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Orthographic Effects on Rhyme Monitoring

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Three experiments examined the role of orthography in rhyme detection. Subjects in Experiments 1 and 2 monitored lists of aurally presented words for a word that rhymed with a cue word. The critical variable was whether the target word was orthographically similar or different from the cue word (e.g., *pie–tie* and *rye–tie*, respectively). In Experiment 1, monitor latencies to detect orthographically different rhymes were longer than latencies to detect orthographically similar rhymes, whether cue words were presented aurally or visually. Experiment 2 replicated this orthography effect using only auditory presentation of the cue word and a larger sample of items. In Experiment 3, orthographic similarity yielded shorter reaction times to decide that two words rhymed and longer reaction times to decide that they did not rhyme. The results are interpreted in terms of some recent models of semantic memory.

Recent theories of memory emphasize the importance of the auditory characteristics of words for recognition, memory storage, and retrieval. Several classic experiments have provided evidence of auditory coding in the perception of both visually and aurally presented stimuli (e.g., Baddeley, 1966; R. Conrad, 1964; Sperling, 1967; Wickelgren, 1965). As a result, as Norman (1972) has noted, "it was (and is) commonly accepted that linguistically based material—printed words—entered the visual system and then was transformed into an auditory or articulatory form in the short term memory (p. 277)." This notion is incorporated into memory models such as Atkinson and Shiffrin's (1968).

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Current models of semantic memory, such as Morton's (1969) logogen model and the spreading activation model of Collins and Loftus (1975), make assumptions that are analogous to the auditory recording assumption of earlier models.

Morton's model associates each word or concept with a location (logogen) in memory. The logogen for a word is thought to contain or provide access to information about the word's meaning, spelling, and pronunciation (semantic, orthographic, and phonological information, respectively). A word is recognized when its logogen passes a threshold and the semantic, orthographic, and phonological codes become available for output. According to this model, auditory recoding can be seen as simply a consequence of contacting the phonological information stored at a logogen. This outcome is predicted to obtain regardless of the modality of the input string, since both auditory and visual feature analyzers feed a single set of logogens.

In the Collins and Loftus (1975) model, the recognition of a word has certain consequences that are subsumed under the notion of "spreading activation." They postulate the existence of interconnected semantic and lexical networks; each node in a network represents a word or feature. Recognition of a word entails activation of a node in memory, and activation subsequently spreads automatically along interconnected pathways to other locations. It follows, then, that presentation of a word may lead to activation of semantically related words that are assumed to be represented at nodes closely connected to the node of the input word and to each other. One consequence of this process is that recognition thresholds for activated words are lowered. The model predicts results from priming studies such as Meyer and Schvaneveldt (1971), in which lexical decision times to a target word were faster when the word was preceded by a semantically related priming word than when preceded by an unrelated priming word. The notion of spreading activation along semantic dimensions can explain a wide range of other results from priming studies, including those of Meyer and Schvaneveldt (1975), Neely (1977), Fischler (1977), and Warren (1977). These results can also be interpreted within the Morton model, however, if one assumes that logogens that share semantic features are functionally interconnected.

The Collins and Loftus (1975) model also appears to cast a somewhat different light on the issue of auditory recoding. Within this model, information concerning the sound and spelling of a word is represented within the lexical network. Although Collins and Loftus are not explicit on the matter, it appears that this information can be accessed either by direct activation of a node in that network or by the automatic spread of activation from a node in the interconnected semantic network (see Collins & Loftus, 1975, p. 413). In either case, the auditory code becomes available not as a result of an explicit recoding stage, but rather as a consequence of contacting a location in the memory network. Since both the semantic and phonological codes of a word are represented and accessed similarly, phonological priming analogous to semantic priming should be observable (see Flanigan, Tanenhaus, & Seidenberg, Note 1; Seidenberg & Dosher, Note 2).

A perhaps overlooked and unexpected implication of both these models concerns a third type of information, orthographic. Just as the semantic and phonological codes of a word become available in both auditory and visual word recognition, so should the orthographic code, since it is represented and accessed in each model in the same ways as the other two codes. The orthographic code also becomes available in word recognition as a consequence of contacting either a logogen or a node in the lexical network. This outcome should hold regardless of the modality of the input string. This entails the somewhat counterintuitive prediction that the orthographic code should become available in auditory word recognition.

