PHONEMIC ACTIVATION OR GRAPHEMIC ACTIVATION:
AN INVESTIGATION ON THE ACCESS
TO WORD IDENTIFICATION OF CHINESE ESL LEARNERS
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Abstract

Vocabulary acquisition is a fundamental and necessary component in second language acquisition. Language learners with a large amount of vocabulary will feel at ease in communication, comprehension and production in the target language. Identifying and recalling a word form efficiently and accurately can profit learners by achieving vocabulary width in a short period of time. This study explores how Chinese ESL learners identify and recall an English word form. Learners identify a word through phonological access and visual access while a writing system may affect the performance of the two accesses. Compared to English, Chinese is a deeper orthographic language. Therefore, native Chinese speakers rely more on visual access than phonological access in Chinese character recognition, which will be transferred to second language acquisition. This study investigates the role of phonemic and graphemic activation in English word form identification and recall for Chinese ESL learners, based on backward masking procedures and materials adopted in the research of Perfetti and Bell (1988, 1991). Twenty Chinese ESL participants are exposed to the targets (e.g., bake), paired with phonological masks (e.g., BAIK), visual masks (e.g., BAWK), unrelated masks (e.g., CRUB) in pseudowords upper case and the blank masks. The targets recall accuracy indicates intermediate and advanced Chinese learners rely slightly more on phonological access than on graphic access in word identification and recall. Their English proficiency and English exposure opportunity affect their extent of reliance on the two accesses.
**Introduction**

Vocabulary has drawn attention in the past decades in second language acquisition (SLA) because it underlies second language acquisition. Without vocabulary, second language learners cannot read, write, speak or listen in a target language, and communication does not exist. Additionally, unlike knowledge such as phonetics and syntax, which can be mastered in a limited period of time, vocabulary acquisition is an enduring learning process in SLA. Learners have to remember large quantities of words and their usage. For example, according to the studies (Goulden, Nation, & Read, 1990; Zechmeister, Chronis, Cull D’ Anna, & Healy, 1995), learners need to grasp around 20,000 word families, which include words (e.g. like) and their derivation (e.g. unlike) to achieve the language proficiency of educated native English speakers. It is time consuming and strenuous to remember all word families and use them appropriately. Whether they are beginners or advanced learners, they will always be at the phase of learning vocabulary and coming across problems due to vocabulary. This may explain the reason many learners struggle with vocabulary learning and would like to discover and apply some methods that can ease such difficulty. As an English language instructor myself, one of the most frequently asked questions from my students is how they can learn numerous English words quickly and retain those words in their memory permanently.

Vocabulary width (the amount of the words second language learners know) and depth (how well they know each word they have learned in its form, meaning and use)
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build up learners’ vocabulary knowledge (Nation, 2001). This paper will focus on the
exploration of word form acquisition, mainly on recognizing and recalling a word form
fast and accurately. This paper attempts to investigate the approaches Chinese ESL
learners apply to identify and recall an English word and find out the approach that may
enhance accuracy within limited time in word form identification and recall. Proper ways
in memorizing a word can enlarge learners’ vocabulary width and save their time.
Additionally, the word can be stored for longer time. Therefore, the effective approach
may provide Chinese ESL learners with a short-cut to memorize new words when they
are overwhelmed by the large amount of English words.

To recognize and remember a word form, learners usually depend on phonemic
and graphemic activation. Baddeley’s working memory model (1986) has supported that
the phonological loop and visual encoding both function in word recognition and short-
term recall while writing systems may affect the involvement of these two accesses in
word identification (Frost, 1998; Lukatela & Turvey, 1994a, 1994b; Van Orden,
Pennington, & Stone, 1990; Van Orden & Goldinger, 1994). Research findings have
demonstrated that phonological mediation plays a more important role in alphabetic
writing system than logographic writing system in recognizing and recalling a word.
Additionally, backward masking experiments reveal phonemic activation enhances more
accuracy and occurs earlier for native English speakers in word identification

This processing approach may pose difficulty for Chinese ESL learners in English
word identification and word retention. As a logographic language, native Chinese
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Speakers rely more on visual access and graphemic activation in Chinese character recognition (Perfetti & Tan, 1998; Taft & Zhu, 1997). Their reaction speed may be slower and their sensitivity may be poorer to this phonological loop dependent language in English word identification and retention, compared with their counterparts from other orthographies in an alphabetical writing system. Therefore, it is worthwhile to research into the manipulation of phonemic and graphemic activation in English word learning and retention among Chinese ESL learners from a cross-linguistics perspective. Chinese learners have been used to whole character recognition while English learners rely on letter clusters (onset or rhyme) and connect the letter clusters to its sound so that they get quick access to recognize and recall the word. It is difficult for Chinese ESL learners to shift their processing approach from whole word recognition to letter clusters. This research investigates the role of these two accesses in English word identification and retention for Chinese ESL learners. It attempts to reveal the access that is more effective, namely, fast and accurate, for ESL learners to recognize and recall an English word form. Moreover, the investigation also includes information on whether factors such as English processing experience influence the performance of the two accesses. Thus, depending on the degree of phonological effect and graphic effect involved, instructions promoting accurate and fast word form recognition and recall can be explored in vocabulary learning aimed at Chinese ESL learners.

**Literature review**

*Working memory*
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Working memory refers to a system that provides short-term storage and processing of information. Baddeley’s working memory model (1986) proposes it can be divided into the following three subcomponents to process complex cognitive tasks such as language learning: (i) the central executive, which is assumed to be an attentional-controlling system, (ii) the visuospatial sketch pad, which manipulates visual images and (iii) the phonological loop, which stores and rehearses speech-based information. Word form identification and recall, as one part in language learning, is assumed to follow the work of this model. Thus, Baddeley’s working memory model has supported that phonological loop and visual encoding both function in word recognition and short-term recall. However, given the limited capacity of working memory, the attentional controlling system may have to manipulate the distribution of information between the visuospatial sketch pad and the phonological loop to better process and store the information received. Therefore, phonological loop and visual encoding may perform variedly to better serve the function of working memory in word form identification and recall concerning languages.

