Right Hemisphere Syntactic Processing in Demanding Conditions-An Event-Related Potential Study

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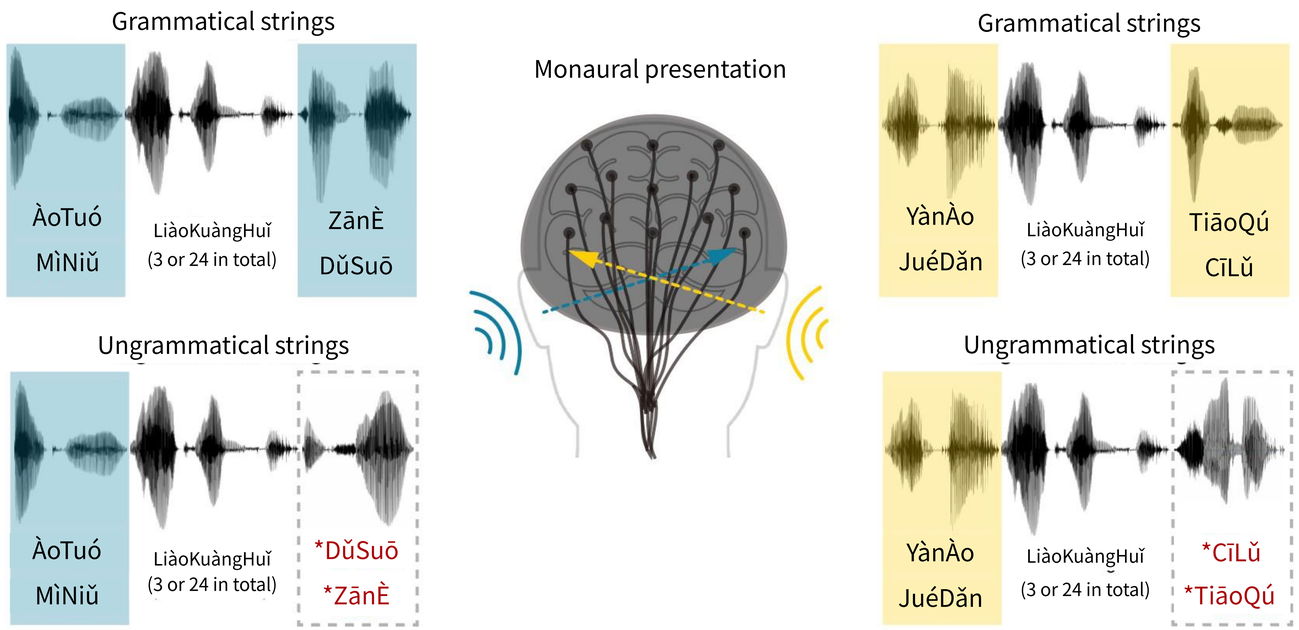
Introduction

- The right hemisphere (RH) is capable of left-hemisphere-similar (LH) syntactic processing as indexed by the P600 [1]. However, RH P600 effects usually co-occurred with lower behavioral accuracies for grammatical judgement (e.g., in lower-intermediate L2 learners [2] and healthy older adults [3][4]).
- The RH P600 effect may reflect interference, or alternatively, resources recruited to aid challenging syntactic processing.
- In light of past studies demonstrating P600 effects using artificial grammar paradigms [5][6], we examined these two possibilities by manipulating the salience, and hence the degree of difficulty in learning, of nonadjacent dependencies.
- Focusing on successful learners with high behavioral accuracy, the hindrance account would expect no RH P600 effects; however, the compensatory account would expect larger RH P600 effects in the challenging condition than in the easier condition.

Method

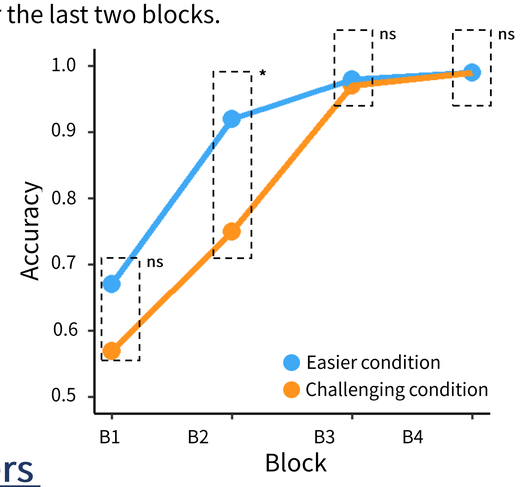
- 63 right-handed Taiwan Mandarin native speakers (29 M, mean age: 22.2; range: 20 – 28; no familial left-handedness).
- Stimuli were 3-element pseudo-word strings. The 1st and 3rd elements formed nonadjacent dependencies. The set sizes (SS) of the intervening elements were manipulated to yield the easier (SS=24) and challenging (SS=3) conditions [7][8].
- Trials were presented to either ear to induce LH- or RH-biased responses. Each ear was exposed to 2 dependency pairs.
- The experiment contained alternated training blocks and testing blocks (4 training-testing cycles; 48 trials per block). During the testing blocks, participants judged the grammaticality of the strings by pressing buttons.