The present experiments were designed to explore the role of orthography in auditory word recognition. This research is related to the work of Meyer, Schvaneveldt, and Ruddy (1974). Meyer et al. found that lexical decision times to the second word in orthographically and phonologically similar pairs such as *pouch–couch* were faster than those to orthographically similar but phonologically dissimilar pairs such as *touch–couch*. They explained their results in terms of a response bias model in which subjects encoded the first word orthographically and phonologically and, when they subsequently saw a target that matched orthographically, expected a phonological match as well. In the case of pairs such as *touch–couch*, this bias was in error, leading to the increased lexical decision times that were observed.[1]

The studies reported in this article are concerned with a complimentary effect. Rather than examining effects of acoustic similarity in the visual perception of linguistic stimuli, they are concerned with

[1] It is interesting to note that Meyer, Schvandeveldt, and Ruddy (1974) interpret the effects of phonological similarity of word pairs within a model that is very different from the one they invoke in the case of semantic similarity. The former are attributed to a response bias, the latter to priming following automatic spreading activation.

visual (orthographic) effects in auditory recognition. Subjects performed a rhyme monitoring task in which they monitored a list of words for a word that rhymed with a cue word. The critical variable was whether cue–target pairs were orthographically similar (e.g., *pie–tie*) or orthographically dissimilar (e.g., *rye–tie*). Since subjects could, in principle, perform the task by making a purely acoustic match, longer monitor latencies to detect dissimilar rhymes would be strong evidence for the activation of orthographic information in this task.

Experiment 1

Method

Subjects. Forty male and female Columbia University undergraduates participated for ½ hr. each in partial fulfillment of a course requirement.

Materials. Stimuli for all trials were taken from monosyllabic rhyme triples such as *pie–tie–rye*. Predictable rhymes (e.g., moon–June, down–town), unusual spellings, uncommon words, homophones, homographs, and homonyms were avoided. Each stimulus word had at least six common rhymes. Within critical (test) triples, word frequency was controlled as nearly as possible by using the Kučera and Francis (1967) norms. For critical trials, median frequencies were 18 for similar orthography cues, 13 for dissimiliar orthography cues, and 9 for targets.[2] Filler trials used to vary the location of the targets were constructed in a similar manner and were divided approximately equally between similar and dissimilar orthography conditions.

Procedure. On each trial, subjects were binaurally presented with a single word in isolation (the cue), followed 2 sec later by a binaurally presented list of five semantically unrelated monosyllabic words recorded at a rate of approximately one per second. Their task was to detect the single word in the list that rhymed with the cue.

Cues were presented in two modes: In the auditory mode, subjects heard the cues prior to the auditory list. In the visual mode, subjects read cues aloud from index cards prior to hearing the target list. Within each of the two cue presentation modes, two versions of the stimuli were prepared. The same target lists were utilized in each version. However, in one version of each mode, subjects heard six critical pairs in which the cue and target were orthographically similar and six in which they differed. Subjects hearing the other version were presented with the same targets paired with the opposite type of cue. Each subject heard only one version. Thus, for example, they received either the *pie–tie* or *rye–tie* combination but not both. This yielded two lists of stimuli crossed with two presentation modes. There were 12 orthographically similar items paired with 12 orthographically dissimilar items in each mode.

On critical trials, the target word was the third in the five-word list. On filler trials, the target appeared equally often at each of the other four positions. There were 12 critical trials, 48 filler trials, and 5 practice trials for each subject. Stimuli used on critical trials are presented in Table 1.

The stimuli were recorded on one channel of a stereo tape. A 500-Hz timing tone was placed on the other channel so as to coincide with the beginning of each target rhyme. Subjects did not hear the tone, which was input to a voice-operated relay that started a Hunter digital timer. The timer stopped when the subject pressed a telegraph key.

Results

Of the 480 possible monitor latencies, 7 were errors (subjects pressed early), and 4 were lost due to mechanical failure. These 11 scores (2.3%) were distributed randomly across conditions. Three scores over 1,000 msec were entered in the analyses as 1,000 msec.

Mean latencies for each subject were computed by collapsing across the six exemplars in the orthographically similar and dissimilar conditions. Mean latencies for each item were computed by collapsing across the subjects that received each target word in the orthographically similar and dissimilar conditions, respectively. Overall mean latencies are presented in Table 1. With both auditory and visual presentation of cues, orthographically similar rhymes were detected faster than dissimilar rhymes. The magnitude of the orthographic effect was similar for both cue presentation modes: 56 msec for auditory presentation and 48 msec for visual presentation. Analyses were performed on both the subject and item latencies for reasons given in Clark (1973).

