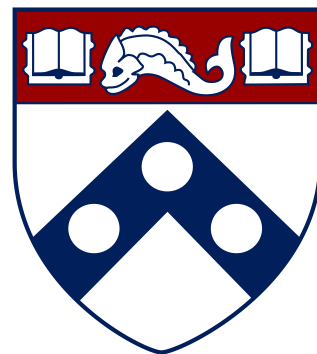


# Morphological priming of Dutch complex verbs is independent of semantic transparency

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SLE, *What is in a Morpheme?*  
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# The role of morphology

- To what extent does morphological structure play a role in the processing of complex words?
  - Morphological effects as interactions between form and meaning (e.g., Baayen et al. 2011; Gonnerman et al. 2007; Seidenberg & Gonnerman 2000)
  - Morphology as explicitly represented (e.g., Stockall & Marantz 2006; Taft 2004)
- We will show that morphological priming effects in Dutch are distinct from phonological or semantic effects

# The role of morphology

- The different approaches especially diverge in their predictions for words that are **semantically opaque**, as contrasted to words that are **semantically transparent**
- Opaque: *corner* (M)
- Transparent: *hunter* (MS)
  - nb: *corner* is pseudo-complex (not just opaque)

# The role of morphology

- **Priming studies:** Facilitation of the processing of a target by the presentation of a prime is taken as evidence that the shared morpheme has been activated
- Facilitation of *corn* after the **semantically opaque** prime (*corner*) would show that morphological / orthographic processing is independent of semantic overlap

# Masked priming studies

- Prime exposure < 60ms
- Morphological priming effects emerge to the same extent for transparent (MS) and opaque (M) prime-target pairs  
(for French: Longtin et al. 2003; English: e.g., Rastle et al. 2004, Beyersmann et al. 2016; Dutch: Diependaele et al. 2005, 2009)
  - ✓ hunter → HUNT (MS)
  - ✓ corner → CORN (M)
  - ✗ cashew → CASH (F)
- Masked priming studies provide evidence for **early morpho-orthographic segmentation** in visual word recognition.

# Overt priming studies

- Prime is fully visible
- Mixed results:
  - Semantically opaque words (M) do not prime their stem in **English** (Marslen-Wilson et al. 1994, Rastle et al. 2000) and **French** (Longtin et al. 2003)
    - ✓ punishment → punish (MS)
    - ✗ apartment → apart (M)
    - ✗ principal → prince (F)
- Both in visual, and in cross-modal paradigms

# Overt priming studies

- However, results from **Semitic languages** show priming for both transparent (MS) and opaque (M) prime-target pairs (Hebrew: Feldman & Bentin 1994, Frost et al. 1997, 2000; Arabic: Boudelaa & Marslen-Wilson 2004, 2005, 2015)
- Non-concatenative morphology: e.g. Hebrew has two abstract morphemes (Root and Word Pattern) that are intertwined
- Root [DRX] can be primed in both MS and M:
  - ✓ [ma**dr**ix] ‘a guide’ → [ha**dr**axa] ‘guidance’ (MS)
  - ✓ [**dr**ixut] ‘alertness’ → [ha**dr**axa] ‘guidance’ (M)

# Overt priming studies

- Similar results for **German** complex (prefixed) verbs (Smolka et al. 2009, 2014)
  - Priming for both MS and M verbs:
    - ✓ *zubinden* ‘tie’ → *binden* ‘bind’ (MS)
    - ✓ *entbinden* ‘deliver’ → *binden* ‘bind’ (M)
    - ✗ *abbilden* ‘depict’ → *binden* ‘bind’ (F)
    - ✗ *zuschnüren* ‘tie’ → *binden* ‘bind’ (S)

