Reduced Proficiency in a Second Language Leads to Delays in Early Lexical Processing

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INTRODUCTION

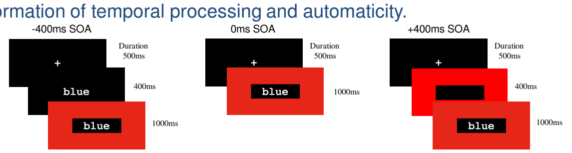
•**Temporal Delay Assumption**
- Proposes that the second language (L2) experiences delayed lexical access compared to the first language (L1) due to the relatively reduced proficiency (Dijkstra & van Heuven, 2002).
- Supported by EEG evidence finding delays both in later components reflecting semantic access (the N400: Moreno & Kutas, 2005; Ardal et al., 1990), and in low-level processes as early as 150 ms (Proverbio et al., 2009; Liu & Perfetti, 2003).

• **Reduced Frequency Hypothesis**
- Proposes that bilinguals use each language less often than monolinguals, leading to reduced proficiency in both languages, and predicts delays in both the L1 and L2 relative to monolinguals (Pyers et al., 2009).
- EEG evidence for delays between bilinguals' L1 and monolinguals in late semantic processing (Ardal et al., 1990), but delays in early components have not been investigated.

Unresolved Questions
- Though evidence of bilingual processing delays exists, there has been no test of how resilient this delay is. All previous studies have used non-repeating stimuli, but if a delay persists despite repetition effects this suggests a fundamental slowing of the bilingual language system.
- There are no studies investigating delays in low-level language processes such as orthographic recognition in bilinguals' L1 compared to monolinguals.

→ How fundamental is the bilingual delay in language processing? Does this delay survive repetition effects, and is it present in the native language at early time windows?

The Current Study
- Monolinguals and bilinguals tested in both their L1 and L2.
- Focus on the **N170** ERP component
  - Reflects early orthographic processing, as it distinguishes between orthographic (words) and non-orthographic (symbols) stimuli.
  - Modulated by reading proficiency and experience (Maurer et al. 2005).
- **Stroop task**:
  - Presents the same color words hundreds of times.
  - Stimulus onset asynchrony (SOA) manipulation provides additional information of temporal processing and automaticity.

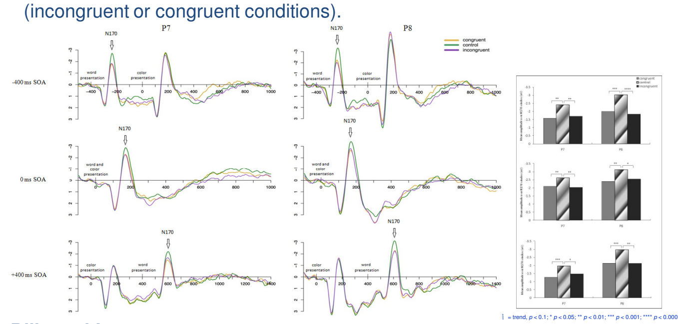


METHODS

- **Experiment 1:** 31 monolingual native English speakers (18 female, mean age = 22 yrs, SD = 5.1), performed the English version of the task in one session.
- **Experiment 2:** 19 Mandarin - English bilinguals (15 female, mean age = 23 yrs, SD = 2.5), performed Chinese and English SOA Stroop tasks in two sessions. Average self-reported proficiency in English was 7/10, average age of English acquisition 11 yrs (SD = 2.2).
- Three SOAs (-400ms, 0ms, +400ms) presented in blocks, manual response
- Incongruent and congruent word conditions ('red', 'green', 'blue' or '红', '绿', '蓝') and symbol control condition ('%%%%' in English, '%' in Chinese). **Total of 142 repetitions of each word/character in the entire session, to test the resilience of the bilingual processing delay.**
- Concurrent EEG recording at 250Hz with a 128-channel Geodesics sensor net.

