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Phonological recoding in word recognition: comparing exception and regular words

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0. Abstract

This experiment was based on a study by Parkin (1984) and was conducted in order to test whether word recognition is mediated by phonological recoding. Rubenstein et al's (1971) model of phonological recoding also assumed that phonological recoding is the access code for visual word recognition. This study used a lexical decision task comprising two lists; each list consisted of both words and non-words. One list contained exception words and the other list contained regular words. The hypothesis was supported and the results showed that visual recognition times were significantly slower for the exception word condition compared to the regular word condition ($P<.001$). This study supports the theory of phonological recoding in visual word recognition.

1. Introduction

The aim of this project is to investigate whether we recode written words phonologically before we recognize them in order to enable lexical entry search to take place. In other words, to find out whether we need to say a word 'to ourselves' in order to recognize it when we are reading it. A lexical decision task is used which requires the participants to recognize a series of words (or strings of letters) in written form while they are timed in doing so. They must discriminate from these lists real words from non-words. For example when using the letter strings MANT and LOVE. Both these strings of letters can be pronounced but LOVE matches with an entry in the internal lexicon so it is usually described by people to be a word while MANT does not match with any lexical entry and is usually described as a non-word. Rubenstein et al (1971) pioneered the lexical decision task. In their study the time taken to read two types of words and two types of non-words were compared. Half the non-words were pseudohomphones or letter strings that sounded like real words (e.g. BRANE and BLUD) while the other half were non-words that did not sound like real words (e.g. SLINT and ROLT). Some of the words were homophones such as SAIL (SALE). Rubenstein found that the pseudohomophones were classified as non-words significantly more slowly than the neutral non-words, which suggests that the sound of the words has an effect on the time taken to recognize them. This was interpreted as supporting the phonological recoding hypothesis because if this had not been the case then the sound would have had no effect on the recognition times. Rubenstein et al proposed a particular model performance in the lexical decision task, which was that the search was a phonological one of serial search. A search is carried out on high frequency words first; if there are two or more words that sound the same the high use words would be checked first. Therefore, if a lesser-used word is the target it will take longer to find. They proposed that the phonological search stops once a match is found but a yes answer has to wait until the spelling is checked.

Coltheart et al (1977) tried to replicate Rubenstein et al's work and to improve the controls through improving the matching of words and provided a different explanation of their results. They found no difference for yes answers between words and homophones if they were matched for frequency and length. However, they

found a difference in reaction times for no answers between pseudohomphones and other non words which they accounted for with a dual route model: one route is phonologically mediated while the other is a visual route with the two routes competing against each other. In the case of homophones and words, the visual route (which is quicker) activates the appropriate lexical entry. Since the pseudohomophones take longer to respond to therefore the phonological recoding has time to work and makes the selection but it is slower than the visual method.

Parkin (1982) also carried out research in this area. He differentiated between very irregular words such as TSAR and GAUGE and not so irregular words such as HEAD. Parkin (1984) defined three degrees of regularity. Words like PINT and THREAT were called true exception words as their phonological correspondence was unique. Words such as HEAD were called mildly inconsistent words because the letters EAD are pronounced ED reasonably often in various other words like BREAD. The third group were called regular words: the ones with the common and expected pronunciation. Parkin used oral reading in his experiments (1984) and found that true exception words took longer to pronounce than mildly irregular or regular words. Exception and regular words from Parkin's study will be used in this experiment. MINT would be an example of a regular word as it has a normal and expected pronunciation compared to PINT, which looks as though it could rhyme with MINT, and would therefore not be matched with a lexical entry so the search would be expected to take longer. Words such as PINT, which do not conform to the rules, are known as 'irregular' or 'exception' words.

The aim of this research is to investigate the effects on word recognition, which can be accounted for by phonological codes. In other words if the sounds of words affect the time to distinguish between words or non words then this would provide evidence that the grapheme-to-phoneme conversion route has been used to recode the letters which spell out the word into a phonological code. Grapheme is a unit of analysis based on writing while phoneme is a unit of analysis based on sound. Through using a lexical decision task participants will be presented with letter strings, some of which are words and some of which are non-words. By varying the types of words in the lists, the experimenter can observe the effects of these factors. Parkin's true exception words should suffer a disadvantage as there are no spelling routes for generating them.

The hypothesis of this experiment is that the reaction times for word recognition will be longer if the words presented are words with irregular pronunciations compared with lists with more regular pronunciations. The null hypothesis is that there will be no significant difference in reaction times between the regular word condition and the irregular word condition.