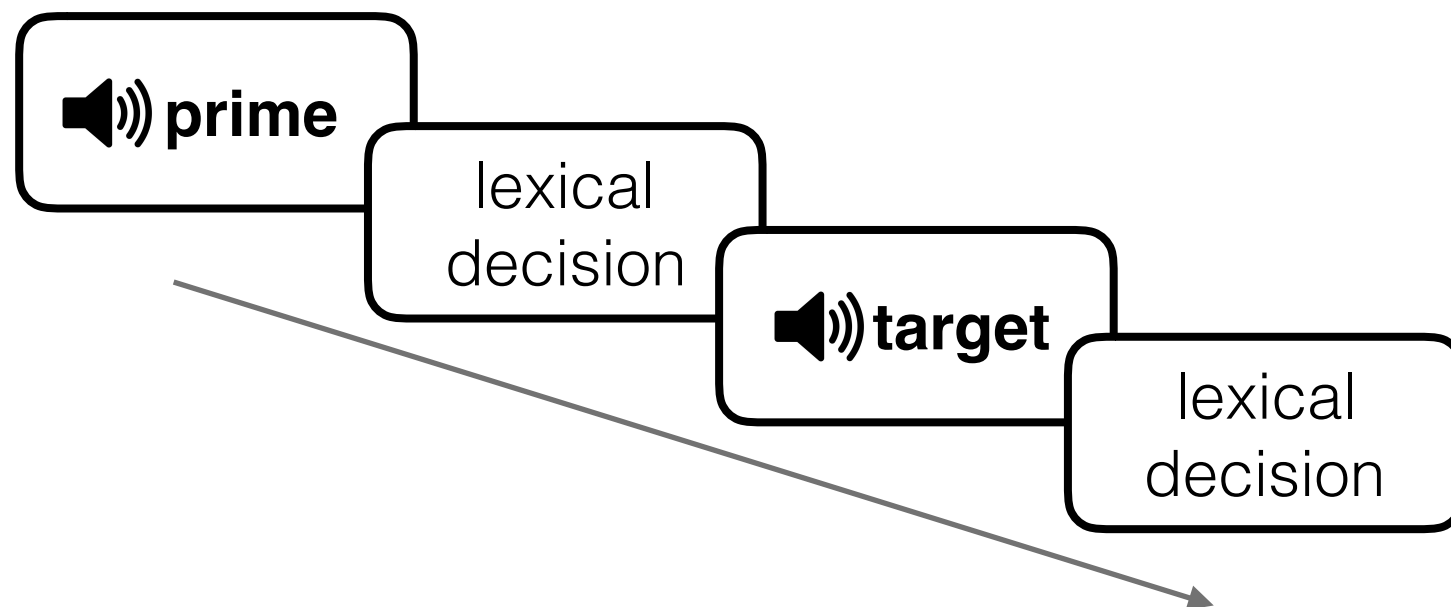


# The present study

- We build on Smolka et al., but with Dutch complex verbs:
- Results for **visual** experiments are primarily about orthography, so inferences about other representations are indirect
  - We use auditory stimuli only
- The “M” conditions used are different across studies
  - We use “M” words for which we have evidence that they are decomposed (e.g. shared allomorphy)

# Experiment 1: Methods

- Goal: investigate whether prefixed verbs in Dutch morphologically prime their stem, and if so:
  - What is the contribution of **semantic** and **phonological overlap** to these priming effects
- Task: Primed continuous lexical decision



# Experiment 1: Methods

- 4 conditions: 36 base verbs (targets), with a prime in each condition

Target	MS prime	M prime	Ph prime	C prime
<i>bieden</i> 'offer'	<i>aanbieden</i> 'offer'	<i>verbieden</i> 'forbid'	<i>bespieden</i> 'spy'	<i>opjagen</i> 'hurry, rush'
<i>werpen</i> 'throw'	<i>afwerpen</i> 'throw off'	<i>ontwerpen</i> 'design'	<i>aanscherpen</i> 'sharpen'	<i>uitdraaien</i> 'print out'

- **MS primes:** Morphologically and Semantically related (transparent) to the target
  - Semantic Relatedness Pretest

# Experiment 1: Methods

- 4 conditions: 36 base verbs (targets), with a prime in each condition

Target	MS prime	M prime	Ph prime	C prime
<i>bieden</i> 'offer'	<i>aanbieden</i> 'offer'	<i>verbieden</i> 'forbid'	<i>bespieden</i> 'spy'	<i>opjagen</i> 'hurry, rush'
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- **M primes:** Morphologically related, Semantically unrelated (opaque) to the target

# Experiment 1: Methods

- 4 conditions: 36 base verbs (targets), with a prime in each condition

Target	MS prime	M prime	Ph prime	C prime
<i>bieden</i> 'offer'	<i>aanbieden</i> 'offer'	<i>verbieden</i> 'forbid'	<i>bespieden</i> 'spy'	<i>opjagen</i> 'hurry, rush'
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- **Phonological primes** rhyme with the target (semantically and morphologically unrelated)
  - To control for the effect of phonology

