Psychol. Belg.
1987, XXVII-2, 113-122.

READABILITY OF SINGLE WORDS AS A FUNCTION OF WORD TYPE

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Reading researchers, compared to experienced reading teachers, probably only know a small portion of the facts of early reading. A plea is made to list such facts. As an example, the readability of different types of monosyllabic words (real versus nonsense words, CV-words versus VC-words, CCVC- versus CVCC-words, CCCVC- versus CVCCC-words) is compared. Real words, VC-words, CCVC- and CCCVC-words are the easier ones. The theoretical and practical relevance of the results is briefly discussed.

Although in the field of reading acquisition a vast number of empirical studies has been conducted, solid descriptive data bases on the facts of early reading are rare. Sometimes theoretical controversies originate in disagreement on such facts. For instance, historically, theories on developmental dyslexia capitalized strongly on a few striking error patterns (reversals, mirror images, cf. Orton, 1937), without a solid data base on the frequency of different reading errors in normal and dyslexic children.

More recently, the irregular English spelling is sometimes viewed as the main source of reading problems. Some children, the argument goes, are limited in their general capacities for rule-learning. As a consequence, they are doomed to have difficulties with the complex grapheme-to-phoneme conversion rules (Morrison & Manis, 1982). According to this theory, normally spelled words do not cause trouble. On the contrary, from another theoretical perspective it is stressed that reading disabled children do have trouble with normally spelled English too, and that reading problems also exist in languages with a perfect one-to-one phoneme-to-grapheme correspondence (Liberman & Shankweiler, 1979). This is part of the argumentation in favour of another theory that posits insufficient awareness of the phoneme level in spoken language is at the core of reading acquisition problems. With a solid data base on the

The author is "aangesteld navorser". of the Belgian National Fund for Scientific Research. The data presented here were gathered as part of a doctoral dissertation. The author is indebted to his advisor, Prof. Dr. W. De Coster, and to R. Windey, F. Veryser and E. Layon-Verstraete for their help in the search for suitable subjects.

readability of regularly and irregularly spelled words, the two theories would probably not have developed in the same way.

Concerning many facts of early reading, reading researchers are probably less well positioned than experienced reading educators. In their class-room experience, reading teachers have access to a very large but probably implicit "data base". "Data" on the relative ease of different graphemes, grapheme combinations, words, sentence types, etc., impinge upon them at a high rate. Admittedly, some researchers have been interested in gathering such data bases. For instance, large efforts have been made to describe and categorize the errors of beginning readers (Weber, 1968; Leu, 1982).

Among the efforts to collect solid and detailed data bases, the work of Coleman (1970) is probably the most noted. With preschool children Coleman scaled the learnability of grapheme-phoneme associations, and of associations between printed and spoken everyday words. He also compared the phonic blendability of all CV- and VC-syllables, and the ease of copying single letters. Coleman dreamed of building up tables of robust measures with these and other yet to be collected data. As in the other sciences, such tables would be at the origin of important and unforeseeable technological innovations. For instruction technology, tables on the learnability of various subskills or contents would be immediately useful for the construction of mastery-learning hierarchies. Moreover, in Coleman's view, a-theoretical data gathering is the best starting point for further and gradually more theoretically guided empirical efforts.

In the spirit of Coleman (1970), we wondered whether the decodability of single words is different for various types of words. Real and nonsense words may be compared as to their readability. The effects of graphemic or phonemic structure may be evaluated (e.g., CV- versus VC-words). The number of syllables, the type of phonemes (e.g., fricative vs. stop), and the grammatical word type (e.g., noun vs. adjective) are other candidates. In this way some stable effects may come out, possibly even with a modest number of subjects. A list of such effects may then act as a "data base" for researchers and theorists to formulate new hypotheses on decoding processes in beginning readers. Some items on the list may be particularly compatible or incompatible with already existing theories. To some extent, such list of reading acquisition facts may be specific for a given language. Cross-language comparisons might be theoretically interesting.

