Semantic Radical Activation in Japanese Two-*kanji* Compound Recognition

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Research Question

- What is a semantic radical?

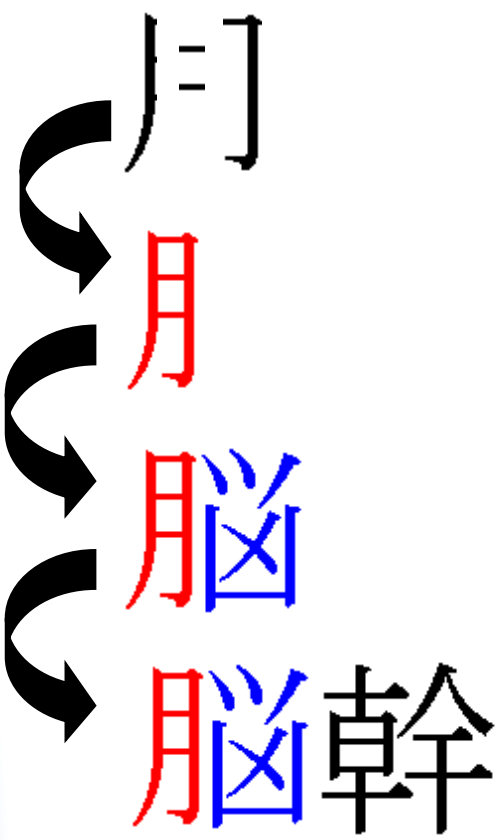
‘brain’ ‘lung’ ‘skin’ ‘waist’ ‘bowel’

 : for body parts

- Semantic radicals are a kind of orthographic morphemes that have no phonological counterpart.
- Does this anomalous morpheme play a detectable role during reading of two-character Japanese compounds ?

Previous Research

- **Decompositional models**: hierarchy of lexical representation



Character features

Semantic radical

Character (morpheme)

Compound

Previous Research

- Evidences for radical processing in visual word recognition
  - Flores d'Arcais & Saito (1993)
  - Flores d'Arcais, Saito, Kawakami (1995)
  - Feldman & Siok (1997)
  - Feldman & Siok (1999)
  - Saito, Yamazaki, & Masuda (2002)
  - Yencken & Baldwin (2006)

- Feldman & Siok (1997) and Feldman & Siok (1999)
  - Larger semantic radical family leads to shorter RTs

