The Place of Readability Formulas in Technical Communication

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READABILITY FORMULAS ARE INADEQUATE MEASURES *of how difficult written material is for adult readers, say these authors. In fact, readability formulas are counterproductive because they focus the writer's attention on words and sentences and draw attention away from important sources of readers' problems. Readability formulas are being used in contexts where they have no research base, and they are being misused by writers who rewrite to achieve a specific required score. A better way of assessing readability is user testing.*

This article has three parts. We begin by defining the topic for those who are not familiar with readability formulas. In the main part of the article, we discuss five facts that lead us to recommend that writers NOT use readability formulas. In the final section, we suggest another approach to testing documents and some possibilities for making this alternative financially and managerially feasible.

AN INTRODUCTION TO READABILITY FORMULAS

What Is a Readability Formula?

A readability formula is a mathematical equation that is applied to prose texts in an effort to predict how difficult the text will be for a given group of readers. When you apply a readability formula, you get a score (either a number from 0 to 100 or a reading grade level, depending on the formula). Common uses of the formulas are to see if a text meets a predetermined numerical goal or to compare two versions of a text.

Hundreds of formulas exist,[1] but all predict comprehension by counting only one or two features of a text—typically sentence length and some aspect of word frequency or word

length. The formula that is most commonly used to measure technical or business writing is the *Flesch Reading Ease Scale*,[2] which is based on sentence length and the number of syllables per hundred words. The Flesch test yields a number from 0 to 100. The higher the number, the easier the text should be to read.

Other popular formulas for testing writing for adults include the *Gunning Fog Index*, which counts sentence length and percentage of multisyllabic words;[3] the *Dale-Chall formula*, which counts sentence length and whether a word appears on a list of acceptable words;[4] the *FORCAST formula* developed for Army manuals, which counts only the number of one-syllable words;[5] and the *Navy's revision of the Flesch formula*, which is now the standard for all Armed Forces publications.[6] Chall,[7] Klare,[8] and Redish[9] have reviewed the history and specifics of these and other formulas.

Why Are Readability Formulas So Popular?

Readability formulas are seductive. They are easy to learn, easy to use, and inexpensive. They require no involvement from other people (such as test developers and test subjects). They give an impartial and objective measure.

Computerization makes the formulas even easier to use. Computer programs can measure the same text against several readability formulas while avoiding the tedium and inaccuracy of having a human count the words and syllables.

We are concerned that the temptation to rely on computer programs such as readability formulas can become overwhelming. We have been asked questions like these: If the computer can calculate reading grade level, why not let it do so? If changing a document on the computer is so easy, why not require documents to meet a certain score?

Writers (and their managers and the people who set readability requirements) need to understand the appropriate uses and the limitations of readability formulas as they need to understand the limitations of other writers' tools that are available on computers today.

For example, a spelling checker can be useful, but it will not find all spelling errors. A computerized spelling checker only matches each word in the text against the word list that has been built into it. It will point out words that are spelled correctly but that are not on its list; it will not point out words that are on its list but that are wrong in the context of the document. Thus, it will not stop at "the" even if you meant to write "they." A spelling checker can help, but only as an addition to, not instead of, a human proofreader.

A program that flags awkward phrases (such as "at this point in time" for "now") or that makes other editing comments (such as listing passive sentences, compound sentences, or

nominalizations) can also be helpful but cannot replace the writer. The writer needs to look carefully at the sentences that the program flags and decide whether they really need to be changed.

Editing programs (like the style programs in AT&T's Writer's Workbench or like IBM's Epistle) are useful in that they show writers possible problems in their text. But writers have to realize that these editing programs only operate on the level of sentences and words. As we will discuss later in this article, when writers concentrate on rewriting words and sentences, they may be missing much more significant problems—in selecting the right content, organizing material so that readers can find what they need, and designing the document to be attractive and useful.

A readability formula is even more limited than a spelling checker or an editing program. A readability formula does not indicate specific possible problems; it just gives a number. Although many writers understand how limited readability formulas are, computerization is bringing readability formulas to many new audiences who may not know where readability formulas come from or how they are used. Before you use a readability formula or ask someone else to, you should ask: *What does the number I get mean? Where does it come from? What will I achieve by changing the number?*

What's Wrong With Readability Formulas?