In contrasting word types, of course, irrelevant features have to be kept constant. A comparison of the readability of real and nonsense words, for instance, is only relevant if in both item series the same graphemes and grapheme combinations are used. This is sometimes overlooked (e.g., Hogaboam & Perfetti, 1978). Indeed, since Coleman's experiment 2 (1970) we know the ease of grapheme-phoneme associations is substantially different among the various graphemes. Mere counterbalancing of graphemes is not sufficient, if different combinations of the same graphemes are not equally difficult (e.g., the 'st' cluster might be easier or more difficult than 'ts'). As there are no reasons for assuming equal difficulty[1], whenever possible counterbalancing of grapheme clusters seems appropriate. With four tests for reading single Dutch words, we try to illustrate the relevance of word type contrasts. Real words are compared with nonsense words (tests 2, 3, and 4). Some phonemic structures are contrasted: CV vs. VC (test 1), CCVC vs. CVCC (test 3), CCCVC vs. CVCCC (test 4). It is also controlled if poor and good readers show the same performance patterns.

METHOD

Reading material

All reading tests contain monosyllabic Dutch real or regular nonsense words. Dutch is a language in which there is a rather good correspondence between phonemes and graphemes. In all current reading instruction methods irregularly spelled words are avoided in the first few years of teaching. All real words in our test have a perfect one-to-one grapheme-to-phoneme correspondence.

Test 1 consists of 10 pairs of a CV- and a VC-syllable containing the same graphemes, in the reverse order (e.g., ro - or). They are presented on 2 cardboards, each with 5 words of each type, in alternating order. All items (see Appendix) are nonsense syllables. In *test 2* ten real and ten nonsense CVC-words are contrasted in the same way as CV- and VC-syllables were in test 1 (e.g., rat - tar, see Appendix). The 10 real words had never before been presented for reading in the class-room.

In *test 3* the real-nonsense contrast is crossed with a CCVC-CVCC contrast, in 2 series of 16 words each. The first series contains only real words, and the second only nonsense words. Each real words of series 1 differs from a corresponding nonsense word of series 2 only in the

[1] Especially about the relative difficulty of grapheme clusters, experienced reading teachers seem to dispose of a kind of detailed information that is completely absent in current reading acquisition theories.

vowel. The vowels are balanced between the series in pairs of item-pairs. For example (see Table 1), the real word "kind" (child) is transformed into the nonsense syllable "kand" by replacing "i" by "a". The reverse replacement turns the nonsense "tind" into the real word "tand" (tooth). As we wanted to cross the CCVC - CVCC contrast with the real-nonsense contrast, it was not possible to have exactly the same graphemes and grapheme clusters in CCVC- and CVCC-words (see Appendix). In *test 4* the real-nonsense contrast is crossed with a CCCVC-CVCCC contrast, in a similar way as in test 3 (cf. Table 1).

Tab. 1. — Examples of the real-nonsense contrast in tests 3 and 4

	CCVC		CVCC	
Test 3	real	nonsense	real	nonsense
	krijt	kraat	kind	kand
	kraak	krijk	tand	tind
	CCCVC		CVCCC	
Test 4	real	nonsense	real	nonsense
	streep	straap	winst	wunst
	straat	street	kunst	kinst

All tests are administered individually. The 10 (tests 1 and 2) or 16 items (tests 3 and 4) of each series are vertically arranged on cardboard. The instruction is to read aloud all words as correctly as possible. Subjects are informed that some words do not exist, and are only invented by the experimenter.

Subjects

Tests 1, 2 and 3 were administered to 48 first grade children, as part of a follow-up study on the relation between speech perception and reading (De Weirdt, 1985). Six boys and six girls were randomly selected among the pupils of four first grades in different schools with predominantly middle-class children. In two schools, reading was instructed with rather "whole word" methods, and with relatively little attention for decoding. In the two other schools, decoding (by analysis and synthesis) was central in the instruction method. Tests 1 and 2 were administered mid-December (after three and a half months of reading instruction). Test 3 was administered in May (ninth month of the schoolyear). At the time of the first testing the mean age was 6;5 years.

The fourth reading test was used in another study in which the speech perception capacities of dyslexic children and various control groups were compared (De Weirdt, 1985). The dyslexic group contains 13 children (9 boys and 4 girls) diagnosed and treated as out-patients in a rehabilitation centre. It was controlled whether these subjects met the criteria Vellutino (1979, p. 7-36) proposed for research on dyslexia. By individual matching on sex, age and their parents' educational level, two control groups of 13 subjects each were formed parallel to the dyslexic group. One group contains children performing rather poorly at school. These subjects were, in addition, individually matched on WISC Verbal IQ with the dyslexics (dyslexics: $M = 92.4$, $SD = 8.1$; poor performers: $M = 92.8$, $SD = 6.4$). Another group contains very well performing children, with a much higher VIQ ($M = 129.8$, $SD = 11.9$). Finally, a fourth group of 13 special education children ("learning disabled") was included too, matched on sex and age, but with a lower VIQ ($M = 85.1$, $SD = 11.5$). Mean ages for the four groups ranged from 9;3 to 9;5 years, with *SD*'s from 6.5 to 7.4 months.

