다음절 단어재인에 있어서 음운적 활성화
Phonological Activation in Multi-syllabic Word Recognition

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요 약

영어단어 중에는 글자 열에 소리가 나지 않는 묵음자를 가진 단어들이 있다(예 : knowledge). 이러한 단어들은 같은 위치의 글자 열에 소리가 나는 글자를 가진 단어들(예 : available)과 수행을 비교하여 다음절 단어 재인에 있어서 음운 정보의 역할을 검증할 수 있는 기회를 제공한다. 파일럿 연구의 성격을 가진 본 연구의 결과, 어휘판단 과제에서 묵음자가 삭제된 단어 (예 : _nowledge)의 수행이 소리음이 삭제된 단어 (예 : _vailable)의 수행보다 빨랐다. 어휘접근을 반영하는 어휘판단과제에서의 이러한 결과는 다음절 단어재인에 있어서 음운 재부호화가 일어날 수 있는 개연성을 보여주는 것이다.

주제어 : 단어재인, 음운적 활성화, 음운재부호화 가설, 다음절 단어, 묵음 글자

Abstract : English has words that have a silent letter in their letter strings (e.g., knowledge). Such words provide an opportunity of investigating the role of phonological information in multi-syllabic words by comparing them to words that do not have the silent letter in the corresponding position (e.g., available). Stimuli that excluded a silent letter (e.g., _nowledge) were processed faster than those that excluded a sounding letter (e.g., _vailable) in the lexical decision task. The evidence from this experiment provides seminal evidence of phonological recoding in multi-syllabic word recognition

Keywords : Word Recognition, Phonologcal Activation, Phonological Recoding hypothesis, Multi-syllabic words, Silent letter

1. 서 론

One of the mostintensely debated topics on word recognition in the last decade has been the manner in which the meaning of a printed word is accessed. The processing of a printed word must begin, obviously, with registration of the orthographic form of the word. At issue has been whether the meaning of the word is directly accessed from its orthographic form or, instead, phonological information that has been generated from the orthographic form mediates in the process of accessing meaning.

One stream of studies argues that the word's orthographic information of the word is sufficient to directly connect the letter string of a word to its meaning (e.g., Coltheart, 1978; Coltheart, Curtis, Atkins, & Haller, 1993; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001, Paap & Noel, 1991; Paap, Noel, & Johansen, 1992; Rastle & Coltheart, 1999). The other stream supports a leading role (perhaps, an exclusive role) for phonological intervention to mediate lexical access (e.g., Gough, 1972; Frost, 1998; Lee, 2002; Lee & Katz, 2002; Lesch & Pollatsek, 1993; Lukatela & Turvey, 1994, 2000; Van Orden, 1987). Under the context of the two streams of studies abouthow lexical access occurs in word recognition, this study was intended to study the presence of phonological recoding in multisyllabic words. Few study have been done on phonological processing of multisyllabic words because of scarcity of corresponding homophones, and difficulty to make pseudohomophones that can elicit observable performance difference as compared to their control words. Yet, reading multisyllabic words is essential

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to be a good reader.Due to the scarcity of homophones for multisyllabic words, this study introduced an alternative stimulus to investigate the role of phonology in multisyllabic words. A word with a deleted silent letter in its letter string (e.g., hin psyc_ology) provides a unique opportunity to investigate the presence of phonological processing. Performance in these kinds of words can be compared with words with a deleted sounding letter in the same position (e.g., assi_tance). The main logic, based on the prediction of the phonological recoding hypothesis, is that by eliminating orthographic information without eliminating the phonological information, it should be easier to perform a lexical task such as thelexical decision than eliminating orthographic information that also degrades the phonological information. As a strong point of this kind of stimuli, the processing of multisyllabic letter strings with a deleted letter (e.g., psyc_ology), as compared to that of the monosyllabic letter strings with a deleted letter (e.g., d_sk), would be fairly fast as compared to the processing of their intact letter string (i.e., psychology). This is because multisyllabic letter strings with a deleted letter usually have no neighbor as compared to the corresponding monosyllabic letter strings, eliciting almost no confusability in activating meaning. In addition, the multisyllabic letter strings provide more information to the word level, in terms of number of letters, than the monosyllabic letter strings. The phonological recoding hypothesis predicts that the letter strings in the phonological condition would be processed faster than those in the orthographic condition in the sense that the former has perfect phonological information in the letter strings whereas the latter has deficient phonological information.

Experiment

One of important points of priming tasks for momosyllabic words in many previous studies is that providing more phonological information in the prime is advantageous in processing the target. In contrast, our task deprives a different degrees of phonological information for multisyllabic words, and interested in how much the processing of the letterstrings is delayed, as compared to the intact form, due to the different degrees of phonological information available in word identification.

The priming task has an important innate problem in investigating a type of information in the prelexical level on word recognition. Due to the fact that one stimulus (i.e., prime) is given before the target, the processing of the target could be benefited from the prime at the lexical level, or even a postlexical level. For this concern, researchers tried to present the prime as briefly as possible (i.e., below 100ms), in order to restrict the range of the processing within a prelexical level. The duration of the prime that was set to be within the prelexical level is, however, arbitrary. Some part of activation for the prime might have reached a higher level than the intended prelexical level evenby this manipulation. Although presenting the letterstring that deletes one letter(e.g., psyc_ology) would also has this problem, this task could be an alternative task to the priming task, which can provide a converging evidence.

Method

Subject.Forty-eight students from University of Texas at Austin participated in the experiment. Twenty-two students were male and 26 were female. Their ages ranged from 18 to 26. Each participant in the experiment was assigned to one of two experiment conditions by order of appearance at the laboratory.