Many writers have pointed out the limitations of readability formulas.[9-15] There are at least five significant problems with readability formulas and the way they are used in technical writing for adults:

1. Readability formulas have been applied to technical and business writing with no research basis.
2. Studies show that readability formulas are not reliable and valid predictors of how understandable a technical, scientific, or legal document will be for adults.
3. Shortening sentences and words does not necessarily make the sentences and words easier to understand.
4. The underlying assumption of readability formulas—that any text for any reader for any purpose can be

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measured with the same equation—does not mesh with our current understanding of how people process information.
5. Readability formulas do not take into account many features that are critical to people's ability to understand and use documents.
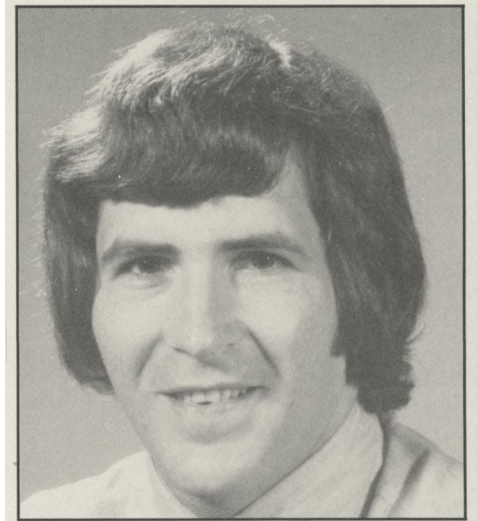
In the next section, we review these five points.

FIVE IMPORTANT FACTS ABOUT READABILITY FORMULAS

Fact 1. It is not clear what a readability score means in technical writing for adults.

Selzer[11] summarizes the tremendous influence that readability formulas have had on the teaching of technical and business writing. But there is very little research basis for their use in those contexts or for their use with adults in general.

Readability formulas were first developed in the 1920s and 1930s so that textbook publishers could assign children's schoolbooks to the appropriate grade levels. To develop a formula, educators assigned passages to certain grade levels based on standardized test scores. They then analyzed the passages to find the features that correlated best with the grade-level assignments. Of the many features they considered, the researchers used in the formula only the few that maximize two goals—having high correlation scores and being easy to count.

We can point to at least three problems with this research. *First*, because only features that can be counted can be included in the formula, many features that experts agree are important were not included when the formulas were developed.

Second, the validity of a formula is only as good as the validity of the grade-level assignments of the original set of passages. In the 1970s, Jacob-

son, Kirkland, and Selden[16] found that the grade-level assignments of the passages on which the formulas are based were badly out of date.

Third, most formulas define reading grade level as the point at which 50% of the children tested were able to answer 50% of the questions on the test correctly. Is this an appropriate criterion for measuring technical writing for adults? Are we satisfied with a book in which half of the audience can understand half of the book?

The formula that is most commonly used for writing meant for adults, the Flesch Reading Ease Scale, was developed in the 1940s by matching popular magazine articles meant for adult readers to the same test passages that had been used with children. Yet technical, business, legal, and scientific writing often has little in common with popular magazine articles.

What does it mean to say that a technical or legal document for an adult is at an eighth-grade reading level? An eighth grader reading on the eighth-grade level has quite different life experiences, motivation, and self concept than an adult who reads on an eighth-grade level.

Readability formulas are being applied in many situations in which they have not been tested. For example, many states now require that life insurance policies meet a specific score on a Flesch test, but we know of no studies of people trying to understand insurance policies with different Flesch scores. The IRS sends tax instructions through several computerized readability formulas and sets as a goal to reach a particular reading grade level. The developers of readability formulas may not have intended their formulas to be used for this type of technical and legal writing, but the formulas are being used—not just as one measure of the writing—but as the *only* criterion of comprehensibility.

Only in the military has there been a research basis for the readability formulas developed for adult readers. Two groups of military researchers set out to adjust the earlier formulas to military texts and adult readers.[6,17] They used the same research procedures: finding reading grade levels for test subjects on standardized comprehension tests and then associating those reading grade levels with the performance of the same subjects on trial passages.

Duffy points out two problems with this research. *First*, the situation of the test doesn't correspond to the tasks of real readers. The test subjects read only test passages—not technical manuals, instruction booklets, or maintenance job aids. As Duffy says, "What does this have to do with the skill required in reading to do a job?"[18]

Second, the criteria for assigning a reading grade level to a text are arbitrary and are set well below the level at which they should be to predict that an adult can read and understand a job-related document. In the Kincaid revision of the Flesch formula, a tenth-grade level means that at least 50% of the readers who scored tenth grade or higher on the standardized reading test can be expected to get 35% of the words correct in a cloze test. (In a cloze test, you leave every fifth word blank and subjects fill in the blanks.) A 35% cloze score equates to getting only 50% of the answers correct on a multiple choice test. If we really want people to read and understand job instructions, we would expect them to get 90% correct on a multiple choice test.[19] That would be a very different standard from the one the formula uses.

