Journal of Speech and Hearing Research Volume 32, 2–11, March 1989

RHYME GENERATION BY DEAF ADULTS

VICKI L. HANSON
IBM Research Division, Thomas J. Watson Research Center, Haskins Laboratories, New Haven, CT

NANCY S. McGARR
*Haskins Laboratories, New Haven, CT**

Congenitally deaf college students were asked to generate rhymes to 50 target words. Results of the investigation indicated that it is possible for deaf individuals to develop the sensitivity to the phonologic structure of words necessary for rhyming: Approximately half of the responses generated were correct rhymes. Of these correct rhymes, the majority were orthographically similar to their target (e.g., *BLUE-glue* and *TIE-lie*), although 30% were orthographically dissimilar to their targets (e.g., *BLUE-through* and *TIE-sky*), indicating an ability to generate rhymes independent of orthographic structure. Errors were analyzed in an attempt to determine the basis on which the subjects generated rhymes. Evidence of both orthographic and speech-related strategies were obtained.

The ability to generate rhymes requires sensitivity to the phonologic structure of words: Words that rhyme are similar in their phonologic structure, differing generally, only in their initial phoneme. Studies have found that normally hearing children generally enter school with an appreciation of rhyme and the ability to generate a rhyme to given words (Jusczyk, 1977; Stanovich, Cunningham, & Cramer, 1984). Such sensitivity to phonologic structure as is required in rhyming has been found to be associated with beginning reading success for normally hearing children (Bradley & Bryant, 1985; Liberman, 1983; Mattingly, 1972; Perfetti, 1985). Indeed, Bradley and Bryant (1978) found that normally hearing children who were having difficulty in acquiring reading skills had difficulty in generating rhymes to target words. Thus, the ability to generate rhymes serves as a measure of language and reading-related skills.

The question addressed by the present paper is whether deaf individuals are able to generate rhymes to specific target words. One line of reasoning would argue that their hearing impairment would render them insensitive to the phonologic structure of words required for rhyming. Yet we know that at least some deaf children and adults display a sensitivity to the phonologic structure of words in making rhyme judgments about pairs of printed words. Hanson and Fowler (1987, Experiment 2) presented deaf college students with two pairs of orthographically similar words, for example, *have-cave* and *save-wave*. The task was a forced-choice task in which subjects had to indicate which of these two pairs rhymed. Results showed that the deaf subjects performed significantly better than chance.

Other studies in the literature are consistent with the notion that deaf subjects are, in some cases, able to use rhyme. Blanton, Nunnally, and Odom (1967) presented hearing-impaired children with a target word followed by two alternatives. The children were to indicate which of the alternatives rhymed with the target. One of the alternatives was an orthographically dissimilar rhyme and the other was an orthographically similar *non*rhyme. Some of the children were able to score better than chance on the task. Similarly, Hanson (1980) reported that some deaf adults were able to judge fairly accurately whether word-word or word-nonword pairs rhymed. Moreover, some deaf individuals, notably the better readers, were influenced by rhyming manipulations in short-term memory tasks (Conrad, 1979; Hanson, 1982; Lichtenstein, 1985).

The present study carried the issue of deaf individuals' rhyming ability one step further by examining the rhymes *generated* in response to specific words. In the experiment to be reported here, deaf subjects were given target words and asked to write down words that rhymed with these targets. A corpus of responses produced by deaf subjects would be useful for investigators requiring rhyming manipulations for testing specific hypotheses about deaf populations.

If the deaf subjects of the present study are found to be able to generate rhymes successfully to the target words, then the question of how they are able to do so must be asked. In this regard, the data will be analyzed to explore whether there is evidence for various strategies. One possibility is that the subjects use an orthographic strategy by generating only words that have the same ending as the target word. Evidence that deaf subjects often rely on such an orthographic strategy has been obtained in previous studies (Blanton, et al., 1967; Hanson, 1980; Hanson & Fowler, 1987). For example, in another condition, Hanson and Fowler (1987, Experiment 1) simply presented pairs of words and asked a group of deaf college students to indicate whether or not the words rhymed. When they were orthographically similar, subjects overwhelmingly answered that the pairs rhymed,

*Also, Center for Research in Speech and Hearing Sciences, Graduate School and University Center, The City University of New York.

© 1989, American Speech-Language-Hearing Association

0022-4685/89/3201-0002$01.00/0

even when they did not. When the pairs were orthographically dissimilar, subjects generally answered that the pairs did *not* rhyme, even when they did. Thus, the subjects often used the orthographic strategy. It was only when required to rely on rhyme information, as in the forced choice task of the study, that subjects did so.

