BILINGUAL PROCESSING STRATEGIES IN WORD READING

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1. Introduction

When bilinguals read in one of their languages, do they use different processing skills from those of the other language? When they switch from one language to another, do they switch their way of reading as well? Reading is a complex cognitive skill which requires encoding text to sound to meaning at speed of the order of milliseconds. Thus, efficiency in information processes becomes important in fluent reading. Reading skills are only acquired by reading experience in the language. It is important that skilled readers are familiar with orthography and rules of spellings as well as being able to search for relevant information as quickly as possible and to ignore less relevant information as much as possible. In fluent bilingual reading, these skills need to be acquired for a reader’s two languages.

Recent L2 reading research suggests that orthographic differences among first languages affect word recognition in second languages (Chikamatsu, 1996; Muljani, Koda & Moates, 1998; Koda, 1998; Nassaji & Geva, 1999; Gholamain & Geva, 1999). If linguistic knowledge transfers from language to language, it is conceivable that L2 processing is heavily constrained by the L1 processing experience. Studies in bilingual word recognition also claim that processing of words can be affected by the other language that is not in use (Dijkstra, Timmermans & Schriefers, 2000; De Groot, Delmaar & Lupker, 2000). It suggests that two languages can be activated at the same time and also the processing strategies can be affected by those of the other language.

The present study investigates bilingual reading for its lower-level processing such as word recognition, in order to clarify whether the other language’s processing skills affect reading. In particular, orthographic processing skills are focused since print processing may well vary across languages, to the extent that the way their lexical information is graphically represented differs. It is assumed that a typical processing style according to a writing system, i.e. a relationship between phonology and

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orthography, is acquired for each language. For example, English speakers need to rely on spellings in order to recognize words as there are many homophones in the language, while Italian speakers can rely on sounds because there are few homophones and the spelling encodes phonology more directly. However, for bilinguals, differences or similarity between two writing systems would influence their processing skills.

1.1. Reading in two languages

Bilingual processing is different from monolingual processing in terms of the accessibility to more than one language. In fact, it is always cross-linguistic involving previous linguistic experience and knowledge of conventions and strategies. Therefore, it is plausible that a bilingual reading in one language includes processing skills in the other language.

Reading itself involves two types of skills: decoding skills and conceptual skills (Bialystok, 2001; Perfetti, 1985). Decoding skills include elemental processes such as letter identification, pattern recognition, and lexical access, which represent bottom-up processes. If a new language is written in a familiar script, these processes can be applied by the other language. In contrast, conceptual skills represent top-down processes such as concept activation, syntactic analysis, prepositional encoding, sentence comprehension, and activation of prior knowledge of the topic. Throughout these higher level processes, comprehension of the text is a required goal so that rereading and reinterpreting take place.

Both the top-down and the bottom-up processes have significant roles for reading acquisition. Recent reading studies found that lower-level reading skills such as knowledge of phoneme and grapheme correspondences were important in acquisition of L2 reading efficiency (Nassaji & Geva, 1999; Koda, 1996). In adult L2 acquisition, the educational settings are mostly formal where reading is highly valued. Adult learners of English who know how to read in alphabetic scripts from their first language already have knowledge of interpreting the symbols of the language. However, they still have to learn new rules governing the relationships between sounds and letters and establish a new strategy to process the rules. Reading fluency of a second language can be determined by acquisition of different systems and processes from a first language. Therefore, although there may be significant overlap, recent bilingual studies claim that L2 reading is not the same as L1 reading (Durgunoglu, 1997; Bialystok, 2001).
2. Writing systems

Written languages are governed by writing systems. Writing systems represent the rules governing relationships between sounds and letters, i.e. phonemes and graphemes. Without knowing these rules, language users cannot read or write a language in correspondence to sounds. Each written language has a particular writing system. Even if two languages employ the same orthographic script (such as the Roman alphabet), the rules of phoneme-grapheme correspondences may differ. For example, Spanish and English are written in the same alphabet. However, as the two languages are governed by different writing systems, words written in the same spellings by those languages may sound differently (Table 1).

