L1 Literacy Strategy Impact on L2 Word-Priming Effects

Clay Williams

Abstract

Previous studies have shown that students studying an L2 whose orthography differs significantly from their L1 may exhibit problems in utilizing both lexical and non-lexical routes in processing L2 text at the word level. This study tests the relative levels of orthographic and phonological priming susceptibility of Japanese students, both in their L1 (Japanese) and in their L2 (English), in a lexical decision task using a masked priming paradigm. The resultant data shows limitations in L2 processing that appear to stem from an L1 interference effect occurring during word-level processing. Prior experimental data from Japanese and Chinese speaker populations will be used to demonstrate that there are language-specific word-processing strategies that, when misapplied to a dissimilar L2, can negatively affect the efficiency and proficiency of students' word identification processes. The author will offer suggestions on how best to ameliorate the problem through targeted pedagogical approaches and techniques designed to assist learners in developing the L2-specific word identification processes needed for the development of effective reading skills.

Keywords: L2 literacy development, orthographic priming, semantic priming

Introduction

For well over 40 years, there has been a well-recognized, established link between L1 and L2 literacy acquisition and development. Studies with second language students from such diverse areas as Peru, Mexico, Vietnam (Gudschinsky, 1977), and Haiti (Bartoff, 1984, in Penfield, 1986) have all demonstrated that both speed and quality of L2 acquisition were dramatically ameliorated by instructing the students (who were previously illiterate) in L1 literacy prior to tackling L2 literacy skills. Chu-Chang (1981) reviewed 16 such studies on refugee and indigenous groups, wherein instructors balanced students into experimental and control groups, with the experimental group being taught to read in their L1 prior to beginning L2 literacy instruction, and the control group receiving only L2 instruction. The results were illuminating: eleven of the studies reported unambiguously higher rates of success for the students who were first taught to read in their L1 (of the remaining 5 studies, two showed no significant difference between groups, and the others yielded no clear results). As these sorts of findings have become the cornerstone of bilingual education pedagogy, the positive effects of L1 literacy on L2 literacy development is largely assumed to be a given. BournotTrites (2005) asserts simply that high levels of L1 proficiency help L2 acquisition, just as high proficiency in L2 nets a positive effect on furthering L1 development. While the generally positive effects of L1 literacy on L2 literacy acquisition at first glance appears to be

unassailable, we must be mindful not to treat L2 literacy as a "slowed-down" version of L1 literacy:

> *"While it is true that the L1 and L2 reading process have similarities, it is also important to recognize that many factors come into play, which in turn make second language reading a phenomenon unto itself. Despite the similarities between reading in an L1 and reading in an L2, a number of complex variables make the process of L1 different from L2"* (Singhal, 1998).

This transfer of L1 literacy skills to an L2 simply cannot be assumed to happen automatically. While certain basic skills and concepts would seem to transfer more or less uniformly across all written scripts (e.g., concepts of writing as a representation of oral language, directionality of script, and that writing/reading involves a process of encoding and decoding words to symbols), many higher literacy skills may well be specific to particular languages or writing scripts. Koda (1997) states that different L1 orthographic properties will produce word processing and decoding procedures which can differ qualitatively from a given L2. This causes the L2 learner to have to learn new, foreign literacy learning strategies in order to compensate for the differences with his/her native script. Difficulties in L2 orthographic processing can lead to increased word misidentification (Koda, 1997), which can reduce both general comprehension, as well as the learner's ability to guess the meaning of unknown words from context. However, teachers are often unaware of the negative effects which spring from students' inability to transfer their L1 reading strategies to the L2 script. Whether this lack of awareness springs from a lack of L2 word processing efficiency on the part of the teacher him/herself, or, as is often the case with native English-speaking instructors working abroad, they may lack the requisite ability in the students' L1 to realize how the students would naturally try to process text in the L2, the end result is that the proper literacy learning strategies which are specific to the target L2 are rarely explicitly taught. As such, students are forced to figure out on their own the differences in script and how to reconcile them. This inevitably leads some students to develop inefficient or ineffective word processing strategies.

How do we process words?

