

# Simultaneity of Planning Increases Interference in Subject-Verb Agreement Production

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## INTRODUCTION

How is agreement computed in language production, and when does it fail?

### Structural Accounts

*Clause Boundedness*: Number features of nouns in separate clauses are planned separately because the planning unit in language production is the clause; number features in separate clauses are unlikely to interfere with each other (Bock & Cutting, 1992).

*Hierarchical Feature Passing*: Features of nouns pass through the syntactic tree to verb targets; occasionally features of hierarchically proximal local nouns pass incorrectly to the verb, causing errors (Franck et al., 2002).

### Timing of Planning Accounts

*Semantic Integration*: A representation of the number of the subject NP is encoded during its planning and then copied to the verb; elements within an utterance that are conceptually linked are planned with more temporal overlap, which allows their features to interfere with each other during encoding (Solomon & Pearlmutter, 2004).

*Scope of Planning*: A representation of the number of the subject NP is encoded during its planning and then copied to the verb; local nouns planned closer in time to the head noun, due to linear proximity and semantic integration, are more likely to interfere with agreement computation (Gillespie & Pearlmutter, 2009).

Do structural or timing-of planning properties determine interference effects?

Gillespie & Pearlmutter (2009) found no evidence of structural effects in NP PP PP preambles, supporting a timing of planning account of agreement computation.

Solomon & Pearlmutter (2004) and Bock & Cutting (1992) found a clause boundedness effect when linear proximity and semantic integration were equated in PP and RC stimuli, which supports structural accounts.

## EXPERIMENT 1A & B

Is the clause boundedness effect observed when phrasal and clausal stimuli are matched in semantic integration, number of adjectives, and overall meaning?

### METHOD

#### Stimuli & Design

**Phrase**: The pizza with the missing slice(s)  
**Clause**: The pizza that had the missing slice(s)

- Semantic integration, number of adjectives, and overall meaning matched across structure
- Singular vs. plural local nouns; head nouns always singular
- 24 critical items; 88 fillers (24 plural head)

### PREDICTIONS

#### Structural Accounts

Main effect of N2 number (mismatch effect)  
N2 number X modifier interaction:  
**Phrase** mismatch > **Clause** mismatch

### ANALYSIS

Identical statistical patterns for subject- and item-based analyses, using ANOVAs on raw and arcsine-transformed proportions, and empirical logit weighted linear regressions (Barr, 2008).

### RESULTS

No interactions with Experiment (1A vs. 1B)  
Plural > Singular (mismatch effect)  
**Phrase** = **Clause**  
**Phrase** mismatch = **Clause** mismatch

### SUMMARY

No evidence for clause boundedness or hierarchical distance observed for these well-matched stimuli, which challenges structural accounts and supports timing accounts.