# Experiment 1: Methods

- 4 conditions: 36 base verbs (targets), with a prime in each condition

Target	MS prime	M prime	Ph prime	C prime
<i>bieden</i> 'offer'	<i>aanbieden</i> 'offer'	<i>verbieden</i> 'forbid'	<i>bespieden</i> 'spy'	<i>opjagen</i> 'hurry, rush'
<i>werpen</i> 'throw'	<i>afwerpen</i> 'throw off'	<i>ontwerpen</i> 'design'	<i>aanscherpen</i> 'sharpen'	<i>uitdraaien</i> 'print out'

- **Control primes:** Morphologically, semantically, and phonologically unrelated to the target (serve as baseline)

# Experiment 1: Methods

- Critical items are rotated over 4 lists
- All primes are complex verbs with prefix/particle
- All items are presented in infinitival form
- 154 filler pairs and 154 non-words
  - Both complex and simplex
- Participants were 32 native speakers of Dutch

# Predictions

- If morphological effects are independent of semantic overlap, we expect equal and robust priming effects in both **MS and M** conditions
- If morphological effects are independent of phonological overlap, we predict **M ≠ Ph**

Target	MS prime	M prime	Ph prime	C prime
<i>bieden</i> 'offer'	<i>aanbieden</i> 'offer'	<i>verbieden</i> 'forbid'	<i>bespieden</i> 'spy'	<i>opjagen</i> 'hurry, rush'

