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**An exemplar model should be able to explain all syntactic priming phenomena: A  
commentary on Ambridge (2020).**

We argue that Ambridge's radical exemplar account of language cannot clearly explain all syntactic priming evidence, such as inverse preference effects (*greater* priming for *less* frequent structures), and the contrast between short-lived lexical boost and long-lived abstract priming. Moreover, without recourse to a level of abstract syntactic structure, Ambridge's account cannot explain abstract priming in amnesia patients or cross-linguistic priming. Instead, we argue that abstract representations remain the more parsimonious account for the wide variety of syntactic priming phenomena.

Keywords:

sentence-level constructions; syntactic priming; abstract syntactic representations

Though there is currently no consensus over the exact mechanisms underlying syntactic priming – the phenomenon whereby people’s sentence processing is influenced by previously experienced syntactic structures – these effects have historically been viewed as key evidence that speakers store abstract representations of syntactic structure. This conclusion stems from evidence that priming occurs between language comprehension and production (Bock, Dell, Chang, & Onishi, 2007; Branigan, Pickering, Liversedge, Stewart, & Urbach, 1995) and in the absence of lexical or thematic overlap (Bock, 1989; Messenger, Branigan, McLean, & Sorace, 2012), suggesting a shared store of representations based on abstract syntax. Notably, sentences with similar surface features but different underlying syntax (e.g. prepositional datives vs infinitives: *Susan brought a book to Stella/Susan brought a book to study*) do not show priming (Bock & Loebell, 1990). Therefore, whether the purported mechanism of priming is residual activation of stored representations (Branigan & Pickering, 2017; Malhotra, Pickering, Branigan, & Bednar, 2008), error-based learning from syntactic prediction (Chang, Dell, & Bock, 2006) or a combination of the two (Reitter, Keller, & Moore, 2011; Segaert, Wheeldon, & Hagoort, 2016), all existing models of syntactic priming posit a layer of abstract syntactic representation in language processing.

By contrast, Ambridge (2019) argues that a radical exemplar model of language can explain syntactic priming effects without appealing to abstract syntactic representations. Within his account, processing a prime sentence activates concrete exemplars of similar sentences stored in a person’s memory. Priming occurs because, when the speaker analogises over exemplars to form a subsequent sentence, it is the prime exemplars that are more readily available for retrieval, having been recently activated. This model of priming might account for some effects, such as the increase in

priming in the presence of lexical overlap (i.e., lexical boost), however, we argue, it cannot easily explain the full range of syntactic priming phenomena, many of which implicate a role for abstract syntactic representations in language processing.

Priming effects are typically stronger for infrequently-experienced syntactic structures (Hartsuiker, Kolk, & Huiskamp, 1999; Jaeger & Snider, 2013). Error-based learning accounts most easily explain this *inverse frequency effect*: processing a prime sentence with an unexpected (low frequency) syntactic structure leads to a larger prediction error signal, increasing the weighting of that representation and consequently its likelihood of re-use (Chang et al., 2006). For frequently-experienced structures, the smaller prediction error signal makes priming less likely to occur. The exemplar model makes the opposite prediction: higher frequency structures would generate a greater number of stored exemplars to analogise over, increasing the likelihood of priming. It is not clear how low frequency structures, for which a speaker would have fewer stored exemplars, would lead to greater priming in this model.

Accounts of syntactic priming must also be able to explain observed differences in the timespan of syntactic priming effects. Lexically-mediated priming (lexical boost) is typically large but short-lived, whereas 'abstract' priming (where the source of priming is lexically-unrelated syntactic forms) is typically smaller but long-lasting (Bock & Griffin, 2000; Branigan & McLean, 2016; Hartsuiker, Bernolet, Schoonbaert, Speybroeck, & Vanderelst, 2008). The exemplar model provides a simple explanation for lexical boost effects, but does not address the different timespans of lexically-mediated and abstract priming. Whilst Ambridge discusses possible decay mechanisms for exemplar models, he does not apply this to the priming data. In fact, he rejects the notion of "abstraction-as-forgetting" (p.45) suggesting instead that exemplars are stored intact, though details may become inaccessible due to memory decay or

interference. In particular he claims that it is implausible that speakers retain an abstract representation of sentences following decay, but this is precisely what the priming evidence indicates: priming results specifically in long-lasting effects on abstract syntactic forms. To explain these differences, both residual activation and error-based learning accounts of syntactic priming suggest different memory systems serve different aspects of processing (Chang, Janciauskas, & Fitz, 2012; Malhotra et al., 2008). Short-term memory may support more immediate and explicit priming effects as in the case of lexical overlap, however abstract priming effects persist because they entail changes to the underlying representations stored in long-term memory.