Word recognition

A large body of studies has revealed that phonological access plays a critical role in word recognition. Van Orden (1987) verified that word naming was accessed through the automatic activation of phonological information. Van Orden’s (1987) categorization task demonstrated that subjects were more likely to falsely categorize the target word “hare” together with “tooth” and “sack” into the category “a part of the human body” than the nonhomophonic control words equated for orthographic similarity “harp”. The
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same tendency was found in nonwords categorization task (Orden, 1988). The increasing errors in homophonic foils either for real words or nonwords by virtue of interference in phonological similarity clearly supported phonological mediation in word recognition. Brown (1994) further strengthened the argument that phonological mediation route was faster at naming irregular words and was independent of word frequencies for English speakers. Apart from the phonological mediation in English, the Universal Phonological Principle proposed by Perfetti, Zhang and Berent (1992) stated that the activation of word pronunciations occurred for skilled readers across all writing systems (Perfetti & Liu, 2005). What mattered in phonological involvement in English and Chinese, as Perfetti et al., (1992) pointed out, was the timing. In English, phonological mediation was activated earlier, at pre-lexical level, while phonological activation occurred later in Chinese, at post-lexical level. Thus, though Chinese and English are two different languages, Chinese character recognition is like English word reading, involving in phonological access. Previous research studies have demonstrated that Chinese native speakers rely on both the phonological loop and graphemic activation in word recognition and recall (Mou & Anderson, 1981; Yik, 1978). They pointed out the dual encoding processes existed in reading and remembering Chinese characters in short-term memory. In addition, phonemic similarity produced retroactive interference on short-term recall.

Though word identification has both phonological and visual accesses, their performance may vary across languages. Chinese speakers show a tendency to depend on graphic information. For example, Huang and Hanley (1994) showed that a test involving visual, paired associate learning was significantly correlated with the reading
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performance of children in Hong Kong and Taiwan, but not with that of British children. In contrast, the reading performance of British children was better predicted by their performance on phonological awareness tasks. In several experimental studies with Chinese adult readers, graphic or visual information was also found to be critical in Chinese character recognition. The distinctive features of writing systems, in particular orthographic depth, may account for these variations.

Different roles of phonological access and graphemic access across languages

Written languages look differently. Arabic, Chinese, Japanese Kanji and Hebrew may overwhelm English speakers. However, they may feel French, Spanish and German are more familiar. Written languages have interrelations based on designed principles. Perfetti and Dunlap (2008), categorize languages mainly into three writing systems, alphabetic, syllabic and logographic based on their respective mapping principle between visual input and sound. The mapping principle of alphabetic system is from graph (letter) to phoneme (sound) like English. For example, the word “cat”, each letter corresponds with one sound. Syllabic writing system such as Japanese Kana, is from graph to syllable. For instance, “ねこ” (cat), pronounced as “neko”. “ね” corresponds to “ne” and “こ” corresponds to “ko”. Logographic language is from graph to word or morpheme. The typical representations for logographic languages are Chinese and Japanese Kanji. As for the Chinese character “猫” (cat), pronounced as “mao”, the graph corresponds to the sound of the whole character. In the alphabetical writing system, written English, Spanish, Italian, etc., are specific written languages, though all belong to the same
system, differing from each other. It is the same case in Japanese Kanji and Chinese. The specific language writing system is called orthography.

Orthographic depth hypothesis (Frost, 1994; Katz & Frost, 1992) proposes that in the alphabetic writing system, the consistency of mapping between grapheme and phoneme is varied. The consistent and clear correspondence between graphemes and phonemes indicates a shallow (transparent) orthographic language. In shallow orthographies, such as Spanish and Italian, the mapping between the letter and the sound is almost one to one correspondence. Conversely, orthographies with irregular mapping between graphemes and phonemes are considered deep and opaque. Taking deep orthographic language English as an example, learners perceive the letter “a” sounds variedly in “about”, “bad” and “bake”. Orthographic depth hypothesis can also be extended to nonalphabetic writing systems. The basic unit of the Chinese writing system is the character, in particular, free morpheme. When the hypothesis is applied to Chinese, a logographic language, which is assumed as a deep orthographic language, the mapping exists between the sound of a free morpheme and a character or a radical. For instance, the free morpheme or character “马” (horse) is mapped to the sound “ma”. The “ma” sound of the free morpheme also matches the sound of the Chinese character “妈” (mother) and “马” (ma) plays as the phonetic radical in the character “妈” (mother). The majority of Chinese characters (81.2%), contains such phonetic compounding (Sun, 2006). Accordingly, recent research evidence from both adult and child studies suggest that early phonological activation is involved in Chinese word recognition but the phonetic information in Chinese characters is defined at the syllable level rather than the
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The depth of orthographies influences the involvement of phonological decoding across writing systems. Learners intend to employ phonological mediation in word identification and their accuracy and speed in word naming are more easily to be affected by the correspondence of the mapping between letter and sound (Frost, Katz, & Bertin, 1987). After comparing the word recognition speed of Hebrew (deepest), English (deep) and Serbo-Croatian (shallow), Frost et al. (1987) presented that Hebrew speakers’ naming speed was most seriously affected by word frequency. Studies on Japanese Kanji (deep) and Kana (shallow) also revealed that phonological decoding was more involved in Kana recall while recall of Kanji relied on both phonological and visual accesses (Mann, 1985). These research findings have supported that shallow orthographies demand more phonological involvement than deep orthographies in word recognition (Katz & Frost, 1992). When the orthography is deep, learners are more used to directly connecting the visual input of a word to its lexical meaning.

