Syntactic Representations Remain Intact in Aging

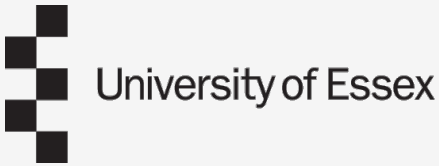
Evidence from Structural Comprehension Priming

Willem S. van Boxtel
&
Laurel A. Lawyer

University of Essex

Dept. of Language and Linguistics

April 30th, 2021



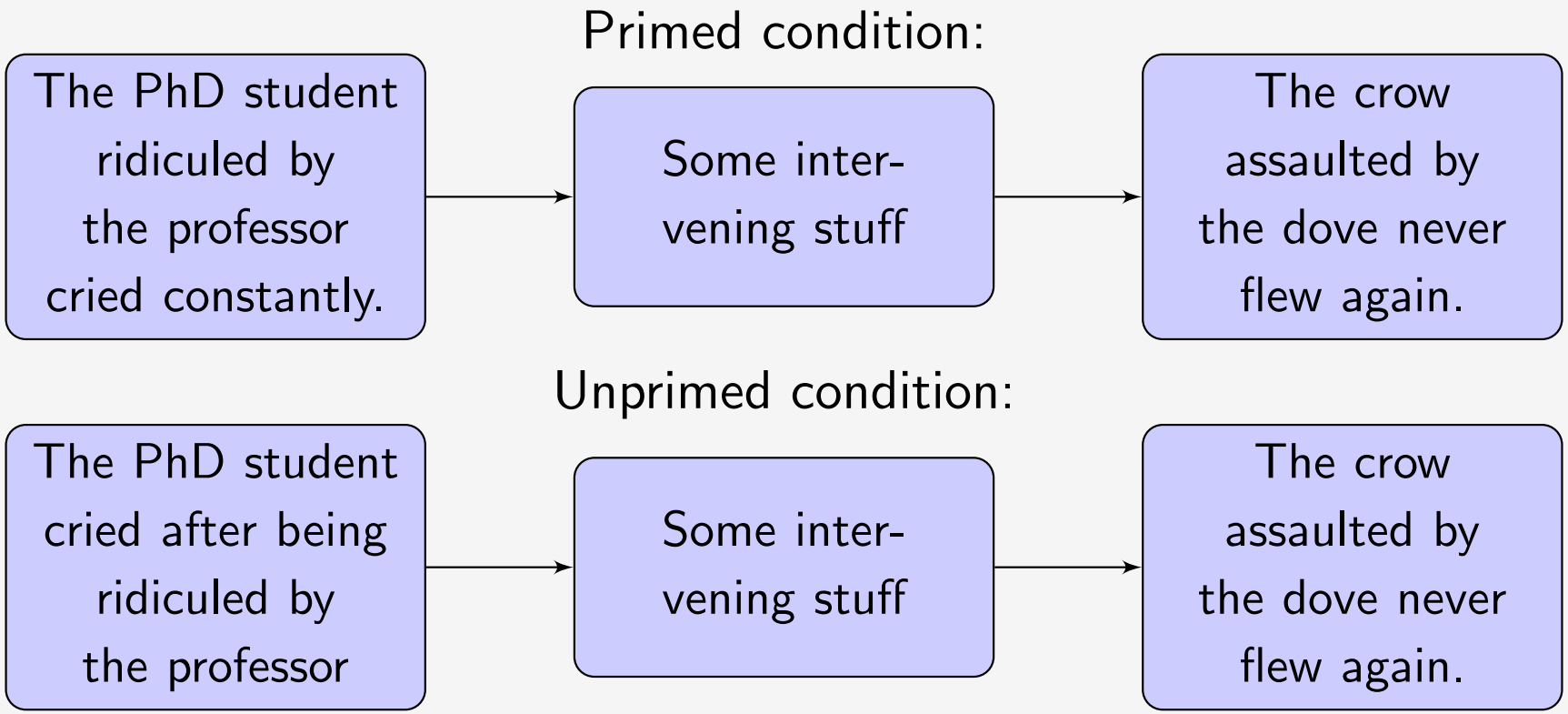
Contents

Syntax & Aging

- Syntax processing in aging:
  - Often thought of as (relatively) unimpaired (e.g. Obler et al., 1991) – but recent research disagrees (e.g. Poulisse et al., 2019)
  - Importance of Working Memory? (e.g. DeCaro et al., 2016)
  - Processing speed? (Salthouse, 1996)
- Language tasks involving *explicit* measures find greater delays (e.g. Sung et al., 2017; Bopp & Verhaeghen, 2005).