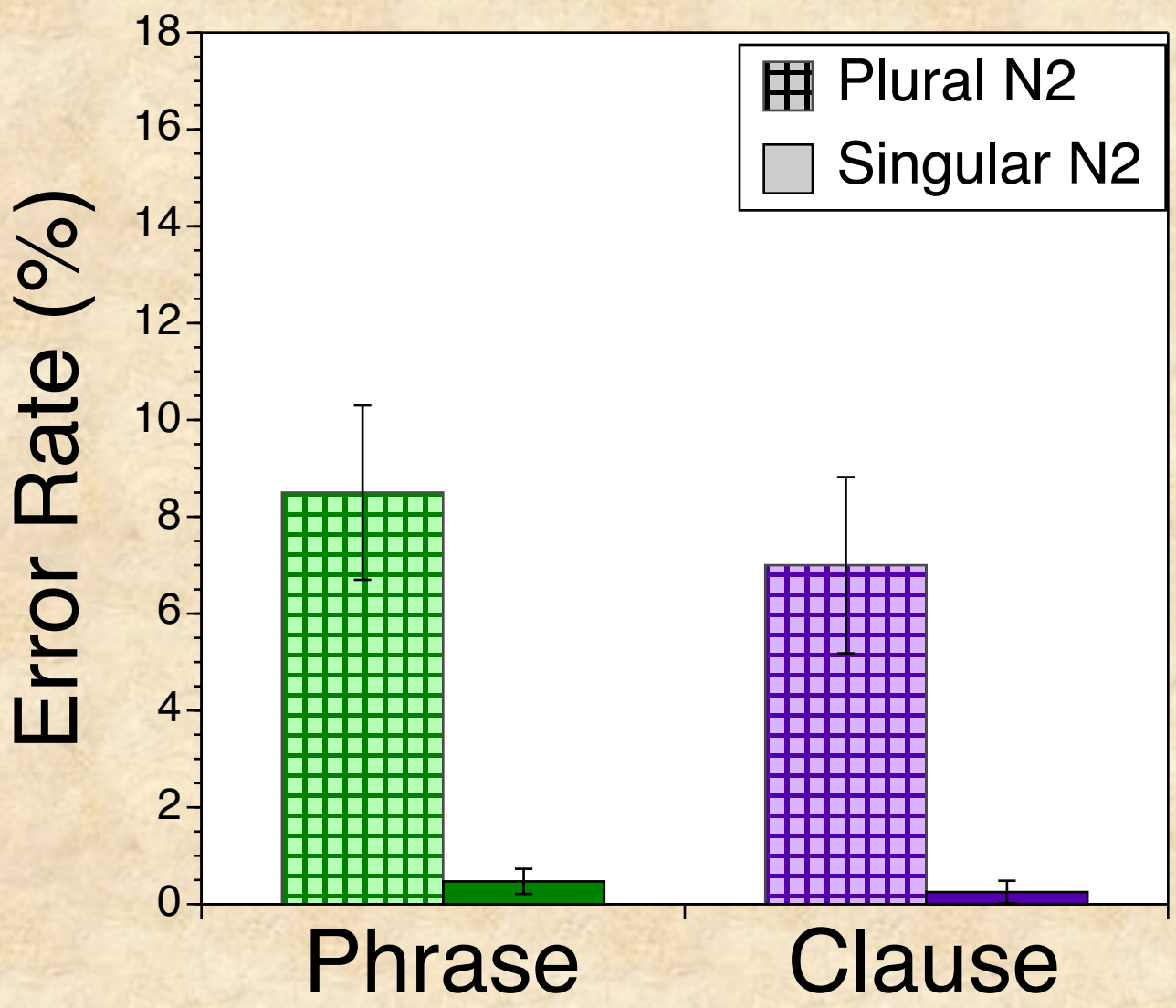
#### Procedure & Participants

-Exp. 1A: Preambles presented visually, read aloud and completed as full sentences.  
56 participants (56 included in ANOVAs)

-Exp. 1B: Preambles presented visually, read silently, repeated aloud after a tone, and completed as full sentences.  
62 participants (55 included in ANOVAs)

#### Timing Accounts

Main effect of N2 number (mismatch effect)  
No N2 number X modifier interaction:  
**Phrase** mismatch = **Clause** mismatch



## EXPERIMENT 2

Was unequal number of adjectives responsible for the clause boundedness effect in earlier work?

### METHOD

#### Stimuli & Design

**Short**: The pizza with the missing slice(s)  
**Long**: The pizza with the large missing slice(s)

- Semantic integration equated
- Singular vs. plural local nouns; head nouns always singular
- 24 critical items; 96 fillers (24 plural head)

### PREDICTIONS

#### Bock & Cutting (1992)

Mismatch effect  
N2 number X length interaction:  
**Long** mismatch > **Short** mismatch

### RESULTS

Plural > Singular  
**Short** > **Long**  
**Short** mismatch > **Long** mismatch

