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The Impact of Second Language Proficiency on Chinese ESL Learners' English Word Recognition

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Abstract

This study investigated the impact of Chinese ESL learners' second language (L2) proficiency on English word recognition in a lexical decision task**.** The study focused on the interaction among one between-participant variable (L2 proficiency) and three within-participant variables (orthographic neighborhood density, word frequency, and words/nonwords). ANOVA and two-tailed t-test indicated that: the accuracy (ACC) differences to orthographic neighborhood density (High/Low N), word frequency (High/Medium/Low F) and words/nonwords between high/low L2 proficiency (High/Low P) participants were significant respectively, while reaction time (RT) was not. In terms of ACC, highly-proficient Chinese ESL learners performed better using words with N, F, words/nonwords factors than low-proficient ones. In conclusion, higher L2 proficiency facilitated Chinese ESL learners' English word recognition in a lexical decision task blocked by N, F, words/nonwords factors.

Keywords: Chinese ESL learners, Second language proficiency, Neighborhood effects, Word frequency, Word recognition, Lexical decision

1. Introduction

Second language (L2) proficiency-how well a person can understand and use a second language coupled with their language learning experience-is likely to affect the way L2 words and meanings are accessed, processed, and represented in the mind. A range of behavioral psycholinguistic studies (Bijeljacbabic et. al, 1997; Chen, 1990; Cheung & Chen, 1998; Dufour & Kroll, 1995; Gascoigne, 2001) have primarily addressed the question of how proficiency (variously defined) affects the strength of connections between forms, concepts and words in the second language mental lexicon.

In alphabetic writing system some studies have been conducted with respect to L2 proficiency with different experimental methods, the native languages of the participants, research focuses, etc (Wang, L., 2003; Kotz, S.A., & Elston-Guttler, K., 2004). In particular, van Heuven (1998) manipulated L2 proficiency in a behavioral experiment. Two groups of participants (all native speakers of Dutch) were selected, differing in their proficiency in English. The two groups of participants were not perfectly balanced bilinguals, and were assumed to differ with respect to their L2 proficiency. The participants were instructed to identify and enter the words appearing on the screen as quickly and accurately as possible in a progressive demasking experiment.

However, few empirical researches have been done concerning the impact of Chinese ESL learners' L2 proficiency on English word recognition in China. The aims of this study were to explore the impact of Chinese ESL learners' L2 proficiency (High/Low P) on English word recognition in a lexical decision task blocking by orthographic neighborhood density (High/Low N), word frequency (High/Medium/Low F), words/nonwords factors. The stimulus materials of this experiment were mainly based on those of van Heuven et al. (1998), and some research findings were made comparison as well.

The current study applied three within-participant variables: H/L N, H/M/L F and words/nonwords. Coltheart et. al (1977) 's definition of an orthographic neighbor (i.e., any word that can be created by changing one letter of the stimulus item, preserving letter positions) has been adopted by virtually all researchers in this field to date. This is why the neighborhood of a word has been defined as the set of neighbors of that word. Neighborhood density implies the number of neighbors. The word frequency item used in this study is the objective occurrences in a vocabulary database. Nonword is constructed by changing one letter in an English word, orthographically and phonologically legal letter string (bigram analysis ensures that only legal combinations are included) (e.g., face & fact).

2. Method

2.1 Participants

149 postgraduate students (Chinese-English bilinguals) from various majors of Dalian University of Technology participated, 113 non-English majors and 36 English majors. They all passed the National English Entrance Examination for Postgraduate Study (NEEEPS) except the students guaranteed for postgraduate study without entrance examination. The English majors all passed Test for English Majors Band 8 (TEM 8), and the non-English majors all passed College English Test Band 4 (CET 4) (Some passed CET 6.). No participant had a known reading or speech disorder and all had normal or corrected-to-normal vision. Before the experiment all participants completed a questionnaire concerning their English proficiency (NEEEPS, TEM4/8, CET4/6) and personal information (major, age, gender, handedness, etc). The participants were at different levels of L2 proficiency (different bilingual status), and they were not perfectly balanced bilinguals. The age range is from 21 to 26, and the mean age is 24.

2.2 Materials: stimulus selection

All the experiment stimuli are those used by van Heuven et al. (1998). First, a list of English four-letter words was extracted from the CELEX database (Baayen et. al, 1993). Only nouns, adjectives, verbs, and adverbs with a printed frequency of at least 2 occurrences per million (o.p.m.) were selected. For each target word, the number of neighbors was calculated (following Coltheart et al., 1977).

