Visual Complexity of Japanese Logographic Words

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Visual Complexity Effects in Reading

- Visually complex words are known to be processed slower (e.g., long words are read slowly)
- However, the nature of the effect of visual complexity is not crystal-clear (e.g., a length effect was in a U-shape non-linear function. See Baayen, 2005 and New et al., 2006).
- For Japanese/Chinese character recognition, a vast majority of studies considered stroke counts in their analyses. A leftist bias was reported as well (Hsiao & Cottrell, 2009).
- This study investigated:
  - Whether the well-known stroke effect is best described by a linear or a quadratic function.
  - Whether JPEG complexity contributes over and above stroke counts.
  - Whether an image averaging technique used in face recognition research can be applied for words to derive a feature template (i.e., visual essence).
  - How visual complexity variables contribute together with other lexical predictors.
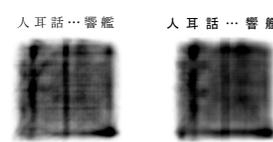
Variables Considered

- Strokes counts
- Number of constituents
- JPEG picture complexity
- Font size (only in Experiment 2)
- Prototypicality based on an averaged image

Averaged US Presidents

Averaged Kanjis in *Mincho* and *Gothic* fonts

人 耳 話 … 響 艦   人 耳 話 … 響 艦

Summary of Findings

- The classical measure of character strokes is insufficient to capture the full visual complexity relevant in Japanese logographic word recognition, in which words are dynamically perceived both as an ordered set of strokes, as an ordered set of constituents, and as an image.
- A stroke effect was found to be positive decelerating in all tasks and quantitatively more important than the other measures.
- A tripartite leftish bias was observed (rather than a binary leftish bias), which can be interpreted as a prototypicality effect relevant only for native speakers.
- Words in larger fonts were responded more quickly than those in smaller fonts.
- Visual complexity variables interacted with lexical variables encoding familiarity.

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1 Visual Complexity Rating
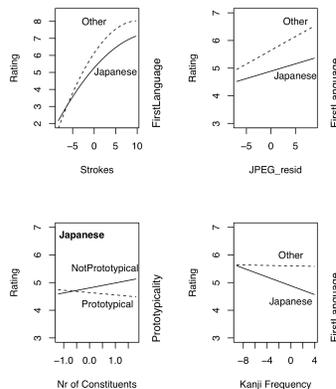
Method

Participants
- 20 Japanese speakers
- 21 non-native speakers

Stimuli
- 300 randomly selected Japanese *kanji* characters

Procedure
- Participants rated visual complexity of Japanese *kanji*s using a 9-point scale (1 = simple, 9 = complex)

Results
- Stroke counts had a positive decelerating effect.
- JPEG complexity had an additive inhibitory effect.
- Prototypicality was a significant factor only for native Japanese speakers.
- Kanji frequency affects Japanese readers' visual complexity ratings.
- Visual complexity ratings were lower for kanji characters responded slowly.

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2 Progressive Demasking

Method

Participants
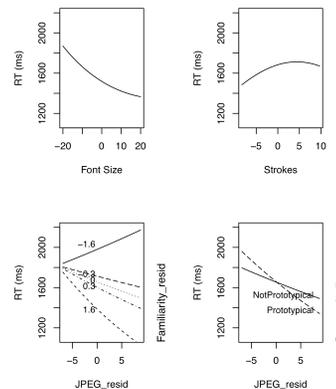- 20 Japanese speakers

Stimuli
- 300 randomly selected Japanese *kanji* characters (as in Experiment 1)

Procedure
- Participants were asked to identify a gradually appearing word as quickly and accurately as possible.

Results
- Responses were faster for words in larger fonts (this may be counter-intuitive).
- A stroke effect was positive decelerating, as in Experiment 1.
- JPEG complexity facilitated for familiar *kanji* characters and inhibited for unfamiliar characters.
- JPEG complexity facilitated more prominently for prototypical *kanji* characters.
- Interestingly, familiarity and prototypicality behaved similarly.

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3 Eye-tracking Lexical Decision

Method

Participants
- 21 Japanese speakers

Stimuli
- Randomly selected 708 two-character words and 708 nonwords

Procedure
- Participants judged whether the presented words is a legitimate word or a nonword as quickly as possible.
- 1st subgazes were analyzed.

Results
- A stroke effect was positive decelerating, as in Experiments 1 and 2.
- JPEG complexity had an inhibitory effect on top of an effect of stroke counts.
- A number of constituents inhibited for unfamiliar characters.
- A number of constituents facilitated for prototypical *kanji* characters and inhibited for unfamiliar characters (see the same pattern in Experiment 1).
- Familiarity and prototypicality behaved similarly (see also Experiment 2).