[2] Stimuli in all the experiments reported in this article were controlled in this manner. Given the other constraints on stimulus selection (e.g., that they be one syllable, of moderate frequency, not have homonyms, homophones, or homographs, etc.), some small differences in frequency could not be eliminated. In each experiment, correlations between the frequencies of prime words and response latencies were calculated. In all cases these correlations were small and nonsignificant.

Table 1
Stimuli and Results for Experiment 1

Cues			Rhyme monitor latencies in msec			
			Auditory presentation		Visual presentation	
Similar	Dissimilar	Targets	Similar	Dissimilar	Similar	Dissimilar
stroke	soak	joke	533	679	620	668
greed	bead	deed	575	644	550	550
doom	tomb	broom	560	620	524	556
beast	priest	yeast	436	519	409	488
chrome	comb	dome	670	642	576	637
tree	key	knee	571	652	553	610
toast	ghost	roast	590	569	506	568
plate	freight	gate	483	565	548	588
blame	claim	name	655	582	579	536
coal	bowl	goal	500	580	433	589
clue	shoe	glue	507	567	560	600
stocks	fox	rocks	661	792	681	727
		M	562	618	545	593

The effect of orthography type was significant by subjects, $F(1, 36) = 36.09$, $MS_e = 1{,}561$, $p < .001$, and by items, $F(1, 11) = 15.20$, $MS_e = 2{,}138$, $p < .005$. The F'_{min} was significant, $F'_{min}(1, 21) = 10.70$, $p < .01$. There was no significant effect of cue mode in either the subject or item analyses. No order effects or interactions obtained. The correlations between the frequency of cue words and monitor latencies did not approach significance in either the auditory or visual presentation modes, $r(24) = .0005$ and $r(24) = -.0406$, respectively. The correlations between the frequency of targets and monitor latencies were also not significant for either targets in the visual condition, $r(24) = -.03$, or targets in the auditory condition, $r(24) = -.12$.[3]

To determine whether there was a difference in the phonemic similarity between cues and targets in the two orthographic conditions, the mean number of phonemes, shared phonemes between targets and cues, and differing phonemes between targets and cues were calculated. These were calculated as in the following example. *Stroke* and *soak* contain five and three phonemes, respectively. They share three phonemes (*s*, *o*, *k*) and differ by two (*t*, *r*). Orthographically similar and dissimilar cue and target words contained 3.8, 3.4, and 3.3 phonemes, respectively. Orthographically similar cue and target words shared an average of 2.1 phonemes and had 2.75 phonemes that differed. Dissimilar cue words shared 2.0 phonemes and had 2.33 differing phonemes. Thus the stimuli were phonemically well matched, and it is unlikely that this factor contributed to the observed pattern of data.

The results indicate that orthographic differences affected rhyme detection even when both cues and targets were presented aurally. Although it was expected that presenting cues visually might induce subjects to utilize visual information in detecting rhymes, the cue presentation mode variable had no reliable effect. Presenting cues visually did not appear to induce orthographic matching strategies that were not also present in the auditory condition. Since the number of critical items was relatively small, a replication was undertaken.

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[3] In the three experiments reported here, response times correlated negatively with the word frequency of the target words. This pattern of correlations suggests that lexical access was occurring during these experiments. The fact that the correlations were marginal can probably be attributed to the narrow range of word frequency used in each experiment. We wish to thank an anonymous reviewer for suggesting that we examine these correlations.

Table 2
Stimuli and Results for Experiment 2: Rhyme Monitor Latencies in Msec

Similar cues and targets	Version 1	Version 2	Dissimilar cues and targets	Version 1	Version 2
bite, kite	600	438	ghost, roast	587	484
blade, grade	635	563	freight, mate	656	573
pope, rope	359	410	roar, lore	636	577
dead, head	625	603	plaid, fad	685	587
pipe, ripe	603	484	numb, gum	629	677
moon, noon	586	542	sauce, boss	679	705
beast, yeast	425	378	stir, blur	716	695
blame, name	546	571	beak, meek	658	515
coal, goal	697	585	freeze, tease	519	593
clue, glue	444	440	pest, breast	619	571
pie, tie	622	544	coat, vote	362	467
lease, cease	745	594	stunt, front	593	694
tool, fool	417	503	net, debt	758	571
joke, poke	670	495	loose, juice	615	456
M	570	511		622	583

Note. Cues and targets were interchanged in Version 2.

Experiment 2

Method

Subjects. Twenty-eight Columbia University undergraduates participated for ½ hr. each as part of a course requirement.