Some problems

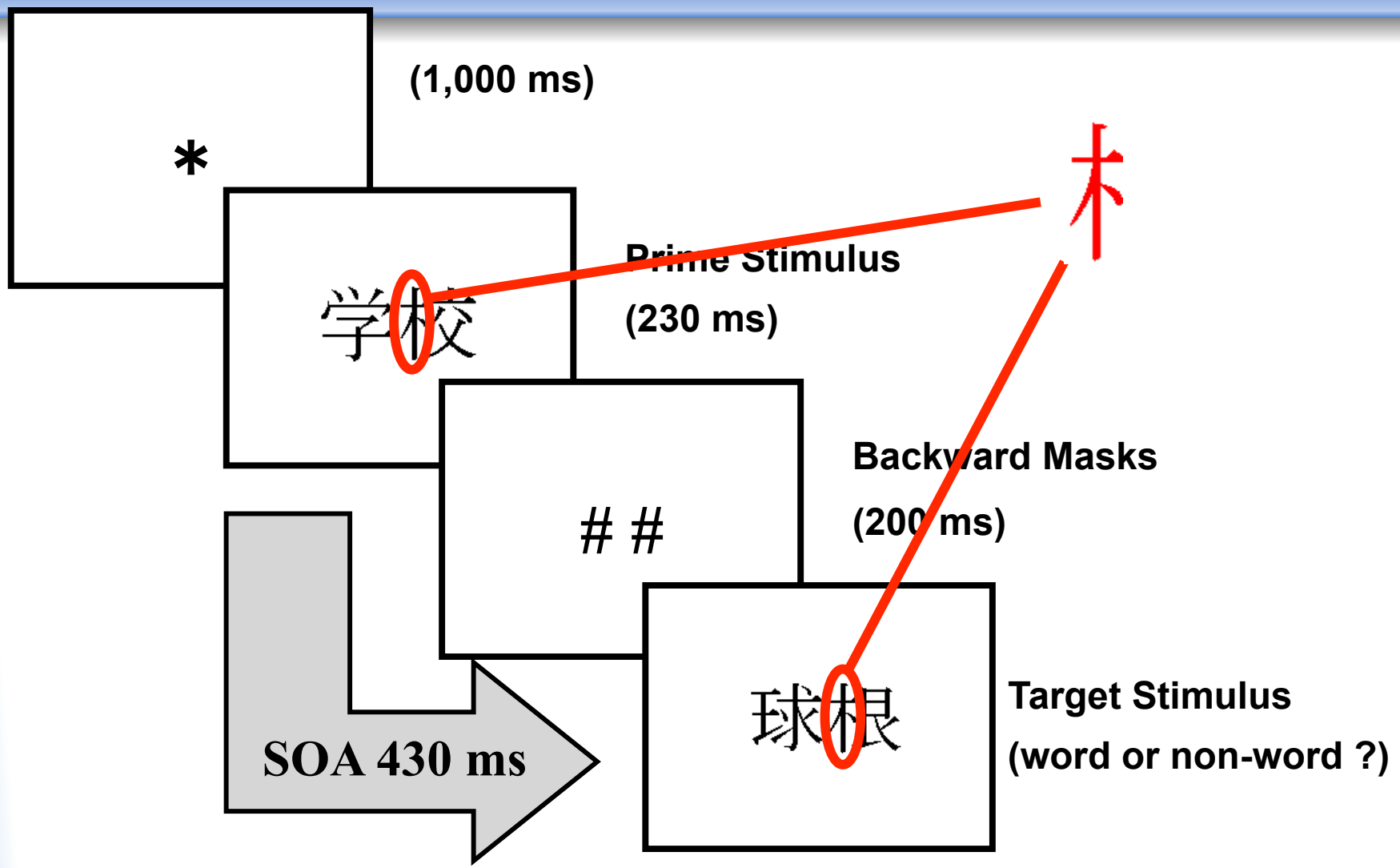
All previous studies on semantic radical processing have one of these problems:

- Isolated character presentation
  - although most Japanese words are compounds.
  - might have encouraged strategic radical decomposition
- isolated semantic radical presentation
  - it is not rare that radicals do not occur in isolation.

The present study extends previous research using lexical decision by:

- Considering semantic radical function in compounds
- Using better non-words.
  - NOT illegal combinations of radicals
  - BUT illegal combinations of characters

Experiment: LD with Priming



Experiment: LD with Priming

Original Hypothesis:

Repetition of semantic radicals induce a facilitatory priming effect.

- **Participants**
  - 30 native speakers of Japanese
- **Material**
  - 46 prime-target pairs of two-*kanji* words
  - 46 prime-nonword pairs

Priming did not work (non-significant) !

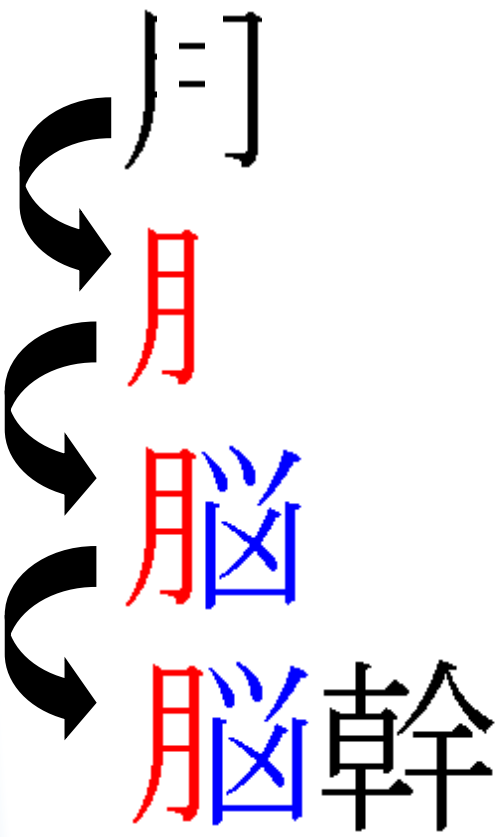
Implications

- Are semantic radical functional only when unnatural non-words trigger radical decomposition ? was our experiment flawed ?
- No, it was not.

