Speech recoding in reading sinograms: evidence from an ERP study on Cantonese (#8033)

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Introduction

When we recognize a word or read a sentence, even in a subvocal way, we would convert its graphemes into corresponding pronunciation, which is speech recoding (Tzeng et al., 1977). Namely, it seems to be a stage existing in silent reading during which readers recode orthographic constituents into phonological constituents. For instance, when we recognize the word "beat", the four letters [B][EA][T] would be recoded into sound /b//i//t/ rapidly, while decoding its meaning of "hit, pound, and win" or obtaining its potential associative word of "drum".

Speech recoding is frequently reported in alphabetic writing systems which conceive a transparent orthography that allows a phonological process to convert written strings to phonemic strings (Perfetti et al., 1998).

However, it is controversial whether the phonological component would be unfolded or not during subvocal sinogram reading in an opaque orthography, like Cantonese, whose logographic system does not apparently indicate the phonological information.

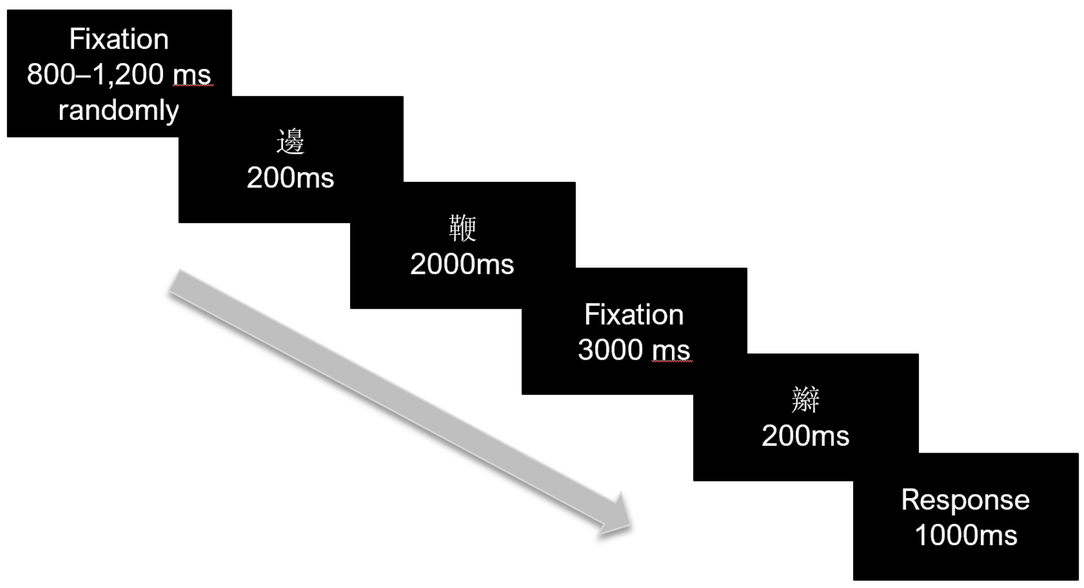
Objectives

1. to investigate whether speech recoding happens in reading sinograms in Cantonese context and how it proceeds;
2. to further explore the neural processing of speech recoding in Cantonese native speakers;
3. to examine which factors, such as working memory, phonological & orthographic awareness, would affect speech recoding in sinogram reading.

Procedure and Stimuli

Procedure:

The retroactive interference paradigm was adopted in the current study (Tzeng et al., 1977). Subjects firstly were presented with a target sinogram for 200ms, then they were asked to read out the second interference sinogram which would appear in the monitor for 2000ms. After 3000ms fixation, subjects were required to judge whether the third probe sinogram was identical to the first target sinogram.



Stimuli design:

8 conditions =

2 sinogram cohorts: homophone and non-homophone

× 2 tonal groups: long tone and short tone

× 2 response conditions: same and different

Sinogram cohort	Tone group	Response condition	Target sinogram	Interference sinogram	Probe sinogram
homophone	long tone	same	山 saan1	刪 saan1	山 saan1
		different	邊 bin1	鞭 bin1	辮 bin1
	short tone	same	汁 zap1	執 zap1	汁 zap1
		different	黑 hak1	刻 hak1	克 hak1
non-homophone	long tone	same	淒 cai1	兔 tou3	淒 cai1
		different	店 dim3	豉 si6	通 tung1
	short tone	same	塾 suk6	勺 zoek3	塾 suk6
		different	笠 lap1	末 mut6	插 caap3