Psycholinguistic grain size theory (Ziegler & Goswami, 2005), in another way, has explained the varied involvement of phonology in word recognition across languages. Psycholinguistic grain size, that is, phonological units, differs in languages. Transparent languages or shallow orthographies have a smaller grain size while opaque languages or deep orthographic languages have a bigger grain size. For example, the grain size of transparent language Spanish is as small as a phoneme whereas the opaque
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language English is consistent at the onset and rhyme level (letter clusters) so its grain size is bigger than Spanish. This theory has further pointed out that learners’ word recognition follows a procedural development from large grain size to small grain size in all languages and the orthographic depth has decided learner’s sensitivity to the grain size. Given the psycholinguistic grain size theory, when reading the English word “light”, learners first adopt a whole word reading approach, without segmenting letters, and then gradually become sensitive to the onset and rime segmentation “l-” and “-ight”. English speakers’ phonological sensitivity is optimal at the onset-rime level (Carroll & Snowling, 2001; Ziegler & Goswami, 2005, 2006).

Based on this theory, it can be concluded that in transparent languages, like Spanish, learners’ phonological sensitivity develops to the phonemic level while the deeper the orthographic depth is, the more likely the learners will be to use whole-word reading or bigger grain size strategy in word reading. Chinese has a larger grain size (morpho-syllabic). Consequently, Chinese readers pay more attention to the whole character or are sensitive at the level of morpheme. Though phonological approach is involved in Chinese character reading, the bigger grain size may cause Chinese speakers to show a tendency to depend on graphic information. Supporting evidence may be found through backward masking tasks, which is documented in detail in the following section.

The different roles of phonological and graphic approaches that learners manipulate in their native language may affect their word identification processes in other languages they acquire. Wang, Koda and Perfetti (2002) examined the performance of
two groups of ESL learners, Korean with alphabetic writing system (shallow orthography) and Chinese from logographic writing system (deep orthography) in a semantic category judgment task. In the task, participants were first shown a category name (e.g. “a flower”) and then a word (e.g. “rows”). They were asked to judge whether the word belonged to the category (e.g. whether “rows” is a “flower”). The participants were instructed to give a positive answer if they regarded the word as a member of the category. Through observation, Korean speakers were found to make more false positive judgment errors when the stimuli were homophones, for example, “feat” from “feet” as “a body part” than spelling controls while the difference or positive error judgment between homophonic stimuli and spelling controls was not significant for Chinese speakers. In contrast, Chinese speakers were prone to make more false positive errors in the judgment task when they were exposed to spelling similar stimuli, such as “beech” as “a feature of an ocean shore” than less similarly spelled foils like “serial” as “a breakfast food”. The judgment of Korean learners is more affected by the phonology while the Chinese learners are affected by the similar visual input.

Cross-linguistic variations

What hinders learners to acquire a second language? Contrastive analysis hypothesis (Lado, 1957) argues that barriers in second language acquisition are mainly attributed to the interference of the native language with the second language. Taking a glance at the sentence structure in different languages, English and Chinese both follow the subject, verb and object order. On the contrary, sentences in Japanese are ended with verbs. English teachers may not need to emphasize the sentence order to Chinese learners but they may have to make more efforts to clarify the difference to Japanese learners.
because they can predict that Japanese learners have more difficulty in acquiring the English sentence order compared to Chinese learners based on this hypothesis. As a result, the awareness of the contrast between the first language and the target language can benefit teachers to offer scientific instructions to language learners.

Though the contrastive analysis hypothesis can assist instructors in the prediction of the difficulty degree in second language learning, it fails to explain all the errors language learners make. Cross-linguistic influence (Kellerman, 1995; Odlin, 2003) claims that the focus of the first language interference is on influence, rather than prediction. First language learning experience impacts the target language learning and its influence cannot be overlooked.

The first language influence, also defined as transfer theory (Gass & Selinker, 1983; Johnson, 1998; Kellerman & Sharwood, 1986) buttresses that previous performance or knowledge will be carried to subsequent learning, thus facilitates or impedes subsequent learning. When the learning experience in first language promotes second language acquisition, positive transfer occurs. Conversely, negative transfer or interference appears when the previous knowledge becomes an obstacle in second language acquisition. In reference to the previous example of sentence order, Chinese ESL learners may profit by the similar declarative sentence order in their native language when learning English; however, Chinese ESL learners struggle greatly when acquiring the order of interrogative sentences in English. A common case for Chinese beginners is to make errors on the subject and verb inversion because there is no need to relocate the subject and the verb in their native language learning experience. Fortunately, with the accumulated second language learning experience, learners will reach a stage, called
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interlanguage, a term adapted by Selinker (1972), which refers to “the separateness of a second language learner’s system, a system that has a structurally an intermediate status between the native and target language” (Brown, 2007). Hereby, learners’ language develops closer and closer to native speakers.

Based on these theories, it can be assumed that learners’ first language word learning processing experience will be transferred to their second language word recognition, either positively or negatively. In addition, they will gradually approach to the processing accesses of native speakers in word recognition. A large number of studies have demonstrated that the distance between L1 and L2 correlates to the transfer and impact of L2 word recognition. Closely related L1 and L2 orthographic backgrounds facilitate learners to recognize L2 words (Akamatsu, 1999, 2003; Fender, 2003; Green & Meara, 1978; Koda, 1988, 1989, 2005; Muljani et al., 1998). This can be attributed to the similar processing between L1 and L2. For example, Akamatsu (2003) compared the reading performance of Japanese and Chinese fluent ESL readers and Persian readers with visually distorted words like “cAsE aLtErNaTiOn”. The results showed that readers from logographic writing system were more adversely affected at processing speed by case alternation than their counterparts from alphabetic writing systems.