Results and Discussion

All analyses are carried out with the number of correctly read words as dependent variable. The first-grade subjects of tests 1-3 were divided into the 50% best and 50% poorest readers. The criterion for partitioning was the first principal component score on a battery of six reading tests (including the three described here, see De Weirdt, 1985, for a detailed description of all reading tests). Reading level and the school-factor were taken up in the analyses of variance. Both factors had significant main effects, but were never involved in significant interactions with the word-type variables. So we leave them out in the presentation of the results.

Test 1

CV-words (mean correct = 6.19) are more difficult than VC-words ($M = 7.37$, $F(1,46) = 11.34$, $p < .01$). Coleman (1970) had reported that C + V blending is more difficult than V + C synthesis. Helfgott (1976) explained this by the fact that, typically, initial consonants are more coarticulated with a following vowel than are final consonants with a preceding vowel. So, in the process of merging the phonological codes (internal sounding out) for successive letters, the codes for initial consonants need more adaptation than those for final consonants. For instance, in blending initial stops with a following vowel, the inevitable "schwa"-tail (/ə/) of the stop has to be omitted. Otherwise the CV-unit would hardly be recognizable. With the stop in final positions omission of the "schwa" is probably less damaging for recognition. With other consonants, especially with fricatives, the coarticulation differences between final and initial positions are probably much smaller. Then the CV-VC effect should be smaller too. Though the present data are not suited for a test of this hypothesis, they could have supported it better. In all VC-CV pairs, the VC-syllable was the easier one. The differences between VC- and CV-syllables are largest with "ro -or", "ra - ar", "ti - it" and smallest with "tij - ijt", "no - on" and "taa - aat", with "su - us" in an intermediate position.

Still it may seem plausible to explain the CV-VC effect in reading by a similar effect in the subtask of phonic blending. But in two blending tasks administered at about the same time as the reading tests, to the same subjects, we could not replicate Coleman's results (De Weirdt, 1985). An alternative explanation might be that phonological codes are less stable for consonants than for vowels. This, in turn, might for instance be due to their shorter duration, or to larger variance in the acoustic signals they represent. Thus, phonological consonant representations might be more disturbed by the process of phonological recoding of the following vowel in reading CV-syllables, than vowel representations would be by the recoding of the final consonant in reading VC-syllables. In mere blending of auditorily presented sounds, of course, no recoding would interfere. Then no CV-VC effect would occur.

Test 2

Real CVC-words ($M = 7.90$) are much easier to read than nonsence CVC-syllables ($M = 6.48$) ($F(1,46) = 31.58$, $p < .001$). This is not consistent with an extreme bottom-up view of reading (cf. Rozin & Gleitman, 1977) in which semantic processes only interfere after complete grapheme to phoneme recoding and subsequent blending. According to such view, the distinction between real and nonsense words can only be made after complete decoding, internal sounding out and subsequent lexical decision. But our results strongly suggest that during decoding some process must be facilitating the reading of real words, and/or hampering the reading of nonsense words. This is true already after 3.5 months of reading instruction. Qualitative inspection of the reading errors clearly contradicts the simple explanation that subjects tried to distort nonsense words into a real word the knew. Only very few nonsense words were read as real words, and at least as many real words were erroneously read as nonsense syllables.

Test 3

The results in Table 2 show that, again, real words are easier than nonsense words ($F(1,44) = 3.33, p < .10$). CCVC-words are easier than CVCC-words ($F(1,44) = 5.41, p < .025$). The interaction between meaningfulness and phoneme structure is not significant ($F(1,44) = 2.26$). The phoneme structure effect may be, rather trivially, a result of differential difficulties of the non-identical CC-clusters in initial versus final positions. Secondly, the articulation of words with final consonant clusters may be more difficult than of words with initial consonant clusters. Thirdly, our results may correspond with a phenomenon Fowler, Liberman and Shankweiler (1977) established in analyzing reading errors in CVC-words. Fowler et al. found twice as much errors in the final consonants as in the initial consonants. They interpreted this as a result of guessing at the final consonant (guided by semantic hypotheses) after decoding of the first two graphemes. Such guessing may also play a part in our results here. Consonants carry a higher information load than vowels. If semantically or lexically based guessing at graphemes increases from initial to final positions, it will be the more detrimental the more consonants are located towards final positions. Then we would expect the CCVC-CVCC effect to be present only with real words. As shown in Table 2, the phoneme structure effect is indeed larger with real words than with nonsense words, although the interaction is not significant.

