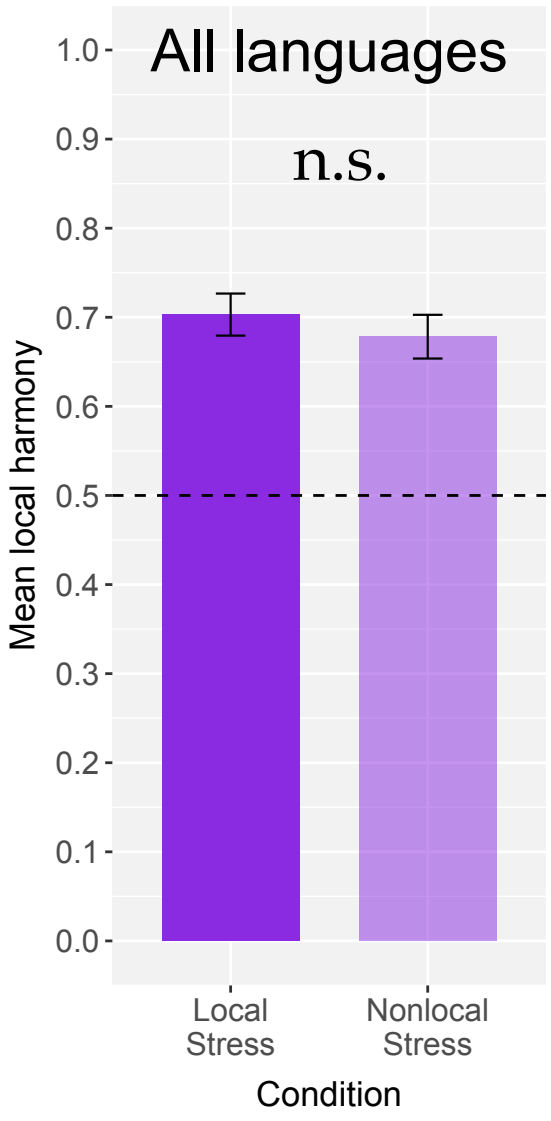
Stress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1.0
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0.4