A second possible basis for rhyme generation that will be explored is the use of speech-related information. Many deaf persons rely on lipreading for reception of speech. One strategy, as suggested by Dodd and Hermelin (1977), is that words that "look alike on the lips" are judged as rhyming pairs. A corollary to this possibility is that speech produced by deaf persons, particularly common segmental errors, may also be influential in rhyme generation. By this strategy, the subject would be referring to articulatory information from their own productions. Like the orthographic strategy the use of this speech-related information will often lead to correct rhyme responses, but at other times will produce characteristic errors as words that have similar production characteristics may not always rhyme.

METHOD

Subjects

The subjects were 15 undergraduates at Gallaudet College, a liberal arts college for hearing-impaired students. All information regarding hearing loss and speech intelligibility was obtained from each student's college records. The subjects were all congenitally deaf and sustained a hearing loss of 90 dB[1] or greater, as based upon the pure-tone average for the better ear. The intelligibility ratings used by Gallaudet staff are based on a scale of 1 to 5, with 5 being unintelligible speech. No attempt was made to reevaluate the speech intelligibility of the subjects for this experiment. The breakdown of speech intelligibility for these subjects was as follows: Seven subjects had speech rated a 3, that is, speech that the general public has some difficulty understanding initially; 4 had speech rated a 4, that is, speech that is very difficult for the general public to understand; and 4 had speech rated a 5, that is, speech that cannot be understood. Eight of the subjects had two deaf parents. Due to time constraints on the experimental session, a test of reading achievement was administered to only 8 of the subjects. The test administered was the comprehension subtest of the *Gates-MacGinitie Reading Tests* (1969, Survey F, Form 2). Survey F of the test is designed for grades 10 through 12. For each subject, a standard score on the test was obtained for grade level 10.1. A standard score of 50 represents the mean performance for grade 10.1, and each 10 points on the scale represents one standard deviation. By this measure, the mean reading level of the 8 students tested was 45.6 (Range = 55 to 41). This is consistent with averages generally reported for Gallaudet students by us (e.g., Hanson & Fowler, 1987; Hanson, Shankweiler, & Fischer, 1983) and others (Reynolds, 1975) and is considerably higher than the measured grade 3.2 median reading comprehension level of profoundly deaf students (hearing loss > 90 dB) graduating from high school (Karchmer, Milone, & Wolk, 1979).

[1]Some of the subjects were tested using ISO standards, and others were tested using ANSI standards.

Stimuli

The stimuli for the experiment were 50 monosyllabic English words. The words were chosen so that each of 25 target words had a matched target word that was phonologically similar (rhyming) but orthographically dissimilar (e.g., *blue* and *shoe*, *late* and *eight*). These 50 words were individually presented. The order in which words were presented was random, with the two words of any pair occurring in succession in only one case. The words were typed (in upper case letters), with several words to a page. Below each stimulus word was space for the subject to write the responses. The space was sufficient for several words to be written. No numbering of responses was given to indicate the number of words a subject should write. A typographical error made on one stimulus word resulted in only 49 items being scored.

Procedure

Subjects were given the test sheet pages for the experiment with the following instructions typed at the top of the first page:

> For each of the following words, write as many rhyming words as you can. (You can use words more than once.) PLEASE PRINT!!

Most subjects understood the instructions and had no questions. For the subjects who did have a question about what was meant by "rhyme," the experimenter informed them that "rhyme" meant words that sound the same and gave the pair *blue-two* as an example of a rhyme. The experimenter for the session was a deaf recent graduate of Gallaudet College who communicated with the subjects by signing.

SCORING

In the few instances where a subject wrote a nonword as a response, the response simply was not scored. Thus, it was considered neither correct nor incorrect in terms of rhyming. This occurred in only eight cases: For example, in the response *poar* for the target word *boat*. All responses were scored independently by the two authors and a third judge.

Each response was scored first in terms of whether or not it correctly rhymed with the target word. The benefit of the doubt was given to subjects in determining correct

rhymes. For example, in response to the target word *BEAR*, several subjects wrote *tear*. The scoring assumed that the subjects intended the response /ter/, rather than the nonrhyming response /tir/. As another example, in response to the target word *DOOR*, some subjects wrote *poor*. It was assumed that the pronunciation of *poor* for these subjects was /por/, not /pur/. Similarly, for the target word *POOR* it was assumed that the pronunciation in some dialects would be /pur/, so the response *tour* was counted as a correct rhyme. Finally, a response that was homophonous with the target word was counted as a correct rhyme. There were no disagreements between the judges as to whether or not an item was a correct rhyme.

The responses were then broken down into the following different categories within both the correct and incorrect responses. When the three judges' categorization did not agree, the two authors discussed the response until an agreement was reached.

