The Influence of Semantic, Phonology and Orthography Priming during Unconscious Reading

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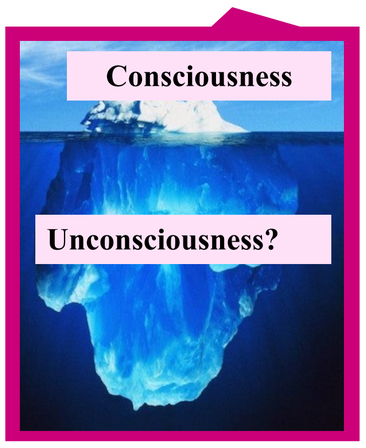
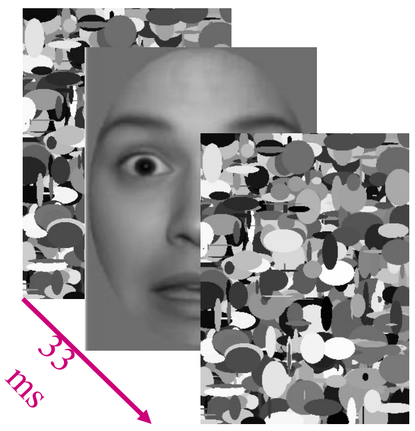
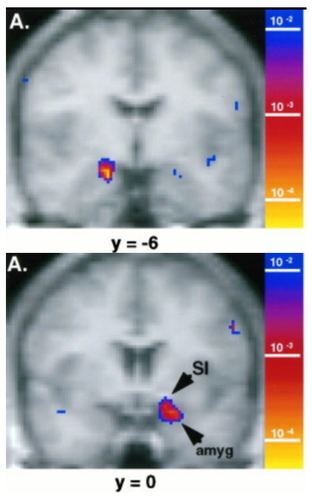
Introduction

The mechanisms underlying unconsciousness remain elusive. Some psychologists argue that humans can perform high-level functioning such as reading when unconscious, while others suggest that unconscious processing seems out of reach and limited.

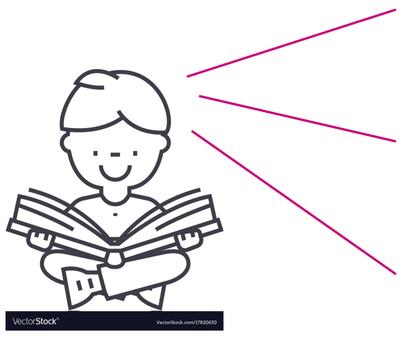






Whalen et al. (1998) presented fearful and happy human faces to participants rapidly that they were **below the threshold of awareness**. None of the participants reported seeing the faces, yet fMRI results showed the amygdala had a stronger response to fearful faces compared to happy faces.

Other studies explored the feasibility of unconscious processing in higher-level cognitive functions such as reading and word recognition. Previous research in typical reading scenarios has demonstrated substantial **positive effects of semantic, orthographic, and phonological priming**. However, investigations into unconscious reading have yielded mixed findings.



Semantic: the meaning of the words. For example, 'cat' and 'dog' are similar in semantics.

Orthography: the structure/ spelling of the words. For example, 'compliment' and 'complement' are similar in orthographic.

Phonology: the pronunciation/sound of the words. For example, 'write' and 'right' are similar in phonetics.

Previous studies	Method	Tested language	Language features	Results
Costello et al	CFS	English	Semantics	+ Significant
Sklar et al	b-CFS	Arabic	Semantics	+ Significant
Cheng et al	b-CFS	Chinese	Semantics	Not Significant
Abrams and Greenwald	CFS	English	Orthographics	+ Significant
Beyersmann et al	b-CFS	English	Semantics + Orthographics	+ Significant
Cheng et al	b-CFS	Chinese	Semantics + Orthographics	- Significant

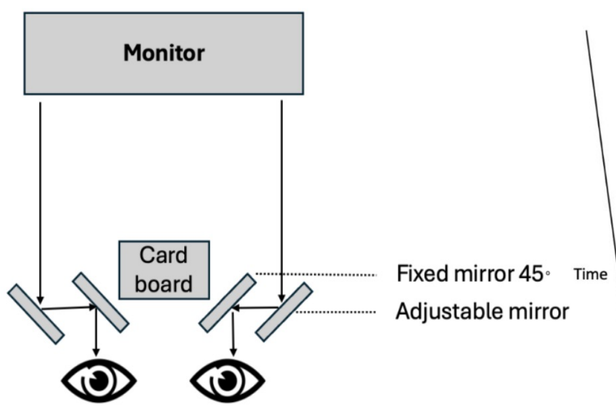
Research Gap: Previous studies overlooked phonology priming. Some stimuli used by researchers to investigate semantics and orthography were phonetically similar, potentially introducing a confounding variable.