  To see this we need to make use of analyses of covariance using a wide range of predictors.

Lexical Predictors (of targets)

- **Decompositional models**: hierarchy of lexical representation



Character features

(Right) Radical Stroke, Target Right Stroke, Target Left Stroke

Left Radical Stroke

Semantic radical

Log (Right) Radical Freq, Log (Right) Radical Type Freq,

Radical Transparency, Log Left Radical Freq, Log Left Radical Type Freq

Character (morpheme)

Log Target Right Token Freq, Log Target Right Type Freq

Log Target Left Token Freq, Log Target Left Type Freq

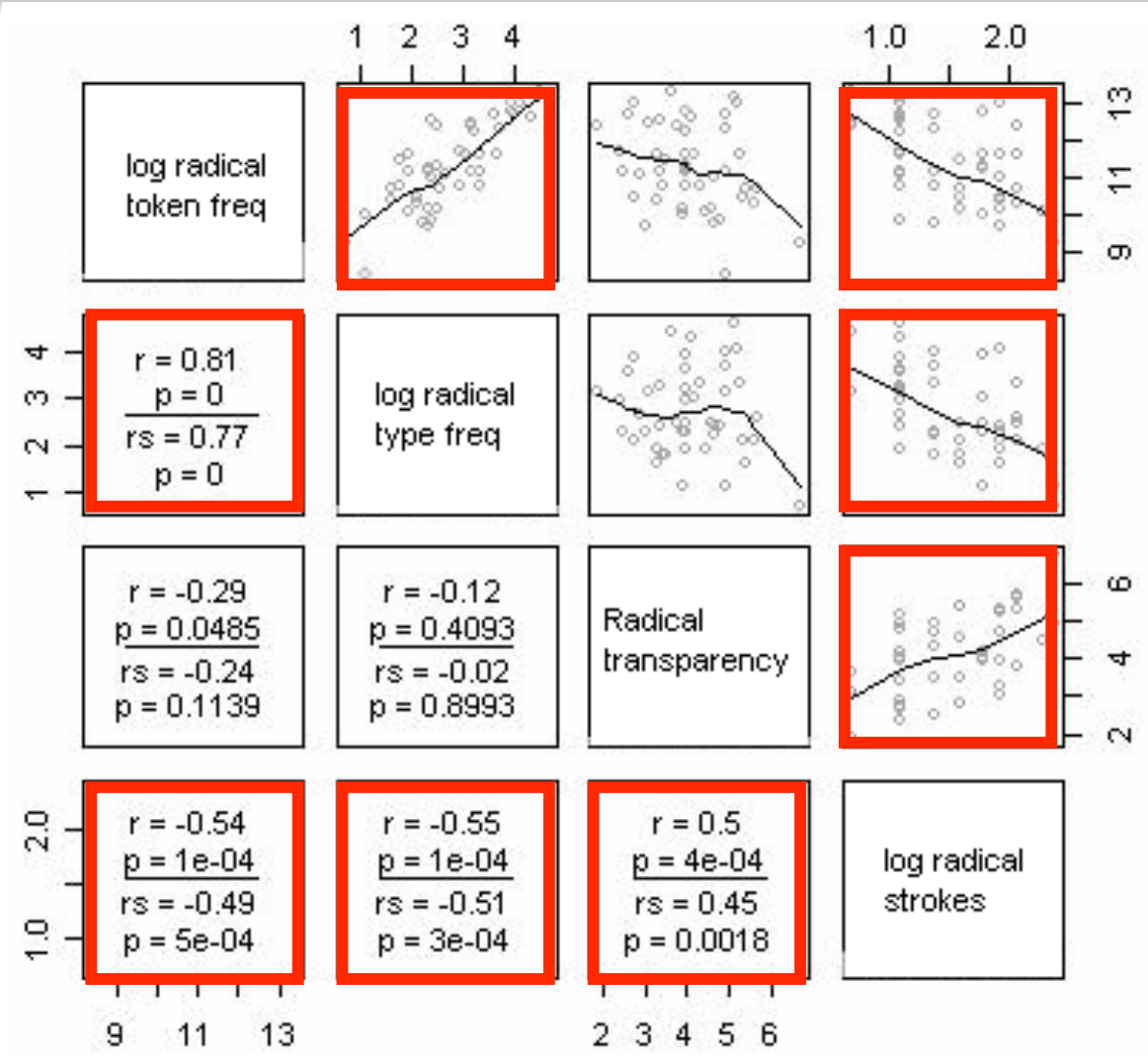
Target Right AoA, Target Left AoA

Compound

Target Word Freq

A problem of Collinearity

- Many of the 21 variables are highly correlated. (e.g. radical properties)