Table 1. Comparison of English and Spanish sounds on the same spelling.

<table>
<thead>
<tr>
<th>Spelling</th>
<th>English sound</th>
<th>Spanish sound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Me</td>
<td>/mi/</td>
<td>/me/</td>
</tr>
<tr>
<td>Simple</td>
<td>/simpl/</td>
<td>/simple/</td>
</tr>
<tr>
<td>General</td>
<td>/dʒenerəl/</td>
<td>/xenerəl/</td>
</tr>
<tr>
<td>Hotel</td>
<td>/hotel/</td>
<td>/otel/</td>
</tr>
<tr>
<td>China</td>
<td>/tʃainə/</td>
<td>/tʃina/</td>
</tr>
</tbody>
</table>

In English, sounds of letters change vastly according to context. Each letter has several sounds, e.g. the letter ‘i’ can be /i/ or /ai/. So, in order to pronounce a new word, knowledge of phonemes and even morphemes becomes very important. On the contrary, Spanish spelling is consistent with its sound: it is written as it sounds.

2.1. Variation of writing systems and processes

The degree of phoneme-grapheme correspondences is diverse across languages. The Orthographic Depth Hypothesis (ODH) claims that the use of phonology is directly determined by properties of the orthography (Katz & Frost, 1992). When a visual representation of a word is processed for meaning, the processing of the word can be affected by its relationship with phonology. The ODH defines that a shallow orthography has consistent relationships between sounds and letters such as Spanish or Italian, while a deep orthography such as Arabic or English is represented by relatively inconsistent sound-letter relationships. Whether orthography affects choice of a
processing route then becomes an interesting question. It is easy to assume that phonological scripts would rely on sounds, whereas logographic scripts would not have a need to access phonology. However it is not likely that a type of orthography would always take a regular processing route.

Visual word processing and recognition are influenced by several factors. For example, familiarity is an important factor. If a word is new to a reader, the reader is likely to use letter-by-letter or phoneme based reading, while a familiar word can be read as a whole word and its meaning understood visually. This notion of parallel processing also applies to logographic scripts. Considering variation of orthographies, previous word recognition studies support that there is more than one pathway for processing words in reading within a language such as Chinese or Japanese (Perfetti, Zhang & Berent, 1992; Wydell, Patterson & Humepeys, 1993; Wydell, Butterworth & Patterson, 1995). Wydell et al. (1993) provided evidence of phonological processing on Japanese Kanji, using a semantic decision task. The results suggested that Japanese Kanji processing may use either of the two processing routes: a visual route or a phonological route according to context, accessing the specific properties in a lexical item for Kanji words. A character’s phonetic radical or phonological element could provide phonological information with which to access the lexicon, while the whole shape of a character could be used to process the meaning with or without recourse to its phonological information. Consequently, it appears that type of orthography is not the factor to choose a particular processing route, however, there could be a preferred route according to factors such as familiarity, context, and furthermore, the number of neighbourhood words, reader’s knowledge of spellings, etc.

2.2. Orthography and reading skills

Does the consistency of grapheme-phoneme correspondences affect reading? Script Dependent Hypothesis (Gholamain & Geva, 1999; Katz & Frost, 1992) argues that the development of reading processes in different languages might vary due to the orthographic regularity. It suggests that accurate word recognition skills develop more slowly in languages with an irregular orthography, e.g. English. It also proposes that the degree of involvement of phonological coding in reading strategies depends on the grapheme-phoneme correspondences. Thus, the orthographic regularity is an important factor of language processing. Furthermore, according to this hypothesis, such
differences in the regularity of sound-symbol associations may vary the patterns of reading disability in different languages as well. Wydell & Butterworth (1999) provide evidence that an English-Japanese bilingual dyslexic was dyslexic only with respect to English. They postulated that any language where orthographic unit representing sound is at a whole character or word level, e.g. Italian and Japanese kana, should not produce a high incidence of developmental phonological dyslexia. In fact, Snowling (2000) claims that about 10% of English children are dyslexic while only 2-3% of Italians have reading difficulties.