Our present understanding of word processing is almost entirely derived from Patterson's & Morton's (1985) *dual route model* (also known as the "standard model"). This model is based on Coltheart's previous (1978) theory that word recognition – no matter the language or script – is conducted via simultaneous searches of the mental lexicon utilizing both lexical processes (mediated by orthography) and non-lexical processes (mediated by phonology).

The basic premise draws heavily from Forster's *Search Model* (1976), and it entails that reading is conducted in the following way: when a word is brought into a reader's field of view, two parallel mental processes immediately commence simultaneous searches of the lexicon. One can imagine it as a sort of 'race' between the lexical and the non-lexical processes, as each scrambles through the entire inventory of words known by the reader, looking for a match. The lexical path searches for matches based upon orthographic similarity. In alphabetic languages, we can readily conceive of our ability to recognize words based upon word 'shape' (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001). Experimental manipulations such as alternating case (e.g., tHiS iSn'T vErY iNtUiTiVe, WoUlD yOu NoT aGrEe? – Akamatsu, 2005) help to demonstrate that changing the shape of words has a dramatic negative effect on reading efficiency. Meanwhile, the non-lexical route searches the lexicon based upon whatever phonological information can be extracted from the text. This is typically conceived of as an analysis of sound to symbol correspondence, and the resultant sound stream is used in a search process much like it would be for oral speech. The first of these two processes to match the received input with an entry in the mental lexicon will cause the word to be opened from the master lexicon (along with all knowledge of meaning, inflectional morphology, syntactic positions, etc.), and the search is suspended along both routes.

As we can see then, successful reading can only occur when at least one of these routes which enable the processing (and ultimately the understanding) of written words. Fluent literacy, likewise, would be defined normally as having both pathways optimally functional. This leads inevitably to the question of whether or not L2 readers have fully developed lexical and non-lexical pathways to reading comprehension, and if so, when do they develop. Fortunately, students' relative facility in utilizing each route for L2 word recognition can be tested via priming paradigms.

Priming data

Priming testing paradigms have been used for many years to show that readers can recognize words both lexically and non-lexically by yielding concrete evidence that related stimuli can facilitate or impede lexical access of target words. Phonologically similar primes often produce a facilitating effect on recognition of target words (e.g., "ate" would prime "EIGHT"), which would indicate that the word was decoded non-lexically. The similar-sounding prime is decoded first, and due to its proximity to the target word in the non-lexical route's search system (as the search files are organized by sound), this allows the target word to be recognized significantly faster than if the target word were read alone (or with an unrelated prime). Similarly, orthographically and semantically similar primes are both used to measure the efficacy of lexical route operation. Orthographic similarity (e.g., "powder" to prime "PONDER")

would facilitate lexical route use directly in much the same way that phonological primes facilitate the non-lexical route. The similar "shape" of the prime makes it easier to find the target word. Semantic priming (e.g., "doctor" to prime "NURSE") works more indirectly, as semantic information is, for the most part, recognized post-lexically; however, it is consulted directly via the lexical route to confirm the entry. As such, semantic prime facilitation effects is usually understood to be more a function of lexical route processing, and, in fact, the lexical route enables the reader to access meaning directly from orthography, thereby bypassing phonology.

All three priming paradigms have a long history of empirical research investigation to support them. Humpreys, Evett, and Taylor (1982) found strong facilitation effects for homophonous primes. Ferrand and Grainger (1992, 1993) found that phonological priming appeared consistently in able readers when the prime was presented for about 45ms or more. Luktatela Lukatela, and Turvey (1993) asserted that, based upon evidence from multiple studies, it was undeniable that lexical access can be achieved through phonological processes. There is a strong agreement across the field that phonological processing is directly correlated with general reading ability – especially during the stages of early development (e.g., Stanovich & Siegel, 1994; Share and Stanovich, 1995; Strauss 2005). Furthermore, its role as a quintessential part of word decoding is widely recognized (e.g., Castles & Coltheart, 2004; Halderman, Asby, & Perfetti., 2012). Orthographic priming effects have, likewise, been validated many times over. Segui and Grainger (1990) reported interference effects by orthographic neighbors when primes were presented briefly. Grainger and Ferrand (1996) noted strong effects for orthographic priming in lexical decision tasks (note: the same study found similarly strong effects for phonological primes). Muter and Diethelm (2001) assert reading performance in both L1 and in L2 can be generally predicted by measuring the readers' general knowledge of language-specific orthography. Chikamatsu (2006) found orthographic processing to be the dominant processing strategy of high-proficiency L2 learners of Japanese, whereas lower-proficiency learners were more reliant on phonology. Semantically related primes have also been widely demonstrated to facilitate target word recognition. Neely (1977) initially found facilitation effects for semantic primes visible for at least 250ms. The requisite time of prime visibility to produce facilitation effects has since been drastically revised downwards with Perea and Rosa (2002) reporting significant effects at 66ms of visibility and Bodner and Masson (2003) demonstrating the same at a mere 43ms of prime visibility.

