L1 grammar influences L2 processing: ERP evidence of transfer effects

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Aim

- Effect of first language (L1) background on second language (L2) acquisition

- How L1 grammar influences neurocognitive correlates of real-time sentence processing in the L2
Second language (L2) processing

How “native-like” are processing mechanisms and neural substrates for L2 vs. L1?

1) **Age of acquisition**
   - After a critical developmental period, ability to acquire language at native proficiency level declines (Lenneberg, 1967)
   - Different brain areas and patterns of language processing for L2 vs. L1 (Kim et al., 1997, Weber-Fox & Neville, 1996)

2) **Proficiency level**
   - Affects brain organization and patterns of processing (Perani et al., 1998; Steinhauer et al., 2009)

3) **Crosslinguistic-transfer**
   - Influence of L1 background
Two views of cross-linguistic transfer

- Influence of L1 in stages of L2 acquisition
  - Depends on similarities or differences between L1 & L2 (Tokowicz & MacWhinney, 2005)
    - **Positive transfer** – when L1 and L2 have similar properties → facilitation in acquisition
    - **Negative transfer** – when L1 and L2 are structurally dissimilar or contradictory → interference
    - **No transfer** – when target L2 structure is absent in L1

- Activation of L1 during L2 processing
  - When L1 and L2 properties differ
  - Automatic
  - Short-lived co-activation OR persistent interference
Evidence of “transfer effects”

- Long history of behavioral studies on L1-L2 transfer (Nitschke et al., 2009 for a review; but see Clahsen & Felser, 2006)

- ERP evidence of transfer is scarce and inconclusive (Kotz, 2009 for a review)
Lexical transfer effects

- **Thierry & Wu (2007)**
  - Native-Mandarin learners of English
  - Pairs of English words (semantic relatedness task)
  - For half the pairs, the words shared a character in Mandarin
  e.g. *Train* and *Ham* → *Huo Che* and *Huo Tui*
  - Subjects’ brain responses showed an implicit character repetition priming effect (reduced N400 effect)
  - **Unconscious L1 lexical activation during L2 reading**
  - Behavioral performance not affected!
    - ERPs tap into implicit processing
Syntactic transfer effects

- Tokowicz & MacWhinney (2005)
  - Native-English learners of Spanish
  - Grammaticality judgment task:
    - Tense-marking (L1 similar to L2)
    - Determiner-number agreement (L1 differs from L2)
    - Determiner-gender agreement (unique to L2)
  - Sensitive to L2 grammatical violations (P600 effect) only on constructions similar in L1-L2 or unique to L2
  - Violations in L2 not detected when L1 and L2 dissimilar
  - No indication of this distinction in behavioral performance
Present study

- Syntactic transfer
- ERP reading study in English
- 2 groups of late L2 learners of English
  - Native-French
  - Native-Mandarin
- Compared to native English monolinguals
Present study

- Adjective-noun word order
- Violation paradigm designed to introduce an **online conflict between L1 and L2**
  - **English** and **Mandarin** – adjectives are **pre-nominal**
  - **French** – majority of adjectives are **post-nominal**

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<thead>
<tr>
<th>English</th>
<th>Mandarin</th>
<th>French</th>
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</thead>
<tbody>
<tr>
<td>i) ...the white vase...</td>
<td>✓</td>
<td>✓ ...le blanc vase</td>
</tr>
<tr>
<td>ii) ...the vase white...</td>
<td>✗</td>
<td>✓ ...le vase blanc</td>
</tr>
<tr>
<td>iii) ...the big vase...</td>
<td>✓</td>
<td>✓ ...le grand vase</td>
</tr>
<tr>
<td>iv) ...the vase big...</td>
<td>✗</td>
<td>✗ ...le vase grand</td>
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Predictions: Native English

- Adjective order violations → Posterior positive-going **P600**
  - Non-canonical adjective orders:
    - e.g. *brown big dog* vs. *big brown dog*
    - (Kemmerer et al., 2006)

2 possible ERP patterns: What precedes the P600?

- Biphasic (E)LAN + P600?
  - Syntactic ERP profile
  - Syntactic word-order violation
    - (Neville et al., 1991)
Predictions: Native English (cont.)

OR:

- Biphasic N400 + P600 pattern?
  - Secondary predication
    - ✓ *He painted the vase white*
  - Depends on lexical properties of verb
    - *He saw the vase white*
  - N400: Search/retrieval of lexical-semantic properties + clash
  - P600: Failed integration

*NP_{ACC} + intransitive verb

Peter met Mary

*Peter yawned Mary

Argument structure violations:
Wrong number of arguments

(Friederici & Frisch, 2000)
L2 groups vs. native English

- **Late L2 learners** of English → ERP indications of “non-native” processing (in line with Critical period)
  - Delayed/longer-lasting N400/P600 effects?
  - Smaller or no P600?
  - Different scalp distributions?

  **OR**

- **High proficiency**, especially in **specific structure** that was tested (= online behavioral performance on adjective-noun word order)
  - Native-like ERP patterns
Transfer: French-L1 vs. Mandarin-L1

- **No interference for Mandarin-L1** and comparable effects for (i) vs. (iii) and for (ii) vs. (iv)
- **Negative transfer/interference only for French-L1 in condition i (vs. ii)**
- Comparison of English **control conditions** i vs. iii could also be informative, as correct control (i) = L1-violation in French

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<tr>
<td>i)</td>
<td>…the <em>white</em> vase…</td>
<td>✔️</td>
<td>✗</td>
</tr>
<tr>
<td>ii)</td>
<td>…the vase <em>white</em>…</td>
<td>✗</td>
<td>✔️</td>
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<tr>
<td>iii)</td>
<td>…the <em>big</em> vase…</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>iv)</td>
<td>…the vase <em>big</em>…</td>
<td>✗</td>
<td>✗</td>
</tr>
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</table>
Participants