Without recourse to a layer of abstract syntactic representations supporting language processing, an exemplar account cannot easily explain priming phenomena within particular groups of speakers. Patients with amnesia, such as Korsakoff's and anterograde amnesia, who have such profound impairments in declarative memory that they cannot formulate new concrete memories (i.e., exemplars), nonetheless show abstract syntactic priming (Ferreira, Bock, Wilson, & Cohen, 2008; Heyselaar, Segaert, Walvoort, Kessels, & Hagoort, 2017). Since amnesia patients have preserved non-declarative memory, such findings are typically explained by an account in which syntactic priming effects are predominantly supported by non-declarative memory systems (Chang et al., 2012). By contrast, these findings are not well-explained by an exemplar model in which syntax generation is primarily influenced by the retrieval of exemplars, stored within declarative memory.

Perhaps the most striking evidence that speakers represent syntactic information in abstract form comes from evidence of cross-linguistic syntactic priming in bilingual adults and children (Van Gompel & Arai, 2018). That is, processing a syntactic structure in one language can prime a bilingual speaker to use the same

structure in their other language (Kantola & van Gompel, 2011; Vasilyeva et al., 2010). Notably, this effect persists with very little surface similarity between the two languages, such as between Korean and English (Shin & Christianson, 2012) and Chinese and English (Chen, Jia, Wang, Dunlap, & Shin, 2013), or for structures that are grammatically possible in both languages, but rarely produced in one (such as prenominal adjectives in Spanish; Hsin, Legendre, & Omaki, 2013). Without experience of sentences that share some surface similarity, these cross-linguistic syntactic priming effects are hard to explain in an exemplar model. Syntactic structure is the only aspect that is shared between cross-linguistic primes and targets, providing the strongest evidence that speakers store abstract representations of syntax.

In sum, the radical exemplar model of syntactic processing cannot clearly explain the wide range of observed priming effects. Of course, work is still needed to clarify the exact nature of the mechanisms and representations that support language processing and explain priming effects, but the exemplar model is no more immune to these issues than other existing models. Furthermore, it must address the range of findings presented here in order to provide a viable explanation of syntactic priming. Based on the evidence discussed, we suggest that to discount accounts in which speakers store abstract syntactic representations in long-term memory would be to discount a more parsimonious way of explaining human sentence processing.

## References

- Ambridge, B. (2019). Against stored abstractions: A radical exemplar model of language acquisition. *First Language*.
- Bock, K. (1989). Closed-class immanence in sentence production. *Cognition*, 31(2), 163–186. [https://doi.org/https://doi.org/10.1016/0010-0277\(89\)90022-X](https://doi.org/https://doi.org/10.1016/0010-0277(89)90022-X)

- Bock, K., Dell, G. S., Chang, F., & Onishi, K. H. (2007). Persistent structural priming from language comprehension to language production. *Cognition*, *104*(3), 437–458.  
<https://doi.org/https://doi.org/10.1016/j.cognition.2006.07.003>
- Bock, K., & Griffin, Z. M. (2000). The persistence of structural priming: transient activation or implicit learning? *Journal of Experimental Psychology: General*, *129*(2), 177–192.
- Bock, K., & Loebell, H. (1990). Framing sentences. *Cognition*, *35*(1), 1–39.  
[https://doi.org/https://doi.org/10.1016/0010-0277\(90\)90035-I](https://doi.org/https://doi.org/10.1016/0010-0277(90)90035-I)
- Branigan, H. P., & McLean, J. F. (2016). What children learn from adults' utterances: An ephemeral lexical boost and persistent syntactic priming in adult–child dialogue. *Journal of Memory and Language*, *91*, 141–157.  
<https://doi.org/https://doi.org/10.1016/j.jml.2016.02.002>
- Branigan, H. P., & Pickering, M. J. (2017). Structural priming and the representation of language. *Behavioral and Brain Sciences*, *40*, e313.  
<https://doi.org/10.1017/S0140525X17001212>
- Branigan, H. P., Pickering, M. J., Liversedge, S. P., Stewart, A. J., & Urbach, T. P. (1995). Syntactic priming: Investigating the mental representation of language. *Journal of Psycholinguistic Research*, *24*, 489–506.
- Chang, F., Dell, G. S., & Bock, K. (2006). Becoming syntactic. *Psychological Review*, *113*(2), 234–272.
- Chang, F., Janciauskas, M., & Fitz, H. (2012). Language adaptation and learning: Getting explicit about implicit learning. *Language and Linguistics Compass*, *6*/5, 259–278.
- Chen, B., Jia, Y., Wang, Z., Dunlap, S., & Shin, J.-A. (2013). Is word-order similarity necessary for cross-linguistic structural priming? *Second Language Research*, *29*(4), 375–389. <https://doi.org/10.1177/0267658313491962>

