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A New Readability Yardstick *

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In 1943 the writer developed a statistical formula for the objective measurement of readability (comprehension difficulty) (5, 6). The formula was based on a count of three language elements: average sentence length in words, number of affixes, and number of references to people. Since its publication, the formula has been put to use in a wide variety of fields. For example, it has been applied to newspaper reports (9, 20), advertising copy (1), government publications (19), bulletins and leaflets for farmers (3), materials for adult education (4), and children's books (12). Its validity has been reaffirmed by five independent studies: the formula ratings of psychology textbooks substantially agreed with ratings by students and teachers (17); the formula scores rated specially edited radio news, newsmagazine, and Sunday news-summary copy "more readable" than comparable newspaper reports (18); advertisements, rated "more readable" by the formula, showed higher readership figures (7); and articles that were simplified with the aid of the formula brought increased readership in two successive split-run tests (13, 14). Since 1943, a number of academic institutions have incorporated the formula in the curriculum of courses in composition, creative writing, journalism, and advertising; it has also been used as the basis of several graduate research projects.

Because of this wide application, it seemed worthwhile to re-examine the formula and to analyze its shortcomings. One of these is to be traced to the basic structure of the formula; others are the results of difficulties in its application.

The structural shortcoming of the formula is the fact that it does not always show the high readability of direct, conversational writing. For

* Samples from the main body of this paper, when tested for readability by the method here proposed, had an average "reading ease" score of 30 and a "human interest" score of 0. Presumably, the paper is easier to read than most other articles appearing in scientific journals. The section, "The Formulas Restated," which contains directions for users of the formulas, has a "reading ease" score of 79 and a "human interest" score of 42—which puts that portion of the article in the class of a good cookbook.

example, in the study of psychology texts mentioned above (17), the score of Koffka's *Principles of gestalt psychology* ("the students' choice for unreadability") was 5.4 ("difficult"); yet William James' *Principles of psychology*, a classic example of readability, rated 6.0 (bordering on "very difficult"). Similarly, the formula consistently rates the popular *Reader's Digest* more readable than the sophisticated *New Yorker* magazine, although many educated readers consider the *Reader's Digest* dull and the sprightly *New Yorker* ten times as readable.

Aside from that, the practical application of the formula led to several minor misinterpretations. Sentence length, for instance, is the element with the heaviest weight; it is also the easiest to measure. As a result, this feature of the formula is often overemphasized, sometimes to the exclusion of the others—as in the directives that have been issued to staff writers of the Associated Press and the *New York Times*, recommending the use of shorter sentences in "leads." On the other hand, the second element—number of affixes—seems often difficult to apply; users of the formula found this count particularly tedious and admitted to uncertainty in spotting affixes. The third element—references to people—raised no such questions; but it was sometimes felt to be arbitrary and the underlying principle was often misunderstood.

In addition, many people found it hard to get used to the scoring system, which generally ranges from 0 ("very easy") to 7 ("very difficult"). Also, the average time needed to test a 100-word sample is six minutes (4). This makes the application of the formula considerably faster than that of earlier formulas, which required reference to word lists (e.g. Gray-Leary (8) or Lorge (10)), but it is still too long for practical use.

The revision of the formula presented in this paper is an attempt to overcome these shortcomings and make the formula a more useful instrument.

Procedure

The criterion used in the original formula was McCall-Crabbs' *Standard test lessons in reading* (11). The formula was so constructed that it predicted the average grade level of a child who could answer correctly three-quarters of the test questions asked about a given passage. Its multiple correlation coefficient was $R = .74$. It was partly based on statistical findings established in an earlier study by Lorge (10).

For many obvious reasons, the grade level of children answering test questions is not the best criterion for general readability. Data about the ease and interests with which adults will read selected passages would be far better. But such data were not available at the time the first formula was developed, and they are still unavailable today. So McCall-

Crabbs' *Standard test lessons* are still the best and most extensive criterion that can be found; therefore they were used again for the revision.

In reanalyzing the test passages, the following elements were used:

(1) *Average Sentence Length in Words*. The same element was used in the previous formula, but the correlation coefficient used was taken from Lorge's earlier findings. In the present study this coefficient was recomputed.