PCA Regression: Method

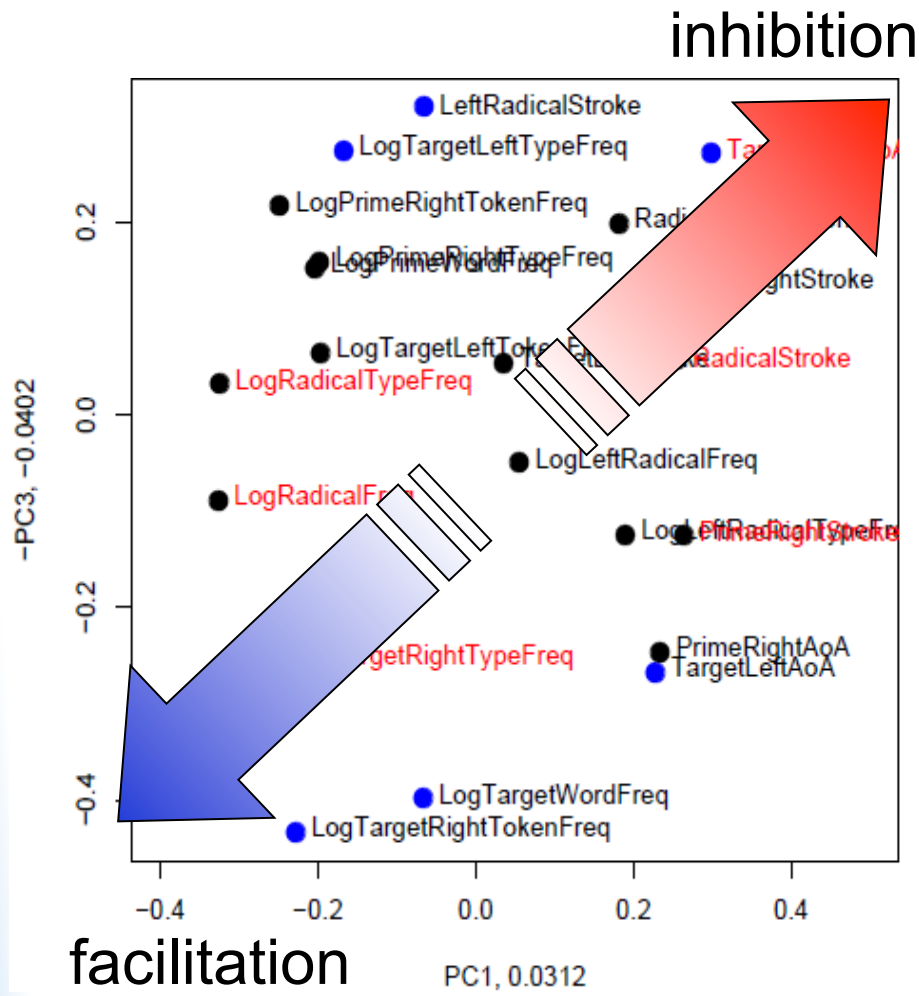
1. We orthogonalized the predictors with principle component analysis.
2. We accepted that some measures would be telling a similar story.
3. We used the principal components as predictors.
4. We interpreted significant principal components by looking at the loadings of the original predictors.