- Ferreira, V. S., Bock, K., Wilson, M. P., & Cohen, N. J. (2008). Memory for Syntax Despite Amnesia. *Psychological Science*, *19*(9), 940–946. <https://doi.org/10.1111/j.1467-9280.2008.02180.x>
- Hartsuiker, R. J., Bernolet, S., Schoonbaert, S., Speybroeck, S., & 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. <https://doi.org/https://doi.org/10.1016/j.jml.2007.07.003>
- Hartsuiker, R. J., Kolk, H. H. J., & Huiskamp, P. (1999). Priming word order in sentence production. *Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology*, *52*(1), 129–147. <https://doi.org/10.1080/713755798>
- Heyselaar, E., Segaert, K., Walvoort, S. J. W., Kessels, R. P. C., & Hagoort, P. (2017). The role of nondeclarative memory in the skill for language: Evidence from syntactic priming in patients with amnesia. *Neuropsychologia*, *101*, 97–105. <https://doi.org/10.1016/J.NEUROPSYCHOLOGIA.2017.04.033>
- Hsin, L., Legendre, G., & Omaki, A. (2013). Priming cross-linguistic interference in Spanish-English bilingual children. In S. Baiz, N. Goldman, & R. Hawkes (Eds.), *BUCLD 37: Proceedings of the 37th annual Boston University Conference on Language Development* (pp. 165–177). Somerville MA: Cascadilla Press.
- Jaeger, T. F., & 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. <https://doi.org/https://doi.org/10.1016/j.cognition.2012.10.013>
- Kantola, L., & van Gompel, R. P. G. (2011). Between- and within-language priming is the same: Evidence for shared bilingual syntactic representations. *Memory & Cognition*, *39*(2), 276–290. <https://doi.org/10.3758/s13421-010-0016-5>



- Malhotra, G., Pickering, M. J., Branigan, H. P., & Bednar, J. A. (2008). On the persistence of structural priming: Mechanisms of decay and influence of word-forms. In B. C. Love, K. McRae, & V. M. Sloutsky (Eds.), *Proceedings of the 30th annual conference of the cognitive science society, Cognitive Science Society*, (pp. 657–662). Austin, TX.
- Messenger, K., Branigan, H. P., McLean, J. F., & Sorace, A. (2012). Is young children's passive syntax semantically constrained? Evidence from syntactic priming. *Journal of Memory and Language*, 66(4), 568–587.  
<https://doi.org/10.1016/j.jml.2012.03.008>
- Reitter, D., Keller, F., & Moore, J. D. (2011). A Computational cognitive model of syntactic priming. *Cognitive Science*, 35(4), 587–637. <https://doi.org/10.1111/j.1551-6709.2010.01165.x>
- Segaert, K., Wheeldon, L., & Hagoort, P. (2016). Unifying structural priming effects on syntactic choices and timing of sentence generation. *Journal of Memory and Language*, 91, 59–80. <https://doi.org/10.1016/J.JML.2016.03.011>
- Shin, J. A., & Christianson, K. (2012). Structural priming and second language learning. *Language Learning*, 62(3), 931–964. <https://doi.org/10.1111/j.1467-9922.2011.00657.x>
- Van Gompel, R. P. G., & Arai, M. (2018). Structural priming in bilinguals. *Bilingualism: Language and Cognition*, 21(3), 448–455.  
<https://doi.org/10.1017/S1366728917000542>
- Vasilyeva, M., Waterfall, H., Gámez, P. B., Gómez, L. E., Bowers, E., & Shimpi, P. M. (2010). Cross-linguistic syntactic priming in bilingual children. *Journal of Child Language*, 37(5), 1047–1064. <https://doi.org/10.1017/S0305000909990213>