Many writers who agree that any particular readability score is arbitrary still want to use readability formulas in a relative sense. That is, they argue, surely an insurance policy with a Flesch score of 50 is better than one with a score of 40. IRS instructions at the eighth-grade reading level must be easier to read than ones at the tenth-grade reading level. As we explain in the next section, however, research has shown that these seemingly logical assumptions are not necessarily true for writing intended for adults.

Fact 2. Studies have shown that readability formulas are not reliable and valid predictors of how difficult documents are.

Charrow and Charrow[20] studied jurors' ability to paraphrase jury instructions. They analyzed jurors' problems in understanding the instructions, rewrote the instructions, and then retested them. They found that the rewritten instructions that improved comprehension did not always have better readability scores. In fact, changes that improved comprehension often made the readability score worse.

Kintsch and Vipond[21] studied college students' ability to recall information from different paragraphs that had the same readability scores. Although the readability scores were the same, the comprehension scores were not. What mattered was not the readability score, but that one passage had fewer ideas in each sentence and that the connections between the ideas were clearer.

When Klare reviewed the literature on readability in 1963, he recounted six studies that simplified vocabulary in order to improve reading comprehension. Only one succeeded. In 1976, Klare reviewed 36 studies that attempted to improve comprehension by improving readability scores. Only about half succeeded and in these the revisions were enormous; they changed the readability scores by an average of 6.5 grade levels.[22]

Duffy and Kabance[23] rewrote passages for Navy recruits using guidelines derived from readability formulas. They created four versions of each passage: the original, one with shortened sentences, one with shortened words, and one with both. Making the sentences and words shorter did not improve comprehension.

Although some researchers claim that the formulas are accurate to about 1.5 grade levels when applied to children's textbooks,[24] Kern[25] found that this claim is not true for the new formulas developed by the military. When Kern applied the Kincaid-Flesch formula to new passages, he found that scores ranged from sixth grade to twelfth grade for passages that should have come out as ninth to tenth-grade level. As Duffy says, "Kern's findings are damning of existing readability formulas."[26] If the formulas are not reliable, why are we using them?

Fact 3: Shorter sentences are not necessarily clearer sentences; shorter

words are not always easier words.

Now that computerized readability formulas are available, writers may be tempted to use them as guides when writing or editing a text. Even the proponents of readability formulas agree that this is an inappropriate use of readability formulas.[3,24] If you shorten sentences and change words to get a better readability score, you are missing the point. A readability formula only *correlates* certain features with reading difficulty; the features do not *cause* the difficulty. (Charrow and Holland,[27] Holland and Campbell,[13] and Selzer[12] review the psycholinguistic research that explains why shortening sentences and shortening words will improve the readability score of a document but will often not improve the comprehensibility of the document.)

Readability formulas pressure writers to write short, simple sentences; but sentences can be difficult to read because they are too short. Compare these passages.

1. The defendant is a fifteen-year-old teenager who is accused of shoplifting.
2. He is the defendant. He is fifteen years old. He is in his teens. Someone says he stole from the store.

The second passage has a better readability score but may in fact be more difficult to understand. The very short sentences inhibit the flow of the ideas. In fact, Pearson[28] found that *combining sentences* improved comprehension when the sentences were causally related.

A readability requirement can pressure writers to violate the rules of grammar and punctuation. An insurance policy writer whose work is judged by a Flesch test achieved a high score by writing sentence fragments:

You may pay at our Home Office.
Or to one of our Agents.

It is not length, by itself, that causes the difficulty in sentences. Flower, Hayes, and Swarts[29] found that readers had problems understanding writing that was full of passive sentences with noun strings and nominalizations (nouns made out of verbs). A noun string, however, is often shorter than the more understandable phrase that untangles the noun string. Sentences with nominalizations are often shorter than the same sentences with more understandable verb phrases.