Prior studies of Japanese EFL learners' priming susceptibility

Despite the strong links found between orthographic, semantic, and phonological factors with fluent reading found in the literature, it stands to

reason that L2 students whose native language makes use of qualitatively different processing would have to build their L2 reading strategies practically from scratch, and as such, they may evince different reading patterns from L1 speakers – which would reveal these routes to reading comprehension to be in an incomplete or still-developing state. While most of the emphasis in studies on cross-linguistic priming has been on translation priming, there is still a body of evidence which suggests that L2 speakers are fully capable of exhibiting semantic priming effects in the L2 (e.g., Schoonbaert, Duyck, Brysbaert, & Hartsuiker, 2009; Devitto & Burgess, 2004; Phillips, Segalowitza, O'Briend,e, & Yamasaki, 2004). Still there are some significant lingering questions over possible limitations to the effect. Silverberg & Samuel (2004) found that age of acquisition heavily impacted semantic priming effects by Spanish (L1) learners of English, with only early-learners exhibiting significant facilitation effects. Likewise, there may be a difference in results for semantic priming depending upon differences in orthography between L1 and L2.

Williams (2012) reported that high-level Japanese learners of English enrolled in a preparatory language program required for admission to an English-medium university exhibited **delay** effects for semantic primes in pretests (at the outset of the preparatory program). While this delay effect disappeared to the point of statistical insignificance by the end of the program (when subjects undertook the posttest), even the top-level students failed to exhibit any significant facilitation effects for semantic primes (whereas they did for phonological primes). In a 2014 follow-up study of the same subjects, Williams showed that, although the students had been successfully admitted to study in the English-medium university and had undertaken 1-2 semesters of regular, content coursework instructed in English, there had been no movement in their relative susceptibility to semantic priming effects (though the subjects were faster across the board). This was taken as evidence of some impairment in the lexical route; however, another study (Williams, 201) testing susceptibility to orthographic and phonological priming effects exhibited strong facilitation for both prime types, thus indicating that while the lexical search can function freely (searching the lexicon based upon letter strings), it is the post-access semantic identification process itself that is being inhibited, and thus preventing any facilitation effects for semantic primes. Furthermore, slight advantages to orthographic processing over phonological processing, evidenced by slight processing time advantages and lower error rates, mirror results more typically seen in studies of Chinese (e.g., Williams & Bever, 2010).

As Japanese is written partially in Chinese character-script, this raises the question of whether or not Japanese learners of English are processing English words via L1-specific strategies, and thus, whether the lack of semantic facilitation is actually an L1-interference effect caused by differing processing strategies used in the respective orthographies of Japanese and English. Japanese