Obvious evidence in transfer can also be found in studies on bilinguals. Studies on bilingual (Chinese-English) children (Wang, Yang, & Cheng, 2009) have presented that phonological and morphological transfer were observed across languages and facilitate bilingual children to adapt to the variance in both Chinese and English reading. The Chinese Pinyin system, especially the Chinese onset awareness contributed to English real word and pseudoword reading.
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Furthermore, in accordance with L1 transfer theory, the degree of phonological and graphic involvement in learners’ native language may be transferred to second language acquisition. Since learners from alphabetic writing system gain more phonological aid in word identification while learners from logographic writing systems rely more on graphic symbols, it can be hypothesized that Chinese ESL learners may not be as sensitive as native English speakers to phonological loop in English word identification and recall.

Wang and Geva (2003) have demonstrated that Chinese ESL children performed poorer than native English-speaking children in a spelling task of pseudowords dictation, but they dramatically outperformed their counterparts in a spelling task of orthographically legitimate and illegitimate letter strings. Similar evidence can be found in adult Chinese ESL learners. Hamada and Koda (2011) compared the phonological loop accessibility in word retention tasks between adult Chinese ESL learners and native English speakers. They were required to recall the English pseudowords under conditions of words with irregular spelling and articulatory suppression in word retention, where the phonological accessibility decreased. Research findings have demonstrated that under these two conditions, the word recall accuracy of native English speakers declined more significantly than Chinese ESL learners. These research findings provide evidence that Chinese ESL learners are less sensitive in the phonological process compared to their counterparts from an alphabetical writing system.

Backward masking task
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Though research findings have shown that Chinese ESL learners’ response relies less on the phonological process, scarce research has revealed to what extent phonemic and graphemic effect function and facilitate word identification and word recall. The backward masking task is a tool to examine the two accesses in word identification and recall, in particular, word form, in detail. In the backward masking task, participants are presented with two stimuli, the first as the target and the second as the prime. The prime only appears in a short period of time even without the awareness of participants but it interferes with the response of the participants to the target. The backward masking applied in the word identification and recall task can reveal how phonemic and graphemic effect plays in the process of identifying and recalling a word form through the manipulation on the prime by researchers.

Recent research findings have presented how these two accesses perform their functions in word form identification and recall across English and Chinese through backward masking experiments. Research findings have demonstrated that the learners approach the lexical meaning and recall of a word in the light of the phonemic activation and graphemic activation. Both function but degree varies (Humphreys & Olson, 1995; Lesch & Pollatsek; Perfetti et al., 1988, 1991, 1998). Perfetti and Bell (1991) further pointed out that the phonemic activation occurred during the first 40 milliseconds (ms) in English word identification and was independent of word frequency for native English speakers.

Perfetti et al. (1988) began to explore the phonemic processes in word identification on native English speakers through backward visual masking. The
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participants were exposed to a target word (e.g., hear), which they were required to identify in the following retention test, paired with a pseudoword mask in upper case letter, which interrupted identification of the target word. The pseudoword mask was composed of three types of masks sharing linguistic properties with the target word, a homophonic mask (e.g., HEER), a graphemic mask (e.g., HEOR) or a controlled mask (e.g., FODE) with little overlap from the target word in a short time duration. The results indicated that phonemic and graphemic activation both functioned for native English speakers in identifying a word. However, when comparing the phonemic, graphemic and controlled mask, researchers discovered that in spite of the interruption of masks in word identification, phonemic masks has the least effect in word identification and recall accuracy while controlled mask resulted in most errors. When the exposure duration was shorter, the accuracy difference was more obvious. Therefore, it is concluded that native English speakers tremendously rely on phonemic activation in word identification.

Phonemic processes occur earlier compared to graphemic activation, at a prelexical stage in word identification, and this activation is automatic and routine.

Studies on native Chinese speakers in character identification pose another picture through backward masking task. Research has shown that the phonological process plays a role in memory and comprehension but its function may not be as obvious as graphemic activation in Chinese character identification (Perfetti & Zhang, 1991; Tzeng & Hung, 1980; Tzeng, Hung, & Wang, 1977).

Perfetti and Zhang (1991) have proposed the assumption that phonemic processes cannot be observed at a prelexical level in Chinese character recognition, which can be
Phonemic activation accounted for by the writing system the Chinese language belongs to. The result of English native speakers in the backward masking task showed phonemic masks’ disruptive effect in word identification was less than graphemic masks and the phonemic effect could be detected as early as between 35 ms and 55 ms, independent of target word frequency (Perfetti et al., 1991). However, Chinese character identification only shows an opposite picture. Perfetti and Zhang (1991) designed a backward making task for Chinese native speakers. In the task, phonological masks, for instance, “事” (shi), meaning “matter”, were visually unrelated but pronounced the same as the targets, for example, “视” (shi), meaning “watch”. Visual masks, for example, the character “现” (xian) meaning “now” paired with the target word (e.g., 视) in some overlapped strokes, were visually similar but differently pronounced characters from the targets. Results revealed the visual masks led to the least disruptive effect in character identification compared to the phonemic masks and controlled masks. Furthermore, unlike the phonemic activation in English word identification, which occurs at an early stage (40 ms), phonemic activation can hardly be observed in Chinese character identification in that target exposure duration. Phonological effect appears only when the targets are fully exposed at 180 ms duration (Perfetti & Zhang, 1991). On the contrary, graphemic effect occurs at an early stage. Tan et al. (1995, 1996) have shown visual effect in Chinese word recognition rather than phonemic effect within 50 ms and 60 ms target words time duration. A detailed investigation on the time duration reveals that the graphic effect facilitates Chinese target word recognition at 43 ms when no phonological effect can be observed (Perfetti & Tan, 1998).
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Such findings support that reading Chinese is partly like reading English, that is, phonological codes are kept activated in some working memory in Chinese character recognition as well (Baddeley, 1979; Perfetti & McCutchen, 1982). However, graphemic access is activated earlier than phonemic access and enhances word identification accuracy in Chinese character recognition. Therefore, these researchers have argued that Chinese word identification arises from graphemic activation.