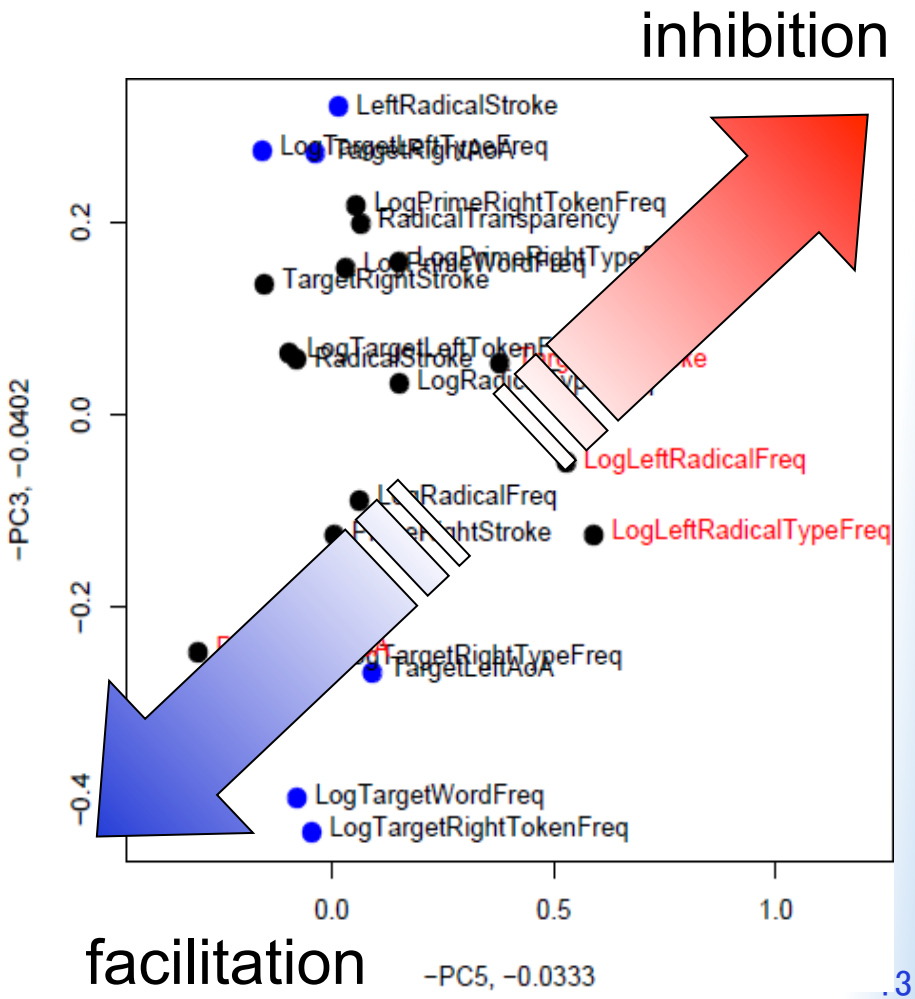
PCA Regression: Result

- In our principle component analysis, three PCs emerged as significant predictors (PC1, PC3, and PC5).

		Estimate	Std. Error	t value	p value
(Intercept)		6.59859	0.02960	222.9	0.000
Trial	facilitatory	-0.02063	0.00494	-4.18	0.000
PC1	inhibitory	0.03118	0.00862	3.62	0.000
PC3	facilitatory	-0.04017	0.01366	-2.94	0.003
PC5	facilitatory	-0.03333	0.01646	-2.03	0.043

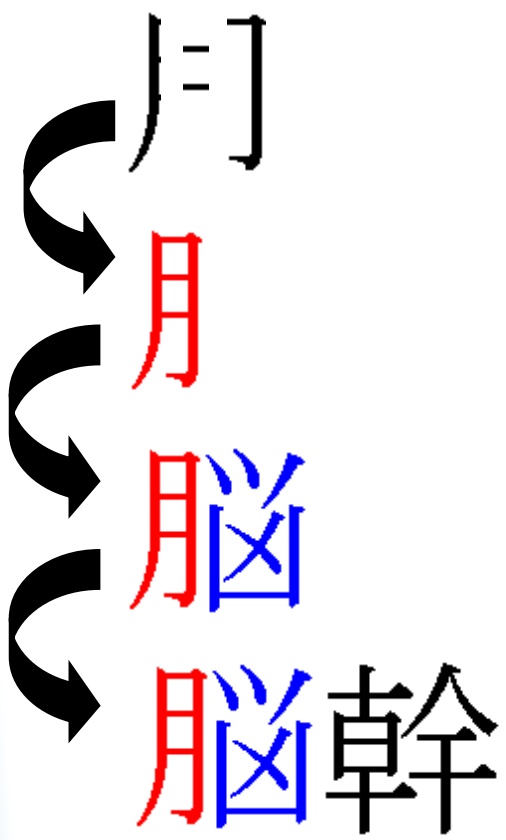
PCA Regression: Results





Lexical Predictors (of targets)

