

Are there segmental and tonal effects on syntactic encoding? Evidence from structural priming in Mandarin

Chi Zhang (Ghent University), Sarah Bernolet (University of Antwerp), Robert J. Hartsuiker (Ghent University)

Numerous studies have established that speakers tend to form utterances by reusing previously experienced sentence structures (i.e., structural priming, Bock, 1986). Repetition of lexical items enhances such structural priming (i.e., lexical boost, Pickering & Branigan, 1998). This facilitation effect occurs not only when there is a full overlap of verbs, but also when one level of the lexical representation (semantic or phonological representation) overlaps between the prime and the target (e.g., Santesteban, Pickering, & McLean, 2010). It is unclear however which levels of representation drive the phonological boost, as the critical items in alphabetic languages like Dutch and English (e.g., *bat*[animal] – *bat*[sports]) overlap in orthography as well as phonology. Further, studies in these languages did not tease apart effects of segmental overlap and overlap in metrical structure. Here, we used Mandarin to scrutinize phonological effects on structural priming. This logographic language allowed us to test whether the phonological boost is independent of orthographic overlap, and whether it is driven by overlap of segments, tone, or both.

In five structural priming experiments (three lab-based, two web-based experiments), native Mandarin speakers described transitive pictures after receiving SVO or SOV “ba” prime sentences (see Table 1). In Experiment 1 ($n = 40$), prime and target verbs had lexical overlap (e.g., 脱[tuo1, to take off]-脱[tuo1], 1a-b), semantic overlap (e.g., 卸[xie4, to remove]-脱[tuo1], 2a-b), phonological overlap (e.g., 拖[tuo1, to mop]-脱[tuo1], 3a-b), or no overlap (e.g., 洗[xi3, to wash]-脱[tuo1], 4a-b) while similarities at other levels were carefully avoided. The phonological overlap condition consisted of verb pairs that overlapped in their full phonological representation or only overlapped in syllable. There was an overall structural priming (16.4%) and a lexical boost (14.8%, see Fig.1A), but semantic or phonological overlap did not boost priming (non-significant modulation of priming for semantic overlap = 2.5%; phonological overlap = -3.9%).

The next two experiments tested the full phonological boost and segmental boost effects in a lab-based experiment (Experiment 2a; $n = 72$) and a large-scale online replication (Experiment 2b; $n = 216$). Verbs in prime and target had full phonological overlap (segmental+tonal, e.g., 拖[tuo1]-脱[tuo1], 1a-b), syllabic overlap only (e.g., 驮[tuo2, to carry]-脱[tuo1], 5a-b), or no overlap. Both experiments showed significant overall structural priming (18.6% and 34.0%) and a boost from full phonological overlap (full phonological boost = 4.9% and 8.0%, see Fig.1B). The effect of syllabic overlap (3.3%) was not significant in Experiment 2a. However, more decisive evidence for a syllabic boost effect (6.5%) was found in the well-powered online replication.

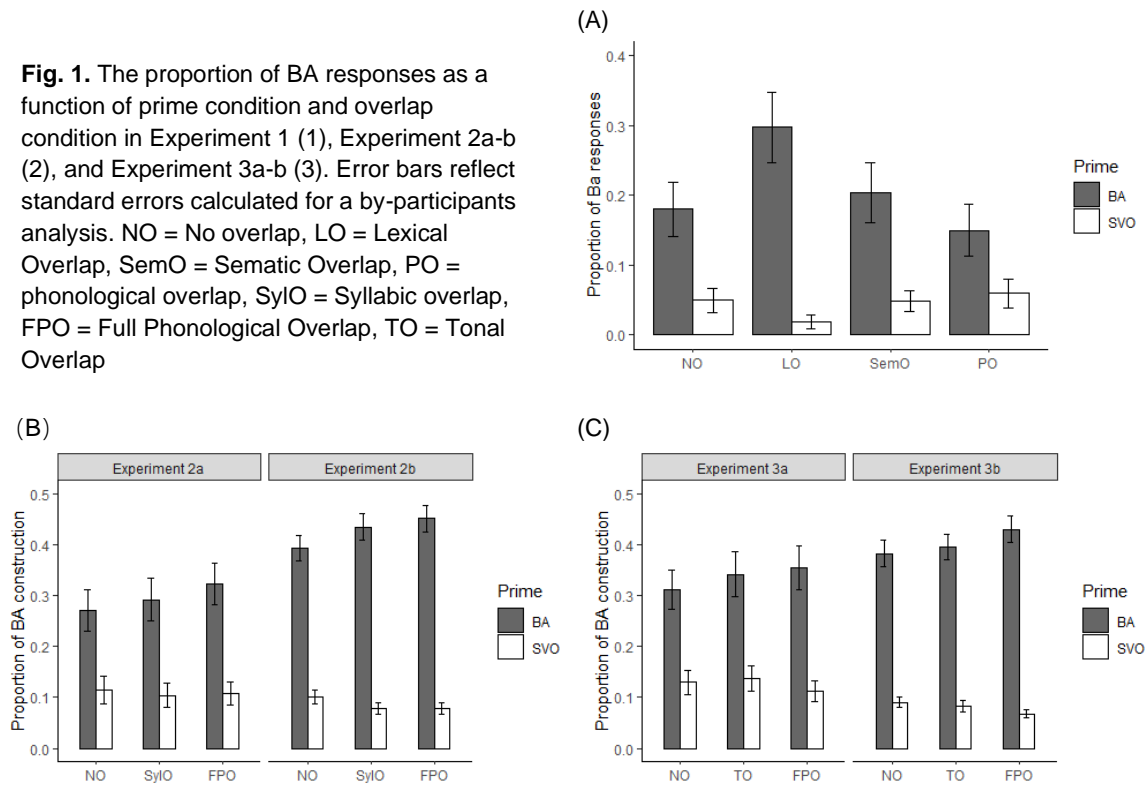
Experiments 3a-b ($n = 72$; $n = 216$) replicated Experiments 2a-b but replaced the syllabic-only condition with a tonal-only condition (称[cheng1, to weigh]-脱[tuo1], 6a-b). The facilitation effect of full phonological overlap was replicated in both experiments (full phonological boost effect = 5.9% and 7.1%, see Fig.1C), demonstrating once more that there is a phonological boost on priming even in the absence of orthographic overlap. However, no evidence of a tonal overlap effect was observed (tonal boost effect = 2.2% and 2.1%).