has three distinct orthographies: *hiragana, katakana,* and *kanji* – the first two are syllabaries (the second of which is used largely for representing foreign loan words), and the third is the name for the set of thousands of characters, borrowed directly from Chinese, which represent meaning *directly* (i.e., as opposed to through phonological mediation). While low-proficiency Chinese learners of English have previously been shown to have trouble intuiting that English words represent groups of sounds due to the low occurrence of direct sound-encoding in Chinese script (e.g., Williams, 2010), at first glance, it would seem that Japanese learners of English would not necessarily have such difficulties as their own native syllabaries encode sound (i.e., syllables) directly. However, this idea must be counterbalanced by the fact that English orthography is relatively opaque (i.e., the fact that "to," "too," and "two" all are pronounced as /tu/ is indicative of the fact that English spelling really doesn't do a very good job of indicating pronunciation, and vice versa), whereas these syllabaries are completely transparent and could potentially be mastered in an afternoon or so, may cause Japanese students to conceptualize English words as being somewhat like *kanji*, which similarly would not necessarily lend itself naturally to finding pronunciation cues. While there are still profound differences between Chinese script and English, if Japanese students were unconsciously transferring some of the strategies they use for processing L1 *kanji* to decoding English words, this could help to explain the lack of semantic facilitation effects. In *kanji*, semantic information is encoded directly into the script and available pre-lexically for the reader, as English lacks direct encoding of semantic information, if they were reliant upon this processing strategy, this would force even advanced students of English to have to consult the L1 post-lexically in order to make semantic connections, thus delaying semantic retrieval, and eliminating any L2 semantic priming effect.

The current study

The question still stands, however, whether or not there is any direct connection between L1 and L2 priming effects which would indicate an L1 interference effect is to blame for the lack of any direct L2 semantic priming facilitation. The present study was conducted in order to investigate precisely that possibility. In order to make direct comparisons, we need to look at how Japanese students of English process their L1, in addition to how they process English. This study is designed to measure Japanese students' relative degree of susceptibility to semantic and phonological priming in both L1 Japanese and L2 English. This will allow us to directly compare their performances between the two languages.

Subjects: Thirty students enrolled in an English-medium university in northern Japan were recruited for testing. All of the subjects were native (L1) speakers of

Japanese, and all of them had started their formal English studies in the first grade of junior high school (approximately age 12). All of them had already studied at the university between 2 and 4 semesters at the time of testing, and all had by that time already passed the required English foundations coursework required for general admission. None had any significant experience studying or living abroad or in an English-speaking area (i.e., all experience abroad was less than 3 weeks in duration). All subjects had normal or corrected-to-normal vision.

Materials: Two lexical decision tests using a masked priming paradigm were created – one testing in Japanese, and the other in English. Each test had 120 items (letter strings in English, and *kanji* characters in Japanese). The tests were created and administered via DMDX software (Forster & Forster, 2003). All test items were preceded by a prime approximately 51 milliseconds in duration. Each test featured three categories of prime type to be analyzed: semantic, phonological, and a control category. The semantic prime category consisted of primes which were semantically related to the target word. For example, "eyes/GLASSES" in the English test, or "餃飯" (dumplings/RICE) in the Japanese test. It's important to note here that language specific differences begin to emerge immediately as the related semantic content in the Japanese script also causes orthographic overlap in the 偏(*hen:* the semantic radical of a Chinese character, usually occurring on the left hand side or top of the character), 食 (eat/food). In the phonological category, English primes were selected to maximize orthographic distinction while still sounding similar to the targets (usually by rhyming): for example, "hate/EIGHT." Here again, script-specific differences necessitate a sizeable difference in testing phonological priming in Japanese. All Japanese *kanji* have at least two different pronunciations: *kunyomi* (the native Japanese reading) and *onyomi* (a "sound" reading based on the Chinese pronunciations of characters when they were imported to Japan – these readings are most often used for multi-character combinations). The *kunyomi* readings, as they are based on a language that existed well before Chinese writing conventions were foisted upon it, tend to have few homonyms, and little or no relation between character and pronunciation; however, the *kunyomi* pronunciation is the basis for character reading in Japanese, and will be the reading which Japanese speakers access by default when searching for single characters. The *onyomi* readings, by contrast, take full advantage of the basic principles of character construction in the Chinese language, whereby the semantic and phonological radicals are combined to create novel words. In Japanese, the 旁(*tsukuri:* the right/bottom half of characters, which represent the pronunciation of a character) is strongly indicative of the *onyomi* pronunciation, and its pronunciation tends to remain stable in a variety of different characters (whereas modern Chinese pronunciations of characters with the same