Behavioral results from successful learners

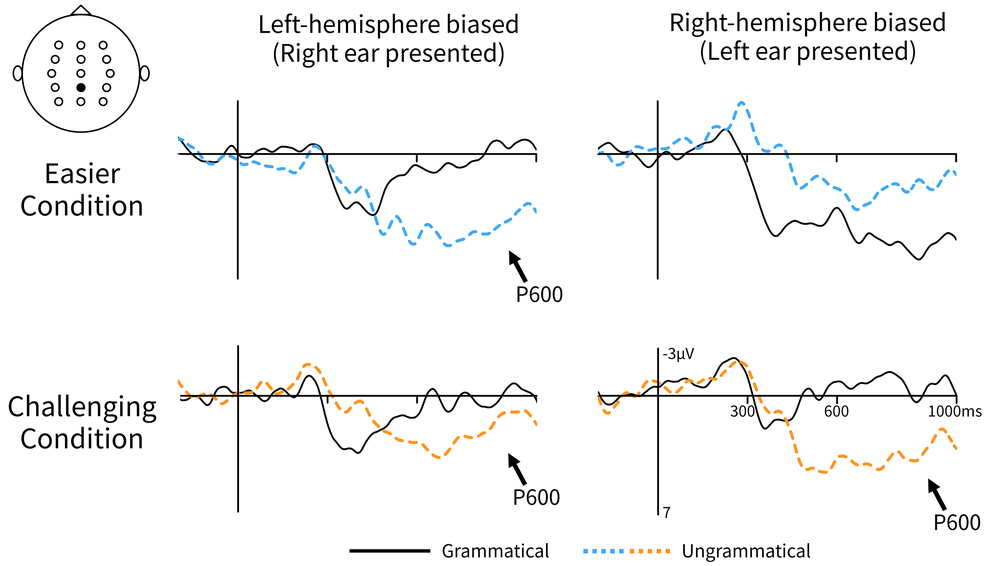
- Slower increase of accuracy for the challenging condition.
- Statistically similar accuracy between conditions for the last two blocks.

	Easier condition	Challenging condition
Number	20 (10M)	20 (8M)
Mean age	23.35 (20 - 28)	21.7 (20 - 24)
Laterality quotient	0.81	0.77
NWR	8	7.45
WAIS-MR	13.4	13.15
Average Accuracy of Block 3 & 4	0.98 (0.9 - 1)	0.98 (0.93 - 1)



ERP results from successful learners

- Both groups showed reliable LH P600 grammaticality effects.
- There was a significant RH P600 effect in the challenging condition, but a negative grammaticality effect similar to the N400 grammaticality effect seen in native language comprehension [1] [3] in the easier condition instead.



Conclusion

- Our results demonstrated that the RH P600 responses can be seen with high behavioral performance, **disfavoring the detrimental account of LH-like syntactic responses in the RH.**
- Furthermore, the RH P600 responses were seen in the challenging condition, but not the easier condition, **supporting the compensatory role of RH P600.**
- These results again endorse the syntactic capability of the RH, and converge with recent findings on the assistive role of the RH in initial, but not later, stages of grammar learning [9].

References: [1] Lee & Federmeier (2015, *Psychological Science*). [2] Chen, Yeh, Lu, Hsieh, Chou, Su, Lee (2018, *Journal of Chinese Language Teaching*). [3] Leckey & Federmeier (2017, *Psychophisiology*). [4] Chen, Chen, & Lee (2017, *Psychophysiology Supplement*). [5] Tabullo, Sevilla, Segura, Zanutto & Wainselboim (2013, *Brain Research*). [6] Silvia, Folia, Hagoort, & Petersson (2016, *Cognitive Science*). [7] Gómez (2002, *Psychological Science*).[8] Hsu, Tomblin, & Christiansen (2014, Frontiers in Psychology).[9] Leonard, Brown, Travis, Gharapetian, Hagler Jr, Dale, Elman, Halgren (2010, Neuroimage). [9] Qi & Legault (2020, *Psych Learn Motivation*)

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