Flanker contrast explains the effects of flanker complexity on crowding in Chinese character recognition

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Objective

- Crowding is stronger if Chinese target and flankers are in similar complexity

  小十天 > 龍十勝

- What possibly makes the difference?
- Would it be due to the basic difference of contrast threshold requirement to process flanker of different complexities?

Stimuli

- 150 most frequently used Chinese characters
- Divided into 3 complexity groups, 50 in each group

午土心七 Low complexity (L-characters)

所行沒些 Medium complexity (M-characters)

張提愛裏 High complexity (H-characters)
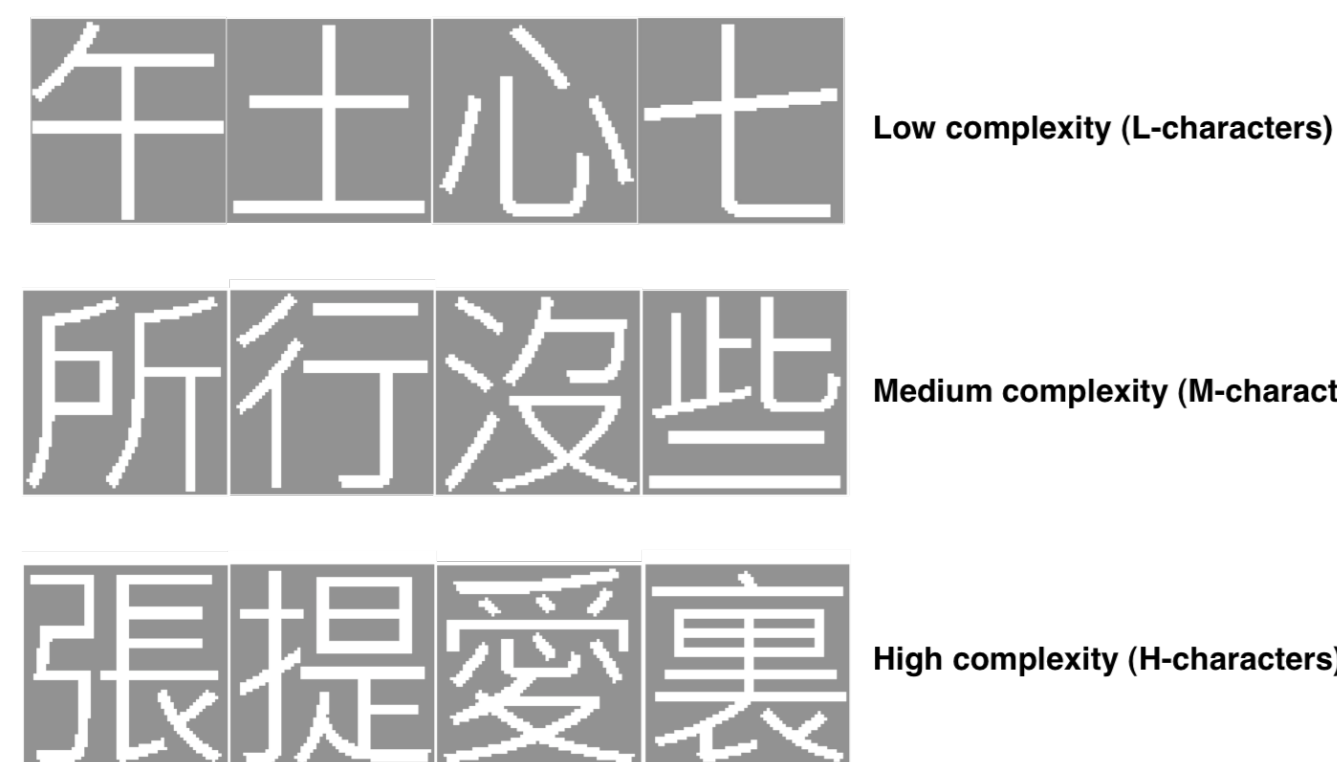
General procedure

