WORD AND PSEUDOSUPERIORITY EFFECTS IN EARLY/NATIVE WELSH-ENGLISH BILINGUALS

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Abstract

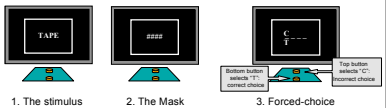
Word and pseudowords superiority effects have been interpreted as indices of familiarity with the words and the orthography of a language, respectively. Grossi, Murphy, & Boggan (in press) have shown that these effects are present in late learners of a language. Here, we are exploring their presence in a different population of bilinguals and a different language. Twenty-five native/early Welsh/English bilinguals performed a forced-choice letter identification task with Welsh words and pseudowords, English words and pseudowords, and nonwords. Participants showed pseudoword superiority effects for both languages but a significant word superiority effect only for Welsh. A control group of monolingual English speakers showed superiority effects only for English. These results show that word and pseudoword superiority effects reliably measure familiarity with the orthography of a language across a variety of alphabetic languages. Future research will more specifically explore whether visual word recognition processes are shaped differently following different learning experiences.

Introduction

In alphabetic languages, learning to read requires becoming familiar with not only a specific set of alphabetic symbols but also the letter combinations that characterize the orthography, that is, the arrangement of letters into sequences according to specific combinatorial rules of the language. The process underlying this increased familiarity with letters and letter sequences is considered a form of perceptual expertise: the visual system becomes increasingly efficient in recognizing the visual form of words, an ability that is considered crucial for the development of fluent reading skills (e.g., McCandliss, Cohen, & Dehaene, 2003). Indeed, research has shown that orthography plays an important role in word recognition and reading.

The Reicher-Wheeler paradigm

• Automatic orthographic processing has been measured successfully using the Reicher-Wheeler paradigm (e.g., Chase & Tallal, 1990; Grainger, Bouttevin, Truc, Bastien, & Ziegler, 2003; Grossi, Murphy, & Boggan, in press; McClelland, 1976; Reicher, 1969; Wheeler, 1970):



1. The stimulus (50 ms) 2. The Mask (500 ms) 3. Forced-choice (until response)

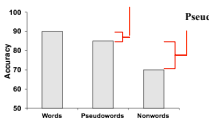
• Three types of stimuli

- ***real words*** (e.g., *tape*)
- ***pseudowords*** (e.g., *lape*): orthographically "legal" and pronounceable letter strings that carry no semantic information
- ***nonwords*** (e.g., *glbk*): illegal and unpronounceable letter strings

• Task: participants choose which of the two letters was presented in the specified position in the previous string of letters by pressing one of two buttons

Word Superiority Effect

Pseudoword Superiority Effect



Word and Pseudoword Superiority Effects

Studies using the Reicher-Wheeler paradigm have shown two main effects (Carr & Pollatsek, 1985; Grainger et al., 2003; McClelland, 1976; Reicher, 1969):

Word Superiority Effect (WSE): participants are more accurate with words compared to pseudowords (considered an index of familiarity with the words of a language)

Pseudoword Superiority Effect (PSE): participants are more accurate with pseudowords compared to nonwords (considered an index of familiarity with the orthography of a language)

Purpose of the Present Study

Previous studies have shown that WSE and PSE are present in late Italian-English bilinguals (Grossi et al., in press). In this study, we are exploring their presence in a different population of bilinguals (native/early) and a different language (Welsh).

Predictions

Based on previous work with late learners (Grossi et al., in press), it was predicted that

1: Early/native Welsh-English bilinguals would show both a WSE and a PSE for both languages.

2: English monolinguals unfamiliar with Welsh would show

2a: both a WSE and a PSE for both English

2b: no WSE and no PSE (or reduced effect when compared to English stimuli) for Welsh stimuli

Methods

Participants. Twenty-five early/native Welsh-English bilinguals and 20 English monolinguals participated. All bilingual participants learned to read in both Welsh and English in elementary school (starting at the age of 4 years). Welsh was the first language for 16 bilinguals (both parents spoke Welsh); English was the first language for 5 bilinguals (both parents spoke English); four participants were native bilinguals (one parent spoke Welsh, the other parent spoke English).
Subjects were matched by age/sex/years of education with the Welsh/English bilinguals.