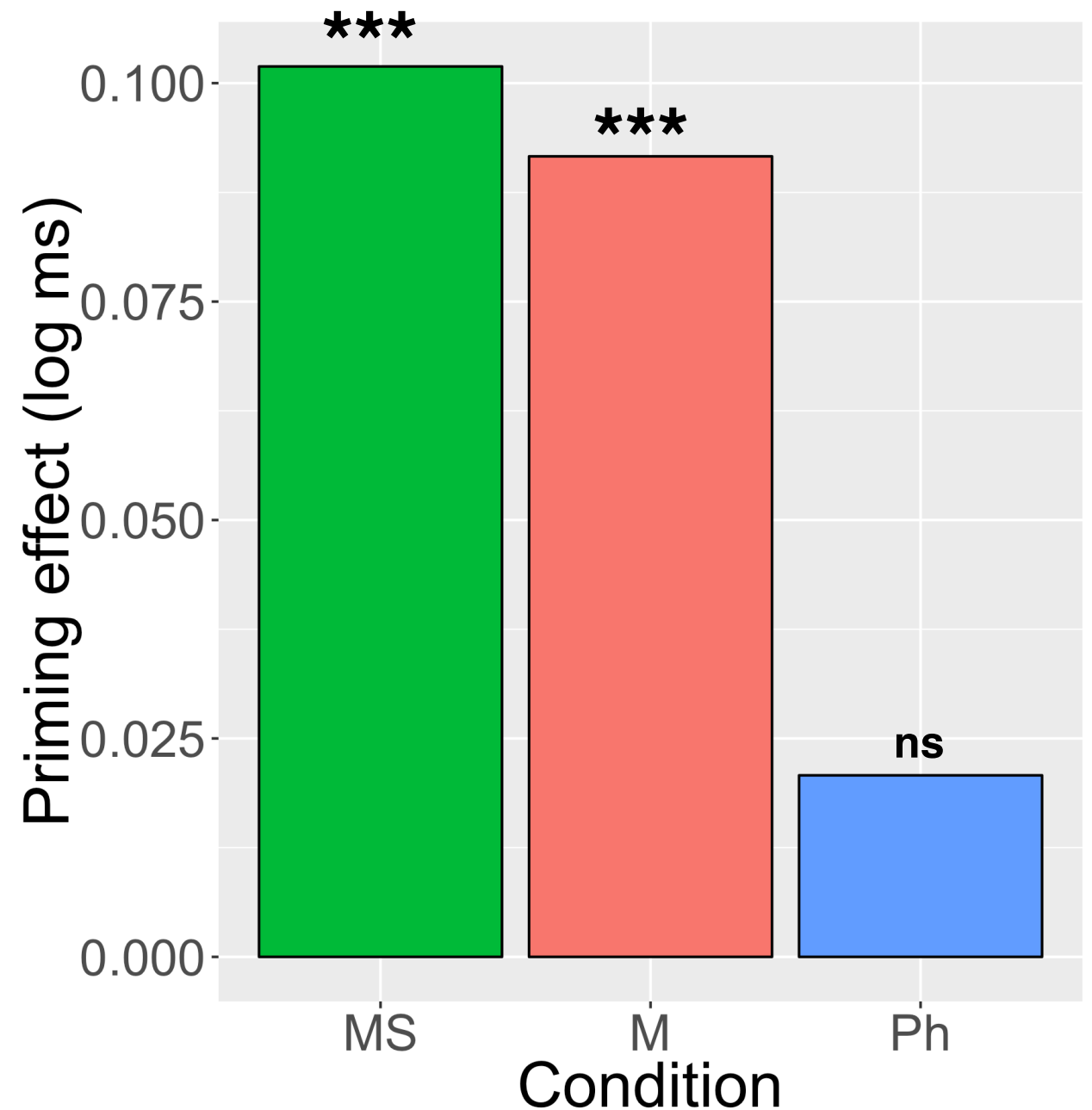


# Analyses

- Effects of **log-transformed RT** are analyzed with Linear Mixed Effects Models (lme4 in R):
  - Random intercepts for subjects and items
  - Main effects:
    - **Prime condition**
    - Particle vs. prefixed prime
    - Inter-stimulus interval, trial nr, target duration, prime RT
    - Prime & target frequency and neighborhood density
  - Post tests for pairwise comparisons