- Compared the contrast elevation between LLL and HLH conditions
- Adjusted the flanker contrast level in LLL and HLH conditions
- 7° eccentricity, 2° target-flanker c-to-c spacing
- 10 AFC task: Response screen consisted of 10 response choices
- Response screen had 5 L-characters and 5 H-characters
- The characters in response screen were randomly selected in each trial
- Flankers were not included in the response screen
- Quest was used to measure the contrast threshold of recognizing the target character

Experiment 1

- 2 flanker contrast conditions:
  1) "3xH" condition: the flanker contrast was 3x the contrast threshold of recognizing a single H-character in peripheral vision
  2) "2.5x" condition: the flanker contrast was 2.5x the contrast threshold of recognizing a single L- or H-character in the corresponding flanker complexity condition
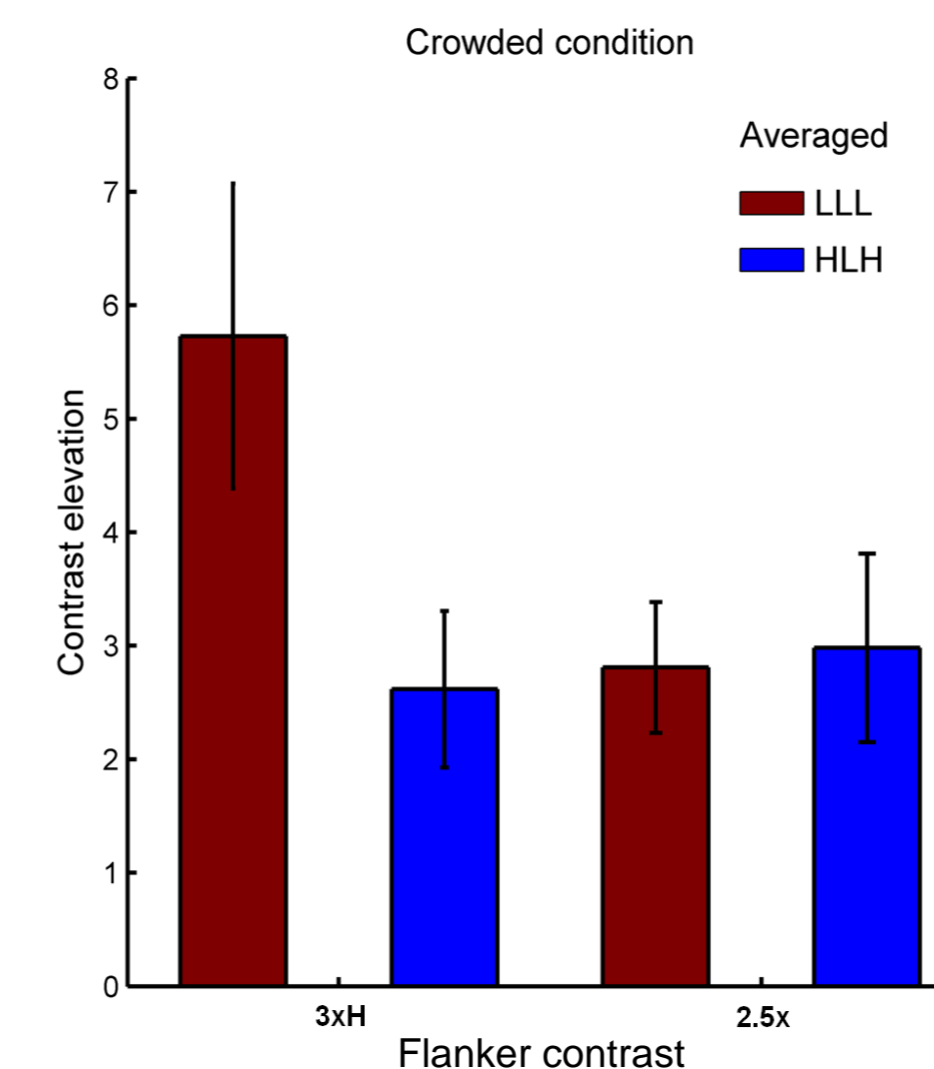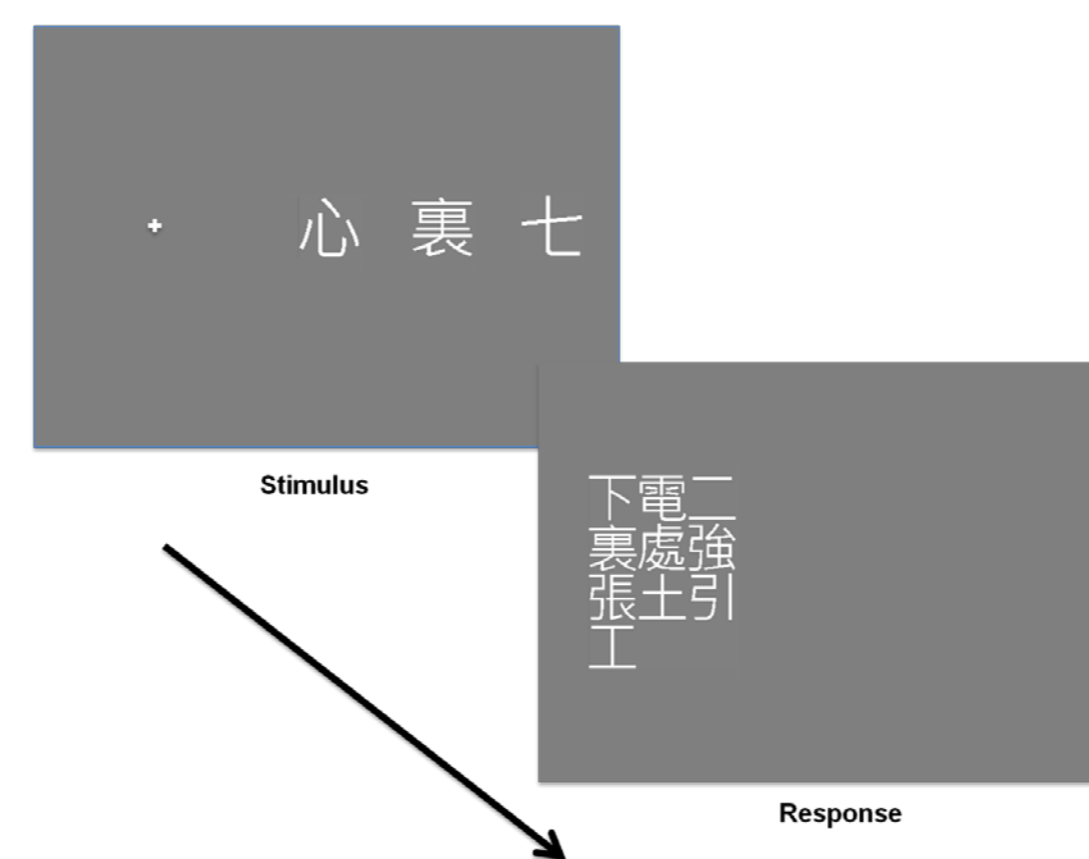
- 3xH condition:
  Crowding effect in LLL (6.38) was larger than HLH (2.62) condition (p =0.006)
- 2.5x condition:
  Crowding effect in LLL (2.88) was similar to HLH (3.03) condition (p = 0.603)

