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Nature of Consistency Effect in Naming Non-phonetic Phonograms*

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This study investigates why Lee et al. (2005) noted an interaction of character frequency and phonetic-sound consistency during their experiment in naming non-phonetic phonograms. To evaluate whether the phonetic-radical consistency produced their results, the balance of summed frequency of friends and the context of fillers are considered. The result shows these factors changing difficulty across conditions and causing Lee's et al. findings. Based on the realization of their mistake, the author suggests that a complete theoretical framework of the orthography-to-phonology correspondence should consider the qualitative and quantitative aspects with equal importance.

Key words: consistency effect, regularity effect, summed frequency of friends, dual route model, connectionism

1. Introduction

There is a similarity in the phonetic-sound correspondences of Chinese phonograms and in the spelling-sound correspondences of English words. Both Chinese readers and English readers have difficulty in correctly pronouncing words violating these correspondences, and this cognitive fact reveals that the human cognitive system has to compute the orthography-to-phonology correspondence flexibly. Lee et al. (2005) argue that the computations of our cognitive system rely on the phonological activation of phonetic radical. The evidence supporting their argument is the effect of phonetic-sound consistency in naming high frequency non-phonetic phonograms. They claim this finding matched the study of naming English words (Jared 1997b). However, a significant interaction of frequency and consistency appeared in their study, whereas this interaction disappeared in the English study. This prompts me to explore the nature of the consistency effect in the study of Lee et al. in a literature review of English and Chinese

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studies. In this study, the experiment in consideration of neighborhood features and strategic factors confirmed the difficulty of pronouncing phonograms resulting in this ambiguous result.

1.1 Evolution of the orthography-phonology correspondence problem

For English words, spelling-sound regularity means the compatibility of the sound of a word (e.g., WADE) and the sound of word the body (e.g., -ADE), and the spelling-sound consistency refers to the distribution of neighboring words with compatible or incompatible correspondence (e.g., all words with the word body -ADE have identical pronunciation). Based on these definitions, the regularity represents the qualitative aspect of correspondence concerning the validity of grapheme-to-phoneme correspondence based rule (GPC rules), and the consistency represents the quantitative aspect of correspondence describing how many neighboring words obey this correspondence (friends) or violate it (enemies). These definitions are adopted by Chinese researchers (Fang et al. 1986, Hue 1992, Lee et al. 2005, Liu et al. 2003, Peng et al. 1994, Sue & Liu 2004) in classifying the phonetic-sound regularity and consistency of Chinese phonograms. The homophonous (e.g., 伸 /shen1/) and non-homophonous (e.g., 坤 /kun1/), which have a pronounceable phonetic, match these definitions. Thus, the correspondence effects, including the effects of regularity and consistency, exactly refer to how Chinese and English readers solve these correspondence problems in naming the words with a pronounceable component (word body and pronounceable phonetic). In addition, there are two other types of Chinese phonograms having the phonetic-sound consistency only. They are the heterophonous phonograms which have a pronounceable but invalid phonetic (e.g., 蛇 /she2/) and the non-phonetic phonograms which have an unpronounceable phonetic (e.g., 遇 /yu4/).

The interaction of frequency and correspondence has provoked a debate between the dual-route model and the parallel-distributed processing model among English studies (Coltheart et al. 2001, Plaut et al. 1996). Since the study of Glushko (1979), accumulated English studies have confirmed the naming responses to the irregular or inconsistent words are significantly slower than those to the regular and consistent words. Most English and Chinese studies further confirmed these correspondence effects appearing in the low frequency only. The main theoretical debate about this phenomenon is which aspect, quality or quantity, of correspondence producing these effects. The researchers preferring the dual-route model insist that the correspondence effects only happened when the sound obeying the GPC rules is incompatible with the actual pronunciation (e.g., Rastle et al. 2000). In the dual-route model, the pronunciation matching the GPC rules is suggested as the default sound of a word. The correspondence effects reflect the effort a cognitive system has to pay in suppressing the activation of a default sound. For the researchers standing on parallel-distributed processing, the frequency distribution of friends and enemies is the appropriate way illustrating the mappings of word form and sound. The probability of the correct mapping determines the efficiency a cognitive system needs in computing the sound to pronounce. Based on the distribution of the accumulated frequencies of neighboring words, one would observe the various magnitudes of correspondence effect (e.g., Jared et al. 1990).