Two conditions of items were defined by orthogonally varying the number of neighbors (N): (1) words with many neighbors (HN), (2) words with few neighbors (LN). Each condition consisted of 40 words, mostly nouns and adjectives. In addition, the word frequency of all items was calculated by Wordsmith Tools in Brown Corpus. The Brown Corpus of Standard American English is the first of the modern, computer readable, general corpora. The corpus consists of one million words of American English texts. The texts for the corpus were sampled from 15 different text categories to make the corpus a good standard reference. Wordsmith Tools, user-friendly and powerful package software, provide six analytical tools, namely Concord Tool, *Wordlist Tool,* KeyWords Tool, Text Converter Tool, Splitter Tool, and Viewer Tool, each for specific text analysis tasks. Here the Wordlist Tool was used to calculate the frequency of the words chosen from the Brown Corpus. The word frequency was divided into three categories: low frequency (LF), words with a frequency of less than 20 o.p.m.; medium frequency (MF), words with a frequency between 20 and 50 o.p.m.; and high frequency (HF), words with a frequency of at least 50 o.p.m.

All 80 words were included in the experiment along with 80 nonwords. Each nonword was constructed by changing one letter in an English word (not a target word in the experiments) in such a way that it formed an orthographically and phonologically legal letter string in both languages (bigram analysis ensured that only legal combinations were included). Analogous to the word conditions, two experimental nonword conditions were defined with respect to the number of neighbors in English, each consisting of 40 nonwords: (1) nonwords with many neighbors in English (high N), (2) nonwords with few neighbors in English (low N).

2.3 Design

Participants saw one block of items. Stimulus selection was described above and can be summarized as follows. The block consisted of 160 items, 80 words (40 HN, 40 LN) and 80 nonwords (40 HN, 40 LN), and 80 words were divided into H/M/L F. Three factors (2×3×2) were examined in the experiment: N, F, words/nonwords. The block consisted of 8 practice trials and 152 experiment trials. Each participant saw a different randomized order of test items within a block.

2.4 Procedure

Presentation of the visual stimuli and recording of the RT (reaction time) was controlled by laptop computer with

E-Prime software. E-Prime is a program that can be used to run psychological experiments. It presents lists of stimuli that are prepared and specified by the user, collects responses, saves the RT and correct/error responses in a data file for later analysis. RT were measured at a 1 ms accuracy by pressing the left/right side of the mouse. The words consisted of black Courier capital letters (18 points) presented at the center of the computer screen on a white background. Participants were tested individually. Before the experiment, participants were informed about their task by means of written instructions. They were told that a series of letter strings would appear on the screen, one after the other, and that they had to decide as quickly and as accurately as possible whether each of the presented items was a word or not. Responses were made by pressing the left/right side of the mouse with the forefingers of their right hands. The participants were asked to press the left side of the mouse when the stimulus was a real word and the right side of the mouse when it was a nonword. When the participants had read the instructions, the experiment began with the 8 practice trials. After the practice trials the participants could read the instructions and then press the space for the experiment trials. 152 experimental stimuli were presented to each participant in a random order. Prior to the presentation of each stimulus word, the symbol "+" was presented at the center of the screen where the stimulus word was to appear. The symbol "+" disappeared after 500 ms and were immediately followed by the stimulus. The stimulus remained on the screen until a deadline of 2000 ms was reached, or until the participant had pressed one side of the mouse. The interval between two successive trials was 500 ms. Experiment lasted about fifteen minutes.

3. Results

Due to the fact that in the experiment all the valid data are those whose accuracy rate is over 60% (according to the L2 proficiency of the participants), whereas the data whose accuracy rate is below 60% are invalid (8 invalid participants data). The 8 invalid data all come from non-English majors, so the valid data are those of 141 participants (36 English majors, 105 non-English majors). All the behavioral experiment data were analyzed with SPSS 13.0, which is a statistical and data management package for analysts and researchers. ANOVA (analyses of variance) was performed on mean reaction time (RT), mean ACCRT (RT based on accuracy) and mean accuracy (ACC).

The data of participants were categorized into two kinds of proficiency groups with regard to the following two perspectives: (1) 36 English majors as HP group, 36 non-English majors as LP group (randomly chosen from the 105 non-English majors); (2) based on the mean NEEEPS score of all 105 non-English majors, 47 non-English majors as HP group, 40 non-English majors as LP group.