Syntactic Priming

Faster processing of structure experienced earlier in a sequence.
Importantly: relies on *implicit* knowledge/learning, not *explicit* recall.



Syntactic Priming (2)

Lexical boost:

- Facilitation increased by Prime–Target *lexical overlap*
- Considered short-lived, contrary to syntactic priming (e.g. Hartsuiker et al., 2008)

Models of syntactic priming:

- *Residual activation* of structures (Pickering & Branigan, 1998);
- *Implicit learning* (Chang et al., 2012);
- *Mixed* (Traxler et al., 2014).

Priming in Older Adults

Past research:

- Older adults show *intact* priming and lexical boost (e.g. Hardy et al., 2017,2020a,2020b).
- BUT: above studies investigated *production* priming, not *comprehension*
  - This leaves older adults' syntactic comprehension priming uninvestigated.

Research Questions & Hypotheses

Model Predictions

Model	*Priming*	*Boost*
Residual Activation	N	N
Implicit learning	Maybe	Maybe
Mixed	Maybe	N

Experimental Design

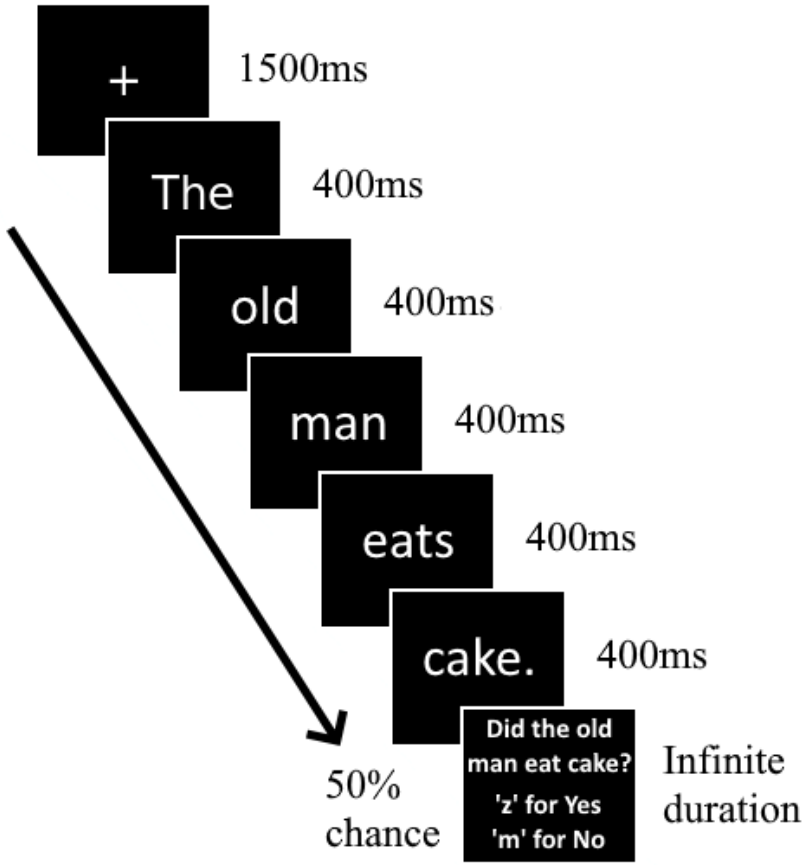
- 90 Prime–Filler–Filler–Target sequences
  - 30% primed, 30% primed + boosted, 30% unprimed
- Lexical repetition control condition (LCC) in Fillers.
- Self-paced reading paradigm, ran online:
- Two defined ROIs for each sentence (Target: NP, Spillover; LCC: Verb, Spillover):

The crow assaulted [by the dove]$_{\text{NP}}$ [never flew again.]$_{\text{Spillover}}$