2.3. L1 and L2 writing systems

When we look at the background of L2 readers, an important difference from L1 reading is ‘experience’. From this viewpoint, the nature of L2 processing can be illustrated by: a) L2 reading experience, b) structural similarity or non-similarity between L1 and L2, and c) transfer of L1 processing experience.

Recent crosslinguistic research shows superior lower-level processing among L2 readers from related L1 backgrounds. Muljani et al. (1998) examined the effects of L1-L2 orthographic distance for intermediate-level of learners. They compared adult learners of English with related (Indonesian) and unrelated (Chinese) L1 orthographic backgrounds using an English lexical decision task. In results, Indonesian learners of English were better than Chinese learners. It confirmed the facilitation of an alphabetic L1 orthography on a L2 alphabetic system compared to logographic L1 orthography. The finding suggests that shared orthographic knowledge facilitates the mastery of individual processing skills. Chikamatsu (1996) found that their Chinese learners of Japanese relied more on the visual information in Japanese syllabic Kana words than the English learners did while the English learners utilized the phonological information more than the Chinese learners. She concluded that L1 word recognition strategies were transferred into L2 word recognition. In terms of development of L2 processing skills, Haynes & Carr (1990) investigated the effects of processing experience by comparing visual processing efficiency among experienced and less experienced Taiwanese learners of English and native English speakers in a same-different matching task. The achievement of experienced Taiwanese learners was close to that of native speakers rather than less experienced learners. The results support that perceptual skills improve with increased processing experience. The previous studies in L2 reading have provided
evidence for the \textit{L1-L2 orthographic distance effects} (Koda, 1996), which claims that the development of L2 word recognition efficiency can be facilitated by the extent to which the two orthographic systems share the same structural properties.

In summary, skills of lower-level processing could be transferred from a language to another and the orthographic distance between two languages may affect L2 processing until the reader receives enough experience.

3. Experiment: A two-phase English word recognition test

An English word recognition test was carried out for two different bilingual groups: Italian-English and Japanese-English. This experiment examined how differently the two groups of bilinguals would utilise their strategies for reading words according to their other language. Its aim was to establish and clarify the relationship between the orthographic regularity and the use of processing strategies by bilinguals.

3.1. Procedure

14 Italian-English and 17 Japanese-English bilinguals studying at university in England participated in the experiment. They were native speakers of either Italian or Japanese who had been using English regularly during their study and life in England. Their English proficiency was measured by Nation’s Vocabulary Test, furthermore, their use of two languages (English and the L1) was self-assessed in a questionnaire (table 2). As a control group, 17 English monolinguals also participated.

\begin{table}[h]
\centering
\begin{tabular}{|l|c|c|c|c|}
\hline
L1 & Nation Score & Speaking & Listening & Reading & Writing E-mails \\
\hline
Italian & 76.2 & 63.8\% & 75.0\% & 89.9\% & 40.8\% \\
Japanese & 77.5 & 60.3\% & 72.3\% & 74.3\% & 47.3\% \\
\hline
\end{tabular}
\caption{Use of English by bilinguals.}
\end{table}