### SUMMARY

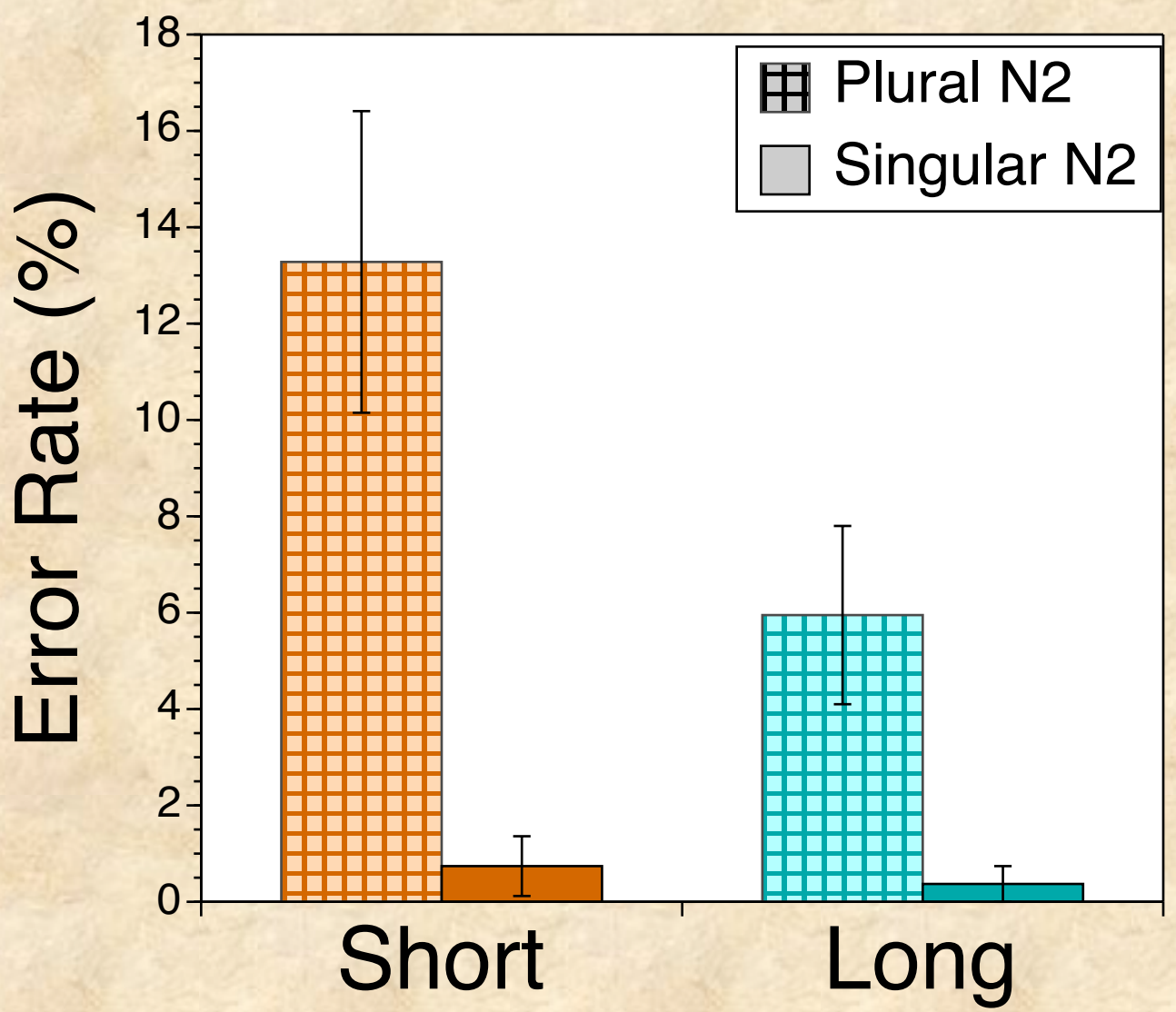
Opposite interaction from Bock & Cutting (1992)

#### Procedure & Participants

Preambles presented visually, read aloud and completed as full sentences.  
68 participants (67 included in ANOVAs)

### ANALYSIS

Same as in Experiment 1



Number of adjectives unlikely to have caused clause boundedness effect in previous stimuli, as preambles with more adjectives produced fewer errors.

### STIMULI COMPARISON

Bock & Cutting (1992; Exp. 3): *The notion of the wild roaming (talking) horse(s)*

*Local nouns more concrete* --> With more adjectives, local nouns become more concrete and more likely to be misrepresented as the head (Bock & Miller, 1991).

*Implausible* --> More adjectives may make stimuli less plausible, leading to greater overall complexity and increased chance of errors.

## DISCUSSION

Timing of planning accounts better explain agreement computation.

### Experiment 1

- Supports and extends Gillespie & Pearlmutter's (2009) scope of planning account: Plural local nouns planned close in time to the head noun cause interference, regardless of structural configuration.

### Experiment 2

- Shows opposite length effect from Bock & Cutting (1992). Likely due to differences in stimuli
- Suggests adjectives are planned before nouns they modify. Increasing number of adjectives delays planning of local noun, thus decreasing chance of interference
- Consistent with scope of planning account.

### Implications for models of agreement computation

Models of agreement processing may not require a structural component, as equal interference effects were observed from elements within and across clauses.

Something besides structure likely to be responsible for clause boundedness effects in previous studies, though unlikely to have been differing number of adjectives.

Scope of planning makes use of the sequential, temporal nature of language production.

Models of agreement computation should use a measure of a local noun's relative timing of planning to predict mismatch effects.

Important to determine which interference effects are due to memory encoding, as suggested by timing accounts, and which are due to retrieval (Badecker & Lewis, 2007).

## REFERENCES & ACKNOWLEDGMENTS

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