The use of sub-character units in writing Chinese characters

Dustin Lau

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Chinese writing system

- Each character is a collection of strokes organized in a rectangular configuration
Phonetic compounds

言 贊
/zaan3/ [agree]

/zaan3/ [praise]

言 贊
/jin4/ [speech]

/jin4/ [speech]

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Functional writing units?

• Previous studies (e.g. Han, Zhang, Shu & Bi, 2007; Law & Leung, 2000; Law, Yeung, Wong & Chiu, 2005) observed errors produced by dysgraphic patients in dictation, copying and delay copying tasks

<table>
<thead>
<tr>
<th></th>
<th>Deletion</th>
<th>Substitution</th>
<th>Transposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radicals</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Strokes</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
However…

- Errors cannot be explained using strokes and radicals as processing units

![Chinese characters](image)

- Logographemes
  - Stroke patterns in radicals that are spatially separated
Issues...

• Radical boundaries are clear but logographeme boundaries are not
• Previous studies relied heavily on observations of errors produced by dysgraphic patients
  – Correct trials are not “informative”
  – Multiple deletions may be misinterpreted
Possible solution

• To capture the whole writing process and study it
Assumption

- Stroke sequence within a functional unit should be well represented.
- Time of the stylus of the pen traveling within functional units should be shorter than that of between functional units.
Method

• Participants
  – Twenty undergraduates (gender balanced) studying in PolyU were recruited
Task

• Direct copying task
  – Copying 10 pseudo-characters on the screen of a tablet using stylus pen
Data obtained

- **Duration** (calculated based on the time between the point the stylus leaves the tablet screen and the point when it returns)
- **Distance** (calculated based on the coordinates where the stylus touches/leaves the tablet screen)
Preliminary results

• http://158.132.125.9/hdc/
Preliminary results

Gap; LS Means
Current effect: $F(7, 135)=5.0769, p=.00004$
(Computed for covariates at their means)
Vertical bars denote 0.95 confidence intervals
Gap: LS Means
Current effect: $F(2, 50) = 9.5678$, $p = .00030$
(Computed for covariates at their means)
Vertical bars denote 0.95 confidence intervals

Covariate means:
Distance: 66.84775
Covariate means:
Distance: 107.3045

Gap; LS Means
Current effect: F(11, 191) = 6.5421, p = .00000
(Computed for covariates at their means)
Vertical bars denote 0.95 confidence intervals
Gap; LS Means
Current effect: $F(7, 127)=3.4990$, $p=.00183$
(Computed for covariates at their means)
Vertical bars denote 0.95 confidence intervals

Covariate means:
Distance: 97.36532
Covariate means:
Distance: 121.5101

Gap; LS Means
Current effect: $F(12, 194)=7.0621$, $p=.00000$
(Computed for covariates at their means)
Vertical bars denote 0.95 confidence intervals
Gap; LS Means
Current effect: F(6, 104) = 5.3853, p = .00007
(Computed for covariates at their means)
Vertical bars denote 0.95 confidence intervals

Covariate means:
Distance: 110.809
What’s next?

• Other tasks: e.g. Dictation, delay copying
• Other stimuli: characters, radicals and logographemes
• Developmental data
  – At which age would kids’ writing process similar to the adult-form?
  – Sequence of development: strokes, logographemes, radicals
Other applications

• Boundaries
  – Page vs Page
  – Teacher vs Teacher
  – Normal vs Dyslexic participants
  – Native English learner vs ESL