Materials, design, and procedure. Although the design, task, and procedure were essentially the same as those in Experiment 1, several changes were incorporated. All cues were presented aurally, and the number of test items was increased to 28 per subject, divided equally between similar and dissimilar orthographic conditions. Monosyllabic word triples were constructed as before. Two versions of the stimuli were again prepared following the procedure used in Experiment 1; however, only one was run. The median Kučera and Francis frequency for the similar orthographic cues was 19; for the dissimilar orthographic cues and targets the frequencies were 12 and 10, respectively. The mean number of phonemes for orthographically similar and dissimilar cue–target pairs were 3.11 and 3.50, respectively. Similar pairs shared 2.0 phonemes and had 2.13 differing phonemes. Dissimilar pairs shared an average of 2.21 phonemes and had 2.43 differing phonemes. The stimuli used on critical trials are presented in Table 2.

The target lists were three words long, rather than five as in Experiment 1. The list positions for the 14 similar orthography targets were as follows: 5 occurred as the first word in the target list, 5 occurred in the second position, and 4 appeared in the third. The same distribution of target positions was utilized for the 14 dissimilar orthography trials; 14 noncritical filler items were distributed such that 4 targets occurred in Position 1, 4 in Position 2, and 6 in Position 3. There were also 14 catch trials on which none of the target words rhymed with the cue. On these trials, subjects did not have to respond. Thus, one quarter of the trials presented similar orthographic pairs, one quarter presented dissimilar orthographic pairs, one quarter were noncritical filler trials divided approximately equally between similar and dissimilar orthographic pairs, and one quarter were catch trials. The 6 practice trials included examples of each type. In the instructions, subjects were informed that catch trials would occur but were not given any information concerning their frequency.

The items were recorded in quasi-random order, with the first two trials following the practice being fillers and the only other constraint being that no more than two trials of any type occur successively. The distribution of item types was counterbalanced by halves.

After one version of the stimuli was recorded, it was re-recorded with the positions of the cues and targets interchanged on each trial. Everything else was identical to the first version. This second version was included to determine whether the increased latencies on dissimilar orthography trials were due to strategies dependent on the order of cues and targets. If, for example, subjects found any of the word spellings odd, this would presumably have different effects depending on whether the odd word was a cue or target word. Presentation version was the only between-subjects variable, with 14 subjects hearing each version.

Results

Of the 784 possible monitor times, 6 were errors. Ten scores between 1,000 and 1,500 msec were entered into the analyses as 1,000 msec.

Mean latencies for each subject and each item were calculated using the procedure described for Experiment 1. These latencies are presented in Table 2.

As in Experiment 1, rhyme monitoring latencies were faster to orthographically similar rhymes than to orthographically dissimilar rhymes. The overall difference was 63 msec. The difference in Version 1 was 52 msec; in Version 2 it was 72 msec.

Analyses were again performed on both the subject and item latencies. The main effect of orthographic type was significant by subjects, $F(1, 26) = 75.61$, $MS_e = 731$, $p < .001$, and by items, $F(1, 26) = 9.45$, $MS_e = 6{,}491$, $p < .005$. The F'_{min} was also significant, $F'_{min}(1, 34) = 8.40$, $p < .01$. Thus the results of Experiment 2 replicated the orthographic effect of Experiment 1.

The main effect of presentation version was not significant by subjects, $F(1, 26) = 1.70$, $MS_e = 16{,}305$, $p > .20$, or by items, $F(1, 26) = 3.10$, $MS_e = 10{,}992$, $.05 < p < .10$.

The correlation between frequency of cues and reaction times was not significant, $r(56) = .108$; however, the frequency of targets and monitor latencies were negatively correlated, $r(56) = -.35$, $p < .01$, indicating that lower frequency targets in general took longer to recognize.

Discussion

The first two experiments established that listeners could detect orthographically similar words that rhymed more quickly than they could detect orthographically dissimilar words. Experiment 3 was designed to extend these findings in another experimental task. Subjects heard pairs of words that were either orthographically similar or dissimilar and were instructed to decide whether or not the words rhymed. Although orthographic similarity should facilitate rhyming decisions, it was expected that it might interfere with nonrhyme decisions.

