The top down role of grammatical knowledge during Mandarin-English code-switching

In the bilingual mind, do the same sentence processing mechanisms operate for monolingual and mixed-language input, containing code-switches? Here we queried the top down role of grammatical knowledge in rapid reading of full sentences, during which certain word order errors can go unnoticed. Specifically, when the inner two words of a four-word sentence are transposed, the processor may treat the sentence as grammatical (Pegado & Grainger, 2020). This is evidenced by the replication of the so-called sentence superiority effect (SSE) for such inner transpositions: Behavioral responses are facilitated both for rapidly flashed grammatical sentences and for inner transpositions, as compared to fully scrambled sentences. This has been referred to as the so-called transposed word effect (TWE) (Asano & Yokosawa, 2011; Snell & Grainger, 2017; Mirault et al., 2018).

While the basic SSE has been demonstrated for code-switching expressions (Declerck et al., 2020) and the TWE has been replicated for monolingual Mandarin sentences (Liu et al., 2020), the top-down role of grammatical knowledge as revealed by the TWE has not been investigated for code-switching. We tested this for 28 Mandarin-Chinese bilinguals who read grammatical sentences, inner transpositions and fully scrambled English, Mandarin, Engl-Mand and Mand-Engl sentences flashed all at once in rapid parallel visual presentation (RPVP) for 300ms (see Table 1 & Figure 1). Our interest was in fully automatic processing, and thus unlike prior TWE studies on Chinese, we did not use grammaticality judgments as the experimental task. Instead, subjects performed a simple match/mismatch task on a second stimulus, which either fully matched the test stimulus or differed from it by one word. Crucially, this task produced a robust SSE for grammatical sentences as compared to scrambled ones, showing that the subjects were not doing the task purely perceptually.

Our results replicate Declerck et al. (2020) in showing a clear SSE both for monolingual and code-switching expressions: match judgments to grammatical sentences were faster and more accurate than those to scrambled sentences in all language conditions, irrespective of code-switching. Declerck et al.'s task was word recall, which resembles our match task more than grammaticality judgments. The inner transpositions, however, patterned differently for monolingual and code-switching expressions. For both English and Mandarin monolingual stimuli, inner transpositions clearly patterned with the fully scrambled, ungrammatical sentences in speed and accuracy, contrary to prior TWE studies on Mandarin which all used grammaticality judgments. Thus the behavioral responses appeared largely driven by the bottom-up recognition of the inner transpositions, such that a similar size SSE was elicited both for scrambled sentences and for inner transpositions, as compared to grammatical sentences. The picture for the code-switches was different and depended on stimulus type: For Engl-Mand stimuli, the size of the SSE was smaller for inner transpositions than for scrambled sentences, while for Mand-Engl stimuli, it was larger. While this supports the special status of inner transpositions as ungrammatical stimuli as proposed in prior literature, the complexity of the pattern suggests a less consistent processing profile for code-switching expressions than monolingual ones, possibly reflecting uncertainty at the junction of two grammatical systems.

In sum, our findings suggest uniform processing of both monolingual and mixed-language input as regards the basic Sentence Superiority Effect (grammatical vs. scrambled). For monolingual input, the SSE was replicated even for inner transpositions, showing that the task performance was clearly sensitive to the error in the bottom-up input. Inner transpositions, however, broke down the uniformity between monolingual and code-switching expressions, since in code-switching, inner transpositions diverged from both grammatical and scrambled sentences, though the details of the pattern differed depending on stimulus type. To reveal the processing stages leading up to the behavioral responses, subjects' neural activity was also recorded millisecond by millisecond with magnetoencephalography. Analyses of the MEG data are ongoing.

Language	WordOrder	Critical	Task 1	Type 1	Task 2	Type 2
English	Grammatical	this tree will fall	this tree will fall	match	this wall will fall	mismatch
English	InnerTransp	this will tree fall	this will tree fall	match	this must tree fall	mismatch
English	Scrambled	tree this fall will	tree this fall will	match	wall this fall will	mismatch
Mandarin	Grammatical	这树要倒	这树要倒	match	那树要倒	mismatch
Mandarin	InnerTransp	这要树倒	这要树倒	match	这要树砍	mismatch
Mandarin	Scrambled	树这倒要	树这倒要	match	树这倒会	mismatch
Engl-Mand	Grammatical	this tree 要倒	this tree 要倒	match	this wall 要倒	mismatch
Engl-Mand	InnerTransp	this will 树倒	this will 树倒	match	that will 树倒	mismatch
Engl-Mand	Scrambled	tree this 倒要	tree this 倒要	match	wall this 倒要	mismatch
Mand-Engl	Grammatical	这树 will fall	这树 will fall	match	这墙 will fall	mismatch
Mand-Engl	InnerTransp	这要 tree fall	这要 tree fall	match	这要 wall fall	mismatch
Mand-Engl	Scrambled	树这 fall will	树这 fall will	match	墙这 fall will	mismatch

Table 1: Experiment design with examples of both matching and mismatching task stimuli.

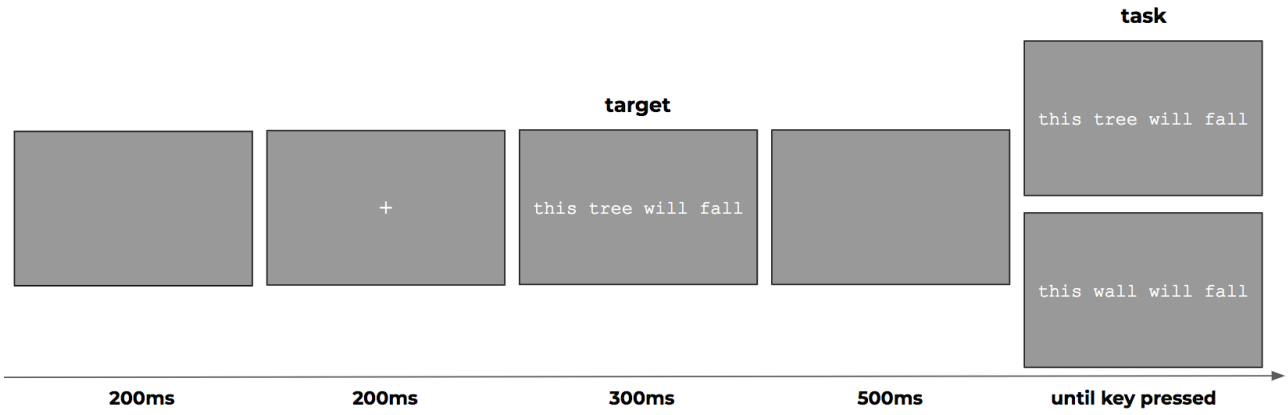

Figure 1: Trial Structure for the RPVP matching task.

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