The experiment was designed with PsyScope on an Apple computer. Firstly, the participants were given an odd-one-out task to choose a semantically different word out of a set of four words in Phase 1. For example, they were asked to choose between ‘tail’, ‘cat’, ‘tiger’ and ‘lion’ (table 3), taking as long as they needed. The accuracy of odd-one-out task was not considered strictly because the choice of odd words may vary
individually even though the odd words were generally distinctive in the task. Rather, the aim of this phase was to let the reader process a word and store it in their memory as they were required to retrieve it in the next phase. After a minute number-counting task to fill a time gap, a recognition test was given in Phase 2 to test whether the participants would recognise the words appeared during Phase 1. The question ‘Did you see the word?’ was displayed on the screen then single words displayed one after another. Participants were required to push buttons corresponding to ‘yes’ or ‘no’ answers as quickly as possible. If they did not respond within 4 seconds, the word disappeared and the next word came up. In this phase, homophone words appear, e.g. ‘tale’ instead of ‘tail’ to see the effect of the same phonology (the homophone effect). The words were all within the basic learner’s English vocabulary (Cobuild Learner’s Dictionary of English, 1996). The abstractness and concreteness of the words were controlled. Error rates and reaction times were observed for the experimental words including homophone words, non-homophone words, and controls.

Table 3. Examples of the Experimental Word-sets.

<table>
<thead>
<tr>
<th>Word-set Type in Phase1</th>
<th>Word in Phase 2</th>
<th>Expected Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homophone (Primed)</td>
<td>cat tail lion Tiger tale</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>trip fare travel journey fair</td>
<td>No</td>
</tr>
<tr>
<td>Non-Homophone (Primed)</td>
<td>horse cow donkey fuel fuel</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>profit benefit loss gain loss</td>
<td>Yes</td>
</tr>
<tr>
<td>Control (Unprimed)</td>
<td>- - - -</td>
<td>phone</td>
</tr>
<tr>
<td></td>
<td>- - - -</td>
<td>trend</td>
</tr>
</tbody>
</table>

The cognate rate was also observed: Out of 288 words in Phase 1, English loanwords were 115 (39.9%) for Japanese and 29 (10.1%) for Italian. In addition, 77 words (27.7%) were cognates for Italian, e.g. total-totale and force-forza. Therefore, in total 36.8 % (106 words) of the experimental words were related to the words in Italian. The meanings of those cognate words in their L1s were semantically similar to the meanings given in the context of Phase 1. Thus, it is assumed that a cognate effect could not differ on the two language groups.
3.2. Results

The accuracy and reaction times (RT) were analysed statistically. The reaction times shown are from all correct answers. In Phase 1, the Italian users were as fast as the English monolinguals but the error rate was much higher than the other groups (table 4). On the other hand, the Japanese users were more than a second slower than the other two groups at average, while their accuracy was the same as the English native speakers. One-way ANOVA shows that the mean responses of the three groups are significantly different \[ F (2,45) =9.362, p< .001 \] for error rate; \[ F (2,45) =4.859, p= .012 \] for RT. These results may suggest that the tendency of reflective reading of Japanese users and, in contrast, impulsive reading of Italian users.

<table>
<thead>
<tr>
<th>L1</th>
<th>Error Rate</th>
<th>SD</th>
<th>RT (ms)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>8.82%</td>
<td>7.03</td>
<td>3765</td>
<td>831</td>
</tr>
<tr>
<td>Italian</td>
<td>19.98%</td>
<td>10.27</td>
<td>3724</td>
<td>609</td>
</tr>
<tr>
<td>Japanese</td>
<td>8.82%</td>
<td>4.86</td>
<td>4923</td>
<td>1848</td>
</tr>
</tbody>
</table>

The responses in Phase 2 (the recognition test) demonstrate contrast between the three groups on the different word stimulus type: Homophone, primed, and unprimed words. There was a significant word type bias \[ F (2,90) =46.560, p< .0005 \]. Figure1 shows a comparison with respect to language group. Overall, the homophone word type showed the highest error rate and the slowest in the reaction time. In a comparison among the three language groups, for homophone words, surprisingly, English monolinguals were less accurate and slower than both bilingual groups. While the difference between the Japanese group and the English native group was not significant, the Italian-English bilinguals were significantly faster for homophone words and unprimed words than the English native speakers \[ p= .038 \] for homophone RT; \[ p= .033 \] for unprimed RT. The primed RT was not significant \[ t(29)= 1.919, p= .065 \]. The overall result that unprimed words were recognised more slowly than primed words indicates a priming effect \( p< .01 \).
Figure 1. Comparison by Stimulus Word Type.

