The Effect of Context on Structural Priming

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Exposure Affects Behavior

People are sensitive to the linguistic variations (phonological, morphological, syntactic, etc) they encounter in their environment.
Exposure Affects Behavior

If they hear a particular form, they are more likely to use the same form or a similar one.

Customer: “At what time does your store close?”
Clerk: “Nine o'clock.” OR “At nine o-clock.”

Levelt & Kelter (1982)
Exposure Affects Behavior

People even replicate the frequency at which they encounter a linguistic variant:

- Goldrick & Larson (in press) probabilistic distributions of phonotactic constraints
- Kaschak et al. (2006) probabilistic distributions of the Dative Alternation
Exposure Affects Behavior

Encountering a linguistic variant leads to the use of that variant.
But Not Always

There are times when exposure to a linguistic form does not lead to the person using the same or similar form.
Hudson & Newport (2005) – Adults and children were trained on a novel language that had probabilistic distributions of features (e.g., a determiner occurred 60% of the time).

- Children usually chose one form from the input and used it all the time.
- Adults did the same when tested with new words.
But Not Always

Encountering a linguistic variant sometimes leads to the use of that variant.
Why Do We Replicate Only Sometimes?

- Features of the learner
  - Age
  - Working memory
  - Attention span
  - Previous learning

- Features of the input
  - Frequency
  - Naturalness
  - Complexity $\rightarrow$ Structural complexity (embedding)
My Primary Question

How does the linguistic context of the input affect the ability to replicate use of a linguistic form?

How does the complexity of the syntactic context affect speakers’ ability to reproduce variation?

**Hypothesis:** The more complex the syntactic context in which a variant occurs, the harder it is to access the variant and to replicate its use.
Outline

- Why context (might) matter
- Using priming to test the effects of syntactic context
- Predictions
- Experiment 1: Priming with complex sentences
- Experiment 2: Priming from embedded clauses over time
- Future studies
Why Might Syntactic Context Matter?

Lightfoot (1991) and others (e.g., Pearl & Weinberg 2007) argue that embedded linguistic forms are not informative to young learners, in particular variation that occurs in embedded position.

“Pat believes that Celina eats beans.”
Why Might Syntactic Context Matter?

We know that syntactic context matters for adult speakers in linguistic tasks such as anaphora, pronoun resolution, and ellipsis.

**Binding of anaphors:**
*Seth$_1$ recognized the man$_2$ that hit himself$_1$.

**Island violations:**
Marta knows the man who Diane saw on Wednesday.
* When does Marta know the man who Diane saw ___ ?
Intended answer: “On Wednesday”
What If Syntactic Context Matters?

If it matters, then we should see different patterns of repetition for alternations that occur in matrix positions versus embedded positions.
How Do We Test This?

Structural priming research has found that speakers are likely to reuse recently encountered syntactic forms (e.g. Bock 1986; Branigan, Pickering & Cleland 2000; Corley & Scheepers 2002; Pickering & Branigan 1998).
Structural Priming and Embedding

Scheepers (2003) -

- Exposed speakers to primes with high-attaching or low-attaching relative clauses
  
  High-Attaching: The assistant announced the score [mas,sing] of the candidate [fem,sing] that [mas,sing]
  Low-Attaching: The assistant announced the score [mas,sing] of the candidate [fem,sing] that [fem,sing]

- Found that speakers produced sentences with the same pattern of embedding as the primes

- Concluded that speakers must be attending to embedding and how clauses are combined
Structural Priming and Embedding

Branigan et al. (2006) -

- Exposed speakers to the Dative Alternation in either matrix position or in a complement clause
- Found that speakers were equally as likely to reproduce a prime regardless of its position
- Conclude that speakers do not (need to) attend to embedding and argue that the priming Scheepers found was due to semantic overlap
How I Will Use Priming

The DATIVE ALTERNATION refers to the ordering of objects after dative verbs such as give, hand, and show.

Dative Object (DO)

- Mohammad gave Lynn the answer sheet.

Prepositional Dative (PD)

- Mohammad gave the answer sheet to Lynn.
How I Will Use the Dative Alternation

I place forms of this alternation in matrix and embedded positions and see whether this affects priming behavior.