1.2 Contributions of Jared's studies

The major contribution of Jared's work is the objective evaluation of the affection of quantitative aspect in naming performance (Jared 1997b, 2002). Among the experiments she reported, the summed frequencies of friends of each type of stimuli words, including word frequency and correspondence, were restricted. Under this control, she measured the correspondence effects from the irregular and inconsistent words with relative higher summed frequencies of enemies (F<E) and from those with relative lower summed frequencies of enemies (F>E). All of her experiments showed that significant correspondence effects only happened to the stimuli words with higher summed frequencies of enemies. Furthermore, she also found equivalent magnitudes of effects for high and low frequency words. In brief, her findings indicate the quantitative aspect of correspondence determining the magnitudes of regularity and consistency effects regardless of word frequency.

Jared proposed the simulation data of her 2002 study which indicates the overestimation of regularity by the dual-route model (DRC, Coltheart et al. 2001) and the overestimation of consistency by the parallel-distributed model (PMSP96, Plaut et al. 1996). The DRC model is able to simulate the effect of spelling-sound regularity no matter high or low the word frequency, but it produces the regularity effect in words with F>E as well. In addition, this model fails to simulate the consistency effects of each experiment. The PMSP96 produces the significant effects of spelling-sound regularity and consistency of the words with F<E only, but the regularity effects are always larger than the consistency effects. When the attractor mechanism of this model is unavailable, the latencies of regular/consistent words were equivalent across word frequencies. Apparently, these failures in simulating human data figure out that the regularity effect is the product of quantitative and qualitative aspects of spelling-sound correspondence whereas the consistency effect comes from the quantitative aspect only.

Jared also confirmed less influence of the strategic factors on the consistency effect in accordance with the strict manipulation of quantitative aspect (Jared 1997a). Prior to this study, there is evidence demonstrating that the difficulty of the stimuli list (e.g., a list of low frequency words) increases the average response latency and that correspondence of filler words (e.g., a group of regular words) amplify the regularity effect (Lupker et al. 1997, Monsell et al. 1992). Using the same stimuli in her study published in the same year (Jared 1997b), Jared found that the inconsistent words with F<E caused equivalent magnitudes of consistency effect in high and low frequency no matter the frequency of filler words. In general, the Jared's study implies limited influence of strategic factors on the effect of spelling-sound consistency.

1.3 Questions about Lee et al. (2005)

First of all, why did Lee et al. (2005) find a significant consistency effect in high frequency phonograms with a significant interaction of frequency and consistency? As the above summary of Jared's studies shows, the restricted summed frequency of friends of target word would result in equivalent consistency effects of the high and low frequency word and eliminate the interaction of frequency and correspondence. It is reasonable to suspect that the method of Lee et al. to lower the summed frequencies of friends of target phonograms would lose the balance of quantitative aspect across stimuli groups. According to the frequency counts of Liu et al. (1975), as presented in Table 1, the high frequency and high consistent phonograms have the highest average summed frequency of friends (301), but the low frequency and low consistent phonograms have the lowest average (13.8). The difference between high and low consistency levels approaches 100 for the high character frequency, and this difference increases to more than 200 for the low character frequency. The unequal summed frequency of friends between the consistency levels suggests that the difficulty of naming responses increases with the consistency levels. The ten percent error rate of naming high frequency and low consistent non-phonetic in this experiment gives authenticity to this suggestion. These data make the first question clear that Lee et al. (2005) would obtain an effect reflecting the difficulty of response caused by unequal summed frequency of friends.