phonological radical vary a lot due to the inevitable pronunciation changes which have affected the language since the characters' advent some 3000 years ago). As such, when Japanese people employ the non-lexical route in identifying *kanji* characters, they are not searching via sound in the same way that speakers of alphabetic languages do; instead, they are decoding the phonological radical (労) as a "sound" (whether this is *onyomi*, *kunyomi*, or something distinct makes little difference – it is essentially just a label for the search process), and using it to search for other characters which have the same radical (and thus the same "sound"). Thus in the phonological category of the Japanese test, prime/target pairs were chosen based upon having the same phonological radical: for example, "桃逃" (peach/FLEE). For the control category, words/characters were chosen which had no discernable relationship in either language: for example, "monkey/WEIGHT." The three test categories were all balanced with negative (pseudo-word/pseudo-character) categories, yielding an equal number of "yes" and "no" responses. For the Japanese test, both real characters and pseudo-characters were constructed using GIMP software, and were presented as image (*.bmp) files.

Procedure: Subjects took both the English and Japanese tests in a single session. The order of presentation of the tests was counterbalanced by subject. Each test took approximately 10 minutes to complete (20 minutes total testing time), and subjects were given the option of taking a break between tests. The tests were preceded by instructions and practice items to familiarize subjects with the testing procedure. Each target word was preceded by a forward mask and a prime (displayed for approximately 51ms). The practical result of employing a forward mask and a prime display time of less than 80ms to make the prime word effectively invisible to the reader's conscious mind; however it still exerts an effect on processing the target stimulus. The target word was displayed up to 4000ms or until the subjects responded by pushing one of two buttons, labeled "yes" and "no," respectively. Each response was followed by immediate feedback regarding both the accuracy and the speed of the response.

Analysis: Reaction times of all participants were recorded and analyzed according to the three prime types. The semantic and phonological prime categories of each test were compared to the positive control category to ascertain if the primes were facilitating recognition, and then results were compared both within tests and between tests.

Results

The mean response time per prime category in the English language test were:

Semantic priming condition: 763ms
Phonological priming condition: 685ms
Control Condition: 715ms

Both semantic and phonological priming conditions produced a significant effect when compared to the control condition: Semantic priming -- *F1=18.91, P<0.001, F2=9.65, P<0.003;* Phonological priming -- *F1=15.74, P<0.001, F2=4.42, P<0.038;* however, while both categories are producing an effect, the effects are opposite one another. While phonological primes are facilitating recognition of the target word, semantic primes are *inhibiting* (and thus slowing) recognition.

The test conducted in the subjects' L1 (Japanese) produced predictable results. Reaction times were faster across the board compared with English, and there were robust priming facilitation effects in both semantic and phonological priming conditions (both, $p<0.001$). Such results comport well with previous priming studies (see literature review), and would be expected for any L1-literate population. The only noteworthy result was that there was no significant difference between reaction times for the semantic priming condition (mean: 621ms) and the phonological priming condition (624ms).

Discussion

The initial implications of the data seem to be that the subjects had ready access to semantic data via L1, but not in their L2. Is this indicative of a simple lack of L2 fluency? While the lack of L2 facilitative priming results may lend some intuitive appeal to this interpretation, still the contrast with data from prior L2 studies showing semantic priming effect for L2 speakers of English (e.g., Schoonbaert, Duyck, Brysbaert, & Hartsuiker, 2009; Devitto & Burgess, 2004; Phillips, Segalowitza, O'Briend,e, & Yamasaki, 2004) requires some explanation, especially keeping in mind that the subjects were all advanced L2 users of English. All of the above contrasting studies were performed on subjects whose L1 and L2 were both western languages using the Roman alphabet. As such, the divergence here is likely due to a script-specific processing constraint. Normally, a lack of semantic priming in L2 would be indicative of L1 and L2 concepts being stored separately (and thus needing to access the L1 to access L2 concepts); however, in this case, we do not see a *lack* of semantic priming. Instead, what we see is a *delay* caused by the semantic prime. This indicates a definite effect. Something is slowing down the lexical decision.