A sentence with 60, 100, or 150 words needs to be shortened; but a sentence with 20 words is not necessarily more understandable than a sentence with 25 words. The incredibly long sentences that are sometimes found in technical, bureaucratic, and legal writing are also often sentences that have abstract nouns as subjects, buried actions, unclear focus, and intrusive phrases. These are the problems that have to be fixed, whether the sentence has 200 words or 10.

Similarly, short words are not always easier words. The important point is not that the words be short, but that your readers know the words you are using. In general, technical words are longer than plain English words, but that is not always true. The word "waive" as in "We will waive your premium" counts exactly the same on a Flesch test as "we," "will," and "your."

Even formulas, like the Dale-Chall formula, that match words against a list of acceptable words can be fooled by homonyms. When the IRS runs income tax instructions through a Dale-Chall formula, the test says that the word "enter" is fine. The Dale-Chall list is based on words known to fourth graders in Ohio in 1948. Yes, they knew the word "enter," but not in the meaning that it has on IRS forms. Similarly, "run" as used by computer programmers will be accepted by the formula as an easy word. Do computer novices understand it in its technical computer meaning?

The basic problem is that all readability formulas are mechanistic. They do not interpret context, meaning, grammar, or content.

Fact 4: People are not text-processing machines.

The underlying assumption of readability formulas—that any text for any reader for any purpose can be measured with the same formula—does not mesh with our current understanding of how people read and understand. The formulas are built on a model of how people read that derives from outdated communication theory. According to that theory, meaning rests on the page, in a "message." A reader, like someone listening to a telephone recording, takes in information passively, word by word and sentence by sentence. From words and sentences, the reader builds larger patterns—paragraphs and sections—until the message has been processed completely.

Reading researchers, however, now find that theory inadequate to describe how readers approach texts. As George Dillon notes, the meaning of a document is not inscribed on a page and extracted neatly by passive readers.[30] Rather, reading amounts to a much messier, much more active, and much less understood activity.

Readability formulas show differences only when you control reading speed, but in the real world, readers go at their own pace, looking ahead to get their bearings, and looking back to see where they have been. The formulas ignore motivation, but reading researchers have found that readability scores are unimportant if adult readers are motivated to read the text.

Readability formulas focus on words and sentences because they reflect the old "bottom to top" view of reading—that people build meaning from the smallest units of language to the largest. Modern cognitive psychology and psycholinguistics have shown that readers read not from the bottom up, but from the top down. They make meaning on the basis of schemas that they bring to the material. They create expectations about where the text is going and look for sentences and words that satisfy or violate their expectations. They look for context (explanatory introductions, signposts) to help them make meaning out of individual words and sentences.[31]

Readability formulas are a simplistic answer to a very complex problem. A formula cannot help the writer adjust a report to an interested or uninterested audience, to an informed or uninformed audience, to a reader who will

consult it occasionally or who will read it straight through. A writer must attend to many aspects of the text that a readability formula does not consider and that are more important to the reader's ability to understand and use the text than are short sentences and short words.

Fact 5: Readability formulas do not measure the most important features of a document.

Readability formulas measure only the features that can be counted. Yet many factors for which we have no objective measures also influence how understandable and useful a document is—and these features may be as important as (or more important than) the length of the sentences and the words. Three critical factors that readability formulas ignore are content, organization, and layout.

Content. Rothkopf[32] pointed out that readability formulas do not measure the appropriateness or accuracy of the content. Some content that is very difficult to understand can be presented in simple sentences and short words. According to several readability formulas, Plato's dialogues are fourth- to eighth-grade reading.[33] But when we talk about "reading grade level," we mean not just the age at which someone can pronounce a word or understand it in isolation, but the age at which we expect the person to understand the meaning of the text. And we would not say that Plato is appropriate reading for elementary school children.

Even for well-educated adults, not all content is equally easy to understand. For example, here are two passages that have identical Flesch scores:

1. Enter your gross annual income. Add all your assets in real estate, stocks, and bonds. Figure your tax from the table.
2. Write down your first name. Now put down your middle initial and your last name. Fill in your age on the next line.

Most of us would find it much easier to follow the second set of instructions than the first. The concepts in the first set may be difficult for some readers, but the Flesch scale or the Fog Index won't measure that difference.

Organization. Readability formulas say nothing at all about how well a document is organized. Yet ease of access to the right information is crucial. When writers concentrate on a readability formula, they often forget to make the information accessible. Duffy[15] cites an extreme example: a technician who wants to repair one malfunction on a C-141 airplane needs to refer to 165 pages in 41 different places in eight separate documents. Running this text through a readability formula will not indicate its difficulty.