3.1 Reaction time data

RT data concerning one between-participant variable and three within-participant variables will be analyzed below.

3.1.1 Proficiency (English v.s. non-English majors) and three within-participant variables

Proficiency & three within-participant variables: RT was not significant between English (HP) and non-English (LP) majors [$F(1, 70) = 2.416$; $p=0.125$]. HP participants did not show any advantage over LP participants in RT.

Proficiency & N: neither HN nor LN showed significant difference between HP/LP participants [$F(1, 70) = 2.998$; $p=0.088$] [$F(1, 70) = 1.801$; $p=0.184$]. HP participants were not faster than LP participants in response to HN/LN words.

Proficiency & F: none of HF/MF/LF produced significant difference between HP/LP participants [$F(1, 70) = 1.212$; $p=0.275$] [$F(1, 70) = 1.218$; $p=0.274$] [$F(1, 70) = 0.783$; $p=0.379$]. In term of HF/MF/LF words RT, no significant difference was found between HP and LP participants.

Proficiency & words/nonwords: neither words nor nonwords indicated significant difference between HP/LP participants [$F(1, 70) = 1.143$; $p=0.289$] [$F(1, 70) = 3.049$; $p=0.085$]. No evidence could be found that HP participants reacted faster to words/nonwords than LP participants.

3.1.2 Proficiency (high-score v.s. low-score non-English majors) and three within-participant variables

Proficiency & three within-participant variables: RT was not significant between high-score non-English (HP) and low-score non-English (LP) majors [$F(1, 85) = 0.085$; $p=0.772$]. HP participants did not show any advantage over LP participants in RT.

Proficiency & N: neither HN nor LN presented significant difference between HP/LP participants [$F(1, 85) = 0.016$; $p=0.901$] [$F(1, 85) = 0.196$; $p=0.659$]. HP participants were not faster than LP participants in response to HN/LN words.

Proficiency & F: none of HF/MF/LF yielded significant difference between HP/LP participants [$F(1, 85) = 1.268$; $p=0.263$] [$F(1, 85) = 0.054$; $p=0.817$] [$F(1, 85) = 0.000$; $p=0.991$]. In term of HF/MF/LF words RT, no significant difference was found between HP and LP participants.

Proficiency & words/nonwords: neither words nor nonwords revealed significant difference between HP/LP participants [$F(1, 85) = 0.099$; $p=0.754$] [$F(1, 85) =0.057$; $p=0.812$]. No evidence could be found that HP participants reacted faster to words/nonwords than LP participants.

3.2 Accuracy data

Accuracy data analysis is also with regard to one between-participant variables and three within-participant variables.

3.2.1 Proficiency (English v.s. non-English majors) and three within-participant variables

Proficiency & three within-participant variables: Accuracy was significant between English and non-English majors [F (1, 70) = 23.402; p<0.001]. HP participants showed advantages over LP participants in accuracy. (Table 1)

Proficiency & N: both HN and LN showed significant difference between HP/LP participants [F (1, 70) = 17.217; p<0.001] [F (1, 70) = 25.143; p<0.001]. HP participants were more accurate than LP participants in response to both HN and LN words.

Proficiency & F: H/L F produced significant difference and MF produced marginally significant difference between HP/LP participants [F (1, 70) = 4.043; p<0.05] [F (1, 70) = 3.286; p=0.074] [F (1, 70) = 11.712; p=0.001]. In term of HF/LF words accuracy, significant difference was found between HP and LP participants; with regard to MF words accuracy, marginally significant difference was found between HP and LP participants.

Proficiency & words/nonwords: both words and nonwords indicated significant difference between HP/LP participants [F (1, 70) = 11.960; p=0.001] [F (1, 70) = 11.292; p=0.001]. So evidence could be found that HP participants reacted more accurately to words/nonwords than LP participants.

3.2.2 Proficiency (high-score v.s. low-score non-English majors) and three within-participant variables

Proficiency & three within-participant variables: Accuracy was significant between high-score non-English and low-score non-English [F (1, 85) = 5.724; p<0.05]. HP participants showed advantages over LP participants in accuracy. (Table 2)

Proficiency & N: LN presented significant difference and HN showed marginally significant difference between HP/LP participants [F (1, 85) = 2.997; p=0.087] [F (1, 85) = 6.110; p<0.05]. HP participants were more accurate than LP participants in response to HN/LN words.