In sum, phonemic and graphemic activation both function in word form identification and recall. Their function varies across languages due to orthographic depth. Chinese is a deeper orthography compared with English. Therefore, Chinese speakers approach to the Chinese words via more graphemic activation. On the contrary, English speakers rely more on phonemic activation in their native language, which is also the optimal access in their native language word form identification and recall. The accuracy is high and time duration is short when the phonological access is activated in word form recall. The contrast optimal access between Chinese speakers, automatically inclining to graphic access in Chinese character identification and English speakers, tending to rely on phonological access in English word identification, brings about the contradiction on the access activation for Chinese ESL learners. To approach to an English word fast and accurately, they presumably need to perform like native English speakers, applying the phonological activation to word identification. However, in accordance with the cross-linguistic influence theory, their recognition approach in the native language, Chinese, will impact their second language word recognition approach. That is to say, the reliance on graphemic activation in Chinese word identification and
Phonemic activation recall may remain for Chinese ESL learners when they identify an English word, which may lead to the hypothesis that graphemic information facilitates better for Chinese ESL learners in English word form identification and recall. However, to gradually achieve native-like processing ability, the optimal access may develop to identify a word faster and more accurately through phonemic activation. Therefore, this research is intended to answer the following questions:

1. Which access, phonemic activation or graphemic activation, occurs for intermediate and advanced Chinese English learners in English word form identification and recall?

2. Which access, phonemic activation or graphemic activation, enhances word recall accuracy in a short time?

3. What factors may impact the option of phonemic activation and graphemic activation?

**Method**

**Participants**

The participants were adult Chinese ESL learners. The number was 20 ($N = 20$), 10 males and 10 females. All the participants were students at Ball State University, across the majors of science and art. Fourteen out of the total number were graduate students and the remaining participants were undergraduate students with a mean age of 24. They were volunteering to be subjects of the research. To control related factors, their English language proficiency was taken into account. All the participants recruited were intermediate and advanced level learners with an average of approximately 10 years of
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English study experience. The criteria used to judge their English proficiency was adopted by the Intensive English Immersive Program (IEI) at Ball State University. The minimum requirement for their English proficiency was having passed the IEI Level 4, which requires the participants to be at the level of between intermediate and advanced level in listening, reading, speaking and writing skills in an academic context.

None of the participants had the experience of being in other English speaking countries except for the U.S. Only three of them had learned other alphabetic languages, including Italian, Spanish and French, but at the beginning level. Therefore, it was assumed that their experience in the third language learning would not cause influential effect in the experiment.

Materials and Tasks

All the participants were required to fill out a questionnaire (see Appendix A) before they took the experiment. The questionnaire was used to investigate the background information of the participants, such as their gender, age, major, length in the U.S. and years of English learning. Two reading comprehension passages selected from a retired version of Test of English as a Foreign Language (TOEFL) were prepared for the participants to help judge their English proficiency. The participants needed to complete 19 multiple choice items within fifteen minutes. The last task they were required to take part in was the word form recall test through a backward masking experiment.

The materials and tasks adopted in the experiment were created based on the study performed by Perfetti and Bell (1988, 1991). The participants were exposed to a
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series of English letter strings, which were composed of real English words in lower case as target words such as main. Each target word was paired with three pseudoword masks in upper case, for example, MAYN as the phonemic mask, which shared the same pronunciation with the target word; MARN as the graphemic mask, sharing the similar spelling with the target word and FOST, a controlled mask, which was both phonemically and graphically irrelevant to the target word.

Twenty-four target words were paired with each of three mask types (see Appendix B), 96 words in total. Each word consisted of 4 or 5 letters, the mean number of letters being 4.3. Since the participants were only exposed to these words by pairs consisting of a target word and a pseudoword mask, the total number for the pairs was 72. Masks generally had the same number of letters as the target words, except for one word “fine”. The target word “fine” had 4 letters while each of its paired masks had 5 letters. Apart from the 72 pairs, all the 24 target words were paired with blank masks where no upper case letter strings appeared to disturb the participants. These pairs were used as a baseline in justifying the participants’ ability of word form recognition and recall. The total number of pairs in the experiment was 96, which were divided into 4 test trials at random. In each test trial, the participant would be exposed to 24 pairs (18 were target words with pseudowords masks and 6 were target words with blank masks. Each test trial would be taken by 5 participants.

Stimuli were viewed on a computer. They appeared in white color on a black computer screen as background. The participants sitting in front of a computer could adjust the seat to find the most comfortable and suitable angle reading the stimuli for the
Phonemic activation experiment. They were first presented with the target words and then one of the three masks as a pair. They needed to recognize and remember the word form of the target word they were exposed to after they saw the mask and took the target word down one by one.