0.3
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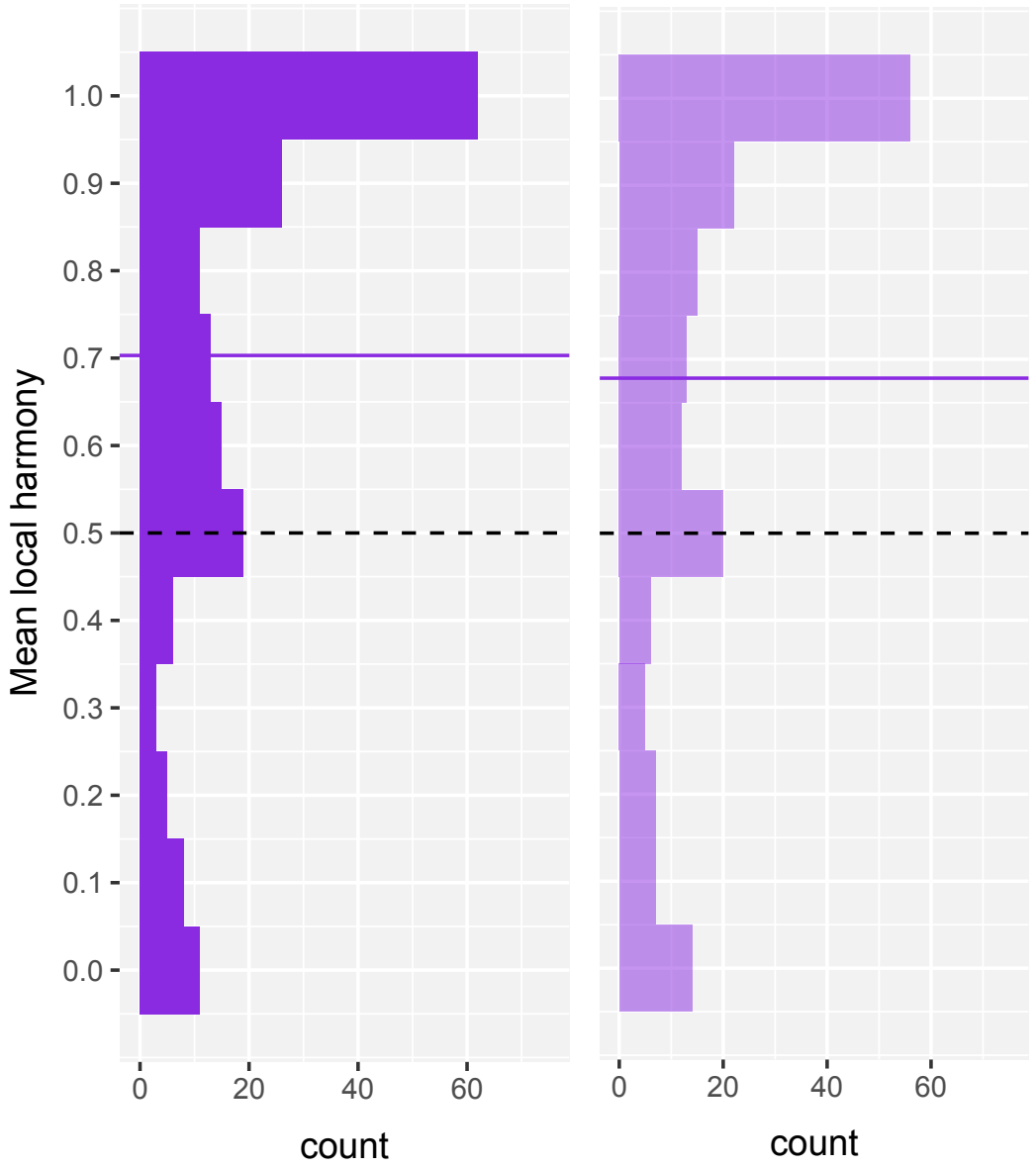
0.1
0.0
Local Stress
Nonlocal Stress