Figure 2. Comparison of Homophone Effect.

Figure 2 closely examines the homophone effect that is drawn by the difference between the responses of homophone words and primed words. Both words were
primed in Phase 1: In Phase 2, the primed words appeared as exactly the same words, while the homophone words were the same sounds but different spellings and meanings. When a homophone word requires longer time than a primed word to be recognised, it suggests that phonology of the word in memory was activated and inhibited recognition processes.

The homophone effect was positive for all the groups for both error rate and reaction times, i.e. homophone word responses showed more errors and longer reaction times than primed word responses. An especially strong effect was found for English monolinguals even though the test language was their first and only language. The Italian group showed the weakest effect. The difference between the Italian group and the English group was only marginally significant [p=.048 for the error rate; p=.051 for the RT].

4. Discussion: Selectivity and reading efficiency

The present experiment supports the view that skills of lower-level processing transfers from a language to another. The Italian users of English are familiar with the English alphabet from their L1 thus it was expected that their processing efficiency of visual words would be the same as the English monolinguals. However, they were slightly more efficient than the English monolinguals for the present word recognition task. It suggests that they have established a different processing strategy for English word reading from English monolinguals. In fact, the L1 orthographic processing strategies seem to facilitate their processing of English homophone words in Phase 2. Italian language is a shallow orthography. In theory, there is no homophone word in Italian. Therefore, Italian-English bilinguals have to acquire a new strategy for irregular relationships between phonemes and graphemes for fluent reading. Those new skills are acquired by both L1 and L2 experience. However, it appears that Italian-English bilinguals could choose to suppress newly acquired skills when their L1 processing skills are more efficient, which suggest that they could have a very different strategy from English monolinguals. In this case, reading homophones visually or in regular phoneme-grapheme correspondences as in Italian avoids making errors. Moreover, the fact that the Japanese-English bilinguals showed similar efficiency to the English monolinguals implies that they had acquired enough efficient alphabetic processing
skills. Thus, it does not seem that in fluent bilingual processing the distance of L1-L2 orthographies interferes with the processing efficiency. Instead, the other language’s processing skills are available and can be selected mechanically in order to obtain efficiency.

In terms of bilingual cognitive processing, Cook (1997: 218) questions whether L2 learners who become balanced bilinguals are actually processing L2 in the same way as monolingual native speakers. The current results suggest that the L2 users will not become the same as the native speakers because the L2 users are processing L2 with a combination of L1 and L2 cognitive skills. They can acquire the same efficiency as the native speakers while using the totally different processing strategies as a whole. These results showed the interlingual processing effect of different orthographies and suggest that the processing strategies of words were adapted from the other language in the case of Italian-English bilinguals.

There was no significant difference between the Japanese and Italian users of English in the recognition test in Phase 2. However, it is interesting that their responses in the odd-one-out task in Phase 1 showed a significant difference. The Italian users were faster but less accurate than the Japanese users. In comparison with the English monolinguals, the Italians were as fast as but less accurate than the English monolinguals, on the other hand, the Japanese users were as accurate as, but slower than English monolinguals. In fact, Phase 1 examined readers’ top-down processes. The results show that significant differences from the monolinguals, which indicates that the bilinguals’ top-down processes were not as efficient as the monolinguals yet, also possibly reflecting their L1 processing strategies.

The current study provided evidence that the bilingual processing strategies are different from the monolingual strategies because of bilingual’s accessibility to two languages and also their L1 experience. Furthermore, the bilinguals could acquire monolingual efficiency for the bottom-up processes but not for the top-down processes as seen in the contrast of results between Phase 1 and Phase 2. Finally, the processing efficiency may have an important role to language selectivity in bilingual lexical access. It is because the other language skills can be selected if they are more efficient than the acquired skills of an activated language in terms of processing.
Bibliographical references


Cognition 70, 273-305.