In a study of more than 50 life insurance policies (all of which meet a Flesch test), Redish[34] found that most still hide the information under uninformative headings. The sentences may be shorter, but the information isn't useful—because the reader doesn't know where to look for it. Redish, Battison, and Gold[35] present case studies in which reorganizing technical documents (not just shortening words and sentences) was the key to making them understandable and useful.

Graphics and Typography. Readability formulas cannot be used on text that is not straight prose. The authors know of no research studies validating the use of readability formulas with forms or with text that relies heavily on charts, tables, graphs, or illustrations. It is simply inappropriate to use a readability formula when the information is presented or supported graphically.

Even when the material is entirely in prose, graphics (that is, page layout and typography) is another critical aspect that readability formulas ignore. Benson[36] reviews research on typography and page design and shows how decisions on these topics affect the readability (in the sense of comprehensibility, not just the legibility) of a document.

When a writer is forced to focus on meeting readability standards, these other issues are often forgotten. We need to find a broader measure for technical writing for adults than readability formulas provide.

SUMMARY: WHAT USE ARE READABILITY FORMULAS?

Do readability formulas have any place in technical writing? Our conclusion: If at all, only as a preliminary screening device for an old document; not as a measuring device for a new document. If a document that was not created with a readability formula in mind gets a very poor score, it almost certainly needs to be reorganized, rethought, and rewritten. If a document (even one created without reference to a formula) gets a good score, however, it may still be impossible for its readers to understand and use. Therefore, setting a readability score as a requirement is not a guarantee of a useful document.

What about the suggestion that we use a readability score as one of several criteria for a good document? We have two major problems with this suggestion. First, we have shown that any particular score from a formula is an arbitrary requirement. We really do not know what it means for adult readers if an insurance policy scores 50 on a Flesch test or if the tax instructions are on an "eighth-grade reading level."

Second, we share the concern of many researchers and writers that writers who are held to a readability requirement will "write to the formula."[15,25,37] After all, when a writer has a deadline to meet and the computer can calculate the score in seconds, the pressure to just meet the readability requirement and forget the sense of what one is doing can be overwhelming. When a readability formula is one of the yardsticks for a document, all the other measurement tools tend to be ignored.

ALTERNATIVES TO READABILITY FORMULAS

If readability formulas are not useful tools for evaluating technical writing, what should we use instead? As Duffy points out, "If we are to aid the practitioner and end the widespread misapplication of readability formulas, we must offer alternatives where the increased effectiveness is not outweighed by the increased cost."[15]

The only way to know if a document is understandable and useful is to test it with a sample of appropriate users. Only then can we take all the situational variables into account.

For example, Redish, Felker, and Rose[38] present a case study of such an

evaluation. They helped the Federal Communications Commission to test a regulation that had been reorganized and rewritten according to a particular set of guidelines for clear writing. To test the old and new regulations, they developed a comprehension test that applied to both versions of the regulation. They then invited two groups of subjects to test the regulation—a group interested in but not knowledgeable about the topic and a group that was knowledgeable about it. Half of each group read the old regulation and half the new; both received the same test and the same set of instructions. Measurements included how long it took people to find each answer, how accurate their answers were, whether they looked in the right place for the answer, and how easy they thought the regulations were to read and use.

Similar user-oriented testing is becoming more common today in high technology industries. Computer manuals are tested before they are released by having people who represent potential customers try out the manuals.[39]

User-oriented testing has many advantages over readability formulas.[40] Everything that is done to make the document understandable and useful is tested. We are not generalizing from other populations, other situations, other types of texts; we are testing the very document we want to know about. The test can do more than just verify that what we did to the document worked. It can help us to find places where the document is inaccurate, incomprehensible, or poorly organized. We get diagnostic information from the test about specific parts of the document. We get no such guidance from a readability formula.

User-oriented testing also has disadvantages. It takes more time, money, people, and expertise than a readability formula does. Conducting a reliable and valid test requires attention to many issues, such as finding the right test subjects, assigning the subjects appropriate tasks, and developing appropriate test measures. Duffy[15] indicates that tryouts are often required in contracts for military manuals but are seldom conducted because of the expense and logistics involved.

However, we should not be comparing the time and costs of user testing to the time and costs of administering readability formulas. We must accept the fact that readability formulas are NOT providing sufficient useful information and instead compare the time and costs of testing documents with the time and costs of NOT testing documents. Publishing a manual that readers cannot understand and use may cost a company more in the long run than the cost and time to test it and fix it before publication.

