Left lateral temporal cortex mediates cross-language translation in logographic reading

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Background

The neural network of lexical processing

1. Prelexical representation: left inferior temporal gyrus (ITG, Gaillard et al., 2006);
2. Lexical representation: Left inferior frontal gyrus (IFG), left middle temporal gyrus (MTG); IFG-MTG circuitry (Nakamura et al., 2010);

About cognates

- *Definition*: Translation equivalents having same/similar word forms.
  e.g. "tomato" in English and "tomaat" in Dutch
  The recognition of cognates is known to be facilitated relative to non-cognate words depends on the task at hand (Dijkstra et al., 2010).

Cognates in logographic scripts

- Roughly 56% of 2,058 Japanese two-kanji-compound words are Chinese-Japanese cognates (Xiong, 2018).

Chinese	Japanese	
数学: /shù.xué/	数学: /suu.gaku/	math
价值: /jià.zhí/	価値: /ka.chi/	value

- Cognates in Japanese and Chinese have:
  same/similar orthographic forms,
  different pronunciations,
  different morphological information.

Research Question:
What is the neural correlates of cognate priming in Chinese-Japanese bilingual brain?

Methods

Participants

Twenty-eight right-handed *native Mandarin speakers living in Japan* (11 males, mean age = 25.96, SD = 2.94) were recruited. On average they studied Japanese for 7.20 years (SD = 2.71). All of them passed the JLPT-N1 test, which indicated that they were very proficient in L2-Japanese.

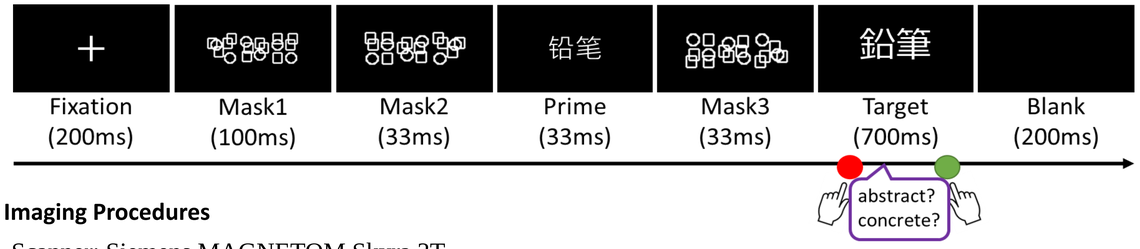
Materials

20 pairs in each condition.
Half of them are concrete words, the other half are abstract words.

Condition	Prime (L1)	Target (L2)
Identical cognates (IC)	数学 (math)	数学 (math)
Similar cognates (SC)	价值 (value)	価値 (value)
Non-cognates (NC)	行李 (luggage)	荷物 (luggage)
Un-related words (UR)	肥皂 (soap)	息子 (son)

Methods

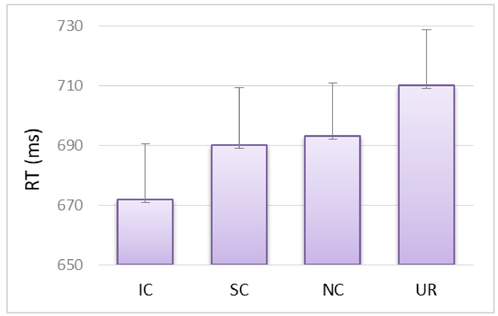
Procedure



Imaging Procedures

Scanner: Siemens MAGNETOM Skyra 3T
Structural: T1 MPAGE, TR = 2300ms, TE = 2.98ms, Flip = 9˚, 224 slices, 1*1*1 voxel
Functional: EPI BOLD, TR = 1000ms, TE = 30ms, Flip = 68˚, 30 slices, 3*3*3.99 voxel