Tab. 2. — Mean number of correctly read words in tests 3 and 4

	Phoneme structure					
	CCVC	CVCC	total test 3	CCCVC	CVCCC	total test 4
Meaningfulness						
real	6.52	5.90	6.21	7.02	6.50	6.76
nonsense	6.04	5.83	5.94	6.40	6.12	6.26
total	6.28	5.87		6.71	6.31	

Test 4

Real words are easier than nonsense words ($F(1,48) = 10.11, p < .01$ and CCCVC-words are easier than CVCCC-words ($F(1,48) = 5.50, p < .025$). Cell means are presented in Table 2. The interaction of meaningfulness and phoneme structure is not significant ($F(1,48) = 1.03$). The results are very similar to those of test 3, and may be interpreted in the same way.

The four groups differ substantially in reading performance (good performers: $M = 15.50$, poor performers: $M = 12.69$, dyslexics: $M = 12.34$, special education group: $M = 11.54$, $F(3,48) = 5.37$, $p < .01$). More important, the group variable does not significantly interact with phoneme structure ($F(3,48) = 0.97$) nor with meaningfulness ($F(3,48) = 1.37$). Neither is the 3-way interaction significant ($F(3,48) = 0.44$). So, there is no evidence the established word type effects act differently in the four groups with divergent reading abilities.

Conclusions

Three phenomena are ascertained. CV-words are easier to read than VC-words, real words are easier than nonsense words, and (with some reserve because of the non-identical grapheme composition) words with initial consonant clusters are easier to read than words with final consonant clusters. Our results do not indicate performance pattern differences between the 50% best and 50% poorest readers (tests 1-3), nor between different groups with or without reading problems (test 4). Neither do pupils of separate schools (instructed with differing methods) show different patterns in the reading of single monosyllabic words.

These results might be useful in three ways. First, they might be immediately relevant for instruction practice. For instance, mastery learning decoding curricula need data on the relative ease of different word types. So, our data would suggest VC-words should be taught before CV-words, and the first consonant clusters should be in initial positions.

Second, the established effects enabled us to comment (ad hoc) on some current opinions or hypotheses on reading acquisition. As real words are easier to read than nonsense words, lexical processes must be operating during decoding. The (C)CCVC-CVCC(C) effect may be interpreted as a result of guessing at final graphemes, on the strength of lexical hypotheses.

Third, the obtained results may be items on some future list of the facts of early reading. Listing of such facts is desirable, as researchers would then have the disposal of the information many good reading teachers probably knew for a long time. Reading researchers typically collect data exclusively in function of a theoretical position. Of course, many such data are very interesting in themselves, and may be added to the list of facts. But in my opinion, the stage of systematic exploration of the early reading phenomena is generally a bit overlooked. Thus, reading teachers and researchers are looking at different facts and problems of reading acquisition. All this may partly underly complaints on the interaction between research and practice in the field of reading acquisition (Vacca & Vacca, 1983; Kintsch, 1979).

APPENDIX: READING MATERIAL

Test 1

card 1: or - ti - aat - no - ijt[2] - su - ar - nij - ir - mi
card 2: ro - it - taa - on - tij - us - ra - ijn - ri - im

Test 2

card 1: rat - sum - tas - nijm - maat - not - tan - ros - mijr - min
card 2: tar - mus - sat - mijn - taam - ton - nat - sor - rijm - nim

Test 3

card 1: stap - best - krijt - muts - blad - kind - trap - pomp - stuk - kust - kraak - poets - bleek - tand - trek - damp
card 2: stup - bust - kraat - moets - bleed - kand - trep - pamp - stak - kest - krijk - puts - blak - tind - trak - domp

Test 4

card 1: sproet - winst - struik - koorts - spraak - worst - streep - links - spreuk - kunst - strop - maarts - spruit - gerst - straat - tanks
card 2: spreut - wunst - strok - kaarts - spruik - werst - straap - lanks - sproek - kinst - struip - moorts - spraat - gorst - street - tinks

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[2] 'ij' is a vowel in Dutch.

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Received January 1987