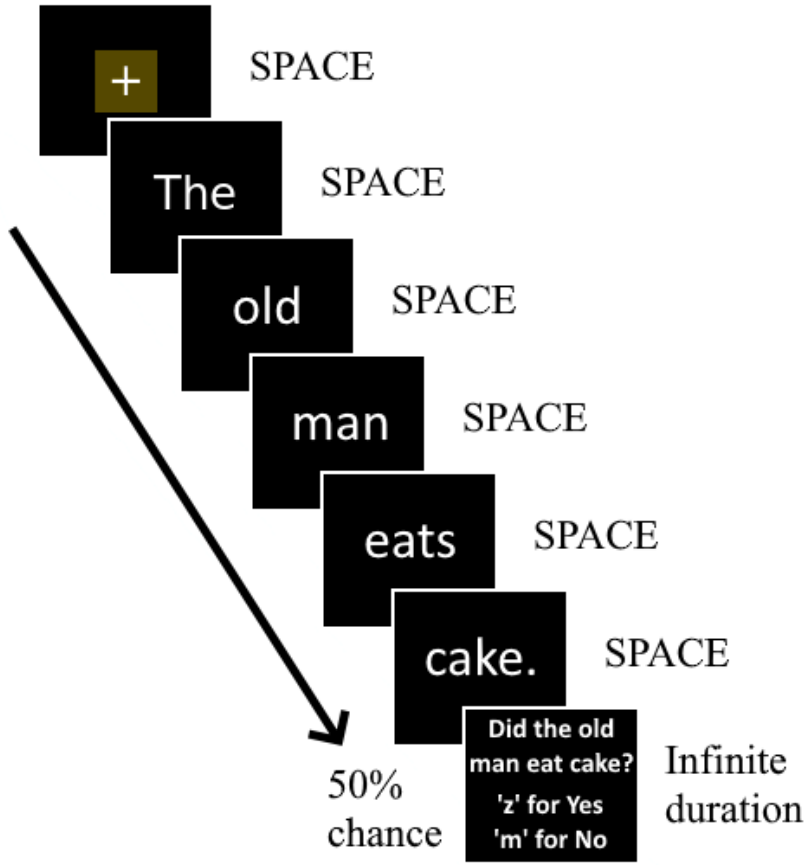
The vengeful man [plotted]$_{\text{Verb}}$ [the enemy's demise]$_{\text{Spillover}}$ yesterday.

Experimental Design (2)