	Age	Years of education
25 Early/native Welsh-English bilinguals (4 males)	Mean = 34.2 yr Range = 21-59	Mean = 20 yr SD = 2.9
20 Native English speakers (2 males)	Mean = 32.25 Range = 19-60	Mean = 18.7 SD = 2.5

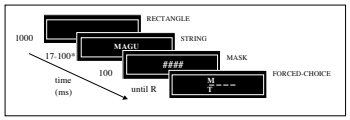
Stimuli. Two lists of 4-letter stimuli

	Words (n=56)	Pseudowords (n=56)	Nonwords (n=56)
Welsh	MAGU	MANU	MSFB
English	DARK	DARM	DSFG

	Words (n=56)	Written Frequency Database	Written Frequency
Welsh	MAGU	Ellis et al., 2001	262.3 (SD = 462)
English	DARK	Kucera & Francis, 1967	256 (SD = 426)

Pseudowords were created from the word stimuli by changing one letter in a non-critical position. Nonwords were formed by replacing the non-critical letters with random consonants, taking into account that "w" is a vowel in Welsh and that some letters (e.g., "k" and "j") are not part of the Welsh alphabet.

Procedure

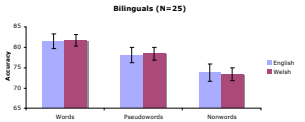


• Critical positions: first and fourth letters
• List order was counterbalanced among participants
* Practice, fatigue, and floor and ceiling effects were avoided by varying the exposure duration to maintain accuracy at a predetermined level (75%) across trial blocks (accuracy was calculated every twelve trials). Therefore, presentation times were treated as a second dependent variable.

Results

Accuracy

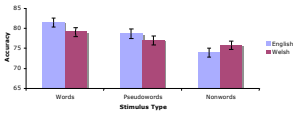
Language x Stimulus Type (p=0.91, n.s.)



Welsh
Stimulus, F(2,48)=19.96, p<0.0001
WSE, p=0.007
PSE, p=0.002

English
Stimulus, F(2,48)=8.09, p=0.001
WSE, p=0.097, n.s.
PSE, p=0.02

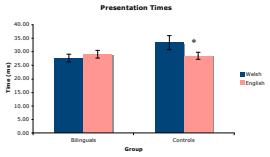
Language x Stimulus Type (F(2,38)=3.28, p < 0.05)



Welsh
Stimulus, F(2,38)=3.41, p<0.05
WSE, p=0.15, n.s.
PSE, p=0.27, n.s.

English
Stimulus, F(2,38)=16.78, p<0.0001
WSE, p=0.004
PSE, p=0.009

Presentation Times



* p < 0.05

Bilinguals
There was no significant difference in presentation times between Welsh and English stimuli (p=0.5, n.s.).

Controls
Presentation times were significantly faster for English (mean=28.46 ms) than for Welsh (mean=33.31 ms; p=0.03) stimuli.

Conclusions and Future Directions

• Grossi et al. (in press) showed that WSE and PSE can be reliably measured for both the first and the second language in proficient late bilinguals. Here, we replicated these effects with a different population of bilinguals (native/early) and a different language (Welsh). Therefore, these effects are reliably found across different languages. Participants unfamiliar with a language do not show these effects.

• Early/native Welsh-English bilinguals showed similar performances for the two languages, although the WSE did not reach significance. Further experiments will explore whether visual word recognition processes are shaped differently following different learning experiences (e.g., learning to read in two languages at the same time vs. learning to read in the second language later in life; or learning to read in two languages with different orthography-to-phonology mappings: transparent for Welsh, opaque for English).

• English native speakers unfamiliar with Welsh showed both a WSE and a PSE for English stimuli but not for Welsh stimuli.

• Presentation times similar for the two languages for bilinguals and faster for English compared to Welsh stimuli for English monolinguals. Therefore, presentation times used as a second dependent variable in the Reicher-Wheeler task provide another useful index of familiarity with a language.

• Future research will address more specific questions concerning the development of orthographic expertise not only at the behavioral level but also at the neural level. For example, how do neural systems involved in processing orthography for the first language reorganize to incorporate the orthography of the second language? Is this process of reorganization modulated by the age of acquisition for the second language? Neuroimaging and electrophysiological methods, in combination with behavioral methods, will need to be employed to answer these questions. At the behavioral level, the Reicher-Wheeler paradigm represents a valuable method of measuring expertise with a new orthographic system in the context of second language acquisition.

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