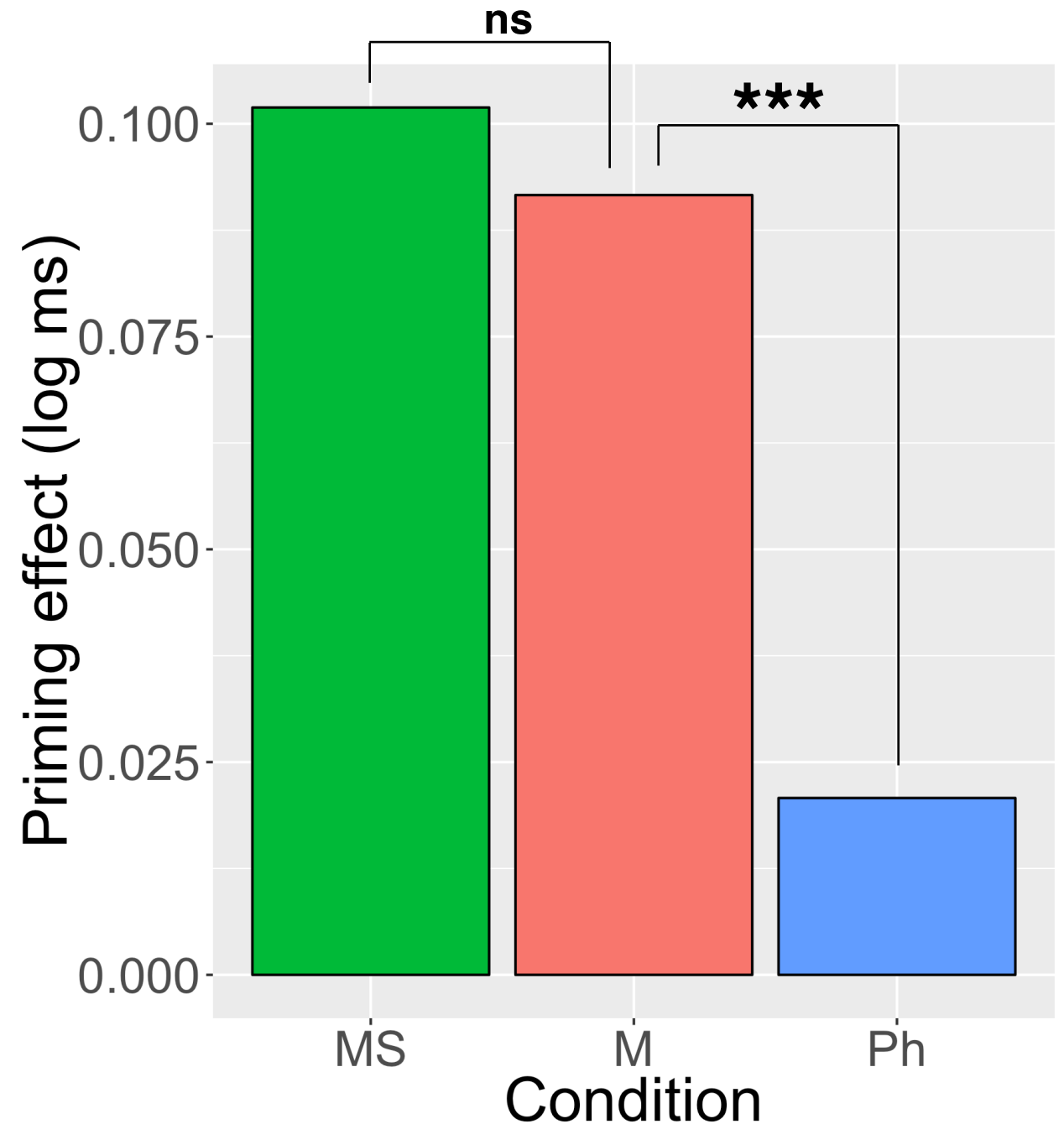
# Results

- Significant priming effect for **MS** and **M**
  - While no effect for **Ph**
- (compared to baseline Control condition)



# Results

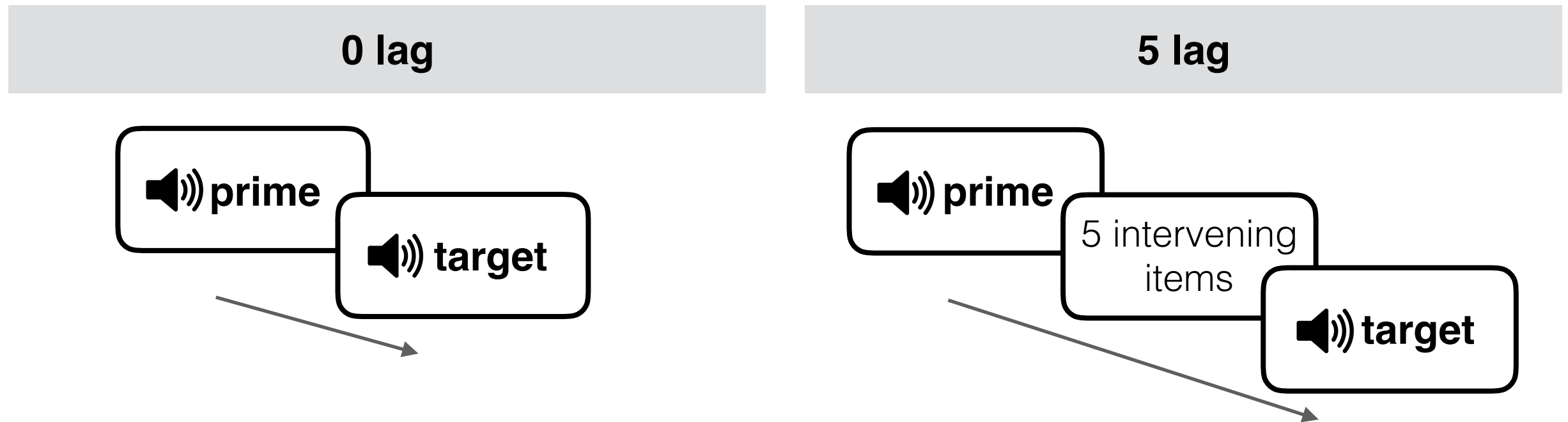
- **MS = M**
  - no additional effect of transparency
- **M ≠ Ph**
  - morphological effect is different from just phonological overlap



# Interim summary

- Experiment 1 shows morphological priming effects for both MS and M primes, which are clearly independent of Phonological effects and semantic transparency
- In Experiment 2: Investigate semantic effects in more detail
  - Include a **semantic condition** (with primes that are synonyms / highly related to the target)
  - Include **intervening items** between prime/target

# Experiment 2



- Previous research suggests that **semantic effects** decay more quickly than repetition and morphological effects (Kouider & Dupoux 2009, Marslen-Wilson & Tyler 1998)
- This should help distinguish semantic from morphological effects at a 5-lag

# Experiment 2: Methods

- 4 conditions \* 2 distances
- Semantic condition replaces the Phonological condition