Table 3
Stimuli and Results for Experiment 3

	Similar		Dissimilar	
Target	Cue	RT	Cue	RT
	Rhymes			
dune	tune	769	moon	847
tie	pie	739	guy	883
cure	pure	711	tour	841
turn	burn	662	learn	902
lance	dance	692	pants	886
glue	clue	837	crew	915
curt	hurt	867	dirt	820
loose	goose	864	juice	1017
fox	box	772	rocks	944
fate	mate	808	freight	930
wise	rise	896	lies	785
toe	foe	782	row	948
ride	hide	744	guide	735
fad	glad	766	plaid	839
M		779		878
	Nonrhymes			
tease	lease	1146	piece	1243
leaf	deaf	930	ref	1075
foot	toot	813	suit	823
base	phase	822	raise	916
gown	blown	880	moan	767
goose	choose	713	cues	875
cough	tough	966	stuff	986
howl	bowl	1089	roll	698
bead	dead	1032	fed	959
hood	mood	1246	rude	823
ward	card	853	guard	772
bomb	tomb	915	room	892
bash	wash	1046	gosh	898
pose	lose	1011	Jews	916
M		961		903

Note. RT = reaction time in msec.

Experiment 3

Method

Subjects. Twenty Wayne State University students served as unpaid subjects.

Materials. The stimuli were taken from 28 monosyllabic word triples. Each triple contained two cue words that rhymed and a target that was orthographically similar to one of the cue words. In 14 of the triples, the cue and target word rhymed (e.g., *fight–bite–kite*). In the remaining 14 triples, the target word did not rhyme with the cue words (e.g., *touch–dutch–couch*). The median Kučera and Francis (1967) word frequencies for orthographically similar and dissimilar cue words and the target words were

25, 36, and 13, respectively. The mean numbers of phonemes for orthographically similar and dissimilar cue and target words were 3.14, 3.17, and 3.07, respectively. Similar and dissimilar cues and targets shared 2.04 phonemes and had 2.11 differing phonemes. The full set of stimuli is presented in Table 3.

Procedure. On each trial, the subject heard a cue word followed approximately 2 sec later by a target word. The task was to indicate whether or not the two words rhymed by pressing the appropriate telegraph key.

Cues were either orthographically similar or dissimilar to the target word. On half of the trials, the cue and target rhymed, and on half they did not rhyme. Two versions of the stimuli were recorded, with each target word appearing once in each version. Target words that were preceded by orthographically similar cues in one version were preceded by orthographically dissimilar cues in the other version. Each subject heard only one version. The procedure was similar to the first two experiments except that two telegraph keys were used. The hand used to indicate each response (rhyme or nonrhyme) was counterbalanced within each version.

Results

Of a possible 560 monitor latencies, there were 17 errors (3%), which were distributed approximately evenly across experimental conditions. Analyses were performed on the remaining data. Two scores over 2,000 msec were entered into the analyses as 2,000 msec.

Means for the four conditions are presented in Table 3. Rhyme decisions were 102 msec faster than nonrhyme decisions. For the rhymes, reaction times (RTs) to orthographically similar pairs were 99 msec faster than RTs to dissimilar pairs. The opposite pattern obtained for nonrhymes with RTs to orthographically similar pairs 58 msec longer than RTs to dissimilar pairs.

Analyses were performed on both subject means and item means. Both analyses revealed a significant effect of rhymes, $F(1, 18) = 11.50$, $MS_e = 23{,}142.91$, $p < .01$ in the subject analyses and $F(1, 26) = 10.21$, $MS_e = 14{,}786.14$, $p < .01$ in the item analyses. There was no significant effect of orthography ($F < 1$) by subject and by item. The Orthography × Rhyme interaction was significant by subject, $F(1, 18) = 16.21$, $MS_e = 7{,}435$, $p < .001$, and by item, $F(1, 26) = 8.53$, $MS_e = 10{,}185$, $p < .01$. The F'_{min} also reached significance, $F'_{min}(1, 44) = 5.59$, $p < .05$. There was no effect of version nor were there any version interactions; however, subjects in Version 2 were 56 msec faster than subjects in Version 1. This difference, although not significant, does compromise the results of the item analyses somewhat, since the similar and dissimilar cues for each target occurred in different versions. In 11 out of 14 rhyme triples, RTs to decide that similar cues and targets rhymed were faster than RTs to decide about dissimilar cues and targets. The opposite pattern held for only 8 out of 14 nonrhyme triples (see Table 3). The weakness of the nonrhyme item comparisons may be due to the differences in versions. The overall pattern, that is, longer RTs to orthographically similar nonrhyme pairs, held for 16 of the 20 subjects.