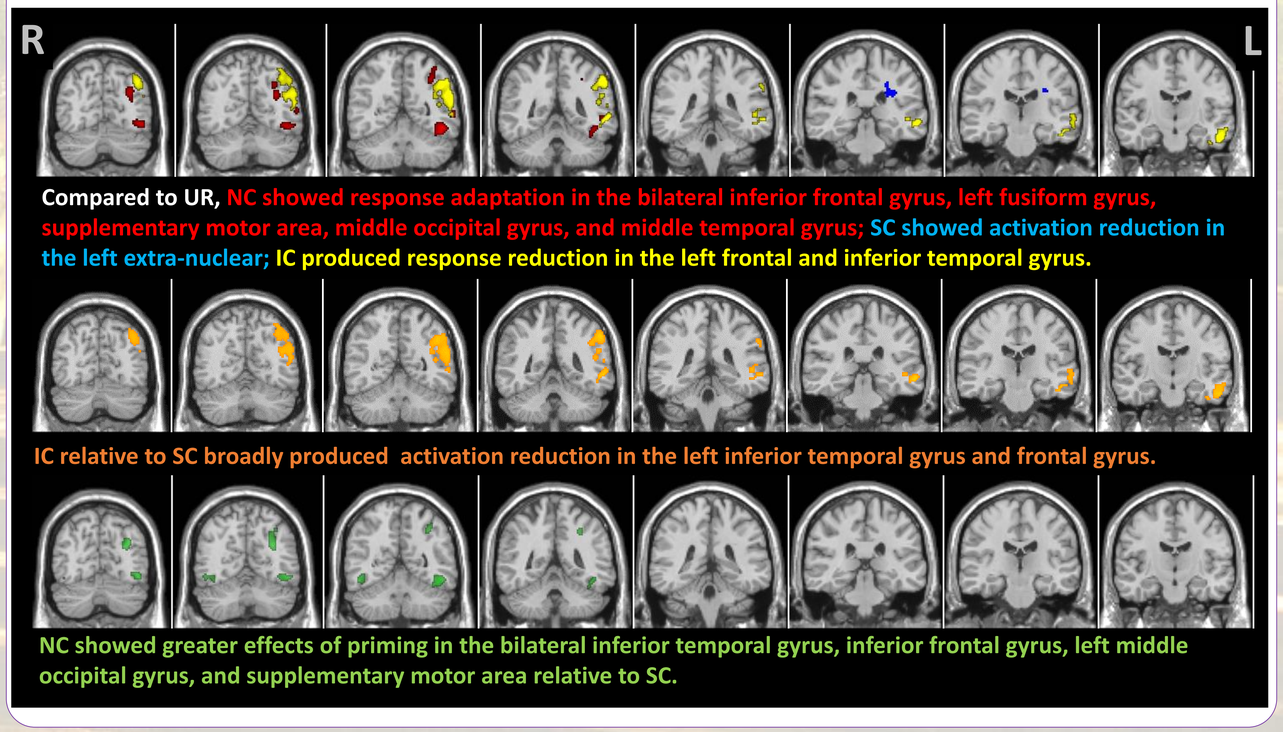
Behavioral Results



The mean accuracy was 88.29%. Two participants were excluded from the analysis of RT due to a mechanical problem.
A one-way repeated measures ANOVA was conducted on RT to compare the priming effect in the four conditions [F (3, 75) = 62.82, p < .001]:

(1) Participants responded more quickly to identical cognates than to similar cognates (p = .000) and non-cognates (p = .000); (2) The RT for similar cognates (p = .000) and non-cognates (p = .000) was equally shorter than unrelated words; (3) There was no significant difference between similar cognates and non-cognates (p = .324).

fMRI Results



Discussion

At the behavioral level:
We found identical cognate priming effect and semantic priming effect. Cognates with identical orthographic forms in L1 and L2 benefit more from L1 than cognates with similar word forms.

However, the priming effect was equal between orthographically similar cognates and non-cognate pairs.

At the neural level:
The cross-language translation priming effect in Chinese and Japanese was found in the left middle temporal gyrus (MTG), inferior frontal gyrus (IFG) and left fusiform gyrus (FG).

Identical cognates produced larger priming effect relative to similar cognates in the left inferior temporal gyrus (ITG) and frontal gyrus. The ITG that involves word form retrieval (Gaillard et al., 2006) mediates orthographic processing in the Chinese-Japanese bilingual brain.

Although undetectable at the behavioral level, similar cognates showed increased activation in the IFG, ITG and left middle occipital gyrus relative to noncognate pairs, indicating that similar cognates induce competition at the orthographic representation. This result provide an evidence to the BIA + model (Dijkstra and van Heuven, 2002), assuming that orthographic representations in L1 and L2 are connected with a inhibitory link.

Conclusion:
The left IFG-MTG network subserves lexical access after morpheme activation in logographic reading. The ITG mediates word form retrieval in Chinese-Japanese bilingual brain.

References

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