Correct Rhyme Responses

Correct rhyme responses can be of two types: those that are orthographically similar to the target (e.g., *BLUE-glue, BEAR-pear,* and *TIE-lie*) and those that are orthographically different from the target (e.g., *BLUE-through, BEAR-pare,* and *TIE-sky*). Those that are orthographically different represent the clearest case for rhyme generation ability because the subject cannot have generated this response based on the orthographic representation of the word. Therefore, the correct responses were divided into those that were orthographically different from the target and those that were orthographically similar. A listing of all correct rhyme responses is given in the Appendix, listed separately by their orthographic similarity to the target.

Incorrect Rhyme Responses

There were several different categories of incorrect responses that are described below. It will be apparent from these descriptions that the divisions do not comprise mutually exclusive, nor even the only possible categories. They proved helpful, however, in providing at least some interpretation of the errors. As there are always inherent difficulties in devising error categories, a complete listing of the incorrect responses is given in the Appendix (along with its classification in this study).

It is also worth noting that because the error categories were not mutually exclusive in all cases, a hierarchy of classification was used. The error categories considered vowel, orthographic, and speech-related similarity of the targets and responses. If the vowel portion of the response was the same as the vowel portion of the target, then the response was classified in the vowel category, whether or not the response was also similar to the target in other error characteristics. Next, if the response and target were orthographically similar, then the response was classified in the orthographic category, whether or not the response was also spoken similarly to the target. In this hierarchy, vowel categorizations were given highest priority because they represent fairly small deviations from correct rhyme responses. Orthographic categorizations were given the next priority because of previous studies indicating a great deal of reliance on orthographic similarity by both hearing (Seidenberg & Tanenhaus, 1979) and deaf subjects (Blanton et al., 1967; Hanson & Fowler, 1987) when making rhyme judgments. This classification system has the obvious disadvantage, however, of underestimating the number of errors that might have resulted from speech-related confusions.

Vowel. This vowel classification was used for responses that had the same vowel as the target word, but did not rhyme, generally because the response contained an error in the final consonant portion of the response. The category was further subdivided in those responses that were orthographically different (V) from the target and those that were orthographically similar to the target (VO). Examples of errors in this category are the following: *PAIL-pay* (V), *PEACE-bee* (V), *PAIL-paid* (VO), *PEACE-pea* (VO). In addition, there were some cases in which the response was a multisyllabic word. Again, using a lenient scoring system, if one of the syllables had the vowel portion the same as the target vowel, then the response was considered to be a vowel error; for example, *RED-ready* (V) and *BOX-oxen* (VO).

Orthographic. A response was counted in the orthographic (O) category if the final spelling pattern was the same as the target (i.e., if the portion of the target word carrying the rhyme was present in the response). In this case, despite the fact that the orthographic patterns were the same, the two words did not rhyme. The following are examples of orthographic errors: *EIGHT-right, BEAR-dear, PHONE-none.* Other responses were also counted in this category if there was some orthographic similarity (SO) with the target, but that the response and target were not identical in their final portions. Examples of this kind of error are *FEEL-fell, BEAR-beer,* and *HURT-cure.*

Speech-related. The speech-related classification (SR) was used primarily for responses in which the response looked similar to the target on the lips of speakers. Although it is also possible that subjects' responses were influenced by articulatory characteristics, for example, their own productions, there was no way to obtain this information for analyses. Therefore, the speech-related errors could arise from lipreading and/or speech production. Examples of some responses thus classified were *ONE-want,* and *BOX-mat.*

Unclassifiable. Responses falling into the unclassifiable (U) category were those that did not meet the criteria of any of the other categories. Examples of unclassifiable responses are *HAIR-earn* and *TIE-stay.*

RESULTS AND DISCUSSION

The purpose of this study was to examine the responses of congenitally deaf students when asked to generate rhythms to target words. This question is answered here

not only by tabulating the percentage of correct and incorrect responses, but also by presenting a complete listing of the responses given by subjects and by providing one possible system of classification of the responses.

Table 1 is a summary of the correct and incorrect responses given by the subjects. The correct responses are broken down into those that are orthographically similar and dissimilar to the target. Table 1 shows that roughly half (52.2%) of the responses generated did correctly rhyme with the target word presented. Given the open response nature of this task, this relatively high percentage of correct responses suggests that the deaf subjects, indeed, did have some means of correctly generating rhymes.

An important element in the examination of the errors is the Appendix, which lists all responses given in the experiment. It is also worth noting from the Appendix that specific responses were often generated by more than one person.

It is possible that the subjects in this experiment might have generated rhymes simply by taking a short cut and generating only words that had the same ending as the target word. Thus, for the target word *TIE*, the responses *die, lie,* and *pie* could have been generated by such an orthographic strategy. However, the responses *dye, sky, sty,* and *eye* could not have been generated by this means.