(2) *Average word length in syllables*, expressed as the number of syllables per 100 words. The hypothesis was that this measure would furnish results similar to the affix count in the earlier formula. Syllables are obviously easier to count than affixes since this work can be reduced to a mechanical routine.

(3) *Average Percentage of "Personal Words"*. The same element was used in the earlier formula. However, the opportunity was used to test a clarified definition, which made no significant difference in correlation. The new definition was stated as follows: All nouns with natural gender; all pronouns except neuter pronouns; and the words *people* (used with the plural verb) and *folks*.

(4) *Average Percentage of "Personal Sentences"*. This new element was designed to correct the structural shortcoming of the earlier formula, mentioned above. By hypothesis, it tests the conversational quality and the story interest of the passage analyzed. It was defined as the percentage of the following sentences: Spoken sentences, marked by quotation marks or otherwise; questions, commands, requests, and other sentences directly addressed to the reader, exclamations; and grammatically incomplete sentences whose meaning has to be inferred from the context.

To make the prediction more accurate, 13 of the 376 McCall-Crabbs' passages that contained poetry or problems in arithmetic were omitted in the count of the first two elements, which are designed to test solely prose comprehension. However, these 13 passages were retained in the count of the last two elements, which are designed to test human interest.

Following the procedure in the earlier study, intercorrelations were then computed. However, multiple correlation of the four elements with the criterion showed no significant gain in prediction value over the earlier formula in spite of the significant prediction value of the additional fourth element by itself ($r = .27$). Therefore, two multiple-correlation regression formulas were computed: one using the first two elements and one using the last two. This procedure had the advantage of giving independent predictions of the reading ease and the human interest of a given passage.

Finally, the resulting twin formulas were expressed in such a way that maximum readability (in both formulas) had a value of 100, and minimum readability a value of 0. This was done to make the scores more readily understandable for the practical user.

Findings

The intercorrelations, means, standard deviations, and regression weights found are shown in Tables 1, 2, and 3. The following symbols were used: *wl* for word length (syllables per 100 words), *sl* for sentence

Table 1
Correlations, Means, Standard Deviations, and Regression Weights
of Word and Sentence Length

	<i>sl</i>	C_{60}	\bar{X}	<i>s</i>	β
<i>wl</i>	.4644	.6648	134 2208	13 6845	.5422
<i>sl</i>	—	.5157*	16 5213	5.5509	.2639

* After the preparation of this paper two articles appeared that pointed out a computational error affecting the writer's original formula (Dale, E. and Chall, Jeanne S A formula for predicting readability. *Educ. Res. Bull.*, Ohio St. Univ., 1948, 27, 11-20, 28, Lorge, I. The Lorge and Flesch readability formulae a correction. *Sch. & Soc.*, 1948, 67, 141-142) The error concerned the correlation coefficient between sentence length and the criterion, which had originally been reported by Lorge as .6174, the writer, acknowledging his debt to Lorge, used that figure without recomputation. The corrected correlation coefficient is now reported as .4681 by Dale and Chall, and as .467 by Lorge, this corresponds closely to the figure of .5157 reported in Table 1, considering the fact that the writer now used a slightly better criterion of 363 passages for sentence length. In other words, the formula presented in this paper incidentally and independently also corrects the error found by Dale and Chall and by Lorge.

Table 2
Correlations, Means, Standard Deviations, and Regression Weights
of Personal Words and Sentences

	<i>ps</i>	C_{60}	\bar{X}	<i>s</i>	β
<i>pw</i>	.2268	— .3881	7 3457	5 5175	— .3446
<i>ps</i>	—	— .2699	29.5745	35.5822	— .1917

length in words, *pw* for percentage of "personal words," *ps* for percentage of "personal sentences," C_{60} for the average grade of children who could answer one-half of the test questions correctly, and C_{75} for the average grade of children who could answer three-quarters of the test questions correctly.

Table 3
Means and Standard Deviations of Two Criteria

	\bar{X}	s
C_{50}	5 4973	1 3877
C_{75}	7 3484	2 1345

The two regression formulas based on these correlations are

Formula A (for predicting "reading ease"). $RE = 206.835 - .846 \text{ } wl - 1.015 \text{ } sl$.