**Matrix:** The man who knows Yaron gave Lynn the answer sheet.

**Embedded:** Yaron knows the man who gave Lynn the answer sheet.
Predictions for this Line of Research

<table>
<thead>
<tr>
<th>Syntactic Context’s contribution</th>
<th>Will both positions prime?</th>
<th>What alternation will people produce?</th>
</tr>
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<tbody>
<tr>
<td>Context Doesn’t Matter: learners cannot make reference to the context, just the alternation.</td>
<td>Yes - and equally as well</td>
<td>They will consistently match their forms to those of the primes but <strong>cannot</strong> associate patterns with the larger context.</td>
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This theory would be in keeping with Branigan et al. (2006)
## Predictions for this Line of Research

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<td><strong>Context Matters I:</strong> variation that occurs in some contexts cannot affect priming.</td>
<td>No – only one, matrix</td>
<td>They will not reproduce the primes that occur in some structurally complex contexts.</td>
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This theory would be in keeping with a strong version of Lightfoot (1991)/Pearl & Weinberg (2007).
Predictions for this Line of Research

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<td><strong>Context Matters II:</strong> learners are sensitive to context and can use information that occurs in some contexts better.</td>
<td><strong>Yes</strong> – but one position may be stronger</td>
<td>They will consistently match in one position and usually match in the other.</td>
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This theory would be in keeping with a weakened version of Lightfoot (1991)/Pearl & Weinberg (2007).
### The Theories Tested in Experiment 1

<table>
<thead>
<tr>
<th>Tested theory</th>
<th>What we would find</th>
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| **Context Doesn’t Matter:** learners cannot make reference to the context, just the alternation. | Main effect of prime  
No effect of position  
No interactions |
| **Context Matters I:** variation that occurs in some contexts cannot affect priming. | Main effect of prime  
Main effect of position  
Significant interactions |
| **Context Matters II:** learners are sensitive to context and can use information that occurs in some contexts better. | Main effect of prime  
(Possible) Main effect of position  
Significant interactions |
Quick Overview

- The experiment was run in a sound-attenuated booth.
- Participants read and completed sentences aloud.
- All responses were recorded, and the entire thing took about 20-30 mins.
Example of an experimental block
The logician brilliantly deduced that the proof was bogus.
The psychologist interviewed the child who showed the coloring book to the officer.
COMPLETE

The gray floppy-eared rabbit . . .

hole
carrot
PUT
The principal confided in the teacher who . . .

answers
raters
SHOW
Design of Experiment 1

- 18 dative verbs, 9 in matrix, 9 in embedded
- Alternations (DO or PD) are restricted to one of the either matrix or embedded position depending on the participant’s condition.
- Each block has 4 filler tasks.
- Each prime-target pair is separated by 1 filler task.
Design of Experiment 1

- There were 2 types of slides: READ and COMPLETE.
- READ slides contained a full sentence (filler or prime).
- COMPLETE slides contained a sentence fragment followed by 3 words, one verb in all caps and two nouns or a noun-adjective pair.

Example:

- ticket cautious
- driver skier
- ISSUE BE
Primes and Targets

- The chosen dative verbs were not overly biased toward either construction (Gries, 2005):
  - Matrix – buy, feed, issue, lend, make, pass, take, teach, throw
  - Embedded – award, bake, hand, offer, owe, promise, sell, serve, show
- Both the verbs and the contexts of the primes were repeated in the targets.
For the READ slides, participants were told to read carefully but at a natural pace.
Instructions

For the COMPLETE slides, they were told that they could change the tense of the verb and that they had to use the other two words in their response somehow. They could add words (e.g., articles and prepositions) as necessary, but they shouldn’t add more than necessary.
Sixty-one native speakers of North American English from the Northwestern University community participated for partial course credit or pay.

- One was excluded due to a high number of OTHER responses (48%), indicating difficulty with the task.
Analysis

Responses were scored as either DO, PD, or OTHER.

**OTHER:**
The pitcher who loved the fans threw the ball at the coach.

**PD:**
The pitcher who loved the fans threw the ball to the coach.

**DO:**
The pitcher who loved the fans threw the coach the ball.
For analysis, the rau scores for the number of PD completions were calculated by taking the number of PD divided by the sum of PD and DO completions.

\[
PD / (PD + DO)
\]
“Other” responses occurred at a normal rate (12%, stdev = 0.15), given results from previous experiments (e.g., Bock & Griffin, 2000).

Participants who were over 2 stdevs from the mean were removed leading to the exclusion of the aforementioned participant.
Results

- Main effect of prime for participants
  \[ F(1, 57) = 5.70, p < .05 \]
- But not for items
  \[ F(1, 16) = 3.07, p > .05 \]

Participants were more likely to produce a PD following a PD prime (57%) than following a DO prime (50%).
Results

- No effect of position
  \[ F(1, 57) = 0.63, p > .05 \]
- No interaction prime * position
  \[ F(1, 57) = 0.18, p > .05 \]

Priming from a PD prime or DO prime was independent of where the prime occurred (matrix or embedded).