2. Method

2.1. Design

Two lists of words were constructed each consisting of 20 words and 20 nonwords **(Appendix B)**. List 1 consisted of both exception words and matched non-words. List 2 consisted of regular words and matched non-words. This experiment used a related, within subjects design as the same participants were used for both conditions, and therefore, the order in which the lists were presented was changed from participant to participant. The independent variable was the type of words used in each condition. The dependent variables were the time taken to recognize the words on the list and the number of errors made in the process.

2.2. Participants

8 participants took part in this experiment. All were native speakers of the English language and adults aged between 18 and 45.

2.3. Stimulus Materials

There was a practice list to try out the task with 5 irregular words and 5 regular words and 10 non-words. Two lists of words taken from the selection used by Parkin (1984) **(Appendix B)**. The two lists of words consisted of 20 words and 20 non-words. List 1 consisted of exception words and matched non-words. List 2 consisted of regular words and matched non-words. The words had already been matched for frequency of use and randomized in each list so that they did not consist of more then 4 words or 4 non-words in sequence. An instruction list (see **Appendix A**). A4 plain paper, pens, timer.

2.4. Procedure

Participants were approached and asked to take part in the experiment. All the participants were tested individually in a quiet room where they would not be disturbed. Each subject was presented with the two lists separately. They were firstly presented with the lists covered by a sheet of A4 plain paper which was removed when the task started. When the paper was removed the experimenter set the timer. All subjects were given the same instructions, which were read out by the experimenter **(Appendix A)**. The participants were asked to read though both lists (half were asked to read list A first and the other half were asked to read list B first) and to place a tick against what they considered to be words which were known to them personally and a cross against what they considered to be non words. They were asked to read through the lists as quickly as possible but to try and not make any errors. The timer was switched off when the participant indicated that they had completed the task and the time taken to complete the task and the numbers of errors was noted by the experimenter. The subjects were debriefed at the end of their task.

3. Results

The results showed that the time taken for the subjects to read list A was significantly slower than the time for the subjects to read list B. This result was in the predicted direction. A one way related t-test conducted indicated that there was a significant difference in the time taken to say aloud the regular and exception words. The final result was:- [$t(7)=6.8$; $P<.001$]. The errors made for normal words was nil while the errors for exception words (condition A) was twice as high as for the regular words (condition B). I have not included the statistical data in this article as I felt it was not necessary to go into such details.

4. Discussion

The hypothesis that the time taken for the subjects to read list A would be significantly more then the times taken to read list B was supported and therefore the null hypothesis can be rejected. This result supports the theory that word recognition is mediated by phonological recoding. In other words it was implied that the sounds

of words affected the ability of the reader to distinguish between words or non-words and that the grapheme-to-phoneme conversion route had been used to recode the letters which spell out the word into a phonological code. Therefore it seems that we need to sound words out rather than recognizing them visually as the pronunciation of words had the predicted effect on the participants' response time. This could be explained by regular words, which are pronounced according to the majority dominant spelling-sound rules being recognized faster. The results of this experiment support the findings of Parkin (1982) and Rubenstein et al (1971) and contrast with Coltheart et al's (1977) findings. The reason that Coltheart et al's research (1977) found no difference between regular and irregular words used could be explained by the fact that he used only mildly irregular words and that therefore was why no significant effect was seen.

Rubenstein et al's model of lexical access would explain the effect found in this study as, since a low frequency word is presented, its phonological representation will still access the high frequency lexical entry first, only to fail on the spelling check. This would mean that lower frequency homophones would need more spelling checks before being recognized as words and therefore would be processed more slowly. This supports Rubenstein et al.'s model of lexical access, which proposes that the access code is solely phonological and that the access procedure is one of serial search. If during the reading a match is detected between the phonological representation and the phonological information stored in the lexical entry, then the search stops but if a YES search cannot be made with confidence as would have happened with the non-words then this would cause a delay. The stimulus letter-strings would only sound like a word but a match would not be made. For English, which was the language that was used in this experiment, there would be a need to check on the spelling. Rubenstein et al. believed that a spelling check is always carried out once a lexical entry has been accessed. This would explain the slower reading time as the phonological match would not be what is considered a proper word so therefore a whole series of spelling checks would have to take place. A participant responds with a NO only after a search is made through the lexical entries and fails to find a match. Parkin's true exception words suffered a disadvantage in this study which could be explained by the fact that there are no spelling routes for generating them. The spelling check would prevent a pseudohomophone being confused with the real word. However, Rubenstein's model was criticised as the basis on which spellings are converted to sounds was not made clear enough. Another criticism would be that if it is necessary to search through all the words in the lexicon then it would be extremely difficult as most people have a vocabulary of between 25,000 and 50,000 words.