The scores computed by this formula have a range from 0 to 100 for almost all samples taken from ordinary prose. A score of 100 corresponds to the prediction that a child who has completed fourth grade will be able to answer correctly three-quarters of the test questions to be asked about the passage that is being rated; in other words, a score of 100 indicates reading matter that is understandable for persons who have completed fourth grade and are, in the language of the U. S. Census, barely "functionally literate." The range of 100 points was arrived at by multiplying the grade level prediction by 10, so that a point on the formula scale corresponds to one-tenth of a grade. However, this relationship holds true only up to about seventh grade; beyond that, the formula under-rates grade level to an increasing degree. Finally, the formula—which predicted grade level and, therefore, difficulty—was "turned around" by reversing the signs to predict "reading ease." (Before this transformation, the formula read: $C_{75} = .0846 \text{ } wl + .1015 \text{ } sl - 5.6835$.) The multiple correlation coefficient of this formula is $R = .7047$.

Formula B (for predicting "human interest"). $HI = 3.635 \text{ } pw + .314 \text{ } ps$.

Scores computed by this formula, too, have a range from 0 to 100. A score of 100 has the same meaning as in Formula A. It indicates reading matter with enough human interest to suit the reading skills and habits of a barely "functionally literate" person. A score of 0, however, means here simply that the passage contains neither "personal words" nor "personal sentences", in contrast to Formula A, the two elements counted here may be totally absent. Since the zero point could be fixed in this way, the scoring was arrived at by dividing the range between 0 (absence of both elements) and 100 (prediction of completed fourth grade) by 100. The formula therefore contains no statistical constant. The signs were reversed in the same fashion as in Formula A. (Before transformation, this formula read: $C_{75} = -1333 \text{ } pw - .0115 \text{ } ps + 8.6673$.) The multiple correlation coefficient of this formula is $R = .4306$.

Since the correlations of three of the four elements with the criterion

C_{50} were higher than those with the criterion C_{75} , the multiple correlation with the criterion C_{50} was computed first. As a second step, the values so found were used to predict criterion C_{75} , since it seemed obviously more desirable to predict 75% comprehension than 50% comprehension.

The correlation between the word length factor (syllable count) and the corresponding affix count in the earlier formula was found to be $r = .87$. For practical purposes the two measures may therefore be considered equivalent.

The number of affixes per 100 words (a) can be predicted from the syllable count (wl) by the formula $a = .6832\ wl - 66.6017$. Conversely, the number of syllables per 100 words (wl) can be predicted from the number of affixes (a) by the formula $wl = 1.49\ a + 94.56$

Comment

It is hoped that the two new formulas will prove more useful than the earlier formula. Formula A alone, with a correlation coefficient of .70, has almost as high a prediction value as the combined earlier formula whose correlation coefficient was .74. Formula B has a much lower correlation coefficient of .43 and, accordingly, does not seem to contribute much to the measurement of readability. It should be remembered, however, that because of the criterion used, Formula B predicts only the effect of the two "human interest" elements on *comprehension*; in other words, the correlation coefficient shows only to what extent human interest in a given text will make the reader understand it better. The real value of this formula, however, lies in the fact that human interest will also increase the reader's attention and his motivation for continued reading.

In addition, the two new formulas will be more useful for the teaching of writing, since the added factor and the division into two parts will show specific faults in writing more clearly.

The significance of Formula A will be more easily understood when it is realized that the measurement of word length is indirectly a measurement of word complexity (as mentioned above, the correlation is $r = .87$) and that word complexity in turn is indirectly a measurement of abstraction—the correlation between the number of affixes and that of abstract words was found to be .78 (5). Similarly, the measurement of sentence length is indirectly a measurement of sentence complexity. In two independent studies the correlation between these two factors was found to be .775 (8) and .72 (15). Sentence complexity, in turn, may again be considered as a measure of abstraction. Formula A, therefore, is essentially a test of the level of abstraction.

