The psychological reality of formal regularities in Chinese characters

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Formal regularities in grammar

• Phonology is the level of language that is patterned (articulated) but meaningless
• It need not even be “interpreted” in sound
  – Prosodic elements (e.g., metrical feet) do not have straightforward acoustic correlates
  – Sign language has phonology without sound
• Can formal regularities in orthography also be considered a form of “phonology”? – And are they “psychologically real”?

Sign phonology vs. orthography

• Sign languages are natural languages
  – Linguistically (e.g., Sandler & Lillo-Martin, 2006)
  – Psycholinguistically (e.g., Emmorey, 2002)
• Orthography is not quite as “natural”
  – Parasitic on speech (e.g., DeFrancis, 1989)
  – Learned with effort (e.g., Koda & Zehler, 2008)
• Yet reading can bypass spoken phonology
  (e.g., Jobard et al., 2003)

Character “grammar”? 

• Duality of patterning
  – 能 月 公 北
• Morphology (Sproat, 2000)
  – 鱗 魚 [米] [夕][牛]]
• Phonology
  – SPE-style analyses (Wang, 1983)
  – OT-style analyses (Goldberg & Goldberg, 2011)

Character “prosody”? 

• Global shape constraints (Myers, 1996)
  – Binarity
  – Prominence at right and bottom
• Similar to spoken/sign metrical feet
  – From biases in motor control, vision, cognition?

Reduplication templates

• Binary horizontal reduplication
  林 比 競 朋 嚇 蟟 蟟 雙 逾期 替 ､
• Binary vertical reduplication
  昌 命 造 多 乏 哥 擎 担 崇 擎 撲
• Triangular reduplication (binary both ways)
  品 童 時 造 造 槿 造 造 造 造
• The constraints are rarely or never violated
  – Binarity: 三 川 黒 靈 巡
  – Top-prominence triangles: * cf. 港
Semantic radical position
- Radicals prefer “weak” left or top positions
- Radicals in “weak” positions are reduced
- Radicals not reduced in “strong” positions
- Many exceptions:

But are these patterns “real”?
- Do experienced readers know the reduplication generalizations?
  - Apparently nobody has ever tested this
- Do they know the radical generalizations?
  - They know radical position (e.g., Taft et al., 1999)
  - But do they generalize the left/top patterns?
- Do these two sets of generalizations share a single underlying explanation?
  (i.e., binary, bottom/right-prominent prosody)

Testing reduplication: Design
- Grammaticality: Obey generalizations?
- Lexicality: Reduplication found in real characters?
- Shape: Horizontal, Vertical, Triangular
- 20 nonce characters each, Latin square design

Testing reduplication: Task
- Judge if nonce characters are Chinese-like
  - Binary scale (see, e.g., Weskott & Fanselow, 2011)
- 120 fillers
  - Combinations of real elements:
  - One extra or missing stroke:
  - Element flipped:
- Judgment and reaction time both recorded
- Participants
  - 20 native Mandarin speakers in Taiwan

Reduplication reaction times

Reduplication judgments

Reduplication RTs by shape

Reduplication: Summary
- Readers do generalize the reduplication pattern beyond their lexical experience
- In judgments, size of grammaticality effect is the same regardless of lexical status
- Reaction times show different processes for lexical vs. nonlexical items
  - Lexical: Lexical access (faster for real)
  - Nonlexical: Violation detection (faster for bad)
- Triangular pattern is the least active
Testing radical position: Design

- Grammaticality: Obey generalizations?
- Lexicality: Real radical?
- Shape: Horizontal, Vertical
- 15 nonce characters each, Latin square design

<table>
<thead>
<tr>
<th>Shape</th>
<th>+Lex+Gr</th>
<th>+Lex-Gr</th>
<th>-Lex+Gr</th>
<th>-Lex-Gr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal</td>
<td>菜</td>
<td>菜</td>
<td>菜</td>
<td>菜</td>
</tr>
<tr>
<td>Vertical</td>
<td>菜</td>
<td>菜</td>
<td>菜</td>
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</tbody>
</table>

Testing radical position: Task

- Judge if nonce characters are Chinese-like
  - Binary scale: like vs. unlike Chinese character
- 60 fillers
  - Selected from reduplication experiment
- Participants
  - 20 native Mandarin speakers in Taiwan
  - Different from reduplication experiment

Radical position judgments

<table>
<thead>
<tr>
<th>Mean acceptance scale</th>
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<tbody>
<tr>
<td>Nonlexical</td>
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Radical reaction times

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Radical RTs by shape

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Radical judgments by shape

<table>
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<th>Interactions significant</th>
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<tbody>
<tr>
<td>Nonlexical</td>
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Radical position: Summary

- Readers generalize beyond lexical radicals, but only for horizontal orientation
  - This may be because left radicals are much more common than top radicals
- Reaction times only show effect of lexical status: lexical radicals are judged faster
  - Greater effect of lexical status compared with reduplication may relate to closed-class nature of radicals

Are the patterns related?

- Do judgments of reduplication and radicals recruit the same (prosodic) structures?
- If so, perhaps one will facilitate the other
- Our first try at this gave a null result…

<table>
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<th>Prime pair</th>
<th>Target pair</th>
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<tbody>
<tr>
<td>Prosodic</td>
<td>菜</td>
</tr>
<tr>
<td>Phonetic</td>
<td>菜</td>
</tr>
</tbody>
</table>

Conclusions

- Purely formal orthographic regularities can be psychologically real
  - Even beyond memorized exemplars
- Linguistic analysis suggests that some of these regularities are similar to prosody
- The search continues for evidence that "orthographic prosody" is itself psychologically real