Table 1: Characteristics of the target characters in Experiment 3 of Lee et al. (2005)

	High-frequency		Low-frequency	
	HC	LC	HC	LC
Number	19	19	19	19
Frequency(LCW)	60	56	5	7
№ of friends	4	1.6	3.1	1.3
Summed frequency of friends	301	209	248	13.8
№ of enemies	0	5.2	0	5.1
Summed frequency of enemies	0	936	0	700

Note: HC, High consistency; LC, Low consistency. Frequency(LCW) is mean Liu, Chuang & Wang (1975) Frequency

The previous problem obviously harms the validity of the Lee et al. (2005) data as the evidence of phonological activation of phonetic radical. They announced this argument based on their finding of the consistency effect in the high frequency non-phonetic phonograms. As the previous section mentioned, the spelling-sound regularity of an English word is defined by the GPC rules. In other word, Lee et al.'s argument demonstrates the default sound represented by the phonetic radical. However, it is clear that the phonetic radicals of non-phonetic phonograms never possess any phonetic information as the homophonous do. Thus, this would be a mistake for Lee et al. to attribute the consistency effect of non-phonetic phonograms to the phonological activations of phonetic radical.

The studies about the strategic factors of naming performance might be helpful for the verification of this mistake. According to the summary of the studies of Monsell et al. (1992), and Lupker et al. (1997), one could infer that the strategic factors affect the magnitude of regularity effect and the difficulty of naming task. Jared's (1997a) study reveals that the consistency effect in consideration of the summed frequency of friends would be immunity to the difficulty of a single experiment. These points offer a plausible prediction for the results of naming non-phonetic phonograms: the strategic factors would cause limited influence on the consistency effect of two groups of non-phonetic phonograms with equivalent quantitative aspects. In summary, an experiment balancing the summed frequency of friends across conditions and adjusting the strategic factors with filler phonograms would be helpful in investigating the mistake of Lee et al. (2005).

2. Experiment

2.1 Design and rationale

The design was a 2 (Character frequency: high vs. low) × 3 (Consistency of phonetic radical: High consistency vs. Low consistency vs. Companion of low consistency) × 2 (Filler condition: high frequency homophonous vs. low frequency heterophonous) factorial design. Character Frequency and Consistency of phonetic radical are within-subject and between-item variables. Filler condition is a between-subject and within-item variable.

The first group of low consistency phonograms is selected for the replication of the third experiment in the Lee et al. (2005) study, and the companions of low consistency phonograms is used for measuring the consistency effect considered balanced quantitative aspect. The filler conditions would change the participants' awareness of difficulty in one experimental session. The overall naming latency would become larger in the condition with low frequency heterophonous phonograms as fillers than in the condition with high frequency homophonous phonograms as fillers. The magnitude of consistency effect would change if the fillers really change the difficulty of this experiment which would interfere with the phonological activation of phonetic radical.

2.2 Participants

The participants were 36 undergraduates enrolled in an introductory psychology course at National Taiwan University. Each participant was a native speaker of Chinese with normal or corrected-to-normal vision.

2.3 Material

According to the Chinese phonetic corpus of Liu et al. (2001), a total of one-hundred forty-four phonograms were used, matching the experimental design of Lee et al. (2005). Seventy-three of these characters were the phonograms Lee et al. had used in their third experiment. The characteristics of these materials are presented in Table 2. Half of these phonograms were high-frequency non-phonetic, and the other half were the low-frequency non-phonetic. The mean frequencies of the high- and low-frequency phonograms were 128 and 9 according to Liu et al. (1975). Within each half set, three sets were classified according to the consistency of phonetic radical. They were the high consistent set (e.g., all of the phonograms with the radical 肙 were articulated *juan*), the low consistent set and the companions of low inconsistent set (e.g., the phonogram 毓 has the fewest summed frequency of friends compared to the other neighbors sharing the phonetic radical 㐬). For convenience of writing, these three sets of phonograms are labeled as “C”, “I1”, and “I2” in the following text. These sets included the 73 phonograms originated from the study of Lee et al. and 23 non-phonetic phonograms selected from Liu et al. (2001). Three high consistent phonograms used by Lee et al. were excluded from this study because they have inconsistent neighbors according to the corpus of Liu et al. Each set of 24 non-phonetic phonograms would be split into two halves to each filler condition.