Testing can reduce the costs of

- Later revisions, technical updates, embarrassing letters to tell people how to solve problems that would have been uncovered in the testing
- Repairs needed because users did not understand how to operate or maintain the equipment
- Training that has to be offered because readers cannot learn from the manual
- Time taken by customer service departments to answer questions about information that should be understandable from the manual.

If the true costs and benefits were compared, usability testing would be a highly desirable option. The problem in most businesses and bureaucracies is that the two sets of costs (test it now or fix it later) do not come from the same budget. The manager who must get the manual to the printer on a certain schedule and within a certain cost is not responsible for whatever havoc the manual might cause later on.

Businesses and bureaucracies need to take a longer-range view of the problem of poor documentation and to move the control of the documentation to a higher level of management, where both the short-term development budget and the long-term maintenance and consumer service budget are both taken into account.   Ω

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What You Can Do for Your Boss

Employees have justifiable expectations of direction, equitable pay, fair treatment, and other good things from their bosses, in exchange for a fair share of work. On the flip side, bosses appreciate fair treatment from their employees. The more you are aware of the boss's performance needs and are willing to meet them, the better your own performance will be perceived.

By performance needs, I mean to include those activities that help your group to function effectively, that make a contribution to your whole company, and that make your boss look good personally.

Some of the things you can do to help your boss are:

Remove the surprises: One of the worst surprises a boss can get is finding out at the last minute that you will not meet your deadline. The proper way to handle a deadline is to monitor your progress as you go, and inform your boss at the earliest possible moment of any impending delays. It gives your boss the chance to muster additional resources.

Present your needs: Contrary to myth, your boss cannot read your mind. For example, if you need a new file cabinet, request it. Don't expect your boss to notice how the old one is crammed full. Present your needs to your boss, being as specific as you can, and describe why you need these things.

Come up with alternatives: When you run into a problem, don't just dump it in your boss's lap. Your boss, thus pressured by you, could be tempted to blurt out the first solution that comes to mind. Once that has happened, the stage is set for confrontation. You can avoid the whole messy scenario by coming up with at least three different ways to handle this situation. It's very likely that, as you mull it over, you'll flash on a solution. *Then* go to your boss and say: "Here's the problem I'm facing, and here's what I can do about it." If your boss disagrees, you can present one of your other alternatives. It's a win-win technique, which is comforting to have when you're dealing with problems.

The nice part about these tactics is that they come in handy not only with your boss, but also with your spouse, your friends, your neighbors—anyone with whom you want an equitable relationship. These tactics enable you to preserve your integrity and to get things done without groveling. They allow the person on the other side of the interaction to save face, and to get things done. And when things get done, that's performance.

Judy Glick

The Last 20 Percent

Writing a column for a newsletter or newspaper is very easy. Coming up with a good workable idea for the piece, however, is not. On occasion I've written 750 words of deathless prose in just under 90 minutes—after spending 40 to 50 dreary hours desperately searching for the idea. Sometimes I fell like the "Professor" in my favorite comic strip—"Shoe"—who once replied to his editor's query, that his column was "Eighty percent complete." He then turned back to his typewriter and mumbled to himself, "I've got the white part done."

Columnists, I've been told, will beg, steal, plagiarize, pray, or prey—if the effort is likely to secure one good idea. The affluent columnist will buy ideas; the lesser writer may contemplate mayhem.

Among my favorite sources of ideas are shopping malls and markets, where large numbers of people are available for study. I also eavesdrop without shame. One such expedition led to an essay on the evolution of spectacle frames. A newspaper piece on the curious usage of "into" emerged from overhearing one shopper ask another, "Are you into yogurt?"

Coffee shops are also sources for ideas. I once documented the behavior of an unusual and amusing waitress. (She later used a copy of that column to get a job at a better restaurant.) Another visit to a coffee shop resulted in a piece that explained how it is that bus boys are not hired, but are ordered from factories where they are mass-produced.

Sometimes ideas arise as pure whimsy. My general theory of the distribution of fat and the formal proof that stupidity is a contagious disease were thoroughly scientific, although utter nonsense.

The reason I'm telling you all this is that I was asked to do a piece for this newsletter. The white part is already done. So, just as soon as I can get ahold of a good idea, I'll finish it. Maybe what I need to do is to go out and buy myself a cup of coffee.

Jim Woolf