Together, these results indicate that processing at the phonological level feeds back to syntactic encoding in sentence production, which further supports an interactive view of language production. Phonological feedback effects on syntactic choice seem to be restricted to feedback from the syllabic level. We speculate that this is because feedback from the metrical level (tone) is less specific than syllabic feedback; an activated representation of tone would feed back to thousands of word forms sharing that tone, whereas a syllable would feed back to only a few.

Table 1: Exemplar prime sentences in each condition. The corresponding to a target picture that depicts a secretary taking off a jacket.

Exemplar SVO prime sentence		Exemplar SOV "ba" prime sentence	
(1a)	<i>Mama tuo1-LE yurongfu.</i> Mum take-off-LE the down jacket. [Mum took off the down jacket.]	(1b)	<i>Mama BA yurongfu tuo1-LE.</i> Mum BA the down jacket take-off-LE. [Mum took off the down jacket.]
(2a)	<i>Shibing xie4-LE toukui.</i> The soldier remove-LE the helmet. [The soldier removed the helmet.]	(2b)	<i>Shibing BA toukui xie4-LE.</i> The soldier BA the helmet remove-LE. [The soldier removed the helmet.]
(3a)	<i>Qingjiegong tuo1-LE yangtai.</i> The cleaner mop-LE the balcony. [The cleaner mopped the balcony.]	(3b)	<i>Qingjiegong BA yangtai tuo1-LE.</i> The cleaner BA the balcony mop-LE. [The cleaner mopped the balcony.]
(4a)	<i>Siji xi3-LE che</i> The driver wash-LE the car [The driver washed the car.]	(4b)	<i>Siji BA che xi3-LE.</i> The driver BA the car wash-LE. [The driver washed the car.]
(5a)	<i>Xiaoniao tuo2-LE shuiguo.</i> The bird carry-LE the fruit. [The bird carried the fruit.]	(5b)	<i>Xiaoniao BA shuiguo tuo2-LE.</i> The bird BA the fruit carry-LE. [The bird carried the fruit.]
(6a)	<i>Hushi cheng1-LE ying'er.</i> The nurse weigh-LE the baby. [The nurse weighed the baby.]	(6b)	<i>Hushi BA ying'er cheng1-LE.</i> The nurse BA the baby weight-LE. [The nurse weighed the baby.]

Fig. 1. The proportion of BA responses as a function of prime condition and overlap condition in Experiment 1 (1), Experiment 2a-b (2), and Experiment 3a-b (3). Error bars reflect standard errors calculated for a by-participants analysis. NO = No overlap, LO = Lexical Overlap, SemO = Semantic Overlap, PO = phonological overlap, SyO = Syllabic overlap, FPO = Full Phonological Overlap, TO = Tonal Overlap



References

- Bock, K. (1986). Syntactic persistence in language production. *Cognitive Psychology*, 18(3), 355-387. [https://doi.org/10.1016/0010-0285\(86\)90004-6](https://doi.org/10.1016/0010-0285(86)90004-6)
- Pickering, M. J., & Branigan, H. P. (1998). The representation of verbs: Evidence from syntactic priming in language production. *Journal of Memory and Language*, 39(4), 633-651. <https://doi.org/10.1006/jmla.1998.2592>
- Santesteban, M., Pickering, M. J., & McLean, J. F. (2010). Lexical and phonological effects on syntactic processing: Evidence from syntactic priming. *Journal of Memory and Language*, 63(3), 347-366. <https://doi.org/10.1016/j.jml.2010.07.001>