A large amount of backward masking experiments have attempted to set different stimulus presentation timing, around 30 ms, 35 ms, around 40 ms, 45 ms and 55 ms with a range of 40% -60% word identification and recall accuracy, to explore the phonemic effect in word identification (Perfetti et al., 1998; Perfetti & Bell, 1991; Tan & Perfetti, 1999). The research has demonstrated that phonemic effect is activated in native English speakers’ word identification when the target exposure time duration is within 45 ms and the masks at around 30 ms. An overview on the research of English native speakers and nonnative speakers in naming tasks has presented that nonnative speakers spend longer reaction time, approximately 6% longer than native speakers (Hamada & Koda, 2008, 2011; Jared, 1997; Perfetti & Liu, 2005). However, based on these formulas, the target duration was set at 72 ms, which seemed too long. It was adjusted to 55 ms, approximately 2% longer than native speakers. Accordingly, the mask time duration was also adjusted from 48 ms (6% longer than native speakers) to 35 ms (2% longer than native speakers).

A pilot study was conducted to check the time duration. Three participants from the same English proficiency took part in the test trials, regardless of their first language background. The results from the pilot study showed target duration at 55 ms led to 70% to 80% recall accuracy, which was too high. Therefore, the target duration was shortened...
Phonemic activation to 45 ms and the pilot study results showed a recall accuracy in the predicted range from 40%-60% thereafter. After the pilot study, the target words exposure duration was adjusted and set at 45 ms in the test trials. The mask exposure time duration remained at 35 ms.

Before the participants took part in the test trial, they had a practice session. Each of them would have an opportunity to identify 15 target words with unrelated masks in three practices. The time durations for the three practices were 300 ms, 100 ms and 45 ms respectively. The three practices were designed intended to help the participants get familiar with the process of the test procedures. The target words used in the practice were not from the test trials.

Results

The main results, as shown in Figure 1, are the mean word form recall accuracy percentage of target words paired with four different masks, namely, phonological masks, visual masks, unrelated masks and blank masks. The accuracy percentage of target words paired with blank masks is used as a baseline to help judge the participants’ performance in word form recall. To further explore what factors may impact the activation of the participants in word recall accuracy, the participants are grouped into advanced learners ($N = 10$) and intermediate learners ($N = 10$) based on their TOEFL scores, as presented in Figure 2, and into groups of new comers ($N = 10$) and residents ($N = 10$) in Figure 3 in the light of their residential length in the U.S. The results of each group are analyzed and compared.
As for groups based on TOEFL scores, the division accords with the criteria the universities in the U.S. set to judge the English proficiency of international students. Since around 80 scores out of 120 scores in iBT TOEFL test are considered as a bar for the majority of the universities, the participants in the experiment gaining the total scores above 65% are grouped together as advanced learners and the other group as intermediate learners consists of those with scores lower than 65%. According to the data, the U.S. is the only English speaking country that all the participants have resided in, so their residential length in the U.S. alone is taken into consideration. They are divided into one group of new comers with less than or equal to 12 months in the U.S. and the other group of residents with more than 12 months study experience.

The mean word form recall accuracy percentage is presented in Figure 1. The percentage differs when the target word is paired with four different masks. The highest recall accuracy comes from target words with blank masks, which is also used as a baseline. The mean accuracy percentage is 75.7%, with a highest score of 100% correct and a lowest percentage of 33.3%. Second to it are the target words with phonological masks, the mean accuracy percentage being 68.4%, highest at 100% and lowest at 16.7%. The accuracy recall of target words with visual masks is slightly lower than those with phonological masks. The mean accuracy of percentage is 62.5%. The accuracy difference is only about 6%. The highest score also reaches 100% and the lowest is 33.3%. The recall accuracy of word form with unrelated masks gains the lowest accuracy percentage, that is, 43.3%, highest at 83% and lowest at 0.
Phonemic activation

Similar to Figure 1, Figure 2 also presents that both intermediate learners group and advanced learners group have the highest word form recall accuracy percentage in the target words paired with blank masks (63.2% for intermediate learners and 88.2% for advanced learners). Their accuracy decrease follows the order from phonological masks (58.4% for intermediate learners and 78.3% for advanced learners), visual masks (55.0% for intermediate learners and 70.0% for advanced learners) to unrelated masks (33.3% for intermediate learners and 53.3% for advanced learners). Apart from this trend, given the superior performance of advanced learners over intermediate learners in TOEFL reading comprehension test, 73.6% vs. 46.8%, the advanced learners excel at target word form recall accuracy in all four masks.

Figure 3 shows a large gap between the residential length of the new comers group, the mean length being 8.7 months, and the residents group, mean length as long as 30.6 months. Though their residential lengths vary greatly, English proficiency of the two groups are perceived to remain at similar level due to their length of English learning years, 10.3 years for the former and 10.9 years for the later. In addition, the TOEFL reading comprehension test scores of both groups attain around 60% accuracy. The mean accuracy word form recall percentage in Figure 3 looks similar to the previous two figures as a whole picture. Target words paired with blank masks achieve the highest accuracy (78.2% for new comers and 73.2% for residents), and the other three masks disrupt the accuracy rate in turn for both new comers group (65.0% in phonological masks, 60.0% in visual masks and 38.3% in unrelated masks) and residents group (71.7% in phonological masks, 65.0% in visual masks and 48.3% in unrelated masks). However,
Phonemic activation

A noticeable finding is the accuracy percentage for words with blank masks (73.2%) and with phonological mask (71.7%) has no significant difference in residents group, which differs from the data presented in the two previous figures.

Discussion

Phonemic and graphemic accesses activated in word form recognition and recall

According to Figure 1, the data has indicated that all the participants have the English proficiency to recognize and recall the majority of word forms, which can be predicted from the highest accuracy percentage of word form percentage at the baseline, exposure to the target words without the interference of the masks. The high accuracy percentage 75.7% in blank masks have provided with proof that all the participants have the language ability to recognize and recall the word forms in 45 ms exposure time duration.