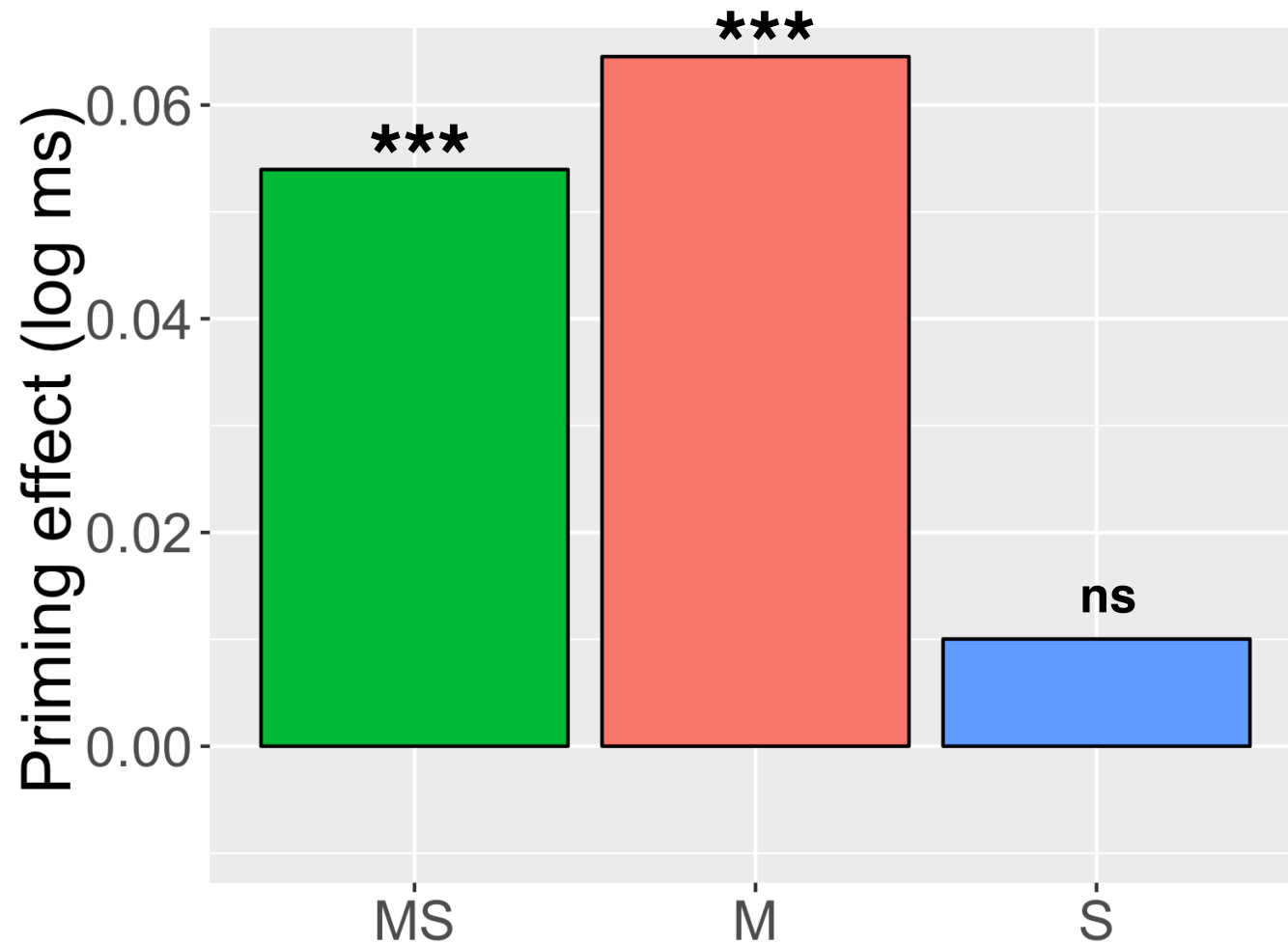
Target	MS prime	M prime	S prime	C prime
<i>bieden</i> 'offer'	<i>aanbieden</i> 'offer'	<i>verbieden</i> 'forbid'	<i>verlenen</i> 'give, grant'	<i>opjagen</i> 'hurry, rush'
<i>werpen</i> 'throw'	<i>afwerpen</i> 'throw off'	<i>ontwerpen</i> 'design'	<i>weggooien</i> 'throw away'	<i>uitdraaien</i> 'print out'