Condition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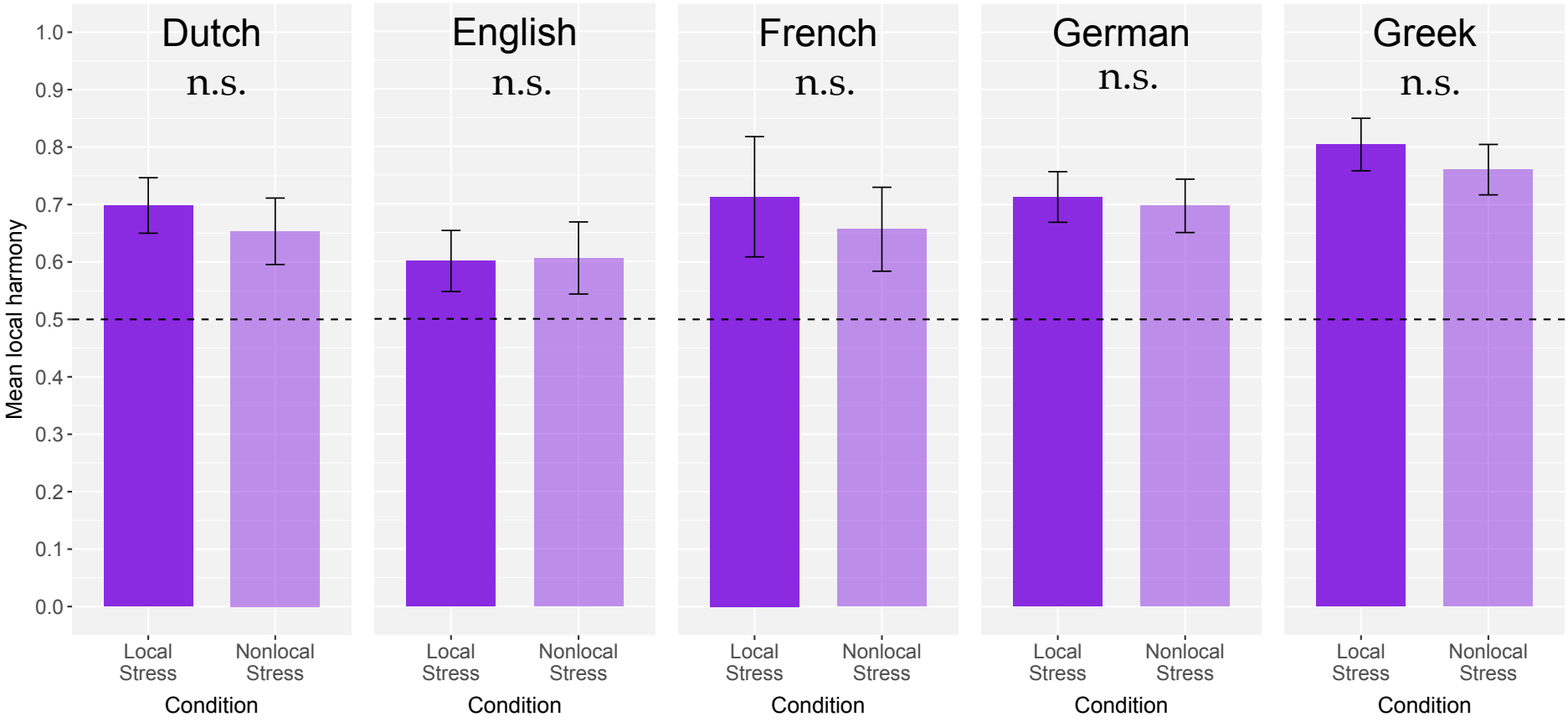
Stress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