Phonological and graphic approaches both take positive effect in the word recognition and recall process, which may account for the results that the dramatic drop in recall accuracy occurs in unrelated masks, from 75.7% in blank masks to 43.3%, while no such distinguishing accuracy drop can be detected in phonological masks and visual masks. Therefore, phonemic and graphemic activation are initiated for Chinese English learners to aid word recognition and recall (Perfetti & McCutchen, 1982).

Phonemic and graphemic accesses related to enhancement of word recall accuracy

Like their English counterparts, phonological activation has played a critical part for Chinese learners, surpassing graphemic activation, which is naturally developed and
Phonemic activation relied on in their native language character recognition and recall. By virtue of 10 years of English learning, Chinese English learners have shown a tendency identical with native English speakers that phonemic access is activated earlier and enhances word form identification and recall accuracy, compared with graphemic access (Perfetti et al., 1998, 1991).

However, the accuracy percentage difference between phonological masks and visual masks is not distinctive. The accuracy in phonological mask only exceeds about 6%. It may manifest that Chinese learners, from a logographic language, have formed the cognitive processing habit to depend on visual information (Tan et al., 1995, 1996). When it comes to English word, the priority of graphemic activation cannot be avoided being transferred and leaving traces in English word form recall. Thus, graphemic dependence keeps an equally important access to approach word form.

Furthermore, it is notable that the distribution of word recall accuracy between the highest score and the lowest score in phonological mask (from 100% to 16.7%) is more scattered than the distribution in graphemic masks (from 100% to 33.3%). The bigger difference in the score distribution in phonological masks may indicate though the reliance on phonemic activation enhances accuracy, its positive effect is not as stable as graphemic effect. If so, it offers further evidence that intermediate and advanced Chinese ESL learners are at the activation transitional stage. Reliance mainly on graphic information to identify and recall a word form is more familiar to Chinese ESL learners while more involvement of phonological information is still relatively new. That may explain their unsteady performance in phonological masks.
Phonemic activation

Factors related to the option of phonemic activation and graphemic activation

A further investigation intends to focus on what factors may impact Chinese learners’ phonemic and graphemic activation to facilitate English word recall. Learners’ English proficiency is to be first examined and then their residential length in an English speaking country.

As shown in Figure 2, reading comprehension ability seems related to the phonological access and visual access employed by Chinese English learners. Advanced learners with higher TOEFL scores achieve a higher accuracy rate in word recall accuracy than the intermediate learners. With regard to the difference between the accuracy percentage of phonological masks and visual masks, it can be observed that in the intermediate learners group, the difference is 3.4% while in advanced learners group, it increases to 8.0%. From this perspective, it may be concluded that the increasing command of English proficiency accelerates learners’ shift to more native-like approach, that is, phonological access dependent, in word form identification and recall. Consequently, the access option may partly lie in the English proficiency of the participants.

An interesting finding is that the residential length of the participants in America may not correlate with English proficiency whereas a correlation may exist between residential length and word form identification and recall accesses activation. The data in Figure 3 has revealed that longer time studying in an English speaking country may not guarantee higher English proficiency, or at least higher TOEFL reading scores. The TOEFL scores of the new comers group and the residents group are almost equivalent; in
Phonemic activation

fact, the scores of the new comers group is a bit higher, which may be rooted in the examination-oriented English learning for Chinese learners. Reading comprehension in the TOEFL test needs practice and techniques in choosing the correct answer faster and accurately, so the new comers may have gone through a large amount of practice more recently to become qualified to be admitted into the universities in the U.S. Thus, though they are in America less than 12 months, their performance in reading comprehension test equals to those staying here longer. Additionally, it also implies that the two groups of participants have equal English proficiency, which can be further demonstrated from their performance in the recall accuracy of target words paired with blank masks. Those who stay in the U.S. shorter even outperform their peers who stay 22 months longer than them.

On the condition that the two groups of participants are at the equivalent level of English proficiency and both groups decrease recall accuracy in order: the highest accuracy percentage in the recall of target words paired with blank masks; unrelated masks cause the most disruptive effect, followed by the visual masks and the phonological masks lead to the least effect, it is worthwhile to find that residential length functions crucially in activation accesses. Those in the U.S. for 30.6 months obviously rely on phonemic activation to identify and recall an English word. Their word form recall accuracy in phonological masks is near 7% higher than new comers and the recall accuracy from blank masks decreases only by 1.5 %, a distinguishing contrast to the 13.2% drop of their peers. It is evident that for the residents group, the recall accuracy in phonological masks is nearly as high as the accuracy in blank masks. These results
address the notion that residential length in an English speaking country may strengthen
the activation of phonology, and phonemic access enhances more English word form
recall accuracy than graphemic access, even for Chinese ESL learners.

The likelihood that the residential length in an English speaking country may be
decisive in word form identification and recall approach can be contributed to the amount
of the learners’ exposure to the target language. In an EFL situation, for instance, China,
the learners’ opportunity of exposure to English words diminishes significantly outside of
classroom. On the contrary, in an English speaking country, learners are granted with
large quantities of opportunities or even forced to get in touch with English word form
incidentally and accidentally so that they have to evolve to phonemic reliance activation
in word form identification in the English environment. This adaptation to approaching
the word faster and accurately may be more aided by environment and is need-based,
hence, those living in an English speaking country will realize that adaptation is urgent
and intend to complete a quick shift compared to those in an EFL situation with
equivalent English proficiency.

Moreover, when Chinese English learners rely more on phonemic activation, their
graphemic activation may become deteriorated. An interesting case is one participant
with 69 months residential length in America, the one with the longest residential length
in all 20 participants. This participant shows a sharp contrast in word form recall
accuracy, 100% accuracy in phonological mask and 50% accuracy in visual masks.