Correlations between the frequency of cues and RTs did not approach significance for either the rhymes $r(28) = .07$ or the nonrhymes, $r(28) = .10$. Correlations between the word frequency of the targets and RTs for both the rhymes and the nonrhymes were nonsignificant, $r(28) = -.12$ and $r(28) = -.32$, respectively.

General Discussion

What is the source of the orthographic effect? There appear to be at least two broad interpretations. One, analogous to Meyer et al.'s (1974) interpretation of their results with visual presentation, places the orthographic effect at a comparison stage in processing. It assumes that subjects accessed both acoustic and orthographic information and that they detected rhymes by attempting to match targets on both dimensions. A mismatch on the orthographic dimension entrained an extra information processing stage—for example, checking the acoustic match. This type of explanation, then, attributes the orthographic effect to interference in the different orthographic condition.

The other alternative is that the effect occurs at the stimulus encoding stage. It is then attributed to facilitation in the same orthographic condition. According to this interpretation, presentation of a word leads to activation of words that share the same orthographic features, as predicted by the Collins and Loftus and Morton models. In the similar orthographic conditions, cue words primed targets; in the dissimilar orthographic conditions, they did not. Primed words had lower detection thresholds than unprimed words and were therefore detected faster. These related models, then, can account for the observed effect in terms of priming along the orthographic dimension following encoding of the cue word.

Some recent studies using the Warren (1972) variation of the Stroop color-naming paradigm suggest that the influence of orthography occurs at the stimulus encoding stage. Conrad (1978) reported a pilot study in which subjects heard three rhymes followed by a single visually presented target word printed in colored ink. In one condition, the target word was orthographically similar to the rhymes but phonologically different (e.g., *punt*, *runt*, *hunt*—aunt). Color-naming latencies were longer in this condition as compared to a control condition in which the target words were both orthographically and phonologically unrelated to the rhymes.

A recent master's thesis by Flanigan (1979) replicates and extends Conrad's results. Flanigan presented subjects with a single prime word presented aurally, followed by a target word printed in a color. The target word *dead*, for example, was preceded by one of four types of primes: (a) an unrelated prime, (b) a phonologically similar prime (e.g., *bed*), (c) an orthographically similar prime (e.g., *bead*), and (d) a phonologically and orthographically similar prime (e.g., *head*). Color-naming latencies were fastest following unrelated primes, with significant color-naming interference following all three types of related primes. Primes that were both orthographically and phonologically similar caused the greatest color-naming interference, followed by phonologically and orthographically similar primes in that order.

The results of the Conrad and Flanigan studies suggest that encoding a spoken word facilitated the subsequent recognition of both orthographically and/or phonologically similar words. It is widely known that subjects performing the Stroop task cannot inhibit processing of the word itself even though such processing typically interferes with color naming (Dyer, 1973). It would appear, then, that accessing of orthographic information may occur without conscious effort.

These results and those of the present studies are compatible with the interpretation that orthographic information becomes available automatically, in the sense proposed by Posner and Snyder (1975). The fact that subjects consistently failed to utilize the optimal rhyming strategy, making a purely acoustic match, lends prima facie plausibility to this interpretation, as does the fact that Conrad and Flanigan observed similar effects using the Stroop paradigm in which activation of this information had a negative effect on performance. Furthermore, our college student subjects were presumably aware of the system of sound–spelling correlations in English and knew that vowel sounds can be spelled in several ways. Thus it seems unlikely that subjects would consciously or tacitly employ an orthographic matching strategy. The use of such a strategy is also contraindicated by the failure to find a difference between auditory and visual cues in Experiment 1.

An interference interpretation, such as Meyer et al.'s (1974), is also compatible with the assumption of automatic activation of orthographic and phonological information. Once activated, this information will lead to interference under circumstances in which subjects are expecting words that are spelled the same to be pronounced the same or vice versa.

During the debriefing period, many subjects expressed a strong feeling of having "seen" the words during the task. Very few subjects guessed what the primary experimental manipulation was, and no one reported using an explicitly orthographic matching strategy. Subjects also reported that they sometimes noticed associations among words, although the stimuli had been designed to minimize them. Thus, they appeared to have analyzed the stimuli at a semantic level as well.

It appears that linguistic stimuli may be multiply encoded during some simple experimental tasks. Both visual and auditory stimuli may be encoded in terms of both visual and auditory features. Of course, auditory encoding may enjoy privileged status within the information-processing system, and further research is necessary to establish the generality of the orthographic encoding effect that we have identified. It is clear, however, that auditory encoding does not always occur to the exclusion of visual information, regardless of the presentation modality.

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