The lexical decision task could be criticized as being unnatural and would score low on a scale of 'ecological validity' because reading strings of letters that form non-words would not be a task encountered very often in normal reading in everyday life such as in sentences. It suggests that phonological recording takes place in a lexical decision task but however does not show whether phonological recoding plays a role in the recognition of real words. In defense of this task, however, it has been shown both in past studies and in this particular experiment that people perform it easily and efficiently and produce similar results and so that this could indicate important processes in reading that could be investigated further. In the debriefing session the participants indicated that they had found the task straightforward. The errors made for words was nil while the errors for exception words was twice as high as for the regular words. To further elucidate the importance of phonological

recoding it could be important to examine the role of phonological recoding in proper word recognition. It therefore would be interesting to conduct a study on the effect of responses to real words in lexical decision tasks.

Researchers have used other approaches such as observing eye movements. However, each method seems to have its problems: as discussed above, the lexical decision methods used in this experiment have been criticised for interrupting the normal reading process and that access processes may be different for non-words compared to words. A very small sample was used in this experiment so it would be interesting to conduct the study using a much bigger sample to see if the same result was found and it would also be interesting to conduct this study with non-native English speakers to show how important dialects are in deciding what are real word and non-word pronunciations.

5. Conclusion

The hypothesis of this experiment that the reaction times for word recognition will be longer if the words presented are words with irregular pronunciations compared with lists with more regular pronunciations was supported, implying that a grapheme-to-phoneme conversion route has been used to recode the letters which spell out the word into a phonological code. Therefore this study supports the findings of Parkin (1984) and Rubenstein and implies that word recognition is mediated by phonological recoding.

References

Barry, C. D309 Reading Project. Thanet Press Ltd. Open University Press

Coltheart, M. (1978) 'Lexical access in simple reading tasks', in G. Underwood (ed.) *Strategies of Human Information Processing*, London, Academic Press

Coltheart, M., Davelaar, E., Jonason, J.T. and Besner, D (1977) 'Acces to the internal lexicon', in S. Dornic (ed.) *Attention and Performance VI*, London Academic Press

Colthart, M., Besner, D., Jonasson, J.T. and Davelaar, E. (1979) 'Phonological encoding in the lexical decision task', *Quarterly Journal of Experimental Psychology* 31, 489-507

Greene, J. D'Oliveira M. *Learning to Use Statistical Tests in Psychology*. Open University Press.

Parkin, A.J. (1982) 'Phonological recoding in lexical decision: effects of spelling-to-sound regularly depend on how regularity is defined', *Memory and Cognition 10*, 43-53.

Parkin, A.J. (1984) 'Redefining the regularity effect', *Memory and Cognition, 10*, 287-92.

Rubenstein, H., Garfield, L. and Millikan, J.A. (197) 'Homographic entries in the internal lexicon', *Journal of Verbal Learning and Verbal Behaviour 9*, 487-94

Rubenstein, H., Lewis, S.S. and Rubenstein, MA. (1971) 'Evidence for phonemic recoding in visual word recognition', *Journal of Verbal Learning and Verbal Behavior 10*, 645-57

Instructions (Appendix A)

Please read straight through the lists from top to bottom as quickly as you can without any long pauses and place a tick by what you personally consider to be real words and a cross by what you consider to be non-words.

Do not make a guess about whether the words are real or not.

Try not to make any errors

Please tell me straight away once you have completed the task.

You will be timed as you complete the task but please be assured that this is a general task and not a task of your ability and you will not be compared to any other people.

Appendix B

List 1 - Condition A (Exception Words)

bave	great
threat	fand
clerk	dose
mook	slare
bater	cruss
rame	gross
soot	touch
breast	flad
halve	bowl
gight	sieve
toll	solt
brack	hage
grafe	steak
pint	monk
broad	chone
wace	yole
break	bear
pour	vase
rared	stine
mough	tink

List 2 - Condition B (Regular words)

tane	glime
click	truck
brab	jated
glave	filt
throat	sting
prain	green
vent	gark
brief	surge
wull	mist
chack	mide
seep	stabe
hitch	pill
tord	daze
crade	shart
grace	brain
breeze	pipe
breeze	pipe
tank	nuck
sare	strat
blane	zale
belt	boar