- **Decompositional models**: hierarchy of lexical representation



Character features

(Right) Radical Stroke, Target Right Stroke, **Target Left Stroke**

Left Radical Stroke

Semantic radical

Log (Right) Radical Freq, **Log (Right) Radical Type Freq**,

Radical Transparency, **Log Left Radical Freq**, **Log Left Radical Type Freq**

Character (morpheme)

Log Target Right Token Freq, **Log Target Right Type Freq**

Log Target Left Token Freq, **Log Target Left Type Freq**

Target Right AoA, **Target Left AoA**

Compound

Target Word Freq

Summary

- The priming manipulation failed, but regression analyses show that semantic radicals are at work.
- Since we know that primes were processed, we know that our task was not flawed. It may well be that positive evidences in earlier studies were due to the nature of non-words.
- The properties of semantic radicals that are important in reading are
  1. Semantic radical type frequency (c.f. Feldman & Siok, 1999)
  2. Semantic radical token frequency
  3. Number of radical strokes

Thank you

Acknowledgment

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Statistics using R

Baayen, R. H. (to appear). *Analyzing linguistic data: A practical introduction to statistics using R*. Cambridge University Press

PCA

	PC1
LogRadicalFreq	-0.32595441
LogRadicalTypeFreq	-0.32461342
LogTargetRightTypeFreq	-0.25719829
LogPrimeRightTokenFreq	-0.24851236
LogTargetRightTokenFreq	-0.22849805
LogPrimeWordFreq	-0.20400900
LogPrimeRightTypeFreq	-0.19793693
LogTargetLeftTokenFreq	-0.19694687
LogTargetLeftTypeFreq	-0.16765199
LogTargetWordFreq	-0.06674472
LeftRadicalStroke	-0.06558624
TargetLeftStroke	0.03508257
LogLeftRadicalFreq	0.05533828
RadicalTransparency	0.18117849
LogLeftRadicalTypeFreq	0.18936575
TargetRightStroke	0.22199603
TargetLeftAoA	0.22712781
PrimeRightAoA	0.23350434
RadicalStroke	0.25461382
PrimeRightStroke	0.26371383
TargetRightAoA	0.29843572

PCA

	PC3
LeftRadicalStroke	−0.31890508
LogTargetLeftTypeFreq	−0.27377317
TargetRightAoA	−0.27015008
LogPrimeRightTokenFreq	−0.21593121
RadicalTransparency	−0.19802870
LogPrimeRightTypeFreq	−0.15852085
LogPrimeWordFreq	−0.15197259
TargetRightStroke	−0.13537410
LogTargetLeftTokenFreq	−0.06331644
RadicalStroke	−0.05751754
TargetLeftStroke	−0.05340011
LogRadicalTypeFreq	−0.03122143
LogLeftRadicalFreq	0.05025043
LogRadicalFreq	0.09020049
LogLeftRadicalTypeFreq	0.12549673
PrimeRightStroke	0.12576490
PrimeRightAoA	0.24687072
LogTargetRightTypeFreq	0.25513908
TargetLeftAoA	0.26796378
LogTargetWordFreq	0.39901548
LogTargetRightTokenFreq	0.43306385

