

1 Background

Languages vary in the way that writing expresses the sounds of spoken language

Alphabetic languages = High orthographic transparency

- Information about phonological structure within orthography
- Each sound usually mapped to one orthographic symbol

Logographic languages = Low orthographic transparency

- Less information about phonological structure within orthography
- Each sound usually mapped to multiple orthographic symbols

BEACH	PEACH
/bi:tʃ/	/pi:tʃ/
郑	张
/'tʃəŋ/	/'tʃɑ:n/

Orthographic effect on auditory lexical decision and picture naming (Rastle et al., 2011)

How does the nature of the writing system impact on reading acquisition and the spoken language representations that underpin reading?

2 Methodology

Participants 24 monolingual native English speakers (16 females) aged 19-34

Stimuli Two sets of 24 CVC pseudowords written in novel symbols and assigned English meanings – Inspired by Taylor et al. (2017) and Mei et al. (2014)

Set 1: Alphabetic

Regular mappings between graphemes and phonemes

Set 2: Logographic

No relationship between graphemes and phonemes

Procedure All participants learn to read aloud and say meanings of both orthographies

Day 1	Day 2	D3	D4	D5	D6	D7	D8	D9	Day 10	Day 11	Day 12	
Pre-exposure		Training							Testing		Scanning	
P-S	O-P	P-S			O-P		O-S		P-S	O-P	O-S	Vis / Aud

fMRI paradigm Visual Semantic Monitoring (TR=2s, TA=2s)

Animals + shu + shu + shu + Rest block 12 seconds

Go/NoGo: Is the meaning an animal?

- 2 scanning sessions
- 8 alternating runs
- 192 trials per run
- 12 blocks per run
- alternating languages
- 12 targets per run
- 2.5s trial + .5s ITI
- 32 slices/3mm³ voxels

fMRI paradigm Auditory Semantic Monitoring (TR=3s, TA=2s)

Tools + + + + + + + Rest block 12 seconds

3 Behavioural results

* = p < .05

Reading Aloud

Alphabetic writing system benefits accuracy and speed of Reading Aloud during training and testing = alphabetic easier to learn and faster to retrieve

Similar results

- Aud Orthographic Search
- Visual Lexical Decision

Saying the Meaning

Alphabetic benefits accuracy but logographic benefits speed during training. Logographic was faster during testing with no differences in accuracy.

Similar results

- Sem Orthographic Search
- Visual Semantic Monitoring

Picture Naming

No differences in accuracy or speed for Picture Naming during training and testing

Similar results

- Picture Search
- Aud Semantic Monitoring
- Auditory Lexical Decision
- Auditory Shadowing
- Phoneme Reversal

Visual Semantic Monitoring (in scanner)

d prime	3.06 *	3.57
RT (ms)	1747 *	1326

Auditory Semantic Monitoring (in scanner)

d prime	3.78	3.56
RT (ms)	1492	1468

4 Univariate contrasts

Visual Semantic Monitoring p < .001 uncorrected, p < .05 cluster-level corrected

Alphabetic > Baseline (z = +0, y = -66, x = -31)

Logographic > Baseline (z = +0, y = -66, x = -31)

Alphabetic > Logographic (z = +6, y = +0, x = -43)

Logographic > Alphabetic (z = +24, y = -66, x = -43)

Shared activity in bilateral occipitotemporal and parietal cortices. Left precentral gyrus (PrG) and superior parietal lobule (SPL) more active for alphabetic. Left superior frontal gyrus and bilateral angular gyrus (AnG) and middle occipital gyrus (MOG) more active for logographic.

Auditory Semantic Monitoring SPM12, standard pre-processing, and canonical HRF

Alphabetic > Baseline (z = +6, y = -18, x = -37)

Logographic > Baseline (z = +6, y = -18, x = -37)

Shared activity in left frontal and bilateral temporal cortices, including left precentral and postcentral gyrus, bilateral anterior insula, frontal operculum, superior temporal gyrus, and transverse temporal gyrus. No brain areas more active for alphabetic/logographic system.

5 Discussion

High orthographic transparency strengthens orthography–phonology mapping

- O-P mappings acquired and recalled more efficiently for alphabetic system
- Significantly higher accuracy and faster RT for O-P tasks, slower RT for O-S tasks

Low orthographic transparency strengthens orthography–semantics mapping

- O-S mappings recalled more efficiently for logographic writing system
- Significantly faster RT for O-S tasks, lower accuracy and slower RT for O-P tasks

Orthographic transparency does not appear to affect spoken language processing

- No differences between alphabetic/logographic when orthography not present
- Does not support orthographic effect on speech perception (Rastle et al., 2011)

Left PrG and SPL more active for alphabetic languages when orthography present

- Increased phonological processing for alphabetic writing system (Taylor et al., 2013)

Bilateral AnG and MOG more active for logographic system when orthography present

- Increased semantic/phonological lexicon processing for logographic (Taylor et al., 2013)

No difference in activation for spoken language tasks where orthography not present

Next steps: Investigate whether neural patterns differ between writing systems

- Are representations more phonemically and/or orthographically structured?

6 References

Mei, L., Xue, G., Lu, Z., Chen, C., Zhang, M., He, Q., et al. (2014). Learning to read words in a new language shapes the neural organization of the prior languages. *Neuropsychologia*, 65, 156-168.

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