Main Experiment Structure



(a) Externally-paced trials



(b) Self-paced trials

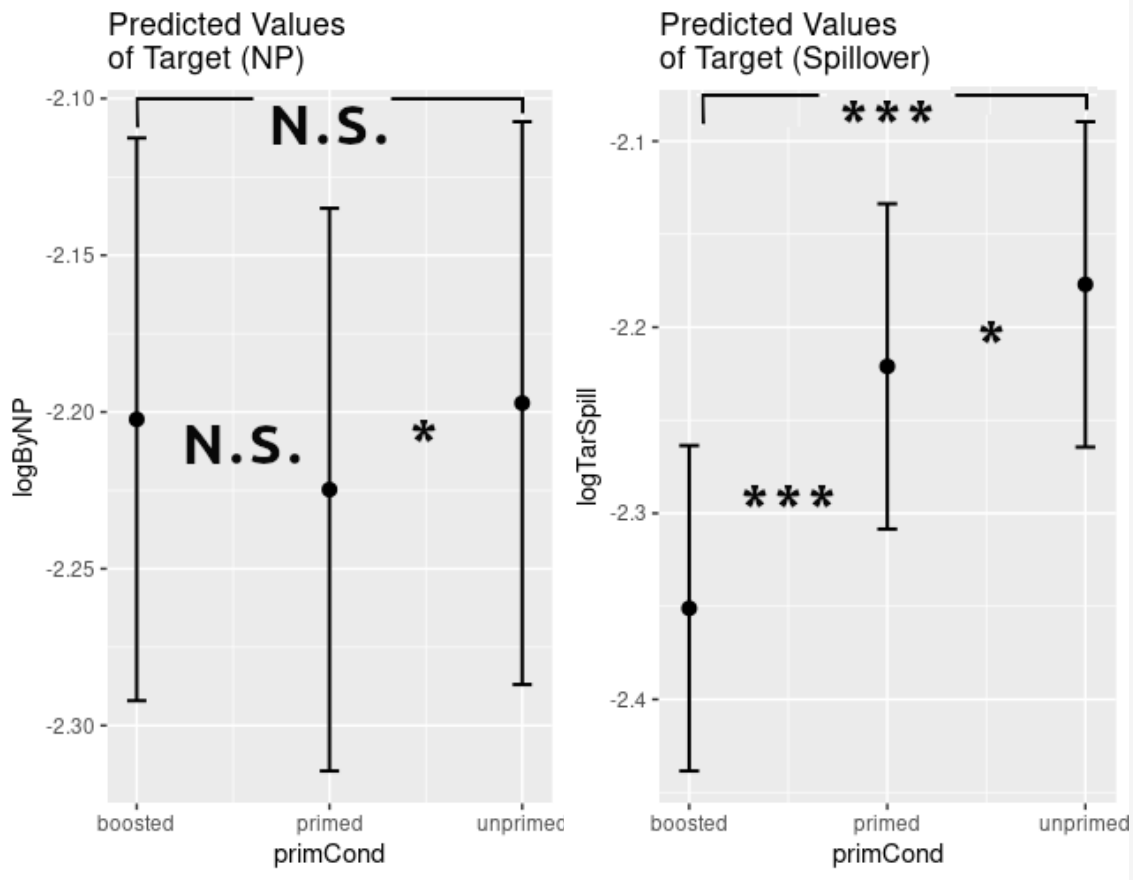
Participants

- 30 Older participants ($M_{\text{Age}} = 68.8$; SD $= 3.68$, [65,79]) took part, all passed data criteria for inclusion;
- Online study: payments through `prolific.co`;
- Attention measured with comprehension questions.

Age	$M = 68.8$, SD $= 3.68$
Gender	13 Female, 17 Male
Years in Education	$M = 15.03$, SD $= 3.35$
WM Span	$M = 21.98$, SD $= 6.94$
LCT Score	$M = 16.37$, SD $= 5.27$