Of the 626 correct rhyming responses given in this study, 70% could have been generated by the orthographic strategy. These are the orthographically similar rhymes shown in Table 1. This high percentage of orthographically similar rhymes is one indication that the orthographic properties of written words do weigh heavily in deaf subjects' judgments of rhyme. Normally hearing subjects, similarly, have been found to be influenced by these orthographic properties when making judgments about rhyme. For example, Seidenberg & Tanenhaus (1979) found that normally hearing college students were influenced by the orthographic properties of written words even when making judgments about whether *auditorily* presented words rhyme.

Consistent with findings that deaf subjects were able to identify rhymes independent of orthographic similarity (Blanton, et al., 1967; Hanson, 1980; Hanson & Fowler, 1987), was the fact that the other 30% of the correct rhymes were orthographically distinct from the target. As indicated in the Appendix, the subjects in many cases generated homophones as responses (e.g., *WEIGH-way, WON-one, BLUE-blew*).

Individual subjects' responses were examined to determine whether there were large differences between subjects' ability to generate rhymes. There was no subject totally unable to generate rhymes, although some subjects clearly were more skilled at this task than others. The number of responses generated by individual subjects ranged from 159 to 42 words, subjects thus averaging from 3.24 to .86 words per target. The percentage of correct rhymes ranged from 83.0% to 24.0%. Although some subjects clearly relied on an orthographic strategy, other subjects were quite adept at generating orthographically dissimilar rhymes. The percentage of orthographically dissimilar rhymes ranged from 66.7% to 10.6%, with the mean being 34.0%. Thus, it is apparent that no subject relied solely on the orthographic strategy.

TABLE 1. Percentage and number of responses classified as correct and incorrect rhymes.

	%	*N*
Correct responses		
Orthographically dissimilar	15.7	188
Orthographically similar	36.5	438
Incorrect responses	47.8	573
Total	100.0	1199

Correlations between rhyme generation and the speech intelligibility of individual subjects were computed. The measure of speech intelligibility was the 1–5 rating for each subject obtained from college records. As measures of rhyme generation ability, the following were used: the percentage of correct rhyme responses, the percentage of correct orthographically dissimilar rhyme responses, the percentage of correct orthographically similar rhyme responses, the total number of correct rhymes generated, and the total number of responses (both correct and incorrect) generated. Due to the limited range of speech intelligibility values, the correlations perhaps are smaller than if some students with excellent speech skills had been available for testing. The highest correlation obtained was between speech intelligibility and the total number of correct rhymes generated, $r = -.33$. Although not statistically significant, the direction of the correlation indicated that the better speech intelligibility was associated with more correct rhymes generated. It is possible also that strong correlations with speech intelligibility were not obtained because of differences in task requirements in the two situations. Speech intelligibility ratings depend on both segmental and suprasegmental characteristics of speech. In contrast, a use of speech-related information by deaf subjects in generating rhymes would depend on segmental charactistics of speech.

Although reading scores were available for only 8 of the subjects, it seemed of interest to determine whether there was any relationship between reading ability and rhyme generation ability. For this reason, correlations were computed between reading level and the measures of rhyme generation ability used previously. There were indications that the better readers were better at generating rhymes. Reading scores correlated −.41 with the total number of responses generated, −.38 with the total number of correct rhymes generated, and, most interestingly, −.33 with the percentage of correct orthographically *dis*similar rhymes. Although not statistically significant, these results can be taken as suggestions that reading ability is related to phonological sensitivity. Whether phonological sensitivity promotes reading or is a consequence of skilled reading, clearly cannot be determined here. Some research with normally hearing children has suggested, however, a causal relation, such that ability to manipulate phonological segments affects the

degree of success that children have in acquiring reading skills (Bradley & Bryant, 1985).

Subjects with deaf parents could not be distinguished from subjects with normally hearing parents by their abilities to generate rhymes. For the subjects with deaf parents, 52% of the responses that were generated were correct rhymes. For the subjects with normally hearing parents, 54% were correct rhymes. Thus, the two groups were comparable in this ability. In terms of the types of rhymes generated, the subjects with deaf parents generated slightly more rhymes that were independent of orthographic similarity: Of the correct rhymes generated, the subjects with deaf parents and those with hearing parents, 34.4% and 28.1%, respectively, were orthographically dissimilar. Consistent with other research, the subjects with deaf parents had poorer rated speech intelligibility than did the subjects with normally hearing parents (Smith, 1975): Those with deaf parents had a mean speech rating of 4.25, whereas those with normally hearing parents had a mean rating 3.29, $t(13) = 2.55$, $p < .025$. When the percentage of correct rhymes is adjusted by speech intelligibility using an analysis of covariance, the difference in the percentages generated by subjects with deaf parents and subjects with hearing parents remains similar, ($F < 1$).