This developmental trend may be a reflection of the psycholinguistic grain size
theory (Ziegler & Goswami, 2005). As the processing experience of English increases,
Phonemic activation

Chinese learners’ whole word reading skill is not fit in the English word reading. Instead, they become more sensitive to the onset-rime phonological involvement in English word reading. That is to say, Chinese ESL learners’ grain size is shrinking. Their most sensitive grain size has changed from big, at the level of morpheme in Chinese, to small size at letter clusters in English. The transition of their optimal grain size sensitivity may result in their lack of reliance on graphic information so the performance in visual masks is poorer than in phonological masks. Therefore, it can be predicted that in English word recognition and recall, the phonemic activation will be reinforced while graphemic activation will be degenerated.

**Conclusion**

This research attempts to explore the phonemic and graphemic activation that Chinese ESL learners apply in English word form recognition and recall. Through the exploration, it is attempted to reveal which access facilitated Chinese ESL learners to identify and remember an English word form accurately and fast in hope of conducing to vocabulary learning and instructions, in particular, aiming at Chinese English learners.

Previous research findings have pointed out that phonological access is universally employed in word form recognition and recall, despite orthographies and writing systems, but to what extent it is involved differs across languages. The more shallow and transparent languages involve more phonological mediation than graphic information in word identification. Backward masking tasks have presented that the logographic language, Chinese (a deep orthography), counts on relatively less phonological involvement but more visual activation while the alphabetic language
Phonemic activation

English (shallower compared to Chinese), depends more on phonological access rather than graphic information to fast and accurately identify and recall a word. Additionally, learners’ first language learning experience will impact second language acquisition in the perspective of cross-linguistic influence theory, which makes the prediction that Chinese ESL learners may be found relying more on graphic information in English word form identification and recall than phonemic information owing to their native language influence.

Grounded on the prior studies, this research has adopted the backward masking task and revealed that intermediate and advanced Chinese ESL learners are at the shift developmental stage from graphemic activation to phonemic activation in English word form identification and recall with the sufficient amount of second language processing experience. Both graphemic and phonemic accesses are observed and facilitate Chinese English learners in English word form recognition and recall. The two accesses almost perform balanced functions, but the tendency is that learners’ recognition and recall process has gradually become closer to native English speakers.

Two factors, learners’ English proficiency and residential length in an English speaking country are found to influence the shift. With the English proficiency improving, Chinese learners gradually develop into a more native-like processing procedure, getting rid of the impact of their native language and relying more on phonological effect in word form recall rather than on visual effect. Most importantly, English environment gears up the transition from graphemic activation to phonemic
Phonemic activation

activation. It helps Chinese learners recognize and recall an English word form more accurately and faster.

On account of these research findings, language instructors may encourage learners to memorize a word form through multilevel phonological aid. Instructors had better stimulate English learners with multiple phonological activations in English word form memorization. For example, instead of rote memorization by repeating the individual letter or scribbling the letters, which are frequently used by learners to remember a word form, instructors can encourage learners to read the word or present the word phonologically. Learners need to be instilled with the concept that word form memorization in the light of its sound maximize the learning result.

Environment has a crucial impact on the shift from graphemic activation to phonemic activation. English environment facilitates learners’ phonemic activation so it is important for both instructors and learners to be aware that the amount of English exposure in daily life may accelerate their word form memorization. Learners may not realize that when they read the English explanation of a product, a road sign and encounter a simple chat with a native speaker, they are accumulating exposure experiences. The accumulated exposure of the target language pushes the shift of word form recall access, which ultimately enhances better efficiency in word form memorization.

What needs to be pointed out is this research only focuses on intermediate and advanced language learners. The current participant population may decrease the possibility to observe the transfer of their first language in word form recognition and
Phonemic activation

recall accesses. The findings may differ when the participants are beginners. Moreover, the targets in the backward masking task are real words. It cannot rule out the possibility that the participants guessed the word form correctly based on their previous knowledge even though they did not identify and recall the word successfully in the test trial. It may be worthwhile to change the targets into pseudowords in further studies.
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Phonemic activation


Phonemic activation


Phonemic activation


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Phonemic activation


Phonemic activation


Phonemic activation


Phonemic activation


Phonemic activation


Phonemic activation

Figure 1. Mean Percentage of Word Form Recall Accuracy

![Mean Percentage of Word Form Recall Accuracy](image_url)
Phonemic activation

Figure 2. Mean Percentage of Recall Accuracy Based on TOEFL Reading Scores
Phonemic activation

Figure 3. Mean Percentage of Recall Accuracy Based on Length in America
Appendix A

Background Questionnaire

This questionnaire is anonymous. DO NOT write your name.

Participant ID Number: ____________

1. What is your native language? ______________

2. How old are you? ________

3. Your gender. Mark one. [ ] Male [ ] Female

4. How long have you lived in America in total? If you have lived in America before, include any previous visits too.

_________ months

5. If you have lived in any other English speaking country, please answer the following questions.

Which country was it? ______________

How long did you live there? _______ months

6. How long have you been studying English? ________ years

7. Are you proficient in any foreign languages other than English? If you are, indicate which language(s).
8. What is your purpose for learning English? Mark all that apply.

[ ] To study at an American university

[ ] To find a better job in my home country

[ ] To find a better job in America or any other English speaking country

[ ] Because I like American culture

9. What is your major? ______________

10. You are

_____ Graduate students

_____ Undergraduate students

_____ IEI (If so, please specify your level)

Mark one or more that fit your status.

Thank you!
### Appendix B

Stimulus items for Trial Session

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<th>Phonological Mask</th>
<th>Visual Mask</th>
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