

How do structural predictions operate between languages for multilinguals? Evidence from cross-language structural priming in comprehension

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Many studies showed cross-language structural priming effects: in particular, speakers tended to re-use the prime structure in a target sentence after processing the prime in a different language. This suggests that multilinguals have a syntactic representation that is shared across their languages or separate but interacting representations for each language. Here we ask whether multilinguals can rely on such language non-specific representations to predict structure in language *comprehension*.

To answer this question, we conducted two visual-world eye-tracking priming experiments with multilinguals (Cantonese-L1, Mandarin-L2, English-L3, see **Table 1** for their language background). Participants were instructed to read aloud prime sentences in either Cantonese, Mandarin, or English; then they heard a target sentence in Mandarin while looking at the corresponding target picture. The sentences either had a double object (DO) structure (e.g., “Gushou di **You**chai yizhang **You**piao”, the drummer passed the mailman a stamp) or a prepositional object (PO) structure (e.g., “Gushou di **You**piao gei **You**chai”, the drummer passed a stamp to the mailman); Note that in the DO, the verb is followed by the recipient (“Youchai”, mailman), whereas in the PO, the verb is followed by the theme (“Youpiao”, stamp). The priming effect is expressed as the proportion of looks to the predicted referent (i.e., the recipient after a DO-prime, the theme after a PO-prime), for two critical time windows during target sentence processing: the verb and the first syllable of the first post-verbal noun (which was identical in theme and recipient). We performed both traditional time-window analysis with linear mixed models and cluster-based permutation analysis for each time window.

In Experiment 1 (N=72), we used six prime verbs that differed in their bias for DO and PO (verb bias) in each language and four relatively unbiased target verbs in Mandarin. There was within-language structural priming only (from Mandarin to Mandarin, see **Figure 1A**). There was no interaction between verb bias and prime structure. In Experiment 2 (N=72), we held the verb in prime and target constant (i.e., the verb was identical between prime and target within Mandarin, shared meaning, orthography and partly phonology in Cantonese and Mandarin, and shared meaning in English and Mandarin). Now there was not only within-language priming but also between-language priming, albeit only from Cantonese to Mandarin (see **Figure 1B**). Interestingly, the within-language priming was comparable to the between-languages priming (Mandarin-to-Mandarin vs. Cantonese-to-Mandarin; Panels B1 vs. B2 in **Figure 1B**). Additionally, these two priming effects were stronger and longer lasting with constant verbs between prime and target in Experiment 2 than with different verbs in Experiment 1 (Panels A1 vs. B1; A2 vs. B2 in **Figure 1**).

These results indicated that the structure prediction system in comprehension when faced with multiple languages: 1) is independent, so that prediction errors within a specific language do not generalize to another language; 2) is at least partly lexically-based, so that cross-linguistic structural priming only occurred with cognate verbs. We interpret the cross-linguistic priming with cognate verbs in terms of a lexicalist shared-syntax account (Huang et al., 2019). This account assumes that there is a link between the lemmas of cognate verbs in Mandarin and Cantonese (e.g., “di-dai”) and that both lemmas are connected to the shared combinatorial node of structure (e.g., DO); Because of the co-activation of cognate verb lemmas, the repeatedly activated lemma of the target verb can serve as a cue to retrieve the representation of prime structure in the prediction of the target sentence.