It seems hardly necessary to prove the importance of human interest in reading, as tested by Formula B. That people are most interested in other people is an old truism. And the readability value of written dialogue, as tested by the added element, is well described in the following, oddly parallel quotations from a printer and a novelist: "Have you ever watched people at a library selecting books for home reading? Other things being equal, if they see enough pages that . . . promise interesting dialogue, they are much more apt to put the book under their arm and walk away with it, than if they see too many solid pages . . . which always suggest hard work" (16). "What is the use of a book without pictures or conversations?" thought Alice just before the White Rabbit ran by, in condemnation of the book her sister was reading, and this childish comment is supported by novel-readers of all degrees of intelligence. Long close paragraphs of print are in themselves apt to dismay the less serious readers and their instinct here is a sound one, for an excess of summary and an insufficiency of scene in a novel make the story seem remote, without bite, second-hand. . . . A great part of the vigor, the vivacity and the readability of Dickens derives from his innumerable interweavings of scene and summary; his general method is to keep summary to the barest essential minimum, a mere sentence or two here and there between the incredibly fertile burgeoning of his scenes" (2).

In preliminary tests of the formulas, the following results were found: When the newly isolated fourth element ("personal sentences") was

Table 4
Comparative Analysis of *The New Yorker* (October 26, 1946) and the
Reader's Digest (November, 1946)

	<i>New Yorker</i>	<i>Reader's Digest</i>
Old Formula.		
Average sentence length in words	20	16
Affixes per 100 words	36	34
Personal words per 100 words	10	8
Readability score	3.59	3.05
New Formula A:		
Average sentence length in words	20	16
Syllables per 100 words	148	145
"Reading ease" score	61	68
New Formula B.		
Personal words per 100 words	10	8
Personal sentences per 100 sentences	39	15
"Human interest" score	49	34

applied to the psychology texts by Koffka and James mentioned above (17), it was found that the percentage of "personal sentences" in Koffka was negligible (4%), whereas in James's first volume it was 16% and in his second volume 10%. A striking example of this difference in style is the following of James's "personal sentences": "Ask half the common drunkards you know why it is that they fall so often prey to temptation, and they will say that most of the time they cannot tell." This sentence shows well the aspect of readability that eluded the earlier formula.

When the old and the new formulas were applied to two random copies of the *New Yorker* (October 26, 1946) and the *Reader's Digest* (November 1946), the results were as shown in Table 4.

As can be seen, the old formula rated the *Reader's Digest* significantly more readable than the *New Yorker*; the new formula A also shows that the *Reader's Digest* is significantly easier to read. But the new formula B clearly shows a large difference in human interest in favor of the *New Yorker*.

The Formulas Restated

For practical application, the formulas may be restated this way:

To measure the readability ("reading ease" and "human interest") of a piece of writing, go through the following steps:

Step 1. Unless you want to test a whole piece of writing, take samples. Take enough samples to make a fair test (say, three to five of an article and 25 to 30 of a book). Don't try to pick "good" or "typical" samples. Go by a strictly numerical scheme. For instance, take every third paragraph or every other page. Each sample should start at the beginning of a paragraph.

Step 2 Count the words in your piece of writing or, if you are using samples, take each sample and count each word in it up to 100. Count contractions and hyphenated words as one word. Count as words numbers or letters separated by space

Step 3. Count the syllables in your 100-word samples or, if you are testing a whole piece of writing, compute the number of syllables per 100 words. If in doubt about syllabication rules, use any good dictionary. Count the number of syllables in symbols and figures according to the way they are normally read aloud, e.g. two for \$ ("dollars") and four for 1918 ("nineteen-eighteen"). If a passage contains several or lengthy figures, your estimate will be more accurate if you don't include these figures in your syllable count. In a 100-word sample, be sure to add instead a corresponding number of words in your syllable count. To save time, count all syllables except the first in all words of more than one syllable

and add the total to the number of words tested. It is also helpful to "read silently aloud" while counting.

Step 4. Figure the average sentence length in words for your piece of writing or, if you are using samples, for all your samples combined. In a 100-word sample, find the sentence that ends nearest to the 100-word mark—that might be at the 94th word or the 109th word. Count the sentences up to that point and divide the number of words in those sentences by the number of sentences. In counting sentences, follow the units of thought rather than the punctuation. Usually sentences are marked off by periods; but sometimes they are marked off by colons or semicolons—like these. But don't break up sentences that are joined by conjunctions like *and* or *but*.