Materials. Overall, 36 stimuli for the experimental condition were made (see appendix). One half of the stimuli consisted of words missing a silent redundant letter (e.g., psyc_ology), and the other half of the stimuli contained ninteen words missing a sounding letter (e.g., assi_tance). Frequency and length were matched across the two types of words. The median frequency of the stimuli was 446.05 700.98 for the stimuli missing a silent redundant letter, and 447.68 706.09 for the stimuli missing a sounding letter, according to the CELEX lexical database (Baayen, Piepenbrock, & van Rijn, 1993). The neiborhood size (Coltheart N) was 0 for both type of stimuli (Coltheart, Davelaar, Jonasson, & Besner, 1977). Thirty-eight stimuli of baseline stimuli were also created. These were corresponding complete word forms for the letterstrings with a deleted letter, (e.g., psychology for psyc_ology; assistance for assi_tance), and a separate group of subjects processed them. Thus, there were two lists of 38 stimuli, one for the experimental condition and the other for the baseline condition. Nonwordswere orthographically legal and pronounceable, except for the stimuli in the experimental group in which a letter is deleted to match the stimulus property with the main stimuli (e.g., pron_tine). In this case, the remaining letterstrings were made up to be not occurring in the corresponding letterlength, making it easy to decide the lexicality just based on the remaining letterstrings.

As an important stimulus manipulation, seventy six word fillers that do not have a silent letter (200% of the stimuli in the experimental condition) were also constructed in orderto prevent possible induced (or strategic) phonological processing for the word with a deleted silent letter. They were included in the two stimulus lists by the different forms of orthographic letterstrings according to the context of each condition : a filler like pres_dentwas included in the list for the experimental condition, and president in the list for the baseline.

Procedures.

Half of the subject was assign to the experiment condition in which the target is a word with a deleted letter in its letterstring (e.g., psyc_ology). Whereas the other half of subject was assign to the baseline condition in which the target is an intact form of letterstring (e.g., psychology). The subject was instructed that a stimulus would be presented one by one in each trial and that the task was to decide the lexicality of the stimulus as quickly and as accurately as possible. The subjects in the experimental group were informed that the stimulus in each trial would be a letter string that has one letter missing to make it a word (i.e., psyc_ology). They were required to decide the lexicality ofthe corresponding word that has a missing letter. Subjectswere sat in front of the monitor of a 586 PC computer and run one at a time. The refresh rate of the PENTIUM monitor was 78 Hz making a refresh cycle (i.e., a "tick") equal to 12.9 msec. All stimuli were presented at the center of the computer screen aswhite characters on a dark background. A row of hash marks, containing same number of symbols as the target, was presented as the premask with the duration of 490.2 ms. The target immediately followed the premask and stayed on the screen for 1806ms. Theintertrial interval (ITI) was 1806ms. Controlled presentation of the sequence of stimuli at the identified temporal parameters was by means of DMASTR software (developed at Monash University and University of Arizona by K. I. Forster and J. C. Forster).

Results and Discussion

A 2 (word type) x 2 (group) mixed design analysis of variance (ANOVA) was employed as the experiment. Lexical decision errors were discarded in the analysis. Analysis of variance showed a statistically significant effect of group marginally by subject and by item analysis, $F1(1,46) = 3.63$, $p<.06$, and $F2(1,36) = 6.36$, $p<.05$, respectively. In addition, no main effect of word type was found, $F < 1$ by subject analysis, and $F = 2.73$, $p > .05$ by item analysis. Importantly, there were statistically significant interactions between group and word type by subjects and by items, $F1(1,46) = 4.35$, $p < .05$, and $F2(1,36) = 5.01$, $p < .05$, respectively. All main effects and interaction effect were not statistically significant in error analysis (all $Fs < 1$).

In a post hoc analysis, one interesting question was whether the experimental condition is processed more slowly than the baseline condition for the phonological condition or not (i.e., psyc_ology vs. psychology). The specific contrast between the two conditions showed no statistical difference, $Fs < 1$, although there was 22ms difference between two conditions (699msversus 677ms). In contrast, the specific contrast between the experimental condition and the baseline condition in the orthographic condition (i.e., assi_tance vs. assiatance) showed a significant statistical difference in both analyses, $F1(1, 46) = 6.12$, $p < .05$, and $F2 (1, 36) = 12.6$, $p <.01$, respectively.

Conclusion

The current study showed that maintaining phonological information is more helpful in word processing than depriving partial phonological information. Relatively fast processing and few errors in processing the stimuli with a silent letter deletedgive validity in reflecting real word processes. The experiment supports the phonological recoding hypothesis in multisyllabic word recognition : phonology plays a necessary role in lexical access of the multisyllabic words.

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Appendix

The main stimuli of the experimental condition in Experiment (Condition 1 : Words with a nonsounding letter; Condition 2 : Words with a sounding letter)

Condtion 1	Condition 2
budd_ism	cann_bal
champa_ne	passen_er
chauffe_r	prototy_e
e_rnest	f_antic
bre_kfast	tra_ition
_neumonia	_olocaust
s_issors	s_crates
r_inoceros	a_phibious
r_eumatism	c_ncentric
ras_berry	tur_uoise
psyc_ology	assi_tance
_nowledge	_vailable
c_olesterol	e_planatory
condem_	nucleu_
dau_hter	com_lete
diaphra_m	apologi_e
di_mond	cr_mson
melanc_oly	contin_ity
campai_n	attitu_e