Proficiency & F: HF yielded significant difference, MF marginally significant difference, LF no significant difference between HP/LP participants [F (1, 85) = 4.687; p<0.05] [F (1, 85) = 3.307; p=0.073] [F (1, 85) =0.065; p=0.799]. In term of HF words accuracy, significant difference was found between HP and LP participants; with respect to MF words accuracy, marginally significant difference was found between HP and LP participants; with regard to LF words accuracy, no significant difference was found between HP and LP participants.

Proficiency & words/nonwords: neither words nor nonwords revealed significant difference between HP/LP participants [F (1, 85) = 0.705; p=0.404] [F (1, 85) = 2.606; p=0.110]. No evidence could be found that HP participants reacted more accurately to words/nonwords than LP participants.

4. Discussion

The interaction among one between-participant variables and three within-participant variables will be discussed respectively in this part.

4.1 Proficiency (English v.s. non-English majors) and three within-participant variables

With respect to the interaction between P (English v.s. non-English majors) and three within-participant variables (N, F, words/nonwords), HP participants showed advantages over LP participants in accuracy but not in RT. As for N factor, HP participants responded more accurately to both HN and LN words than LP participants. As for F factor, HP participants responded more accurately to HF/MF/LF words than LP participants as well. As for words/nonwords factor, HP participants responded more accurately to both words and nonwords than LP participants again. It is obvious that higher L2 proficiency facilitated Chinese ESL learners' English word recognition performance (in accuracy) in a lexical decision task blocked by N, F, words/nonwords factors.

In a progressive demasking task van Heuven et al. (1998) found that "the proficiency manipulation was not very effective, since proficiency neither yielded a significant main effect nor interacted with the neighborhood density factors". They further concluded the hypothesis that "high proficiency participants are able to exert a certain degree of control over the relative activity of their lexica clearly deserves further investigation" (also see Dijkstra et. al, 1998). Although with different experiment paradigms, the above findings of the current study may contribute to the explanation that high proficiency participants are able to exert a certain degree of control over the relative activity of their lexica.

With respect to words/nonwords factor, highly-proficient Chinese ESL learners also performed with more accuracy to words and nonwords than low-proficient ones in English word recognition. In a lexical decision task with the same stimuli, van Heuven et al. (1998) observed that "the monolingual (English) and bilingual (Dutch & Dutch) participant groups showed the same type of effect, slower RT to nonwords when the number of English neighbors of the nonword targets increased (inhibitory). That is to say nonwords with large neighborhoods take longer to reject than nonwords with small neighborhoods for both bilinguals and monolinguals". They further concluded "the presence in that experiment of target items from the native language of the bilingual participants had a pervasive effect on nonwords responses". When bilinguals read or listen to words in their L2, information about words in their first language (L1) is also active (e.g., Dijkstra & van Heuven, 2002; Jared & Kroll, 2001; Marian & Spivey, 2003). Chinese ESL learners with high proficiency seem to be able to exert higher degree of control over the relative activity of their lexica (here Chinese). So they could have better performance in the nonword identification task as well due to high proficiency. However, more qualitative and quantitative research is necessary to support this viewpoint.

4.2 Proficiency (high-score v.s. low-score non-English majors) and three within-participant variables

With regard to the interaction between P (high-score v.s. low-score non-English majors) and the three within-participant variables (N, F, words/nonwords), HP participants showed advantages over LP participants in accuracy but not in RT. As for N factor, HP participants reacted more accurately to LN words than LP participants. As for F factor, HP participants responded more accurately to HF words than LP participants as well. However, due to the marginally significant difference to HN/MF between HP and LP participants, no significant difference to LF/words/nonwords, the proficiency effects of two groups are different. The participants were at different levels of L2 proficiency (different bilingual status), and they were not perfectly balanced bilinguals. Proficiency group one is made up of English and non-English majors, while proficiency group two consists of high-score and low-score non-English majors. It can be concluded that participants in group one differ in proficiency much more than those in group two. The present study manipulated two proficiency groups in the data analysis to better prove how L2 proficiency affected Chinese ESL learners' English word identification in a lexical decision task.

Both within-group (English v.s. non-English majors, high-score v.s. low-score non-English majors) and between-group proficiency differences (major v.s. score) can be seen from the above data analysis. Data showed a linear relation between proficiency difference and control degree of mother tongue interference. Especially for nonwords, this linear relation existed as well, for much more data differences can be seen from the first group than those in the second one. The more the L2 proficiency differs, the more the control degree of the native language differs. However, more quantitative researches are still necessary for better explanation.