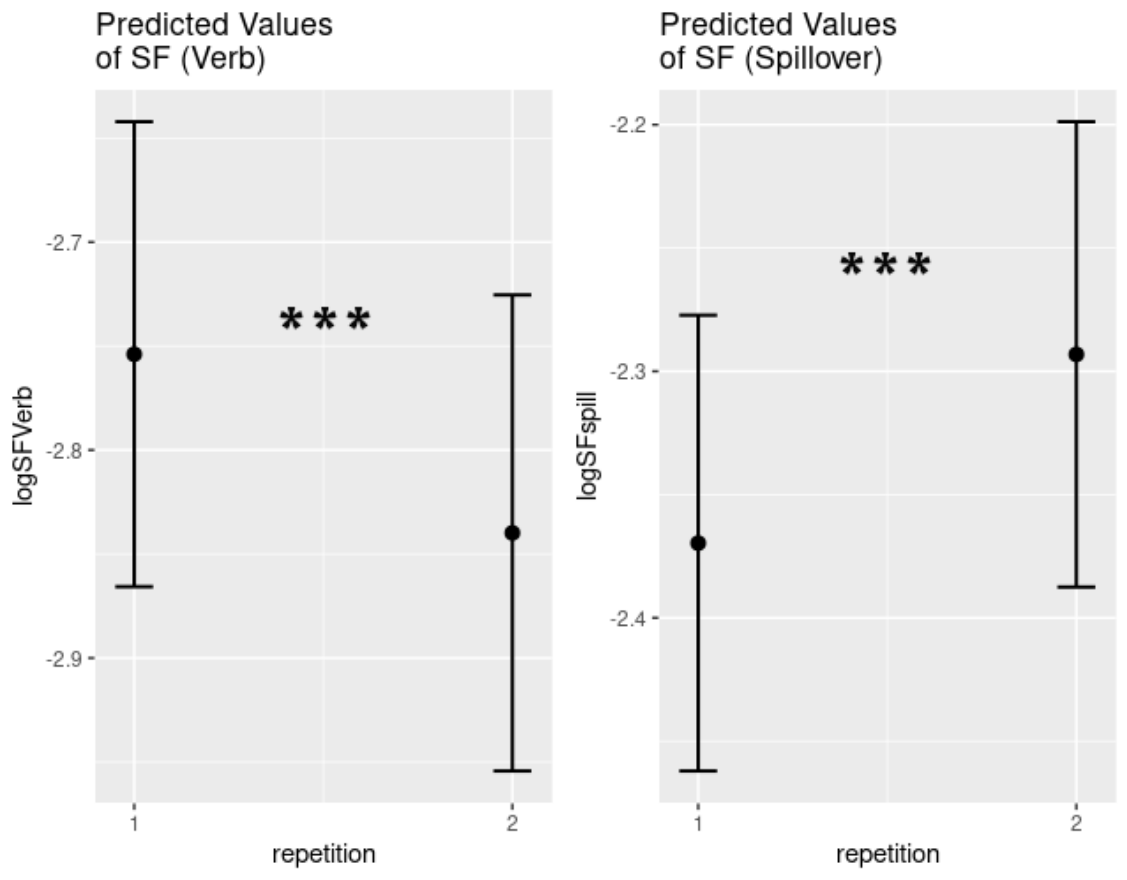
Table: Participant Demographics

Results: Priming



(a) Target (NP) (b) Target (Spillover)

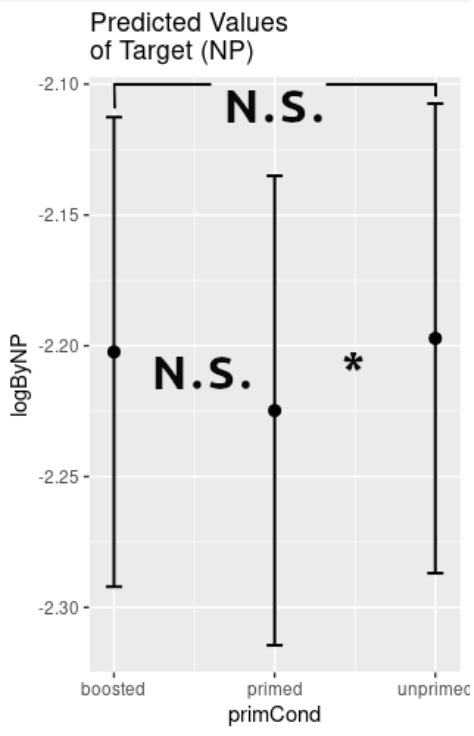
Results: Lexical Repetition



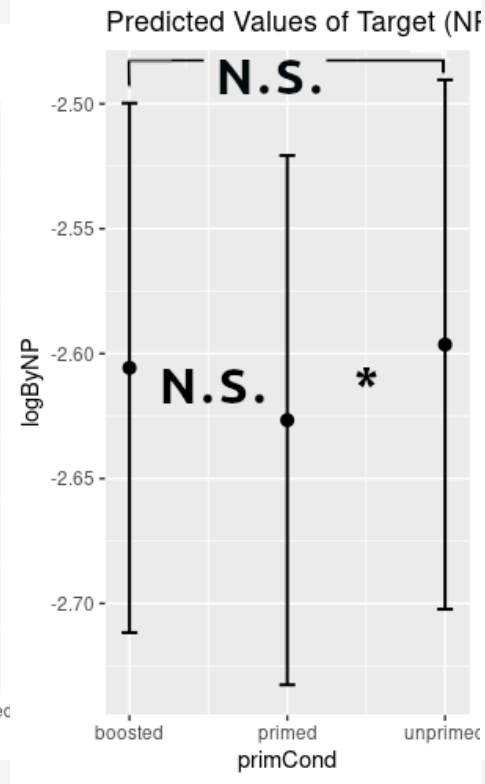
(a) LCC (Verb)

(b) LCC (Spillover)