Further supporting the notion of rhyming ability in these subjects was the finding that many of the incorrect responses in the study (14.5%) correctly had the vowel in common with the target word. These vowel errors may have been given as "best guesses" when the subjects were unable to think of exact rhymes. In these cases, they gave responses that were almost rhymes, often differing from a correct response only in that a final consonant was added erroneously to the response or in that a final consonant was omitted from the response.

The question must be asked: How are deaf individuals able to generate rhymes? A few possibilities are apparent, and the subjects' errors were analyzed to take these possibilities into account. One possibility, as has already been discussed, is that the subjects match orthographic patterns. As indicated previously, many of the correct rhyme responses did have an orthographic pattern in common with the target word. Additional evidence supporting an orthographic strategy can be observed in the error patterns shown in Table 2: Of the 573 incorrect rhyme responses in this study, fully half (53.4%) bore at least some orthographic similarity to the target word. Included in this percentage are the responses classified as orthographic errors, either O or SO, as well as vowel errors with a common orthographic pattern, the VO errors. An example is the target word *SAID*, which elicited the responses *aid, raid, paid,* and *faint,* among others.

TABLE 2. Percentage and number of incorrect responses classified into each category.

	%	N
Vowel		
Vowel (V)	14.5	83
Vowel/Orthographic (VO)	16.4	94
Orthographic		
Orthographic (O)	13.3	76
Some Orthographic (SO)	23.7	136
Speech-related (SR)	14.1	81
Unclassifiable (U)	18.0	103
Total	100.0	573

Another possible basis on which deaf individuals could generate rhymes is speech information—either the visual characteristics of words on the lips of speakers (Dodd & Hermelin, 1977) or characteristics of the subjects' own productions. Due to the method of scoring in this study, the percentage of errors resulting from such a strategy (the speech-related errors) indicates the lower limits of such a use. Most are easily explained in terms of visibility (e.g., *RED-ran*). However, several interesting examples suggest that the intrusion of segmental errors in the speech of the subjects may have given rise to rhyme errors (e.g., *PHONE-phony* or *BLUE-balloon,* both suggesting the common addition of /ə/ to the monosyllabic target).

Nonetheless, there were some responses that remained unclassifiable by the scoring categories used in the present study. Some of these appear to have been semantically/morphologically determined (e.g., *RED-green, RAIN-dry*). For most of the others in the unclassifiable category, however, the origin is unknown.

One possibility, not yet mentioned, is that correct responses in this task could have been generated by subjects having memorized pairs of rhyming words from classroom or speech instruction. This may have occurred in some cases. For example, the response *eat* (by two subjects) to the target word *EIGHT* could have resulted from subjects having learned that *eight* rhymes with *ate,* and then responding with a morphologically wrong form of the verb; thus, the response *eat.* Although some responses may have been based on memorization of this sort, it seems unlikely that this was the primary basis on which subjects arrived at their responses. It is inconceivable that the subjects would have been specifically taught rhymes for each of the words used in this study.

SUMMARY

In summary, the finding that over 50% of the rhymes generated by deaf students in response to specific target words corroborate indications from other studies that it is possible for congenitally, profoundly deaf individuals to develop the appreciation of the phonologic structure of words (Blanton et al., 1967; Dodd & Hermelin, 1977; Hanson & Fowler, 1987). Thus, despite the fact that rhyming generally is considered to be an auditory task, these results provide evidence that a severe-profound hearing loss does not preclude an ability to rhyme. The correct rhyming responses are provided here to be used as a resource for other investigators interested in testing questions about, for example, reading or short-term memory, that require a corpus of words that are recognized as rhymes by deaf students.

The results of this study should not be taken to indicate, however, that rhyme ability is necessarily characteristic of deaf individuals. In this regard, it is worth remembering that the subjects of the present study were all college students. Although the present study was not designed to address the question of reading skill in relation to rhyme generation ability, correlations suggesting that better readers are better able to generate rhymes were obtained. Given the limited range and number of subjects' reading scores, this result is quite provocative. The obtained correlations are consistent with findings that sensitivity to rhyme on tests of short-term memory is more characteristic of deaf readers who are reading well than among those who are reading poorly (Conrad, 1979; Hanson, Liberman, & Shankweiler, 1984; Lichtenstein, 1985).

Finally, the present study provided an analysis of the responses, with evidence being obtained for both orthographic and speech-related strategies in rhyme generation. Because it is recognized that other investigators will be interested in different aspects of the responses, the full documentation of correct and incorrect responses is provided here.

ACKNOWLEDGMENTS

This research was supported by grants NS-18010 and NS-13617 from the National Institute of Neurological and Communicative Disorders and Stroke. We would like to thank Nancy Fishbein for testing subjects and Ann Marie Behrman for her help with data scoring.

