Can experience with written language change mental grammar?

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Introduction
• It is a common assumption that spoken language is primary, writing being an optional add-on.

• But: Learning to read and write has a profound effect on speakers’ mental grammars (Dąbrowska in press; Dąbrowska, Pascual, and Macias Gomez-Estern in preparation).

• Dąbrowska (in press):
  • Writing enables speakers to produce and understand more complex syntactic structures.
  • Once the speaker has learned to produce a particular complex structure in writing, she will start using it in speech.

• This hypothesis makes two predictions:
  (i) Complex structures should be easier to process in the written modality than in the spoken modality.
  (ii) More experience with written language should facilitate processing such structures.

→ We will present an experimental study testing these predictions.
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- Clauses with complex subjects with an intervening NP that takes over agreement.

1. The key$_{SG}$ to the cabinets$_{PL}$ were$_{PL}$ lost.

   (Bock, Carreiras, and Meseguer 2012)

Such complex NP structures are considerably more frequent in writing than in speech (cf. J. Miller and Weinert 1998: 135-143).

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- **semantic & structural effects** that make agreement attraction more/less likely
  
  (e.g. Solomon and Pearlmutter 2004; Brehm and Bock 2013; Eberhard 1999; Vigliocco, Butterworth, and Semenza 1995; Humphreys and Bock 2005)

- **structural or linear processing** of agreement attraction structures?
  
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- Previous studies mainly had highly educated participants (often university students).

  Because of education-related differences in linguistic representation and processing (e.g. Dąbrowska 2012; Dąbrowska 2015; Huettig and Pickering 2019), the results may not generalize to other parts of the population.
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Our approach

Hypothesis I: education & acceptability ratings
High-ed participants will be better at detecting agreement attraction errors than low-ed participants.

Hypothesis II: education & production
High-ed participants will make fewer agreement attraction errors in production than low-ed participants.

Hypothesis III: modality
Agreement attraction errors are more easily detected in the written than in the spoken modality.
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The present study: Method
Design

The study includes 4 sentence types:

1. grammatical experimental items
   The \textit{structure}	extsubscript{SG} of the new \textit{buildings}	extsubscript{PL} \textit{is}	extsubscript{SG} fascinating.

2. ungrammatical experimental items
   The \textit{structure}	extsubscript{SG} of the new \textit{buildings}	extsubscript{PL} \textit{are}	extsubscript{PL} fascinating.

3. grammatical control items
   Why \textit{did} we not \textit{start} to pay attention to environmental issues earlier?

4. ungrammatical control items
   Why \textit{did} we not \textit{started} to pay attention to environmental issues earlier?
Design

Within participant variables
- experimental vs. control items
- grammatical vs. ungrammatical items

Between participant variables
- spoken vs. written modality
- high vs. low academic attainment

Tasks
1. acceptability judgment
2. production / recall task
Task 1: acceptability judgment

- 24 experimental items
  - 12 gr, 12 ugr
  - counterbalanced between participants
- 24 control items
  - (12 gr, 12 ugr),
  - counterbalanced between participants
- response: rating on a 7-point scale from least to most acceptable

Many examples of scientific research show how little we know about this world.
Task 2: recall

- sentence recall after the acceptability judgment, correcting the sentence, if necessary
- 4 items in each condition

To ensure that participants attended to the sentences
to obtain an agreement attraction error rate in production

Please enter the last sentence that you saw, correcting it if it was ungrammatical.
Participants & procedure

High-education group

- 75 high-ed participants:
- 1st year undergraduates studying literature or history

Low-education group

- 46 low-ed participants:
- students studying for a vocational qualification

Procedure

- online experiment
Results
Descriptive summary: control sentences

Results
Descriptive summary: control sentences
Descriptive summary: control sentences

Results

10/19
Descriptive summary: experimental sentences
Descriptive summary: experimental sentences

Results
To assess the association between ratings (7-point scale) and condition, grammaticality, group, and modality, we fitted an ordinal regression model using Bayesian methods with STAN in R using the brms package (Carpenter et al. 2017; R Core Team 2020; Bürkner 2017).

```
fit <- brm(rating ~ condition * gram * group * modality +
           (1 | participant) +
           (1 | item),
           family = "cumulative")
```
Ideally, the estimated proportions of ratings would follow these patterns:
Model estimates: experimental sentences

Results
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Results
Recall data: examples

(The participants always recalled the sentences in writing, independently of the modality of the stimulus.)

Example target sentence

(2)  \textbf{Concerns}^{PL} about employee \textbf{selection}^{SG} \textbf{are}^{PL} raised in many companies.

Examples of uncodable recalls

(3)  
\begin{itemize}
  \item a. “the concern of employees”
  \item b. “conscens^{PL} have^{PL} been raised in componays recently”
  \item c. “\textit{Employee}^{SG} \textit{selection}^{SG} \textit{raises}^{SG} \textit{concerns}^{PL} in many companies.”
\end{itemize}

Examples of codable recalls

(4)  
\begin{itemize}
  \item gr “\textbf{Concerns}^{PL} raised about \textbf{employee}^{SG} \textbf{selection}^{SG} \textbf{are}^{PL} prevalent in many work placements.”
  \item ugr “\textbf{Concerns}^{PL} about employee \textbf{selection}^{SG} \textbf{has}^{SG} been raised as an issue in many companies.”
\end{itemize}
(The participants always recalled the sentences in writing, independently of the modality of the stimulus.)

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(2) \( \text{gr } \text{Concerns}_{PL} \text{ about employee selection}_{SG} \text{ are}_{PL} \text{ raised in many companies.} \)

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Recall data: AGR attraction errors

Recalls of grammatical AGR sentences

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<tr>
<td></td>
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Recalls of ungrammatical, AGR attraction sentences

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- very high production error rates, particularly for low-ed participants
- for sentences with AGR attraction, high-ed participants did better in the written modality
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Discussion & Conclusion
Summary

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- High-ed participants will be better at detecting agreement attraction errors than low-ed participants.

✓ confirmed (ratings in task 1)

Hypothesis II: education & production

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Are AGR attraction errors really errors?

Rating of sentences with AGR-attraction errors

- participants accepted AGR attraction error items 54% / 90% of the time

Production (recall)

- participants had an error rate of 19% / 46%

“A syntactic error can be characterized as the distortion of an abstract relational structure that departs from speaker-intended structural relations.” (Bock 2011)

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Conclusion

Education

- We showed that education has a substantial effect on the detection and production of AGR attraction for native speakers of English.

Modality

- The written modality only facilitates the processing of such structures in the high-ed group.
  - critical mass of exemplars?

Does AGR attraction count as an error?

- In both groups, participants accepted and produced a relatively large number of AGR attraction errors.
  - Their status as errors is debatable.
Acknowledgments

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Thank you!
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Model estimates: control sentences

Appendix

20/19
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Appendix 20/19
To what extent do participants differ in their sensitivity to AGR attraction errors?

We can compare the proportions of items judged as acceptable (😊, 😉, 😊) for gr and ugr AGR items.

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59% of the low-ed participants either had no preference or preferred ugr AGR attraction sentences over GR ones.
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<tr>
<td>estimated proportion of AGR attraction recalls</td>
<td></td>
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</tr>
</tbody>
</table>