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<thead>
<tr>
<th>Prime</th>
<th>PD</th>
<th>DO</th>
</tr>
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<tbody>
<tr>
<td>Emb</td>
<td>52%</td>
<td>49%</td>
</tr>
<tr>
<td>Mat</td>
<td>56%</td>
<td>52%</td>
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## Experiment 1: Priming with Complex Sentences

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Discussion

- These data replicate the findings of Branigan et al. (2006), demonstrating that priming is possible from embedded positions, while extending their findings with complement clauses to relative clauses.

- Because there was only a main effect of prime, the “Context Doesn’t Matter” account may be correct.
Discussion

These data suggest that priming is equally as strong under certain conditions (e.g., when there is a only one filler between prime and target and when the verb is repeated).

But what if we changes these conditions?
Experiment 2: The Effects of Complexity over Time

**Manipulating the lag** - Priming occurs from both positions, but is the priming as strong over time from each?

**Change:** Lengthen the number of filler tasks between prime and target (Bock & Griffin, 2000).
Experiment 2: The Effects of Complexity over Time

If the prime is strong, then we should see continued priming over longer lags, i.e., when more filler items separate the two.

If we see less priming from embedded clauses when the lag is longer, then we can assume that context influences accessibility to the prime.
## Experiment 2: Design

<table>
<thead>
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<th>Example block 3-lag</th>
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<tbody>
<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>FILLER</td>
<td>FILLER</td>
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<tr>
<td>TARGET</td>
<td>FILLER</td>
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Experiment 2: Other design changes

Verbs:
Each verb occurred in both positions.
Total of 24 dative primes (12 matrix, 12 embedded).

Primes & Fillers:
Used only PD primes.
Used eight DO sentences with relative clauses as fillers.
- These sentences never occurred between a prime and target and did not use any of the test-item dative verbs.
Results: Experiment 2

- No effect of position
  \[ F(1, 58) = 0.25, \ p > .05 \]

- No effect of lag
  \[ F(1, 58) = 0.66, \ p > .05 \]

- No interaction position*lag
  \[ F(1, 58) = 0.75, \ p > .05 \]
Results: Experiment 2

People were just as likely to produce a PD completion regardless of the position of the prime or the number of intervening fillers.

<table>
<thead>
<tr>
<th>Lag</th>
<th>1</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embedded</td>
<td>49%</td>
<td>50%</td>
</tr>
<tr>
<td>Matrix</td>
<td>46%</td>
<td>47%</td>
</tr>
</tbody>
</table>
Discussion

- There was no significant decline in the amount of priming due to longer lag for primes in either matrix or embedded clauses.
- We cannot argue that embedding is a relevant characteristic affecting priming behavior.
Summary

- Priming effects appear to be independent of structural issues such as embedding.

- Perhaps whatever drives priming is independent of syntactic context, unlike other forms of linguistic behavior (e.g., pronoun resolution and anaphora) that are sensitive to syntactic context.

- But before we conclude this, we must first determine whether other features of the experimental design are hiding the effects of embedding.
Future Studies

Experiment 3: Extending to novel verbs

- Is priming as strong from each position when the prime’s and target’s verbs differ?
- **Change:** The target and prime will have different dative verbs.

Experiment 4: Extending to other contexts

- Is priming as strong when the prime’s and the target’s contexts don’t match?
- **Change:** The prime will occur in one position and the target will be in the other.
Final Summary

- Speakers seem to be primed regardless of whether the prime occurs in matrix or embedded position.
  - This offers support for the Context Doesn’t Matter theory at least for relative clauses and supports Brannigan et al. (2006).
  - However, the results do not discount Scheeper (2003). People may still be able to attend to and integrate information about embedding. To test this theory, we would need to determine whether speakers can form associations between alternations and embedding (e.g., if relative clause, then DO; otherwise, PD).
Thanks to . . .

- My advisors Brady Clark, Kay Bock, Matt Goldrick, and Sid Horton
- My colleagues in the Syntax and Meaning group at Northwestern University
- And the English language for having the dative alternation
Appendix: Filler Tasks

- Filler tasks included both READ and COMPLETE slides.
- There were 4 types of filler sentences/fragments: two-place predicates, where-clauses, object-raising, and object-control.
- The ordering of the nouns/adjectives for the filler tasks were counterbalanced within subjects.
Appendix: Filler Tasks

Examples:

- **Full sentence (READ slides)**-
  
  The librarian somehow convinced the researcher to be quiet.

- **Sentence fragment (COMPLETE slides)**-
  
  The foreign correspondent convinced . . .
  
  guard
  helpful
  BE
References


