



# Phonological Interference in Working Memory and Sentence Comprehension



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## Background

### Phonological Information in Sentence Processing

- In most models of sentence processing, phonological information is only important for word recognition
- Once words are recognized, semantics and syntax are derived, and it is this information that guides sentence comprehension (i.e. Frazier, 1987)
- Example: Comprehending Complex Sentences**  
Object Relatives (ORs) are more difficult than Subject Relatives (SRs)

**OR:** "The reporter that the senator attacked admitted the error."  
**SR:** "The reporter that attacked the senator admitted the error."

### Explanations of Processing Difficulties:

- Maintenance of multiple incomplete syntactic dependencies (Lewis, 1996)
- Interference due to semantic overlap in noun phrases (Gordon, Hendrick and Johnson, 2001)
- Neither account considers a role for phonological information

### Re-evaluating the Role of Phonological Information in Sentence Processing: Working Memory Perspective

- Relationship between measures of verbal working memory (i.e. Reading Span) and language processing mediated by an overlap in processing demands between the two tasks (Daneman and Tardiff, 1987; MacDonald and Christiansen, 2002)
- Verbal working memory may be used to maintain the *serial order* of words while processing of complex sentences (Baddeley, Eldridge and Lewis, 1981)

## Study

- Examine the role of phonological information in the processing of OR sentences by taxing the phonological system through the introduction of phonological overlap
- Explore the relationship between the short-term maintenance of phonological information and the processing of complex sentences

## Materials

### Experimental Sentences\*

#### OR with Phonological Overlap

The player that the mayor met bet the editor

#### OR without Phonological Overlap

The coach that the mayor aided bet the editor

\*Sentences matched for length, frequency and plausibility

### Working Memory Tasks\*

#### Word Span with Phonological Overlap

i.e. tent, rent, spent

#### Word Span without Phonological Overlap

i.e. compose, beard, hall

\*Lists were matched for number of syllables, imageability and frequency

## Procedure

### Sentence Processing

- Self-Paced Reading Paradigm** (Just, Carpenter and Wooley, 1982)

- Sentences read one word at-a-time by hitting the space bar
- Yes/no comprehension question followed each sentence

### Dependent Variables:

- Question Accuracy, Question Reading Time, Word Reading Time

### Working Memory Tasks

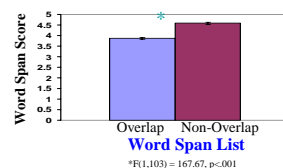
- Trials began with cross, words were read out loud one word per second, and cued for recall
- Participant recalled the words in the serial order when possible
- Overlap and non-overlap lists were randomly ordered
- List length began at 2 words and went up to 7
- Scoring:** An individuals span score= last set in which 3 of 5 sets were correctly recalled, half credit was given for 2 of 5 correct sets correct

## Participants

104 Undergraduate psychology student participated for course credit. All were native speakers of English. Age range 18-23

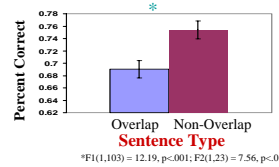
### Word Span

Results: Word span lists with overlap harder than those without



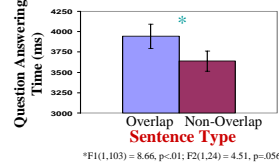
### Sentence Comprehension

Result: Sentence comprehension worse for OR sentences containing phonological overlap relative to those without

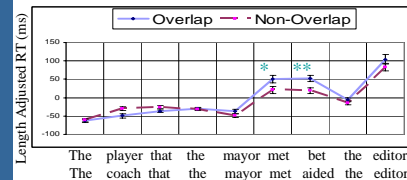


### Question Answering Time

Result: More time spent answering questions for OR sentences with phonological overlap relative to those without



## Word by Word Reading Times



\* F(1,103) = 8.361, p<.01; (1,23) = 6.780, p<.05  
\*\* F(1,103) = 13.558, p<.001; F(2,123) = 9.126, p<.01  
+ Reading times were for correct answers only  
All reading time >3000 ms trimmed, then reading time >2.5 SD above the mean  
Reading times were adjusted to account for the length of each word

### Interaction of Overlap Word Span and Mean Verb Reading Time

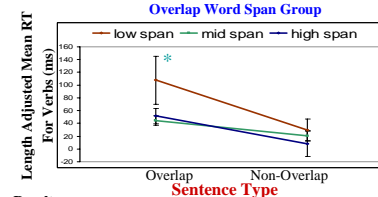
#### Individual Differences Approach

Participants divided groups based on the word span lists containing phonological overlap

High: Span scores > 1 SD above the mean (N=12)

Low: Span scores < 1 SD below the mean (N=12)

Mid: In between high and low (N=80)



#### Results:

- Low span individuals slower at reading OR sentences with phonological overlap (\*F(2,101) = 4.03, p<.05)
- Near significant interaction between span group and sentence type (F(2,101) = 2.614, p=.078)  
-Low span individuals show a larger difference in reading time between the overlap and non-overlap sentences than the mid and high span individuals

## Conclusion

- Replication of the phonological similarity effect in the word span task (Conrad and Hull, 1964): Participants worse at lists containing phonological overlap
- Evidence for role of phonological information in sentence comprehension from question answering time, question accuracy, and reading times
- Evidence for a role of short-term/working memory in language comprehension:
  - Interaction between performance on word span with overlap and reading time at the verbs suggests that the locus of phonological interference during sentence comprehension may lie in the ability to maintain the serial order items in short term memory
- Future studies:**
  - Examine effects of phonological overlap on other complex sentence structures
  - Ascertain the locus of phonological interference: central representation or production?

## References

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