Table 2: Characteristics of the target characters in this study

	High-frequency			Low-frequency		
	Con(C)	Inc(I1)	C of Inc(I2)	Con(C)	Inc(I1)	C of Inc(I2)
Number	24	24	24	24	24	24
Frequency(LCW)	84	90	209	5	7	16
№ of friends	3	1.6	3	3.3	1.3	2.7
Summed frequency of friends	522	247	578	238	11.5	451.1
№ of enemies	0	5	3.5	0	5.1	3.7
Summed frequency of enemies	0	886	552	0	647	207

Note: Con, consistent characters; Inc, Inconsistent Characters; C of Inc, Comparative Characters of Inconsistent characters. Frequency(LCW) is mean Liu, Chuang & Wang (1975) Frequency

The fillers were forty-eight high frequency homophonous (e.g., 神 *shen1*; average character frequency was 514) and 48 low frequency heterophonous (e.g., 肋 *le4*; average character frequency was 3) selected from Liu et al. (2001). Each group of fillers was used in each corresponding filler condition. Thus, an experimental list of one filler condition had 120 stimuli including 72 non-phonetic phonograms and 48 fillers. The experimental list of one filler condition had two versions: the high-frequency non-phonetic phonograms were mixed with fillers in the first sixty stimulus and the low-frequency non-phonetic phonograms were mixed with fillers in the second sixty stimulus (version A), and the reverse sequence for the two frequency groups of non-phonetic phonograms (version B). The order of target phonograms and fillers was randomized in each version.

2.4 Procedure

Participants completed two experimental sessions approximately 1 to 2 weeks apart. Half of the participants were given the homophonous fillers then the heterophonous fillers, and the others were given the reverse sequence. Participants in each sequence were given the experimental list version A or version B in first session. Every participant was tested individually. Before each experimental session began, they received written instructions on the screen and were told most characters in the experimental session were like the practice stimulus. Both accuracy and speed were emphasized for their responses.

Participants took a rest after 30 trials. The entire experimental session lasted approximately 10 minutes. Each participant received 20 practice trials with feedback. Those error trials during the practice were repeated until a correct response was made. No feedback was given on the subsequent experimental trials. Each trial in the experimental session consisted of the following sequence of events. First, an asterisk, used as a fixation point, was presented for 500 ms at the center of the monitor. Second, the stimulus character, which occupied a 48 × 48 dot matrix area and subtended a visual arc of approximately 1.6 degrees, was presented at the center of the screen to replace the asterisk. The character remained there till the computer detected the onset of the participant’s pronunciation, or the elapsed time exceeded 1200 ms. The RT measured the time between the onset of the presentation of the stimulus character to the time the voice key was triggered. Third, the whole screen was immediately erased and there was 1000 ms inter-trial interval before another asterisk was presented for the next trial. Participants’ pronunciations in both experimental sessions would be recorded by a digital voice recorder, and their correct response would be indicated by rechecking recorded voice files.

2.5 Results

Before the formal analyses, an overall analysis of participants' latency data showed the sequences of the filler conditions had no affection on the naming latency, $F(1,35) = 1.61$, $p=.2$. In the formal analyses, the character frequency and consistency level were treated as within-subject factors in the analysis by subjects (F1) and between-item factors in analysis by items (F2); the filler condition was treated as between-subject factors in the analysis by subject and within-item factors in analysis by items. 1.26% of latency data were excluded because of machine problems. Analyses of variance (ANVOA) were performed on the latency data and error rate twice that first time the outliers were kept, and the second time the outliers were truncated and the difficult responses were excluded. These mean latencies and percentage of error rates for each experimental factor are presented in Figures 1 and 2.

2.5.1 Analysis without dealing with outliers

The latencies of high-frequency non-phonetics were significantly shorter than the low-frequency non-phonetics, $F1(1,35)=207.91$, $p<.001$, $MSE=1436.862$, and $F2(1,138) =95.42$, $p<.001$, $MSE=10637.447$, and more accurately, $F1(1,35)=923.48$, $p<.0001$, $MSE=0.742$, and $F2(1,138)=57.73$, $p<.001$, $MSE=17.80$. There were significant differences among the three consistency levels both in the latency data, $F1(2,70)=82.28$, $p<.001$, $MSE=1436.862$, and $F2(2,138)=10.01$, $p<.001$, $MSE=10637.447$, and in the error data, $F1(2,70)=167.34$, $p<.001$, $MSE=1.41$, and $F2(2,138)=19.86$, $p<.001$, $MSE=17.80$. The interaction of character frequency and consistency was also significant in the latency, $F1(2,70)=24.43$, $p<.001$, $MSE=1628.707$, and $F2(2,138)=3.49$, $p<.05$, $MSE=10637.447$, and in the error rate, $F1(2,70)=102.69$, $p<.001$, $MSE=1.23$, and $F2(2,138)=10.67$, $p<.001$, $MSE=17.80$. Participants read faster in the regular condition than in the exception condition, $F1(1,35)=8.69$, $p<.01$, $MSE=16670.856$, and $F2(1,138)=15.53$, $p<.001$, $MSE =2669.085$, but not more accurately, $F1<1$, $F2<1$. The factor of filler condition did not interact with character frequency and/or consistency level in the analyses by subjects and by items.