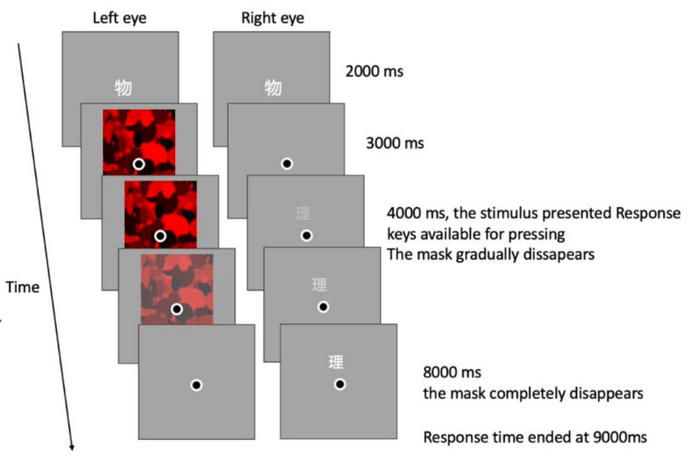
Research Question

1. Can reading be performed unconsciously?
2. How will semantic, phonological and orthographical similarity between the prime and target facilitate the unconscious reading?

Method: breaking – Continuous Flashing Suppression

b-CFS adopts interocular suppression where one eye is exposed to a rapidly flashing, high-contrast, and dynamic visual mask, while the other eye receives static stimuli. The brain is naturally drawn to dynamic visual information, which can capture attention and dominate perceptual processing. Consequently, the visual mask suppresses conscious awareness of the static stimuli for up to seconds, thus allowing the target stimuli to experience prolonged unconscious processing. This study first presents a prime character consciously, then presents the target character unconsciously. **We measure the time it takes for stimuli to 'break' through suppression and become consciously perceptible**.





This study adopts a logographic language; **simplified Chinese single characters as stimuli**. The stimuli list is divided into 8 conditions, which are either semantically, orthographically, or phonetically similar or dissimilar. Each condition consists of 8 pairs of Chinese characters as prime targets.

Twenty-one native Chinese speakers (M = 22.85, SD = 2.81), who were students at the University of Reading, participated in the experiment. In total, participants completed 256 trials of b-CFS.

Results and Discussion

Figure 1

The mean reaction time (in milliseconds) for all 8 conditions.

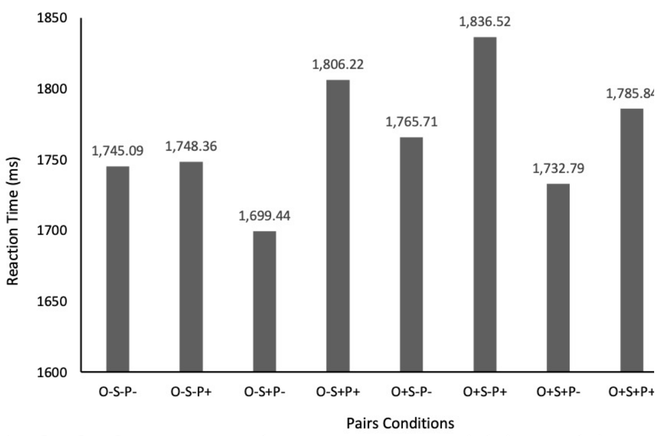
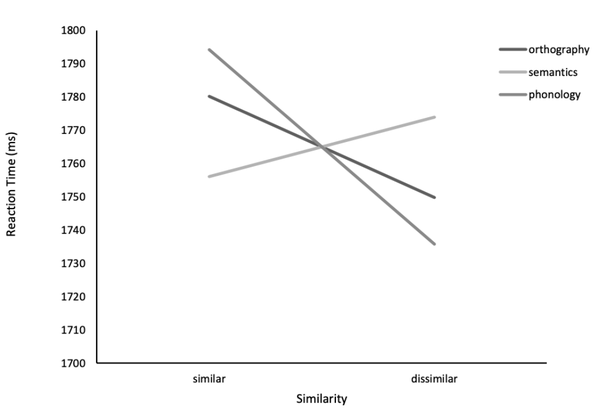


Figure 2

Changes in reaction time as similarity and language features



A 2x2x2 repeated measures within-subject ANOVA analysis was conducted. Our independent variables are semantic relatedness (2 levels: related vs unrelated), orthographic similarities (2 levels: similar vs dissimilar) and phonetic similarities (2 levels: similar vs dissimilar).

- No significant effect was found on semantic priming and orthographic priming. However, a positive priming effect was observed for semantic priming and a negative priming effect was detected on orthography.
- A significant negative priming effect was found on phonology ($p = .008$).
- No significant interaction was found between any independent variables.

The results indicate that phonology is activated during the early stages of reading and may compete with other cognitive processes before awareness. Additionally, no interactions among the three factors were detected, which could be attributed to methodological issues. Future research could involve larger stimuli lists and explore other languages. Moreover, this study raises questions about the ability to read when unconscious.

Stimuli Examples	S+O+P+	S+O-P-	S+O+P-	S+O-P+	S-O+P+	S-O+P-	S-O-P+	S-O-P-
Examples	椅 / 倚	赤 / 红	刀 / 刃	连 / 联	情 / 晴	午 / 牛	淡 / 蛋	高 / 虫
Meaning	Chair / lean on	Red / Red	Knife / Blade	Connect / Connect	Feelings / Sunny	Noon / Cow	Light / Egg	Tall / Worm
Pronunciation	Yi / Yi	Chi / Hong	Dao / Ren	Lian / Lian	Qing / Qing	Wu / Niu	Dan / Dan	Gao / Chong