Subjects

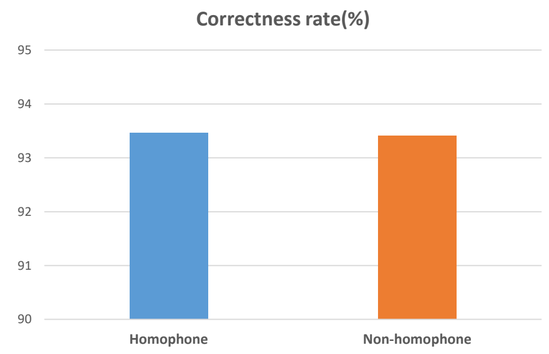
	Number	Age	Working Memory	Phonological Awareness	Orthographic Awareness	Native Language
Male	6	21.3±2.4	10.5±2.0	61.1±27.4	90.7±3.8	Cantonese
Female	4	20±1.2	9±1.4	70±19.0	77.6±9.7	Cantonese

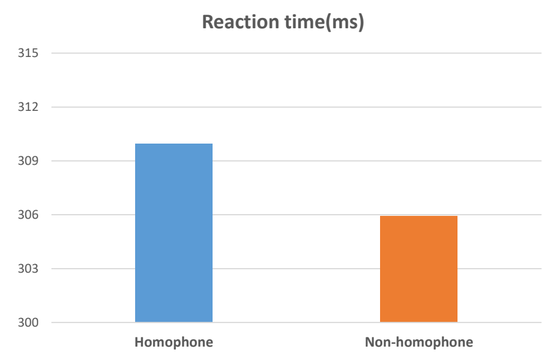
Ten Cantonese native speakers were recruited. The above table shows their basic information. Working memory was measured by the digit span test. The maximum score of the phonological & orthographic awareness test is 100.

Results

Behavioral Results:

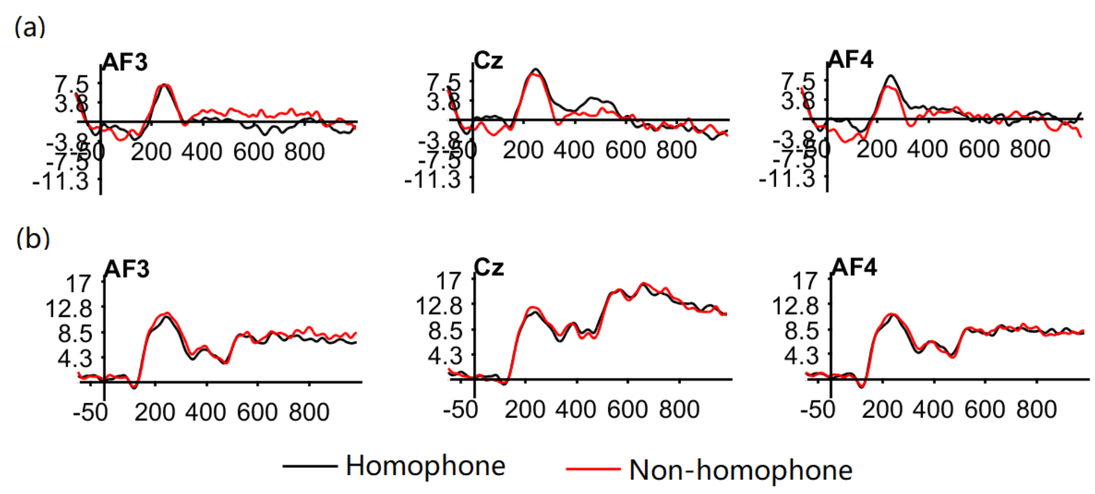
Subjects performed similarly in both homophonic and non-homophonic conditions when recognizing whether the probe sinogram was identical to the target sinogram.





ERPs Results:

Event-related potentials (ERP) recordings made from the onset of the interference sinogram revealed that homophones produced the reduced N400 component that distributed at middle-right frontal and central electrodes (see the below figure a). This is consistent with the results of Mandarin native speakers (Valdes-Sosa et al., 1993).



However, this N400 component vanished at the probe sinograms in the homophonic trials, suggesting a declining phonological priming effect within a short period (see the above figure b).

Conclusions and Limitations

1. The observed N400 effect may reflect that speech recoding influences written ideographic language comprehension, which is similar to those who speak an alphabetic language. And this phonological activation is sensitive to the retention length.
2. One major limitation of the current study is that we did not obtain a detailed trajectory of speech recoding. Future studies need to explore when phonological activation happens and how long it could retain. Another limitation is that we did not yet discover prominent factors that were highly related to speech recoding in current results probably due to the small sample size.

References (Selected)

Perfetti, C. A., & Tan, L. H. (1998). The time course of graphic, phonological, and semantic activation in Chinese character identification. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 24(1), 101-118.

Tzeng, O. J., Hung, D. L., & Wang, W. S. Y. (1977). Speech recoding in reading Chinese characters. *Journal of Experimental Psychology: Human Learning Memory*, 3(6), 621-630.

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