Delving into the literature can provide some clues concerning the possible source of the delay. Studies from Chinese readers specifically designed to distinguish whether semantic or phonological radicals were more useful to readers in word identification have demonstrated a small but definite advantage

for semantic processing (e.g., Williams & Bever, 2010; Liu, 1983). If readers are dependent upon the directly encoded semantic information embedded in *kanji* characters, the lack of such information in the alphabetic code of English may make Japanese readers unable to access semantic information through the L2, and instead force them to access it indirectly via the L1. Pilot studies currently being conducted by the author in Taiwan help to bolster this point as, thus far, they seem to be indicating the same behavior (a delay in English word recognition when preceded by a semantically-related prime) by L1 speakers of Chinese; however, admittedly, this could change as more evidence emerges.

The bright spot for these Japanese learners of English is that their phonological processing seems to be unencumbered, as evidenced by the facilitation effects achieved by preceding targets with phonologically-related primes. This stands in contrast to prior studies with Chinese-speaker populations (e.g., Williams, 2010) who exhibited considerable difficulty in extracting phonological information from English words due to the contrasts in processing procedures between their L1 and the L2. While Japanese use the same Chinese characters, the fact that they also possess two native syllabaries may predispose them toward greater intuitive awareness of the properties of direct sound encoding, and thus make it generally easier for them to learn to extract said information from the L2 script. Still, this may require further scrutiny, especially by testing Japanese learners with more elementary-level English skills in order to achieve a more valid basis for direct comparison of learners.

It is important to note the inherent limitations on the generalizability of this study, as well as to underscore the necessity of further research in this area. First, while by this time, the results are strong, particularly in light of their connection with past research, the fact that the subject sample was taken from a highly-ranked, English-medium university introduces a possibility of a selection bias which would preclude the results from pertaining to the wider Japanese population. While the students participating in this study represented a range of geographic origins, covering the length and breadth of Japan, it would still be preferable to try to confirm the generalizability of the results by testing at various types of institutions with more students more varied in their English skill levels and interest towards English learning. Similar testing in Chinese and/or Korean educational settings would also be helpful towards confirming if the effect displayed here is specific to L1 speakers of languages written with Chinese characters. It would also be interesting to test other languages written in non-Roman scripts (e.g., Thai or Hindi) to determine if this effect is specific to languages that make use of Chinese characters, or if it applies more broadly to L2 English learners whose L1's script varies significantly from that of English.

Suggestions for pedagogical development

Does it matter if foreign language learners are evincing processing delays in L2 written word recognition? Certainly at the low end of the learning scale, low proficiency learners' L2 literacy development can be severely handicapped by processing problems or inefficiencies (Williams, 2010). However, in this case, these are high-proficiency L2 users studying at university in the L2. If there is any degree of impairment, it is certainly not prohibiting them from effectively using the language. Therefore, are attempts at remediation in order? Williams' (2012) study on the effect of intensive language training on priming susceptibility certainly seems to indicate that training can still benefit learners to process words more effectively and efficiently. Put another way, just because someone already CAN read doesn't mean they can't be taught to do so more proficiently. If students are having trouble accessing semantics directly through L2, this can be remediated through simple adjustments to existing pedagogical methods. Essentially, the goal is to encourage the students to tie L2 vocabularies directly to the (extra-linguistic) concept. This can be facilitated through specific activities. First and foremost among the means of improving word recognition procedures is for students to engage in regular extensive reading (e.g., Nation, 2015). Additional activities which educators can use to facilitate direct semantic connection to L2 vocabulary include "grouping" vocabulary items for instruction. Teaching items grouped together thematically/semantically helps to create semantic links between related vocabulary items. Finally, explicit instruction of word "roots" is likely to be an effective strategy for Japanese (and Chinese) learners of English, as processing via derived roots more closely approximates the strategies within their L1 processing of *kanji* characters. If L2 learners receive explicit instruction and tacit encouragement to link semantic concepts directly to L2 vocabulary, they will hopefully be able to bypass the L1 altogether, and to check meaning directly within the L2 lexicon, thereby more closely approximating L1 processes, leading to more efficient word-level processing (not to mention susceptibility to semantic priming effects).

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