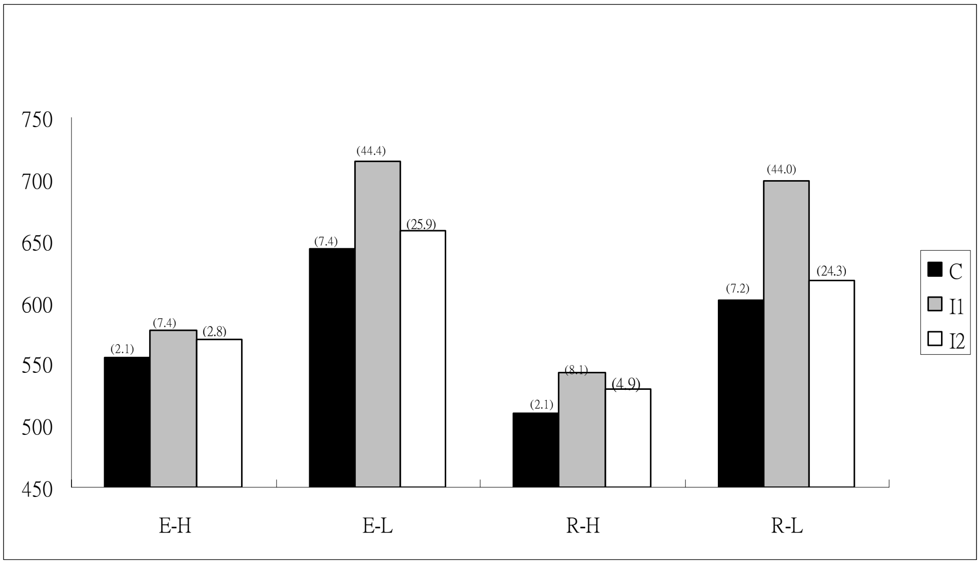

Figure 1: Mean naming latencies and percentages of errors for high- and low-frequency consistent, inconsistent, and comparative characters of inconsistent non-phonetics in exception and regularity filler conditions. The outliers were not truncated and the data of slow and difficult responses were not excluded in this analysis.

Excluding group "I1", the analyses on the latencies data showed main effects of character frequency and consistency and no interaction of these two factors. The main effect of character frequency was significant by subject, F1(1,35)=153.81, p<.001, MSE =3722.52, and by item, F2(1,92)=51.05, p<.001, MSE=8968.50. The difference between groups "C" and "I2" was significant by subject, F1(1,35)=16.60, p<.001, MSE= 1115.38, and marginal by item, F2(1,92)=3.81, p=.54, MSE=8968.50. There was no interaction of character frequency and consistency, F1<1, F2<1. These meant that the consistency effect in consideration of neighborhood characteristics was near equal for the high-frequency and low-frequency characters.

2.5.2 Analysis with truncating outliers

Before performing this analysis, the following high-frequency phonograms, 梭, 峻, 謬, 寥, 津, 律, 端, 揣, 深, 琛, 毓, 琉, 陸, 睦, and 髓, were excluded because these phonograms could not be named correctly by more than half the participants or average naming latencies of these characters were longer than 600 ms. One of the phonograms in the group "I" was deleted, then the comparative character in the group "C" was excluded too. The remaining outliers that were larger 2.5 SD than the average of each experimental group were replaced with the cutoff value. As Figure 2 presents, this procedure shortens the mean latency of group “I1” close to the mean latency of group “C”, but affect little on the mean of group “I2”.