Table 1

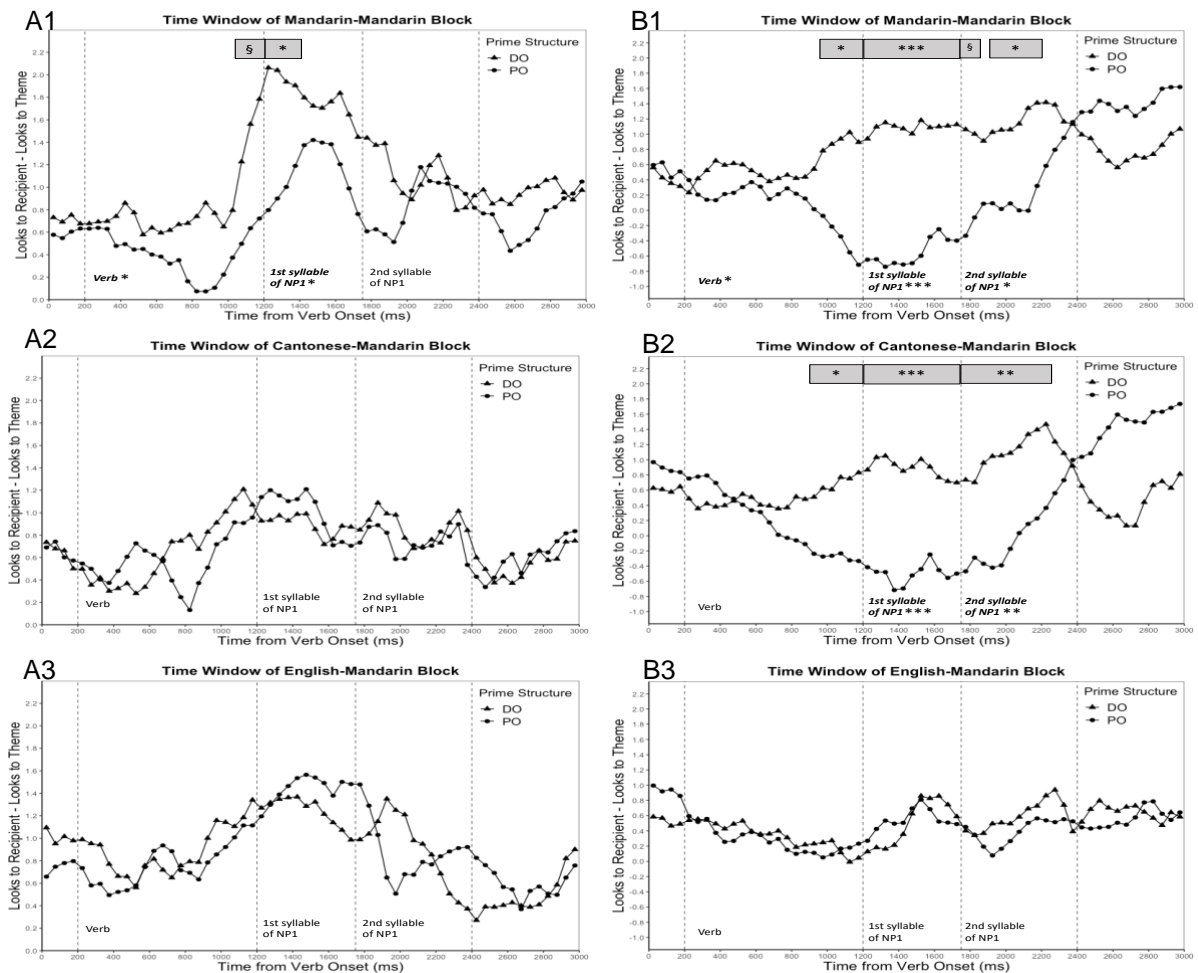
Language background self-ratings and Lextale scores of English in Experiments 1 and 2

Language background	Experiment 1			Experiment 2		
	Cantonese	Mandarin	English	Cantonese	Mandarin	English
Listening	8.86(1.30)	9.18(1.00)	6.39(1.04)	8.47(1.27)	9.01(0.93)	6.35(1.15)
Reading	8.21(1.44)	9.24(0.94)	6.96(1.09)	7.96(1.42)	9.14(0.88)	6.92(1.17)
Speaking Fluency	8.46(1.35)	8.96(1.05)	6.49(1.07)	8.06(1.39)	8.96(1.12)	6.46(1.27)
Speaking Pronunciation	8.01(1.47)	8.18(1.13)	6.90(1.04)	7.71(1.34)	8.40(1.12)	6.96(1.27)
General Proficiency	4.24(0.83)	4.58(0.55)	3.32(0.55)	4.14(0.81)	4.69(0.52)	3.32(0.69)
Age of acquisition (AOA)	-	2.85(2.07)	6.08(2.02)	-	2.97(2.27)	6.65(2.18)
Lextale	-	-	69.17(8.62)	-	-	70.17(10.10)

Note. We tested participants' language proficiency with both self-rating language questionnaire (for Cantonese, Mandarin and English, a 10-point scale (1=very poor, 10=very proficient) on their proficiency of sub-categories; a 5-point scale (1=very poor, 5=very proficient) on their general proficiency) and Lextale test (for English only, see Lemhöfer & Broersma, 2012). Their rating of listening, reading, speaking fluency and general proficiency for Mandarin was higher than both Cantonese and English ($p < .001$), and Cantonese was higher than English ($p < .001$), except that their rating of speaking pronunciation for Mandarin was similar to Cantonese in Experiment 1 and both of them were higher than English ($p < .001$).

Figure 1

Difference in proportion of looks to recipient and theme for each time bin (50ms) from onset of target verb in three language blocks of Experiment 1 and 2



Note. The time window of verb is from 200ms to 1200ms and the time window of the first syllable of the first noun phrase is from 1200ms to 1750ms. The unambiguous time window of the second syllable of first noun phrase is from 1750ms to 3600ms. Six plots indicate the difference in the proportions of looks to recipient (predicting DO structure) and to theme (predicting PO structure) after prime sentences with different structure (DO vs. PO) in Experiment 1 when the prime and target have different verbs (A1, A2, A3 on the left) and in Experiment 2 when prime and target shared the translation-equivalent verbs (B1, B2, B3 on the right). The first two plots (A1, B1) suggest the priming effect for within-language block of Mandarin. The following four plots suggest the priming effect for between-languages blocks of Cantonese-to-Mandarin (A2, B2) and English-to-Mandarin (A3, B3). The label of time window (i.e., in italic) indicates significant priming effect. The grey rectangles within the time windows indicate the clusters (by-subject) where the main effect of structure was significant. $^{\$}p < .1$, $*p < .05$, $**p < .01$, $***p < .001$.