5. Conclusions

The interaction among one within-participant variable (proficiency) and three between-participant variables (N, F, words/nonwords) revealed that higher L2 proficiency facilitated Chinese ESL learners' English word recognition in a lexical decision task blocked by N, F, words/nonwords factors. Although HP participants performed better (had lower reaction times and higher accuracy) than the LP participants in the experiment, highly-proficient Chinese ESL learners are able to exert higher degree of control over the relative activity of their lexica still deservers more qualitative and quantitative investigation in the future.

References

Baayen, H., Piepenbrock, R., & van Rijn, H. (1993). *The CELEX lexical database (CD-ROM)*. Philadelphia: University of Pennsylvania, Linguistic Data Consortium.

Bijeljacbabic, R., Biardeau, A., & Grainger, J. (1997). Masked priming in bilingual word recognition. *Memory and Cognition*, 25, 447-457.

Chen, H. C. (1990). Lexical processing in a nonnative language: The effects of language proficiency and learning strategy. *Memory and Cognition*, 18, 279-288.

Cheung, H., & Chen, H. C. (1998). Lexical and conceptual processing in Chinese-English bilinguals: Further evidence for asymmetry. *Memory and Cognition*, 26, 1002-1013.

Coltheart, M., Davelaar, E., Jonasson, J. T., & Besner, D. (1977). Access to the internal lexicon. In Dornic, S. (Ed.), *Attention and Performance* VI (pp. 535-555). New York: Academic Press.

Dijkstra, A., & van Heuven, W. J. B. (1998). The BIA model and bilingual word recognition. In Grainger, J. & Jacobs, A. (Eds.), *Localist Connectionist Approaches to Human Cognition* (pp. 189-225). Hillsdale, NJ: Lawrence Erlbaum Associates.

Dijkstra, A., & van Heuven, W. J. B. (2002). The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and Cognition*, 23, 175-197.

Dufour, R., & Kroll, J. F. (1995). Matching words to concepts in two languages: A test of the concept mediation model of bilingual representation. *Memory and Cognition*, 23, 166-180.

Gascoigne, C. (2001). Lexical and conceptual representations in more- and less-skilled bilinguals: The role of cognates. *Foreign Language Annals*, 34, 446-452.

Jared, D., & Kroll, J. F. (2001). Do bilinguals activate phonological representations in one or both of their languages when naming words? *Journal of Memory and Language*, 44, 2-31.

Kotz, S.A., & Elston-Guttler, K. (2004). The role of proficiency on processing categorical and associative information in the L2 as revealed by reaction times and event-related brain potentials. *Journal of Neurolinguistics,* 17, 215-235.

Marian, V., & Spivey, M. (2003). Bilingual and monolingual processing of competing lexical items. *Applied Psycholinguistics*, 24, 173-193.

van Heuven, W.J.B., Dijkstra, A., & Grainger, J. (1998). Orthographic Neighborhood Effects in Bilingual Word Recognition. *Journal of Memory and Language*, 39, 458-483.

Wang, L. (2003). Switching to first language among writers with differing second-language proficiency. *Journal of Second Language Writing*, 12, 347-375.

Table 1. the interaction between proficiency and three within-participant factors

	Neighborhood density (N)		Word frequency (F)			Words and nonwords	
	High	Low	High	Medium	Low	Words	Nonwords
ACC (HP) (%)	0.87±0.09	0.87±0.07	0.96±0.05	0.95±0.06	0.86±0.08	0.91±0.06	0.83±0.16
ACC (LP) (%)	0.78±0.09	0.78±0.09	0.93±0.06	0.92±0.07	0.79±0.09	0.86±0.06	0.69±0.17

Table 2. the interaction between proficiency and three within-participant factors

	Neighborhood density (N)		Word frequency (F)			Words and nonwords	
	High	Low	High	Medium	Low	Words	Nonwords
ACC (HP) (%)	0.79±0.08	0.79±0.07	0.95±0.06	0.92±0.06	0.76±0.11	0.85±0.06	0.73±0.16
ACC (LP) (%)	0.76±0.08	0.75±0.08	0.92±0.08	0.89±0.09	0.76±0.11	0.84±0.08	0.67±0.18