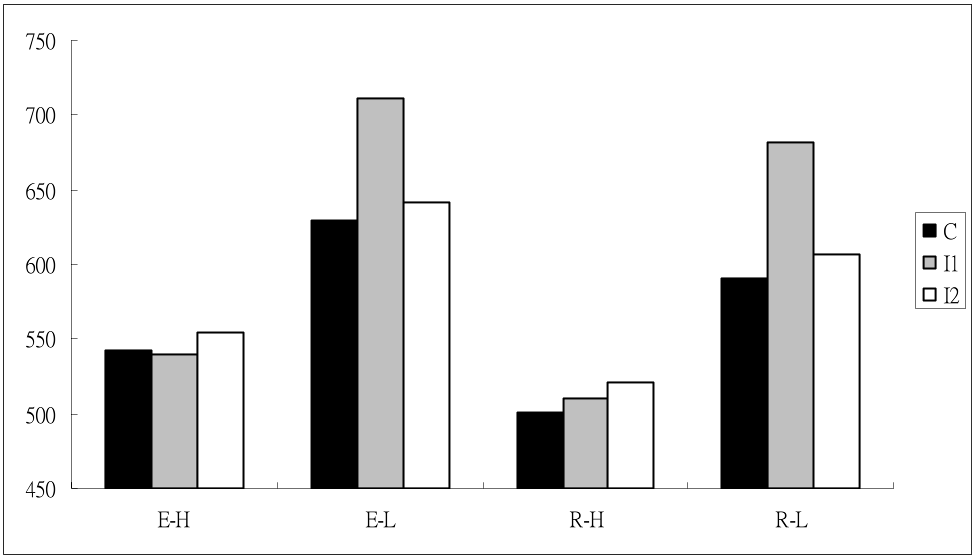

Figure 2: Mean naming latencies for high- and low-frequency consistent, inconsistent, and comparative characters of inconsistent non-phonetics in exception and regularity filler conditions. The outliers were truncated and the data of slow and difficult responses were excluded in this analysis.

The analyses including the latencies data of group “I1” indicated the similar results as the outliers were kept. The naming latencies for high-frequency characters were significantly shorter than those for low-frequency characters, $F1(1,35)=256.53$, $p<.001$, $MSE=5604.096$; $F2(1,123)=160.86$, $p<.001$, $MSE=5760.655$. The differences among the three consistency levels were significant, $F1(2,70)=71.09$, $p<.001$, $MSE=1069.399$, and $F2(2,123)=17.52$, $p<.001$, $MSE=5760.655$. The interaction of the two factors was also significant, $F1(2,70)=69.68$, $p<.001$, $MSE=1203.606$, and $F2(2,123)=5.88$, $p<.01$, $MSE=5760.655$. The impact of fillers condition was significant, $F1(1,35)=10.42$, $p<.01$, $MSE=12368.475$; $F2(1,123)=16.93$, $p<.001$, $MSE=1414.6906$, but did not interact with the other factors, all $Fs<1$.

The analyses excluding the data of group “I1” confirmed that the influences of quantitative nature of consistency on high- and low-frequency characters were similar. The main effect of character frequency was significant, $F1(1,35)=166.25$, $p<.001$, $MSE=3316.918$; $F2(1,84)=91.18$, $p<.001$, $MSE=4024.123$, and either was the main effect of consistency, $F1(2,70)=22.01$, $p<.001$, $MSE=764.437$, and $F2(1,84)=11.69$, $p<.001$, $MSE=4024.123$. Most importantly, the interaction of character frequency and consistency disappeared, $F1<1$ and $F2<1$. The effects of filler conditions still remained, $F1(1,35)=12.53$, $p<.01$, $MSE=7827.535$; $F2(1,84)=35.58$, $p<.001$, $MSE=704.678$, and still did not interact with the other factors, all $Fs<1$.

3. Discussion

3.1 What could we learn from non-phonetic?

This study indicates that the consistency effects of non-phonetic phonograms reported by Lee et al. (2005) hardly support the notion of the phonological activation of phonetic radical. The results of the I1 set indicated that the unequal quantitative aspects of target phonograms increase the difficulty of response. With the summed frequency of friends as equal as the C set, the I2 set caused equivalent consistency effects from high to low character frequency. The analysis with and without truncating outliers confirmed strategic factors having a positive impact on the consistency effect of the I1 set and no influence on the consistency effect of the I2 set. These results indicate that the observed effect of Lee et al. is irrelevant to the phonetic-sound correspondence and that the quantitative difference on naming performance is measurable.