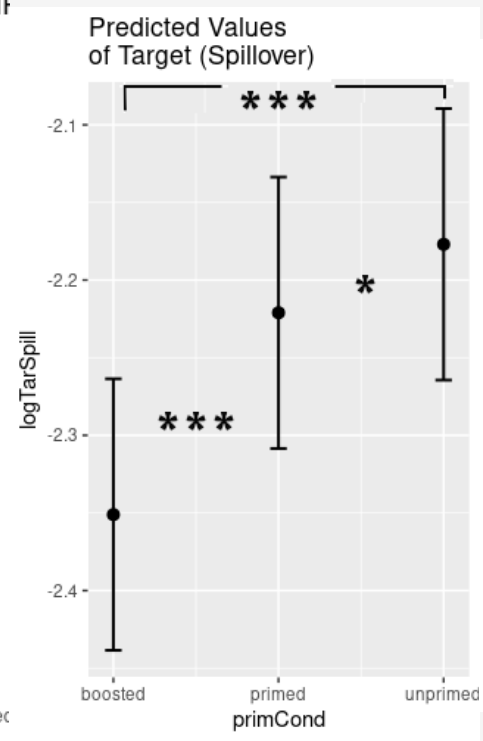
Younger Adult Comparison (Target)



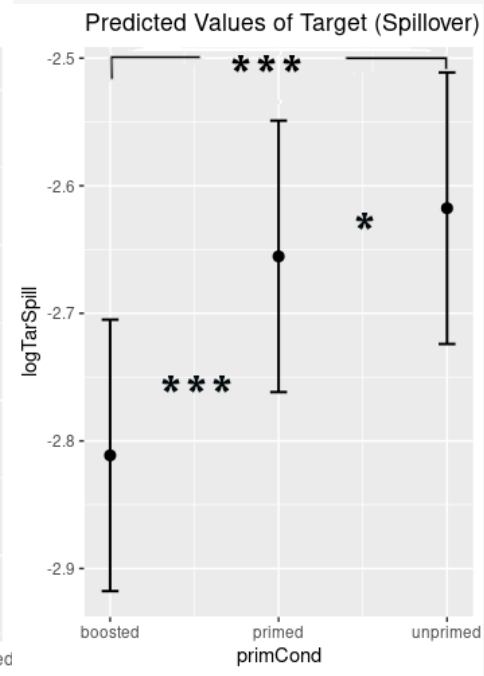
(a) Tar (NP) O



(b) Tar (NP) Y

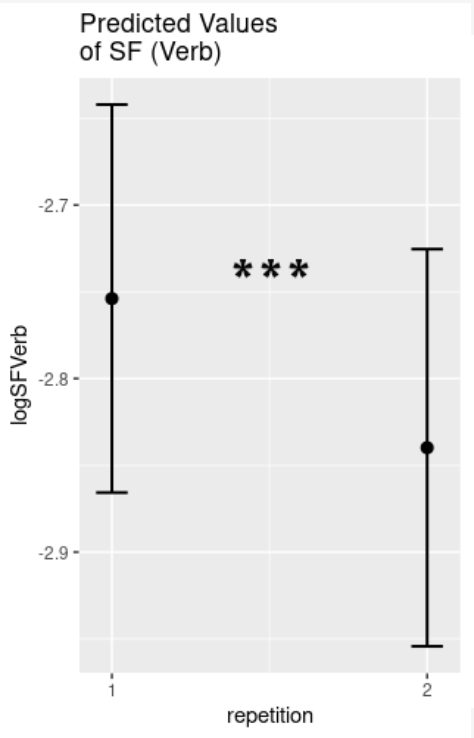


(c) Tar (Spill) O

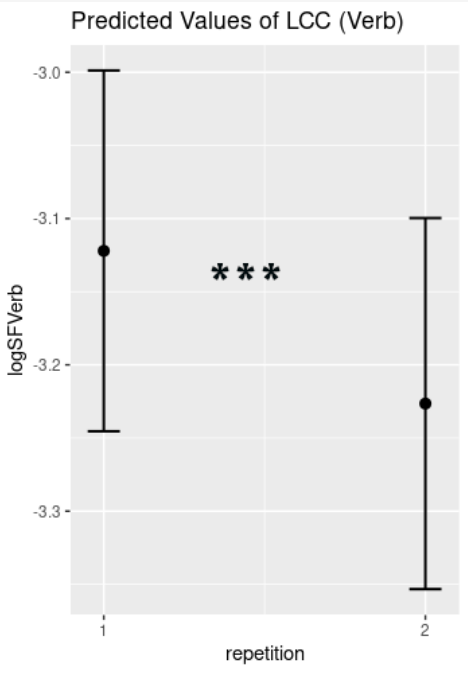


(d) Tar (Spill) Y

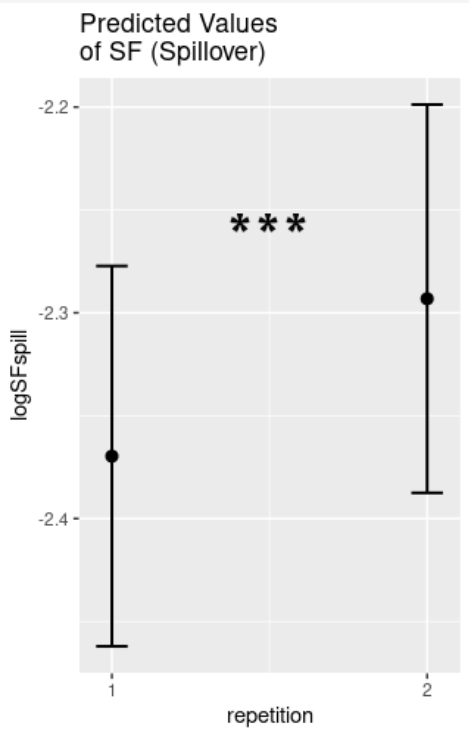
Younger Adult Comparison (LCC)



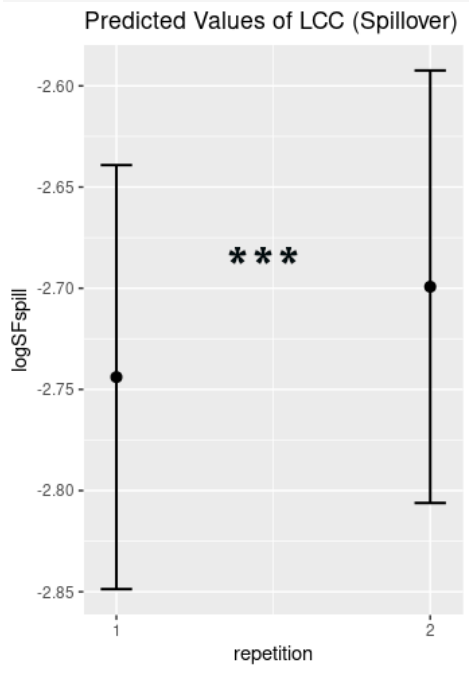
(a) LCC (Verb) O



(b) LCC (Verb) Y



(c) LCC (Verb) O



(d) LCC (Spill) Y

Implications (1)

Intactness of syntax:

- Implicit syntactic representations intact;
- Challenges result from traditional, explicit tasks;
- Persistence of the lexical boost.
- Conflicts *residual activation* (Pickering & Branigan, 1998), *implicit learning* (Chang et al., 2012), and *mixed* (Traxler et al., 2014) accounts of priming $\rightarrow$ adaptation account?

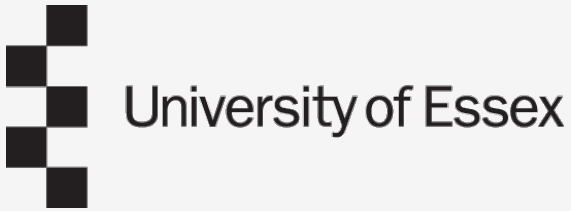
Model	*Priming*	*Boost*
Residual Activation	N	N
Implicit learning	Maybe	Maybe
Mixed	Maybe	N
Adaptation	Y	Y
Results	Y	Y

Implications (2)

No impact of WM or LCT:

- WM and LCT never improved model fit;
- Especially the LCT result is surprising.

Thank you for your attention!
Questions, comments: please ask, or contact me on
w.s.vanboxtel@essex.ac.uk or willemvanboxtel.eu