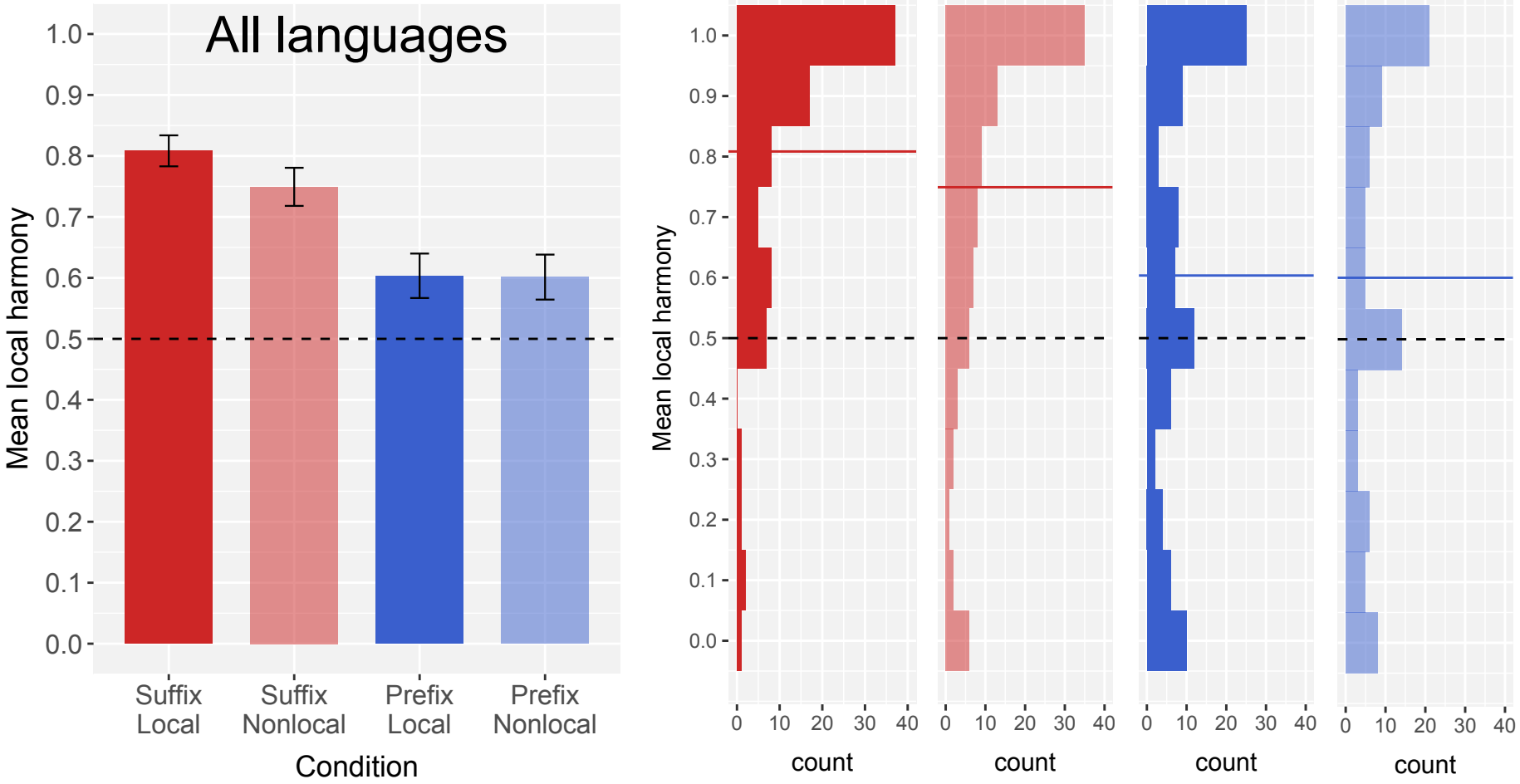
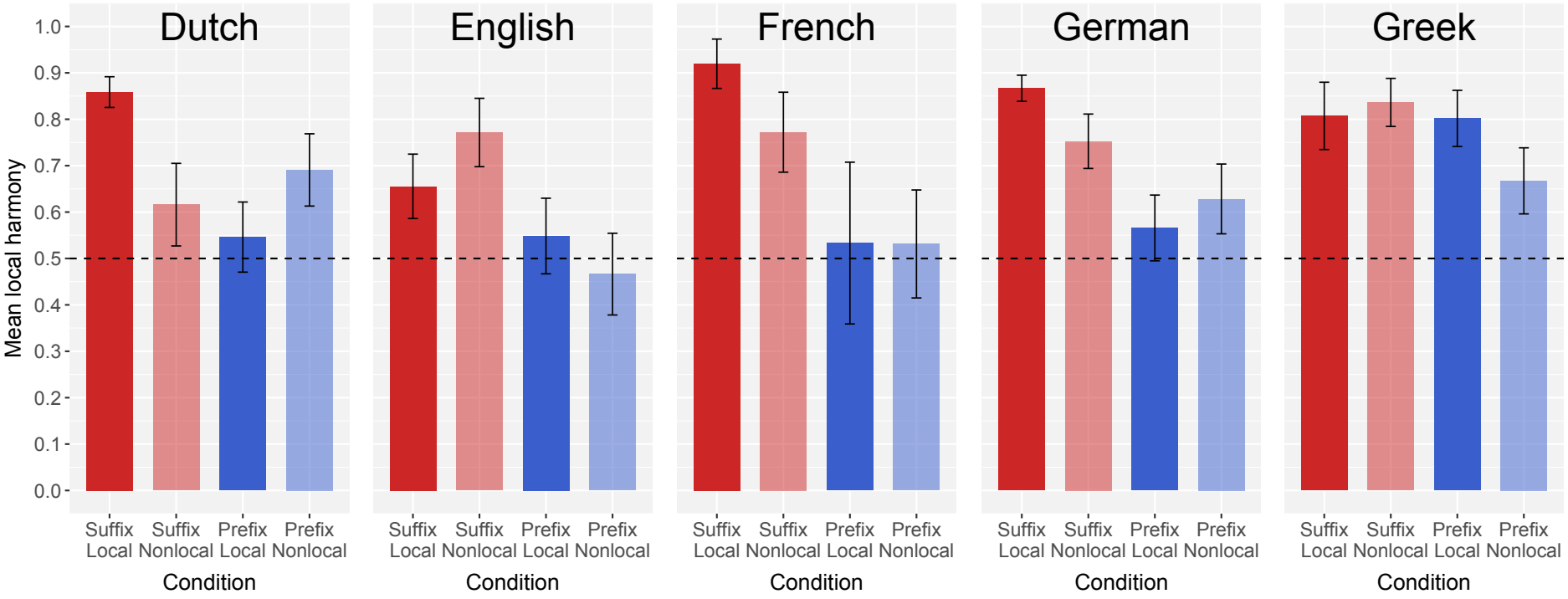
Local Stress
Nonlocal Stress
Condition