REFERENCES

BLANTON, R. L., NUNNALLY, J. C., & ODOM, P. B. (1967). Graphemic, phonetic, and associative factors in the verbal behavior of deaf and hearing subjects. *Journal of Speech and Hearing Research, 10,* 225–231.

BRADLEY, L., & BRYANT, P. E. (1978). Difficulties in auditory organization as a possible cause of reading backwardness. *Nature, 271,* 746–747.

BRADLEY, L., & BRYANT, P. E. (1985). *Rhyme and reason in reading and spelling.* University of Michigan Press: Ann Arbor, MI.

CONRAD, R. (1979). *The deaf school child.* London: Harper & Row.

DODD, B., & HERMELIN, B. (1977). Phonological coding by the prelinguistically deaf. *Perception & Psychophysics, 21,* 413–417.

Gates-MacGinitie Reading Tests (1969). New York: Columbia Teachers' College Press.

HANSON, V. L. (1980). Implications of research on sign languages for theories of reading. In B. Frøkjær-Jensen (Ed.), *The sciences of deaf signing* (pp. 71–80). Copenhagen, Denmark: Audiologopedic Research Group.

HANSON, V. L. (1982). Short-term recall by deaf signers of American Sign Language: Implications for order recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 8,* 572–583

HANSON, V. L., & FOWLER, C. A. (1987). Phonological coding in word reading: Evidence from hearing and deaf readers. *Memory & Cognition, 15,* 199–207.

HANSON, V. L., LIBERMAN, I. Y., & SHANKWEILER, D. (1984). Linguistic coding by deaf children in relation to beginning reading success. *Journal of Experimental Child Psychology, 37,* 378–393.

HANSON, V. L., SHANKWEILER, D., & FISCHER, F. W. (1983). Determinants of spelling ability in deaf and hearing adults: Access to linguistic structure. *Cognition, 14,* 323–344.

JUSCZYK, P. (1977). Rhymes and reasons: Some aspects of the child's appreciation of poetic form. *Developmental Psychology, 13,* 599–607.

KARCHMER, M. A., MILONE, M. N., JR., & WOLK, S. (1979). Educational significance of hearing loss at three levels of severity. *American Annals of the Deaf, 124,* 97–109.

LIBERMAN, I. Y. (1983). A language-oriented view of reading and its disabilities. In H. Myklebust (Ed.), *Progress in learning disabilities, Vol. 5* (pp. 81–101). New York: Grune & Stratton.

LICHTENSTEIN, E. H. (1985). Deaf working memory processes and English language skills. In D. S. Martin (Ed.),*Cognition, education, and deafness: Directions for research and instruction* (pp. 111–114). Washington, DC: Gallaudet College Press.

MATTINGLY, I. G. (1972). Reading, the linguistic process, and linguistic awareness. In J. F. Kavanagh & I. G. Mattingly (Eds.), *Language by ear and by eye* (pp. 133–147). Cambridge, MA: MIT Press.

PERFETTI, C. A. (1985). Development of reading ability in relation to deafness. *Proceedings of the VIIIth World Congress of the World Federation of the Deaf.* Washington, D.C.

SEIDENBERG, M. S., & TANENHAUS, M. K. (1979). Orthographic effects on rhyme monitoring. *Journal of Experimental Psychology: Human Learning & Memory, 5,* 546–554.

SMITH, C. R. (1975). Residual hearing and speech production in deaf children. *Journal of Speech and Hearing Research, 18,* 795–811.

STANOVICH, K. E., CUNNINGHAM, A. E., & CRAMER, B. B. (1984). Assessing phonological awareness in kindergarten children: Issues of task comparability. *Journal of Experimental Child Psychology, 38,* 175–190.

Received August 20, 1987
Accepted March 15, 1988

Requests for reprints should be sent to Vicki L. Hanson, IBM Thomas J. Watson Research Center, P.O. Box 218, Yorktown Heights, NY 10598.

APPENDIX

Listed here are the responses given to each of the target words. The numbers in parentheses indicate responses given by more than one subject. Shown in the first column are correct rhymes that are orthographically dissimilar from the target. Shown in the second column are correct rhymes that are orthographically similar to the target. Shown in the third column are incorrect rhymes and the classification given to each of these responses (see text for explanation of the classification system). Note: *indicates homophones.