In addition to true affection of quantitative aspect, the mistake of Lee et al. (2005) opens a window to measure the true affection of qualitative aspect in naming Chinese phonograms. According to the similarity between the spelling-sound correspondences and the phonetic-sound correspondences, we have realized that the regularity effect of homophonous phonograms should be the integration of qualitative and quantitative aspects. This means that any intention to understand the effect of qualitative aspect should return to the homophonous phonograms. The affections of qualitative and quantitative aspects on the correspondence effects of the homophonous phonograms are hard to be separated because they possess both aspects. Fortunately, the materials like non-phonetic which have no qualitative aspects might be able to be the baseline to isolate the affection of qualitative aspects. This measurement will become true one day when one continues concentrating on the qualitative differences between phonetic types.

3.2 Theoretical implication

First, I would like to discuss the debate between the dual route model and parallel-distributed processing. Because the two models never view quality and quantity with equal importance, none of them could account the correspondence effects without interacting with frequency. The current finding suggests that none of the models would account for the naming performance of Chinese readers. In future studies, it should be a challenge to establish a theory able to account for the qualitative and quantitative aspects of correspondence. The initiation of phonological information for character naming would be the matter of this theoretical issue.

Lee et al. (2005) obviously agree on consistency as an appropriate way of describing radical-sound correspondence and argue for the phonological activation of phonetic radical in deciding the consistency effect. This argument depends on the assumption that phonetic radical has a default sound ready to be retrieved. However, there is no critical statement about where the default sound of non-phonetic phonogram is from in the literature of Lee et al. In this case, they would presume that all of the corresponding sounds of the inconsistent phonetic radical have to be activated initially. Through the discussion about the present theoretical accounts in this article, we have realized that the assembly route of dual-route model generates one sound initially, and the parallel-distributed processing model uses the distribution of spelling-sound mappings to account for the consistency. Both statements make it clear that the consistency effects of naming non-phonetic phonograms cannot be the evidence supporting the phonological activation of phonetic radical. The regularity effect of naming phonograms with pronounceable phonetic is the critical point for those interested in the issue of phonological activation.

3.3 Conclusion

This study reveals the reasons why the consistency effect of naming non-phonetic phonograms in Lee et al. (2005) are insufficient evidences for the phonological activation of phonetic radical. First, their loss manipulation of quantitative aspect made unequal difficulty in naming consistent and inconsistent phonograms. In the replication study, a new group of participants had longer response latency and higher error rates in naming the inconsistent phonograms from the Lee et al. study. When the summed frequency of friends is considered, the naming performance of inconsistent phonograms becomes faster and more accurate. The analysis further confirms that the context of fillers affects the consistency effect observed from their materials. These data indicate that the consistency effect of non-phonetic phonograms which Lee et al. reported is neither the product of quantitative aspect nor the qualitative aspect of phonetic-radical correspondence.

The mistakes of Lee et al. (2005) figure out that the objective measurement of correspondence effect should be under the strict manipulation of quantitative aspect. Like the English studies, the consistency effect nearly becomes additive to the character frequency when the summed frequency of friends is considered. Although the effect is not as large as the consistency effect in the Jared's study, this study shows the possibility of isolating the affection of quantitative and qualitative aspects on naming performance. Considering both the aspects of phonetic-sound correspondence, there would be an objective evaluation for the phonological activation of phonetic radical.

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本研究探討李佳穎等人 (2005) 於朗讀非字含旁字的實驗中發現字頻與一致性交互作用效果的其他理論意義。爲確認聲旁–發音一致性的實際影響力，刺激字朋友頻率總和的平衡與填充刺激的內容皆列爲關鍵變項。新實驗結果顯示李佳穎等人的發現實際反映作業難度的變化。透過實驗問題的揭露，筆者認爲處理形音對應問題的理論模型應同時考慮量性與質性的因素。

關鍵詞：一致性效果，規則性效果，朋友頻率總和，雙路徑理論，聯結主義