- 40 base verbs (targets)
- Rotated over 8 lists, 40 participants

# Experiment 2: Analyses

- Similar to Experiment 1:
- $\log.RT \sim \text{condition} * \text{distance} (0 \text{ vs. } 5 \text{ lag})$ 
  - Random intercepts for subjects and items
  - Post tests for additional comparisons

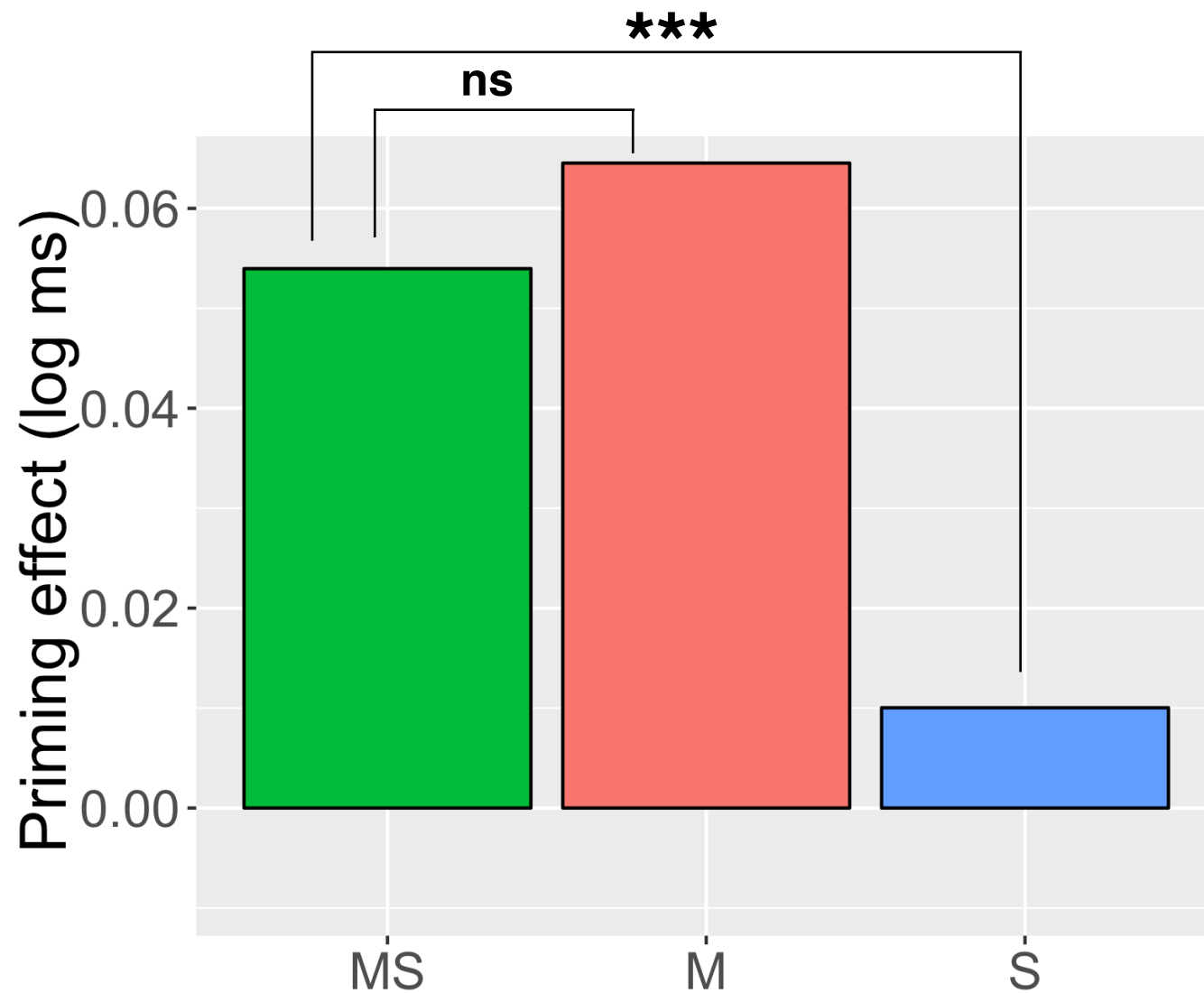
# Results at 0-lag



- Significant facilitation for **MS** and **M**
- No significant facilitation for **S**  
(compared to C)