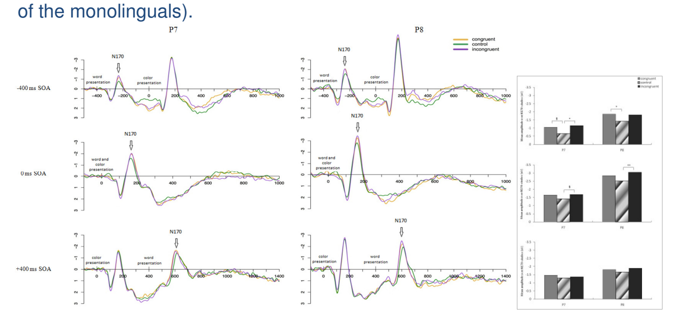
RESULTS

• **Monolinguals**
- N170 in response to words and colours in all 3 SOAs at P7 and P8 (left and right temporo-parietal electrodes).
- Distinction between orthographic and non-orthographic stimuli at N170 peaks: average amplitude of control stimuli is more negative than word stimuli (incongruent or congruent conditions).



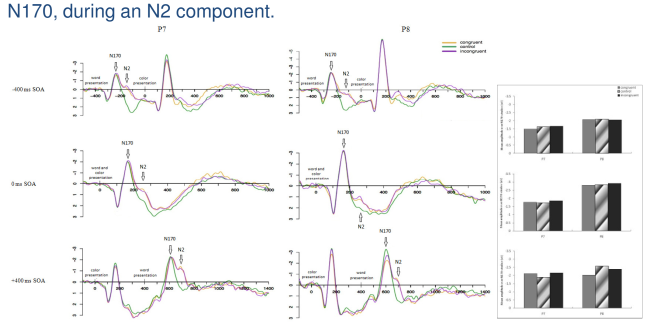
Ɨ = trend, $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; **** $p < 0.0001$

• **Bilingual L1**
- N170 in response to words and colours in all 3 SOAs at P7 and P8.
- Distinction between orthographic and non-orthographic stimuli at N170 peaks: word stimuli more negative than control stimuli (opposite pattern to that of the monolinguals).



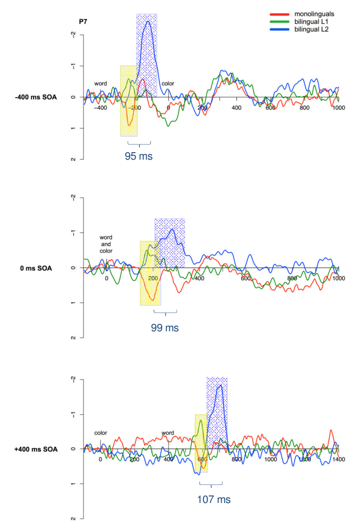
Ɨ = trend, $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; **** $p < 0.0001$

• **Bilingual L2**
- N170 in response to words and colours in all 3 SOAs at P7 and P8.
- **No** distinction between orthographic and non-orthographic stimuli at N170 peaks (no difference in average N710 amplitude between conditions).
- Instead, word and control stimuli distinguished on the down-slope of the N170, during an N2 component.



Ɨ = trend, $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; **** $p < 0.0001$

• **Difference Waves**
- Incongruent – control waveforms (word vs. symbol string) for each group/language.
- Large peaks after word presentation (shaded regions) indicate differences between words and symbol strings, so are interpreted as orthographic processing peaks.



- Monolingual and bilingual L1 orthographic processing peaks occur at the same latency (all p's > 0.17; yellow shaded regions)
  - **→ There is no difference in early orthographic processing speed between monolinguals and L1**
- Bilingual L2 orthographic processing peaks occur significantly later than bilingual L1 and monolinguals (all p's < 0.0001; blue shaded regions): average delay of100 ms across all SOAs.
  - **→ Early orthographic processing is delayed by 100 ms in an L2**
- Similar latencies of orthographic processing peaks across SOAs.
  - → Word recognition is automatic, even in a second language
- The L2 delay persists despite repetition effects
  - **→ L2 language processing delays are a fundamental slowing of the L2 system.**

DISCUSSION

- Lexical processing was delayed by 100 ms in a second language, and this delay persisted despite huge repetition effects, indicating that language processing is fundamentally slower in an L2.
- There was no difference in lexical processing speed in the L1 vs. monolinguals, indicating that at early, low-level processing stages there is no bilingual processing delay in the native language.
- Orthography does not seem to play a major role in L1 word recognition: in both monolinguals and L1 (English and Chinese), words were distinguished from symbols at a similar rate, despite large orthographic differences between the languages.

• **Outstanding Issues:**
- How does orthography affect the magnitude of the L2 delay and the N170 effects seen in the current data?
- How do other linguistic factors affect the magnitude of the delay (proficiency, age of acquisition, relative language dominance, immersion, etc.)?

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