Experiment 2

- 2 more flanker contrast conditions:
  1) "2x" condition: the flanker contrast was 2x the contrast threshold of recognizing a single L- or H-character in the corresponding flanker complexity condition
  2) "4x" condition: the flanker contrast was 4x the contrast threshold of recognizing a single L- or H-character in the corresponding flanker complexity condition

- 2x condition
  Crowding effect in LLL (2.46) was similar to HLH (2.52) condition (p = 0.626)
- 4x condition
  Crowding effect in LLL (4.35) was similar to HLH (4.38) condition (p = 0.886)
- Crowding is determined by flanker "above-threshold" contrast level
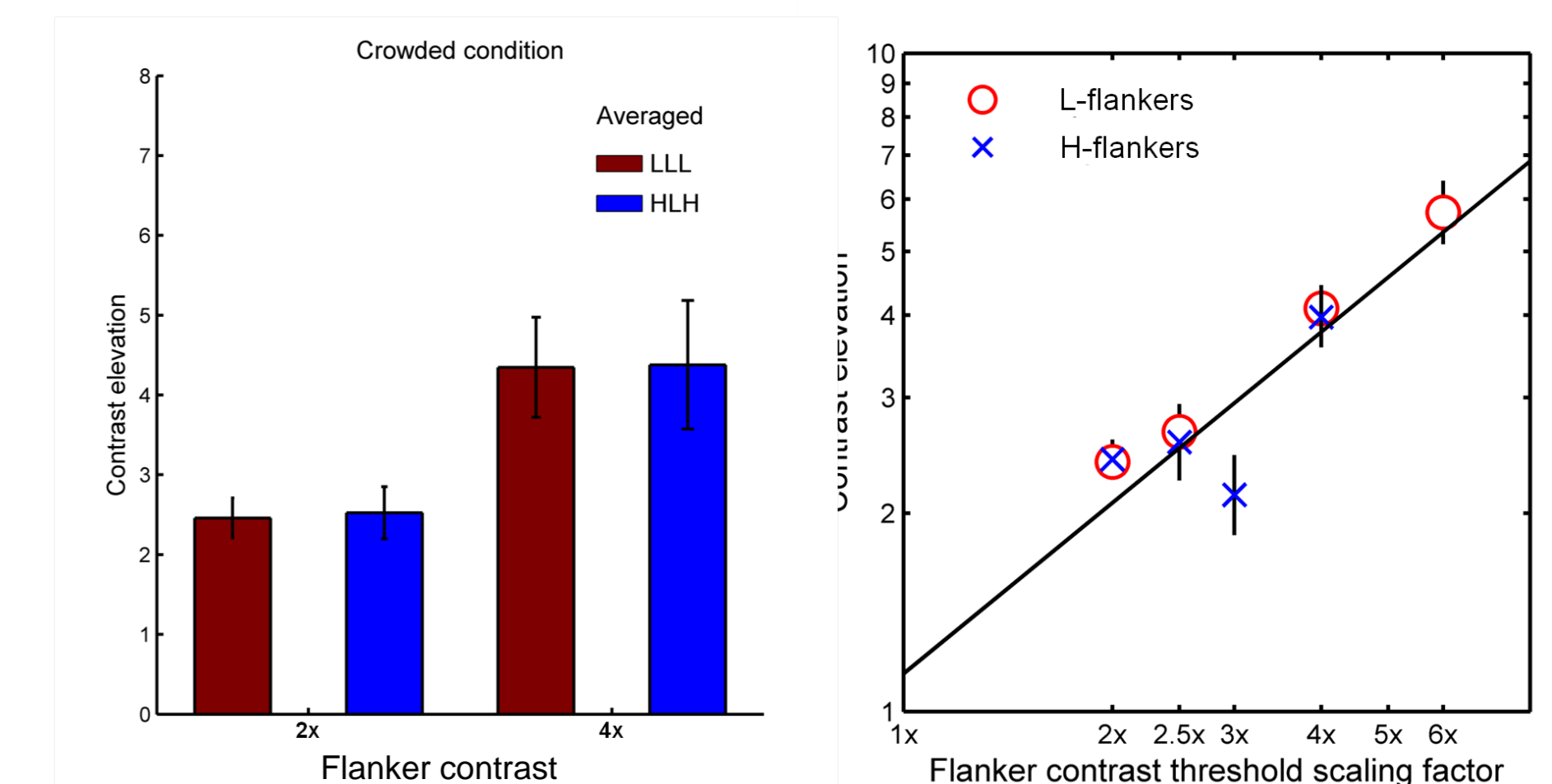 Log-log slope = 0.862

Conclusion

- The "LLL>HLH" phenomenon might be explained by different contrast threshold required to process L- and H-flankers
- The "LLL>HLH" effect might not be due to similarity rule in crowding
- Crowding effect might be determined by flankers' "above-threshold" contrast level if target's complexity is low

References
Chung, S. T. L., Levi, D. M., & Legge, G. E. (2001). Spatial-frequency and contrast properties of crowding. *Vision Research, 41*, 1833-1850.
Zhang, J.-Y., Zhang, T., Xue, F., Liu, L., & Yu, C. (2009). Legibility of Chinese characters in peripheral vision and the top-down influences on crowding. *Vision Research, 49*, 44-53.