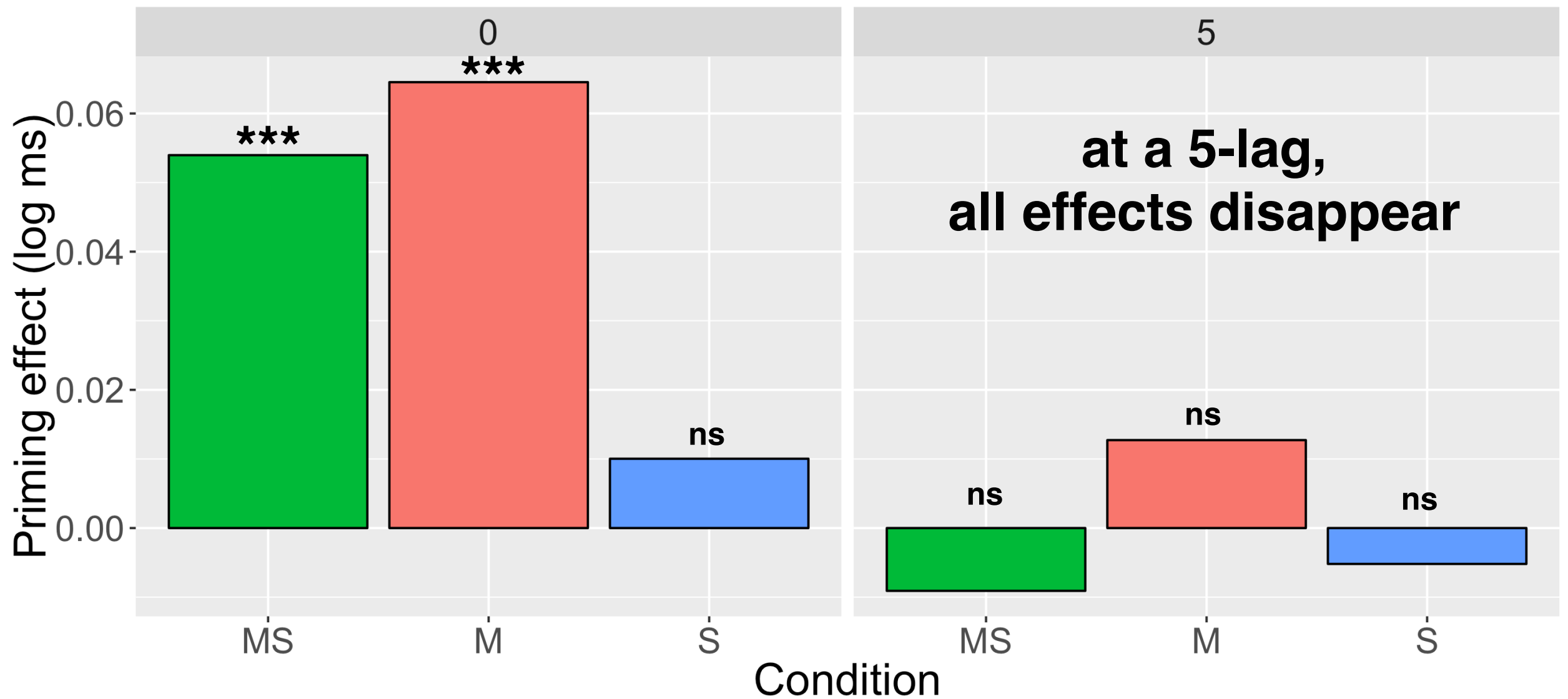


# Results at 0-lag



- **MS = M**
- **MS  $\neq$  S**  
morphological effect  
is different from just  
semantic overlap

# Results at 5-lag



- Lag too big to see differences in drop off?

# Discussion

- The results show equal and robust priming in both MS and M conditions (at 0-lag), while we did not find priming for only phonologically related items (Exp1) or only semantically related items (Exp2)
  - These results are inconsistent with any universal claim that morphological processing is dependent on semantic and phonological overlap
  - Rather, the results show that morphological processing exists even when the semantic relationship is opaque

# Discussion

- Results do not necessarily reflect a difference in morphological processing between different languages, but rather show that what people define as their “M” condition differs across studies
- *corner* → *corn* in English is different from truly morphologically related words like *verbieden* → *bieden* (‘forbid’, ‘offer’)