BLUE		
two (4)	true (2)	balloon (2)V
through (2)	glue (2)	bloom V
you (4)	clue	boom V
too (6)		tool V
*blew (3)		school V
shoe (2)		duo V
new		cute V
		sure SR
		blur SR
		hole U

CRY		
	try (12)	strike V
	dry (10)	write V
	fry (3)	gray (2) SO
	wry (3)	scream U
	why (2)	rain U
PAIL		
pale (3)	bail (7)	pay V
tale	nail (4)	paid VO
	tail (3)	pain VO
	hail	bill SO
	jail (2)	peel SO
	mail (6)	pill SO
	quail	
	rail (2)	
	sail	
	fail (2)	
	gail (2)	
BEAR		
scare	tear (5)	carry V
*bare (3)	wear	ear (2) O
pare	pear (5)	dear (2) O
care		fear (2) O
		gear (2) O
		near (2) O
		hear (2) O
		rear O
		beer (5) SO
SCHOOL		
	stool (12)	blue V
	pool (3)	shoe V
	cool (6)	too VO
	tool (6)	stood SR
	drool	stole SR
	fool	told U
		tall U
PEACE		
*piece		pea (3) VO
niece		peas (2) VO
cease		bee V
		meat (2) VO
		bean VO
		speech V
		beam VO
		beat VO
		please (4) VO
		meet V
		tease VO
		ease VO
		pace (2) SO
		mace SO
		best SR
		test SR
		pet U
PHONE		
	bone (3)	phony (4) V
	cone (3)	vote (2) V
	lone (2)	veto V
	pone	fold V
	stone (2)	gone O
	tone (3)	none O
		one O
		foot U
		for (2) U
		fool U
		vow U

DOOR		
tore	poor (3)	dog (2) SO
store (3)	floor	doer SO
core		do you SO
boar		straw SR
pore		saw (3) SR
		care U
		char U
BOX		
	cox (2)	oxen VO
	fox (5)	pot V
	lox (2)	ax SO
	pox (6)	must SR
	sox (3)	pest SR
	ox (3)	mat SR
		bat SR
		pat (2) A
		mix U
STEAL		
*steel (6)	conceal	teeth V
feel	seal (5)	see V
peel	deal	tale SO
	veal	tell SO
	real	sale SO
	heal	still SR
		til SR
TEA		
see (6)	sea (11)	tie SO
*tee(3)	pea (2)	desk U
	flea	stay U
	plea	
SHOE		
two (5)		soon (3) V
too (4)		shoot V
*shoo (4)		tool V
you		school V
new		hoe (2) O
		toe (2) O
		doe O
		woe O
		shot (2) SO
		short SO
		sew SR
		so SR
PLEASE		
	disease	lease (4) VO
	ease	peace (4) VO
		plea (2) VO
		cease (2) VO
		flea VO
		easy VO
		pleased VO
		bleed V
		peasant SO
		pleasure SO
		pleasant SO
		bless SR
		best U
		play U
		male U
		plus U

TAX			*SPEECH*		
	flax	taxi (2) VO	peach (6)	breech	peace V
	wax (2)	tag (2) VO	each	screech	mean V
	sax (2)	ant VO	beach	beseech	beer VO
	ax (3)	dance VO	impeach	leech	peer VO
	lax (2)	sat VO	bleach		please V
	max	thanks VO	reach		bear U
	ajax	latex SO	teach		pear U
		socks SR			
		tie SR	*WON*		
		next SR	*one (9)	ton	want (3) SO
		yes U	none		own SO
		dog U			wow SO
LATE					won't SO
	plate (5)	lay (2) V			wood SO
	slate (3)	lane (2) V			went SO
	rate	pay V			will (2) SR
	ate (4)	lake VO			what (2) SR
	date (2)	last SO			wet SR
	gate	bite U			quit SR
	mate	lick (2) U			well SR
	state	box U			crow U
					vow U
CARE					
tear	share (2)	are (3) O	*SHIRT*		
	dare (4)	car (6) SO		dirt (3)	sure (2) V
	mare (2)	lane SO		squirt	church (2) V
	fare (3)	claw U		skirt (4)	thirst VO
	hare (2)	door U		flirt	short (2) SO
	bare	tire U			shot SO
	flare	hole U			shit (2) SO
	stare				should SR
	scare				hair U
					your U
OWN					
		owe (4) VO	*COUGH*		
		oh (3) V	off (4)		caught (2) V
		only (2) V			taught V
		no V			coffee V
		blow VO			coffin V
		mow VO			ought (2) VO
		brown (2) O			rough (3) O
		crown (2) O			tough (4) O
		clown O			enough (2) O
		down O			though O
		frown O			dough O
		gown O			laugh SO
		one (2) SO			
		how SO	*OFF*		
		on SO	cough (4)		stuff U
		owl SO			office VO
		won SO			coffee VO
		our SR			coffin VO
					awful V
WOOD					of (8) SO
*would (3)	good (2)	wool (2) VO			dwarf SR
	hood (2)	book VO			
		mood (2) O	*RED*		
		brood O	*read (4)	bed (2)	ready (3) V
		food O	tread		reed (3) SO
		flood O			breed SO
		word (3) SO			ran (2) SR
		worst (2) SO			cry (2) SR
		school SO			run SR
		cool SO			cried SR
		work SO			train SR
		true U			what U
		tour U			green U
		orange U			