Step 5. Figure the number of "personal words" per 100 words in your piece of writing or, if you are using samples, in all your samples combined. "Personal words" are: (a) All first-, second-, and third-person pronouns except the neuter pronouns *it*, *its*, *itself*, and *they*, *them*, *their*, *theirs*, *themselves* if referring to things rather than people. (b) All words that have masculine or feminine natural gender, e.g. *Jones*, *Mary*, *father*, *sister*, *iceman*, *actress*. Do not count common-gender words like *teacher*, *doctor*, *employee*, *assistant*, *spouse*. Count singular and plural forms. (c) The group words *people* (with the plural verb) and *folks*.

Step 6. Figure the number of "personal sentences" per 100 sentences in your piece of writing or, if you use samples, in all your samples combined. "Personal sentences" are: (a) Spoken sentences, marked by quotation marks or otherwise, often including so-called speech tags like "he said" (e.g. "I doubt it."—We told him. "You can take it or leave it."—"That's all very well," he replied, showing clearly that he didn't believe a word of what we said). (b) Questions, commands, requests, and other sentences directly addressed to the reader. (c) Exclamations. (d) Grammatically incomplete sentences whose full meaning has to be inferred from the context (e.g. Doesn't know a word of English.—Handsome, though—Well, he wasn't.—The minute you walked out). If a sentence fits two or more of these definitions, count it only once. Divide the number of these "personal sentences" by the total number of sentences you found in Step 4.

Step 7. Find your "reading ease" score by inserting the number of syllables per 100 words (word length, *wl*) and the average sentence length (*sl*) in the following formula:

$$\text{R.E. ("reading ease")} = 206.835 - 846 \text{ } wl - 1.015 \text{ } sl$$

The "reading ease" score will put your piece of writing on a scale between 0 (practically unreadable) and 100 (easy for any literate person).

Step 8. Find your "human interest" score by inserting the percentage of "personal words" (*pw*) and the percentage of "personal sentences" (*ps*) in the following formula:

$$\text{H.I. ("human interest")} = 3.635 \text{ } pw + .314 \text{ } ps$$

The "human interest" score will put your piece of writing on a scale between 0 (no human interest) and 100 (full of human interest)

In applying the formulas, remember that Formula A measures *length* (the longer the words and sentences, the harder to read) and Formula B measures *percentages* (the more personal words and sentences, the more human interest).

Roughly, "reading ease" scores will tend to follow the pattern shown in Table 5.

"Human interest" scores will follow the general pattern shown in Table 6.

Table 5
Pattern of "Reading Ease" Scores

"Reading Ease" Score	Description of Style	Typical Magazine	Syllables per 100 Words	Average Sentence Length in Words
0 to 30	Very difficult	Scientific	192 or more	29 or more
30 to 50	Difficult	Academic	167	25
50 to 60	Fairly difficult	Quality	155	21
60 to 70	Standard	Digests	147	17
70 to 80	Fairly easy	Shick-fiction	139	14
80 to 90	Easy	Pulp-fiction	131	11
90 to 100	Very easy	Comics	123 or less	8 or less

Table 6
Pattern of "Human Interest" Scores

"Human Interest" Score	Description of Style	Typical Magazine	Percentage of Personal Words	Percentage of Personal Sentences
0 to 10	Dull	Scientific	2 or less	0
10 to 20	Mildly interesting	Trade	4	5
20 to 40	Interesting	Digests	7	15
40 to 60	Highly interesting	<i>New Yorker</i>	11	32
60 to 100	Dramatic	Fiction	17 or more	58 or more

Sample Application

As an example of the application of the new formulas, two recent descriptions of the "nerve-block" method of anesthesia will be used.

By an odd coincidence, these two variations upon a theme appeared within the same week in *Life* (October 27, 1947) and *The New Yorker* (October 25, 1947). The *Life* story served as text accompanying a series of pictures; it is straight reporting, not particularly simple, and lacks human interest (which was supplied by the pictures). The *New Yorker* passage is part of a personality profile, vivid, dramatic, using all the tricks of the trade to get the reader interested and keep him in suspense.

From *Life*.