Affix Type x Stress



Affix Type x Stress



Summary

1. **Strong locality bias overall**.

2. **Robust effect of Affix Type**.
   - Strong locality preference between root + suffix.
   - Much weaker preference between root + prefix.

3. **Very limited effect of stress.**
   - No overall effect of stress.
   - Stress appears to interact with Affix Type in some languages.

Implications

- Consistent with [root+suffix] as a preferred domain for local harmony compared to [prefix+[root]].

  → Consistent with a (preferred) word structure with the root and suffix more closely integrated than the prefix. (Nespor & Vogel 1986, Peperkamp 1997)

- Possible role in explaining why prefixes are less likely to participate in harmony.

- Unified account of prefix/suffix asymmetry for vowel harmony and other processes such as foot assignment.

L1 differences

- **Subtle differences between L1s in the interaction of Affix Type and Stress.**
  - Most apparent interactions in Dutch and Greek.
    - **But**: a potential interaction even in French!
  - Mostly sensible:
    - Suffix & Local Stress >> Suffix & Nonlocal stress, Prefix & Local Stress >> Prefix & Nonlocal stress
    - **But**: strongest locality preference for Suffix & Nonlocal Stress in English??

- **Next step**: Can aspects of the languages' foot structure, morpho-phonology, etc. explain these differences?

Future plans

- Hungarian speakers
  - Have vowel harmony in the L1.
- Speakers of a predominantly prefixing language.
  - Will they still show a locality preference with suffixes?
- Closer look at vowel height as a factor.

Thank you!

Acknowledgments:

- Help with experiments:
  - Martin Rönsch
  - Remco van der Veen
  - Andrew Clark

- Funding:
  - Deutsche Forschungsgemeinschaft
  - British Academy/Leverhulme Trust

Finley & Badecker (2009)

- AGL study of root-controlled and affix-controlled vowel harmony (VH).
- Affix controlled:
  - Prefix-controlled VH learned more poorly than Suffix-controlled VH.
  - [beme] … [mu-bomo] worse than [beme] … [bomo-mu]
  - Consistent with bias against prefix as harmony trigger.
- Root-controlled:
  - Prefixes and suffixes as VH targets learned equally well.
  - Generalized equally often to other affix type.
  - Conclude that the bias is specifically against prefixes as harmony triggers.

Comparison with Finley & Badecker 2009

- Unlike us, F&B found no preference for suffixes in root-controlled harmony.

- Perhaps due to task differences.

Comparison with Finley & Badecker 2009

- F&B training: [beme] … [mi-beme]
  - Very similar to ours.
  - Our results suggest that several participants actually learn a non-local co-occurrence restriction from such input, rather than local harmony: [mi_x-$beme_x$]

- F&B testing:
  - [tede] … [mi-tede] or *[mu-tede]
  - [beme] … [beme-gi] or *[beme-gu]

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  - [tede] … [mi_x-$tede_x$] or *[mu_y-$tede_x$]
  - [beme] … [be_xme-gi_x] or *[be_xme-gu_y]

- Success on task does not tell us what kind of pattern was learned.