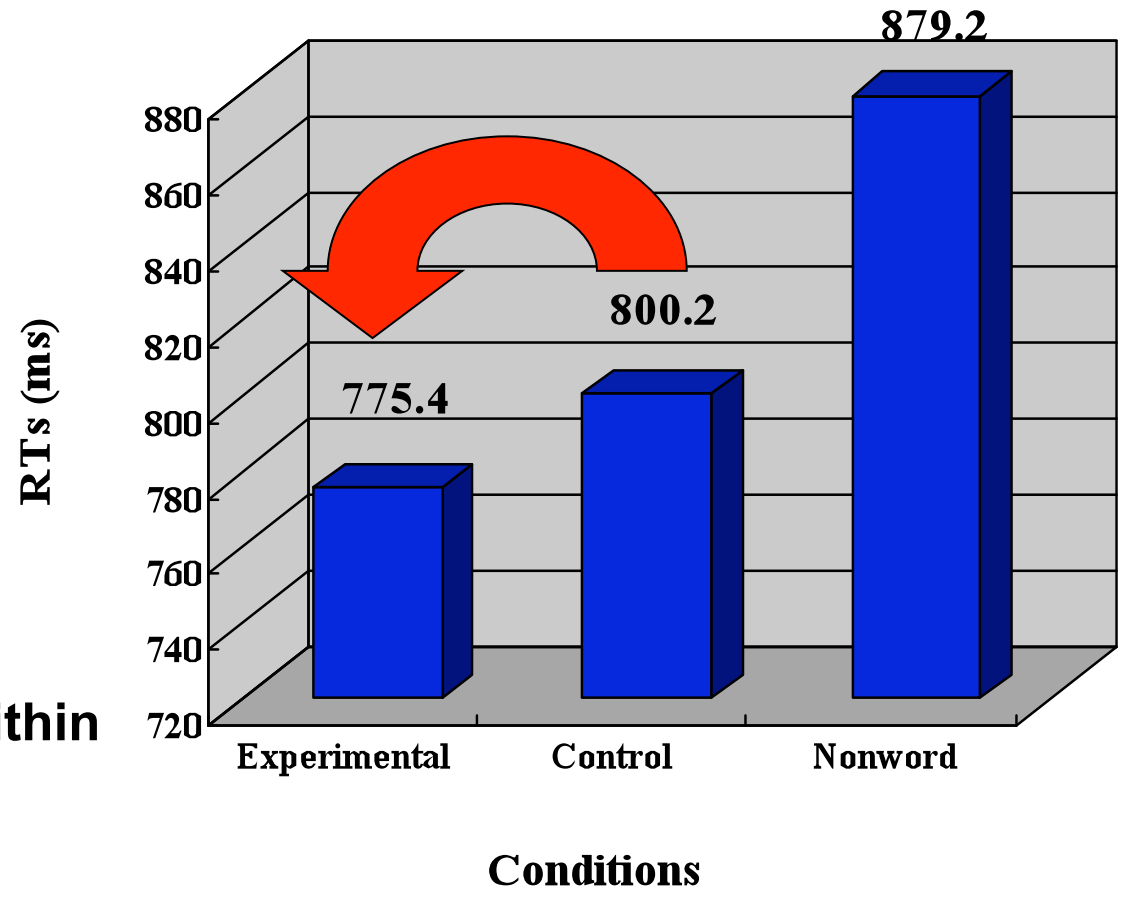
PCA

	PC5
LogLeftRadicalTypeFreq	−0.590242019
LogLeftRadicalFreq	−0.526935150
TargetLeftStroke	−0.377893898
LogRadicalTypeFreq	−0.151640066
LogPrimeRightTypeFreq	−0.149656442
TargetLeftAoA	−0.090099401
RadicalTransparency	−0.063713697
LogRadicalFreq	−0.061873990
LogPrimeRightTokenFreq	−0.054440805
LogPrimeWordFreq	−0.030480989
LeftRadicalStroke	−0.014648391
PrimeRightStroke	−0.004027343
LogTargetRightTypeFreq	0.028660268
TargetRightAoA	0.038024481
LogTargetRightTokenFreq	0.045912640
LogTargetWordFreq	0.078954418
RadicalStroke	0.080092633
LogTargetLeftTokenFreq	0.096903705
TargetRightStroke	0.152684837
LogTargetLeftTypeFreq	0.157344826
PrimeRightAoA	0.301901441

Results: Observing the surface

- No apparent priming effect. (p = 0.09)
- From an insignificant result in lexical decision, we cannot conclude anything.

What actually happened within 800 ms of lexical decision processing is a mystery.



Stimuli used

	Prime			Target			
Condition	***Word***	***Morphology/ Translation***	***Radical***	***Word***	***Morphology/ Translation***	***Radical***	***Radical Shared***
Experiment	空港	***ku-ko*** **'airport'**	シ **(water)**	血液	***ketsu-eki*** **'blood'**	シ **(water)**	**Yes**
Control	砂嵐	***suna-arashi*** **'sandstorm'**	山 **(mt.)**	血液	***ketsu-eki*** **'blood'**	シ **(water)**	**No**
Non-word	額縁	***gaku-buchi*** **'frame'**	糸 **(string)**	円筆	**N/A**	竹 **(bamboo)**	**No**