

THE EFFECT OF ORTHOGRAPHIC TRANSPARENCY ON COGNITION, BRAIN STRUCTURE AND CONNECTIVITY

Jia'en Yee | ESR 6 | WP3



UPM
UNIVERSITI PUTRA MALAYSIA



University of Reading

BACKGROUND

Several brain regions related to language processing, along with the white matter tracts that connect them change their structure in response to continuous handling of two languages (Ressel et al., 2012; Pliatsikas, 2019).



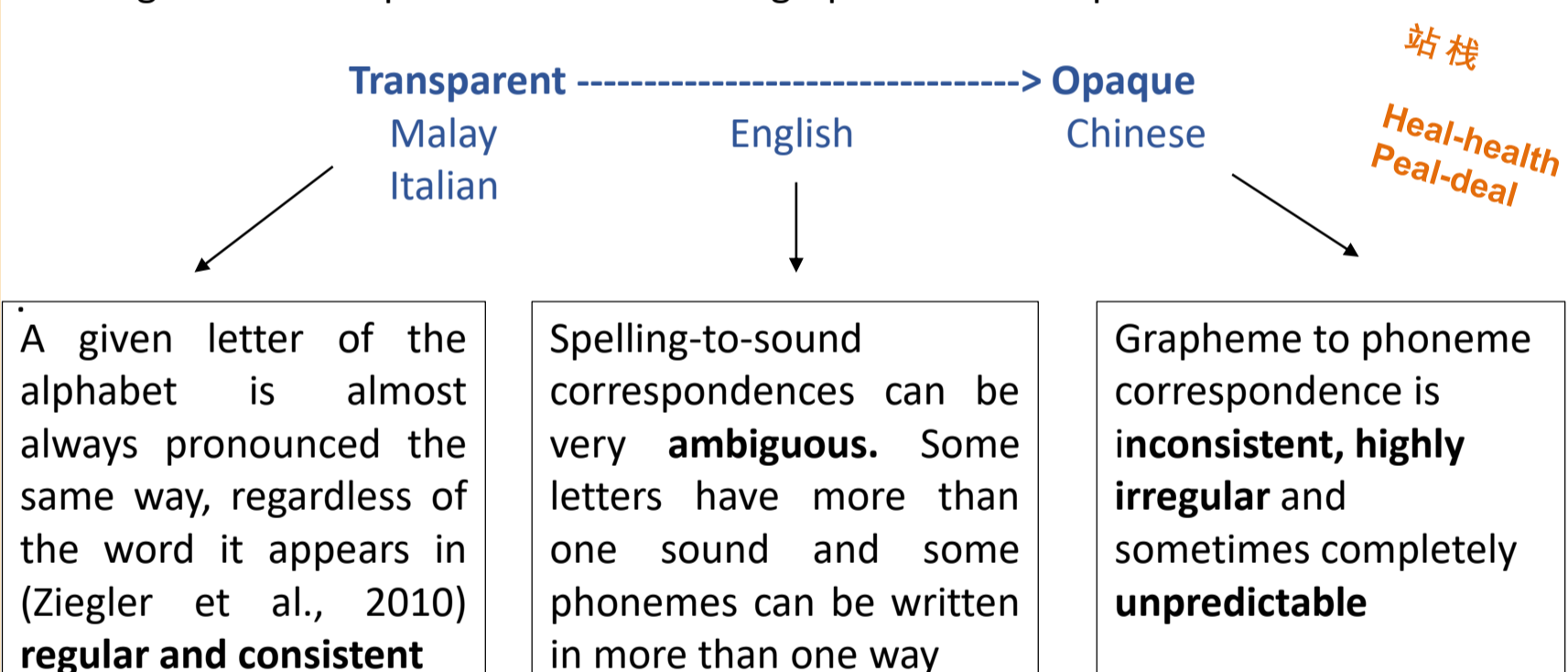
Early bilinguals develop more highly connected and efficient sub-networks related to language processing and monitoring (García-Pentón, Fernández, Ituria-Medina, Gillon-Dowens & Carreiras, 2014).

The writing systems/orthographies of languages differ in various ways such as in its **script** and orthographic **transparency**. Many languages use alphabets – English, Italian, some use syllabaries (Japanese Kana) while others like Chinese are logographic.

Alphabetic languages:	Non-alphabetic languages: logographic	Non-alphabetic languages: syllabary
Ideally all phonemes of the language are denoted by separate elements (letters) English, Malay	Each character represents a word or phrase or a concept Chinese: 你好	Written symbols represent syllables – a consonant sound followed by a vowel sound Hindi: नमस्ते

Orthographic Transparency

The degree of correspondence between a grapheme and its phoneme



RATIONALE & AIMS

Unlike bilingualism, studies on biliteracy have mainly adopted a cross-linguistic skills transferability framework, instead of a cognitive effect framework (Branum-Martin, Tao, Garnaat, Bunta & Francis, 2012; Bassetti, 2007)

- The more similar the orthographic properties of a learner's two languages, the more efficient the *language skills' transfer* (Kahn-Horwitz et al., 2014).
→ Hence what does it take to learn a language of different orthographic properties?
- Different learnability – “in opaque orthographies, many words cannot be pronounced accurately without accessing the phonological representation of the whole word. This could lead to one **developing different recoding tactics** that help with decoding at different grain sizes in order to supplement grapheme-phoneme correspondences, naturally requiring a **larger range of cognitive skills**” (Borleffs et al, 2017).

However, these studies are mostly done on children or L2 learners (Schwartz et al, 2012)

- comparisons between **balanced** biliterates of **different combinations of orthographies** are scarce
- unclear what the effects of biliteracy are on **cognition**, beyond cross-linguistic transfer
- Current research also do not distinguish between the roles of **alphabetic vs non-alphabetic** languages and **variation in orthographic depth**



The broad aims of the study are to:

- Shed light on a group of severely understudied multilinguals
- Examine the effect of orthographic transparency on language processing/ cognition
- Examine activation networks between biliterates of alphabetic languages and biliterates of a mix of alphabetic and non-alphabetic languages

METHODS

Participants

- 2 groups of bi-/multilinguals with different combinations of languages varying in writing systems and orthographic transparency
- English monolinguals as a control group

- 1) English-Malay monoliterate bilinguals
- 2) English-Chinese-Malay biliterate multilinguals

Task in scanner

Cognition

- Mental flexibility/inhibitory control: Flanker task/Stroop task
 - o Reaction Time/Accuracy

Study 1: Neuroimaging task – orthographic transparency on:

Brain connectivity & structure

- Resting state fMRI
 - o Brain network organisation
- fMRI while undergoing behavioural linguistics task
 - o Orthographic processing regions of different writing systems
 - o correlates, activation overlap
 - o Do different groups have different activated neural networks for **language processing relating to orthographic transparency?**
- Structural MRI/Diffusor Tensor Imaging:
 - o Volume and integrity of gray and white matter
 - o Between group comparison
 - o Within group comparison(e.g. language medium as IV)

Study 2:

Behavioural task - effect of orthographic transparency on:

Language processing

- Priming/Interference paradigm
- Potential aspects of language processing:
 - Phonology/Morphology
 - o Morphological decomposition/Masked-priming/Lexical decision task
 - o Word-recognition task in Chinese?



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