Except in the field of surgery, control of pain is still very much in the primitive stages. Countless thousands of patients suffer the tortures of cancer, angina pectoris and other distressing diseases while their physicians are helpless to relieve them. A big step toward help for these sufferers is now being made with a treatment known as nerve-blocking. This treatment, which consists of putting a "block" between the source of pain and the brain, is not a new therapy. But its potentialities are just now being realized. Using better drugs and a wider knowledge of the mechanics of pain gained during and since the war, Doctors E. A. Rovenstine and E. M. Papper of the New York University College of Medicine have been able to help two-thirds of the patients accepted for treatment in their "pain clinic" at Bellevue Hospital.

The nerve-block treatment is comparatively simple and does not have serious aftereffects. It merely involves the injection of an anesthetic drug along the path of the nerve carrying pain impulses from the diseased or injured tissue to the brain. Although its action is similar to that of spinal anesthesia used in surgery, nerve block generally lasts much longer and is only occasionally used for operations. The N. Y. U. doctors have found it effective in a wide range of diseases, including angina pectoris, sciatica, shingles, neuralgia and some forms of cancer. Relief is not always permanent, but usually the injection can be repeated. Some angina pectoris patients have had relief for periods ranging from six months to two years. While recognizing that nerve block is no panacea, the doctors feel that results obtained in cases like that of Mike Ostroich (*next page*) will mean a much wider application in the near future.

From *The New Yorker*:

. . . Recently, [Rovenstine] devoted a few minutes to relieving a free patient in Bellevue of a pain in an arm that had been cut off several years before. The victim of this phantom pain said that the tendons ached and that his fingers were clenched so hard he could feel his nails digging into his palm. Dr. Rovenstine's assistant, Dr. E. M. Papper, reminded Rovenstine that a hundred and fifty years ago the cure would have been to dig up the man's arm, if its burial place was known, and straighten out the hand. Rovenstine smiled. "I tell you," he said. "We'll use a two-percent solution of procaine, and if it works, in a couple of weeks we'll go on with an alcohol solution. Procaine, you know, lasts a couple of weeks, alcohol six months or longer. In most cases of this sort, I use the nerve block originated by Labat around 1910 and improved on in New Orleans about ten years back, plus one or two improvisations of my own." (Nerve blocking is a method of anesthetizing a nerve that is transmitting pain.) . . .

The man with the pain in the nonexistent hand was an indigent, and Rovenstine was working before a large gallery of student anesthetists and visitors when he exorcised the ghosts that were paining him. Some of the spectators, though they felt awed, also felt inclined to giggle. Even trained anesthetists sometimes get into this state during nerve-block demonstrations because of the tenseness such feats of magic induce in them. The patient,

thin, stark-naked, and an obvious product of poverty and cheap gin mills, was nervous and rather apologetic when he was brought into the operating theatre. He lay face down on the operating table. Rovenstine has an easy manner with patients, and as his thick, stubby hands roamed over the man's back, he gently asked, "How you doing?" "My hand, it is all closed together, Doc," the man answered, startled and evidently a little proud of the attention he was getting. "You'll be O.K. soon," Rovenstine said, and turned to the audience. "One of my greatest contributions to medical science has been the use of the eyebrow pencil," he said. He took one from the pocket of his white smock and made a series of marks on the patient's back, near the shoulder of the amputated arm, so that the spectators could see exactly where he was going to work. With a syringe and needle, he raised four small weals on the man's back and then shoved long needles into the weals. The man shuddered but said he felt no pain. Rovenstine then attached a syringe to the first needle, injected the procaine solution, unfastened the syringe, attached it to the next needle, injected more of the solution, and so on. The patient's face began to relax a little. "Lord, Doc," he said. "My hand is loosening up a bit already." "You'll be all right by tonight, I think," Rovenstine said. He was.

A comparative analysis of these two passages is shown in Table 7.

The two passages furnish a good illustration of the stylistic features measured and emphasized by the two new formulas.

Table 7

Comparative Analysis of Treatment of Same Theme in *Life* and *The New Yorker*

	<i>Life</i> (290 words)	<i>New Yorker</i> (495 words)
Old Formula		
Average sentence length in words	22	18
Affixes per 100 words	48	35
Personal words per 100 words	2	11
Readability score	5.16	3.20
New Formula A		
Average sentence length in words	22	18
Syllables per 100 words	165	145
"Reading ease" score	46	66
New Formula B:		
Personal words per 100 words	2	11
Personal sentences per 100 sentences	0	41
"Human interest" score	7	53

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