References

- Bopp, K. L. and Verhaeghen, P. (2005). Aging and Verbal Memory Span: A Meta-analysis. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 60(5):P223-P233.
- Chang, F., Janciauskas, M., and Fitz, H. (2012). Language Adaptation and Learning: Getting Explicit about Implicit Learning. *Language and Linguistics Compass*, 6(5):259-278.
- DeCaro, R., Peelle, J. E., Grossman, M., and Wingfield, A. (2016). The Two Sides of Sensory-Cognitive Interactions: Effects of Age, Hearing Acuity, and Working Memory Span on Sentence Comprehension. *Frontiers in Psychology*, 7:236.
- Friedman, N. P., and Miyake, A. (2004). The Reading Span Test and its Predictive Power for Reading Comprehension Ability. *Journal of Memory and Language*, 51(1), 136-58.
- Hardy, S. M., Messenger, K., and Maylor, E. A. (2017). Aging and Syntactic Representations: Evidence of Preserved Syntactic Priming and Lexical Boost. *Psychology and Aging*, 32(6):588.
- Hardy, S. M., Segaert, K., and Wheeldon, L. (2020a). Healthy Aging and Sentence Production: Disrupted Lexical Access in the Context of Intact Syntactic Planning. *Frontiers in Psychology*, 11:257.
- Hardy, S. M., Wheeldon, L., and Segaert, K. (2020b). Structural Priming is Determined by Global Syntax Rather Than Internal Phrasal Structure: Evidence from Young and Older Adults. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 46(4):720.
- Hartsuiker, R. J., Bernolet, S., Schoonbaert, S., Speybroeck, S., and Vanderelst, D. (2008). Syntactic Priming Persists while the Lexical Boost Decays: Evidence from Written and Spoken Dialogue. *Journal of Memory and Language*, 58(2):214-238.
- Jaeger, F.T., and Snider, N.E. (2013). Alignment as a Consequence of Expectation Adaptation: Syntactic Priming is Affected by the Prime's Prediction Error Given both Prior and Recent Experience. *Cognition*, 127(1): 57-83.
- Obler, L. K., Fein, D., Nicholas, M., and Albert, M. L. (1991). Auditory Comprehension and Aging: Decline in Syntactic Processing. *Applied Psycholinguistics*, 12(4):433-452.
- Pickering, M. J. and Branigan, H. P. (1998). The Representation of Verbs: Evidence from Syntactic Priming in Language Production. *Journal of Memory and Language*, 39(4):633-651.

References (2)

- Poulisse, C., Wheeldon, L., and Segaert, K. (2019). Evidence Against Preserved Syntactic Comprehension in Healthy Aging. *Journal of Experimental Psychology: Learning, Memory, and Cognition.*
- Salthouse, T. A. (1996). The Processing-Speed Theory of Adult Age Differences in Cognition. *Psychological Review*, 103(3):403.
- Salthouse, T. A. (1992). What Do Adult Age Differences in the Digit Symbol Substitution Test Reflect?. *Journal of Gerontology*, 47(3), P121-P128.
- Sung, J. E., Yoo, J. K., Lee, S. E., and Eom, B. (2017). Effects of Age, Working Memory, and Word Order on Passive-Sentence Comprehension: Evidence from a Verb-final Language. *International Psychogeriatrics*, 29(6):939.
- Traxler, M. J., Tooley, K. M., and Pickering, M. J. (2014). Syntactic Priming During Sentence Comprehension: Evidence for the Lexical Boost. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40(4):905.

Supplementary Data (1)

TARGET:

- Effects are strongest in Spillover and Whole-sentence regions:
  - Whole-Target: $t(2638) = 4.327$, $p < .0001$, $d = .168$;
  - Spillover: $t(2642) = 8.991$, $p < .0001$, $d = .350$;
  - NP: $t(2638) =$ -1.950, $p = .05$, $d = .040$.
- Whole-Target: Boosted-Primed ($p < .0001$), Boosted-Unprimed ($p < .0001$), Primed-Unprimed ($p = .594$);
- Spillover: All contrasts significant;
- NP: Boosted-Primed ($p = .125$), Boosted-Unprimed ($p = .894$), Primed-Unprimed ($p = .044$).

Supplementary Data (2)

LCC:

- Whole-SF: $t(1306) = \text{-}1.012$, $p = .312$, $d = \text{-}.056$;
- Verb: $t(1314) = \text{-}3.949$, $p < .0001$, $d = \text{-}.218$;
- Spillover: $t(1300) = \text{-}3.806$, $p = .0001$, $d = \text{-}.211$.

Contrasts only show expected effect in Spillover ($p = .0001$);
Verb: opposite effect (as in plot; $p = .0009$)
Whole-SF: $p = .312$.