- **Initial sample**
  - English-L1 (n = 13)
  - French-L1 (n = 11)
  - Mandarin-L1 (n = 12)

- **Age of acquisition (AOA) of English**
  - Self-report on background questionnaire

- **Offline proficiency measures (overall L2 proficiency)**
  - Self-ratings
  - Cloze test

- **Online behavioral proficiency measure (structure-specific proficiency; more relevant than overall L2 proficiency)**
Procedure

- Silent reading of correct/incorrect English sentences

Examples of stimuli

<table>
<thead>
<tr>
<th>Example Type</th>
<th>Sentence Structure</th>
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<tbody>
<tr>
<td>i. L1-French violation</td>
<td>He put the white vase on the table</td>
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<tr>
<td>ii. L2-English violation</td>
<td>He put the vase white on the table</td>
</tr>
<tr>
<td>iii. L1-L2 control</td>
<td>He put the big vase on the table</td>
</tr>
<tr>
<td>iv. L1-L2 violation</td>
<td>He put the vase big on the table</td>
</tr>
</tbody>
</table>

- Intermixed with 8 types of filler sentences (1/2 violations)
- Rapid serial visual presentation (300ms, 200ms ISI)
- End-of-sentence acceptability judgments
- ERP epochs -100 to 1500ms
- Repeated measures ANOVAs on time windows of interest
Results: Initial sample

- **Behavioral results: % Acceptability**
  - All groups were highly accurate in acceptability judgments.
  - But L2 groups **rejected violations less accurately than English natives**.
  - However, **L2 groups did not differ from each other**.

![Insert Plot Here!](image-url)
Results: Initial sample

- **ERP results: English**
  
  Baseline correction: -100 to 0 ms

- **N400:** Lexical search/retrieval
- **P600:** Integration failure
- **Secondary predication**
Results: Initial sample

- **ERP results: Mandarin**

  - Same ERP patterns as English natives: N400/P600
    - No interference
Results: Initial sample

- ERP results: French
  Baseline correction: -100 to 0 ms

- Pre-nominal adjectives both in L1 and L2: Same patterns as English natives
Results: Initial sample

- ERP results: French
  
  Baseline correction: -100 to 0 ms

- L1 post-nominal vs L2 pre-nominal: Different pattern?
- N400 only?
Results: Initial sample

- ERP Results: French
  Baseline Correction = -100 to 0 ms

- **L1-interference**

- **Short-lived L1-clash?**
  - “L1-P600” triggered by *adjective* (and perhaps earlier effect: N400?)
  - L2 control condition = **L1 violation**

- Baseline verification
Results: Initial sample

- ERP Results: French

  New Baseline correction = 700 to 800 ms

  He put the...

- L2-violation: English native-like pattern: N400/P600
Discussion: initial sample

- No significant ERP differences between English, Mandarin and French participants (no interferences between L1 and L2) when L1 and L2 converge

- L1-clash in French participants for L2 pre-nominal adjectives (i.e. post-nominal in French)
  - “The white vase”: short lived “L1-P600” (+ L1-N400?)
  - L2-like processing in French participants after baseline correction: N400/P600

- L1-activation transient: Does not impede L2 processing
Initial hypothesis and follow up...

- **Initial hypothesis:** Concurrent L1-L2 activation for French

- **Test initial results with larger sample** (including initial)
  - English (n= 17)
  - Mandarin (n= 21)
  - French (n=23)

- **Behaviorally:** high accuracy in acceptability judgments
  - No change between initial and larger sample

- **ERP results:** similar ERP patterns between English & Mandarin participants across conditions
  - No change between initial and larger sample
French participants (n=23)

- All four conditions

No additional baseline correction necessary!
Close-up on “the white vase”...

- Eng-GOOD = Fr-BAD

- English
- Mandarin
- French

N400 (French viol.)

P600 (French viol.)
Discussion: Larger sample

- Similar ERP signatures: L2 N400/P600
  - Across groups: English, Mandarin, French
  - Across adjective types: Secondary predication (verb argument structure violation)

- L1-effect in French subjects in English pre-nominal adjectives
  - L1-N400/P600
  - L1 grammar activated while processing L2
  - L1 grammar activation quickly overridden by L2 grammar processing.
General discussion

- Evidence in favor of transfer effects
  - **No interference when L1-L2 converge**: Similar ERP signatures in L2 processing
    - Pre-nominal adjectives in English, Mandarin and French
  - **ERPs**: Cross-linguistic effects when L1-L2 differ
    - Post-nominal adjectives in French vs. pre-nominal in English
General discussion

Similar findings to Thierry & Wu (2007) but for syntax
- Unconscious, transient L1 activation without impeding concurrent L2 processing.

Future work:
- Currently investigating whether these L1-transfer effects are tied to AoA and/or proficiency
- Behaviorally: no difference in structure specific proficiency despite late AoA (contra Critical Period)
- Low proficiency = more persistent L1 activation = less native-like L2 processing? (classical transfer effects)
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- University of Montreal: Bursary of Excellence to NB
Larger sample (incl. initial)

- Behavioral results:

  - English-L1 = 17, French-L1 = 23, Mandarin = 21
Larger sample (incl. initial)

- **English (n = 17)**
- **All four conditions**

- **Control conditions only**
  - No differences
Larger sample (incl. initial)

- Mandarin (n = 21)
- All four conditions

- Control conditions only
  No differences
## Initial Sample

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<thead>
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<th>L1-</th>
<th>AOA</th>
<th>Listening</th>
<th>Reading</th>
<th>Pronunciation</th>
<th>Fluency</th>
<th>Vocabulary</th>
<th>Grammar</th>
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## Larger Sample

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