SEE		
*sea (5)	tee (4)	seed (3) VO
tea (6)	pee	seen VO
	wee	need VO
		feel VO
		sew SR
		so SR
		said U
		stay U
POUR		
more (4)	four	mourn VO
*poor (6)	tour	sour (3) O
for		hour O
pore		our O
bore		nourish O
		pare U
TIE		
dye (3)	die (9)	science VO
sky	lie (4)	diet VO
sty	pie (2)	say U
eye		tax U
		tag U
		tea U
		stay U
		ten U
		ticket U
ONE		
*won (6)	done	bone O
		cone O
		gone O
		lone O
		shone O
		own SO
		want (2) SR
		what (2) SR
		quit SR
		when SR
		mine U
HURT		
shirt (2)	burt	turn VO
	curt	fur VO
		cure SO
		your SO
		put U
		should U
		squash U
KEYS		
please		key VO
these		bee V
seas		yes SO
		kiss (4) SR
		yeah U
		kite U
SALE		
*sail (2)	pale (4)	sole SO
tail	bale (2)	salad SO
	hale (2)	dial SO
	scale	tell (2) SR
	yale (2)	silly U
	kale	steal U
	dale (2)	alley SO
	male (2)	
	tale (2)	
	ale	
	stale	

SHOULD		
	would (5)	shoulder (2) SO
	could (4)	foul SO
		shoot SO
		hold SO
		sold SO
		she SR
		hurt SR
		saw U
		horse U
		shelter U
		shit U
		shirt U
SOCKS		
box	docks (2)	tack SR
	knocks	tax SR
	mocks (2)	taxes SR
	stocks (2)	bake U
	jocks	stock VO
	rocks	shock VO
		hog V
THIEF		
beef (2)	chief	knife (2) SO
leaf		thrift SO
		the SO
		if (2) SO
		theft SO
		life SO
		left U
		live U
		stiff U
RULE		
cool	mule (3)	ruler VO
tool	yule	rude VO
		pull SO
		role SO
		wool (4) SR
		roll U
VOTE		
float	tote (3)	phone (2) VO
	note (3)	veto V
		jot SO
		vow SO
		for SR
		fall SR
		foot U
		bake U
TACKS		
	stacks (2)	sack VO
	backs (3)	tack VO
	jacks (2)	tackle VO
	sacks (3)	slack VO
	racks	stack VO
	hacks	ticks SO
	lacks	sock SR
		hick U
		heck U
RAIN		
*rein	train (6)	raid VO
	stain	ran (3) SO
	drain (2)	red (2) SR
	strain (2)	write SR
		cry (2) U
		dry U
		moon U

HAIR			*SAID*		
*hare (4)	pair (3)	car SO	dead		aid O
share	air (9)	hear SO			raid O
bare (2)	fair	here (2) U			paid O
pare	chair (2)	earn U			faint SO
	lair				say (3) SO
					sad (6) SO
EIGHT					dad SR
	freight	hey V			stay SR
	weight	right O			fad SR
		tight O			die U
		bright O			ton U
		sight O			son U
		might O			
		night O	*BEACH*		
		light O	speech (2)	peach (9)	green V
		fight (2) O	breech	teach (2)	perch SO
		height O		bleach	punch SR
		high SO		leach	butch U
		eye (2) U		preach	better U
		I (2) U			
		hat U	*NEW*		
		eat (2) U	two	*knew (5)	shoot V
		hi U	you	jew	soon V
		ice U	who	dew	sew (3) O
			shoe	few	now SO
DAY				blew	
	bay (3)	tale V		pew	
	say (6)	die SR			
	hay (2)	dye SR	*WEIGH*		
	lay (2)	sad SR	gray	sleigh	wait (4) V
	gay	dying U	they	neigh	weight VO
	fay		*way		we SO
	jay				why SR
	pay				quiet SR
					did U
FEEL					write U
steal	steel (4)	feet VO			
	peel (3)	fell (4) SO	*BOAT*		
	eel (2)	veil U		coat (3)	post V
	reel (2)	ball U		goat (3)	potato V
	heel			moat	boast VO
	kneel			bloat	most V
				float	boot SO
BEEF					boom SO
belief	reef (3)	believe (2) V			bomb SO
thief		before V			
		beef VO			
		need VO			
		puff SR			
		move U			
		buffet U			
LANE					
plain	pane (2)	late (4) VO			
	cane (4)	lay V			
	sane (2)	line (4) SO			
	plane (2)	plant SO			
	bane	long SO			
	dane	lick SR			
	mane	nine U			
	vane				
	wane				