

to the digital form is an automatic process for the METAFONT system.

#### RESEARCH AT MIT

An Office Automation Group, headed by Prof. Michael Hammer, was formed at the Massachusetts Institute of Technology in 1979 as part of the Laboratory for Computer Science. Together with several other group members, I have been developing a text processing system designed specifically for the office environment. We are currently building a prototype of the system, called Etude. It features a high resolution screen which displays actual typefaces as the Bravo system does.

We are interested in making the system very easy to use. As the Bravo system demonstrates, it is much easier to format documents if the user can see the results of his formatting commands immediately before him on the screen. We have chosen to isolate the user from the details of formatting in a manner similar to Scribe. For example, the user would tell Etude that he was making a letter or annual report. The format of these documents would be predefined to conform to the standards of the office.

Etude has an extensive "help" facility. At any time, the help key can be struck and the current situation would be explained to the user, along with a menu of his alternatives.

There is also an "undo" key which is used to reverse the effects of any operation.

Etude allows the user to label any point or region of text with a name. The user could then operate on the region (for example, to delete or move it) just by specifying the region's name. Or he could ask the system to move the cursor to the named region. The names of the formats can also be used in this manner. For example, the user could say, "go to the end of chapter three" or "delete the previous quotation." The system can handle these requests because the document was formatted using the "chapter" and "quotation" commands.

In summary, there are many benefits which result from integrating text editing and formatting in an easy-to-use, interactive environment. We expect that within the next few years the cost of systems like Etude and electronic printers will be low enough so that their benefits will be accessible to any office.

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## Write for Your Reader

DELLA A. WHITTAKER

**Abstract**—In writing for your reader, adopt the habit of considering his needs and you will succeed in communicating technical information effectively. Write to meet the reader's personal needs—his use for the information and his background regarding it. Write the report to educate the busy reader quickly—emphasize through repetition and placement what you especially want the reader to know. Write for your reader's understanding—choose familiar words in familiar patterns, be consistent, and be grammatical. To catch accidental misspellings and cumbersome connections, read your report aloud. In the format allow plenty of blank space to rest the reader's eyes.

**A**NYONE can lead a horse to water, but if you can get him to float on his back, you've got something." As with that law of Murphy's, I have a message that may be helpful. It is philosophical, pragmatic, and educational. It is old, yet fresh, simple, and useful for writing technical reports:

Write for your reader. You can succeed in communicating technical information effectively if you are sensitive in knowing to whom you are writing. Sensitivity is a habit as easy or as hard to adopt as any other habit, good or bad. Some writers are habitually ambiguous. In a technical report, there can be no ambiguity. There must be no misinterpretation. There can be only one right meaning, and it must be clear. It must be so clear that the busiest of readers will not mistake it.

Developing the habit of writing for your reader is not so arduous as the twelve labors of Hercules nor so strict as the Ten Commandments or the eightfold path of Buddhism. Remembering three steps will help you form the habit of writing clearly word by word, paragraph by paragraph, report after report: Identify your reader's personal needs. Get to your point quickly in a plain way. Please him.

#### WILL THE REPORT MEET YOUR READER'S PERSONAL NEEDS?

To write your report to meet the reader's personal needs, think about who he is as a person. What does he do for a

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living? What will he do with your report? Think about your purpose for writing. Are you writing this technical report to *inform* the reader so that he will act on the information? To *explain* a situation or a process so that he can continue from where you left off? To *request* equipment that he can supply or to *give directions* that he can carry out? To *propose* a plan for which he might give approval? By your explanations you can influence him. You can best do so by first analyzing him as a person.

Who is your reader in relation to you: Is he your supervisor? a peer? a subordinate? a contractor? a client? How much information does he already have about the contents of your report: Has he expertise in this subject? general knowledge? ignorance? What is his educational level? What interest has he in your subject: Is he interested intensely? superficially? How does he feel about your subject, your point of view, and you: Is he supportive? dispassionate? antagonistic? How much time will he give to your report: Will he study it in detail? peruse it quickly? Knowing the personal needs of your reader should force you to write your report to suit him.

#### WILL THE REPORT EDUCATE YOUR BUSY READER QUICKLY?

To write your report for a busy reader, emphasize what you especially want him to know. Put your main ideas up front. In the most-read parts of your report—the title, the abstract, the contents page, and the introduction—bombard your reader with more and more of the same information so that before he reads the body of your report, he will know all about it. Pack your title with key words. State your subject and what you learned about it within 100 typewritten characters and spaces.

Put your main ideas in your abstract. You may think that the abstract is the most difficult page to write. Remember that it will be the most-read group of sentences under your by-line when the report appears in print. This abstract, fewer than 200 words, must glitter with the gems of your entire investigation. Be so informative that your abstract alone can educate your reader. On the contents page, use key words in your headings to inform your reader about your methods, classify your results, and summarize the discoveries that you discuss.

In your introduction, elaborate on the information in your abstract. What was the problem? How did previous work help or not help solve the problem? Under whose authorization was the new work carried out? Where and when did it take place? What was the approach? What were the limitations? What were the main results? What do you mainly conclude and recommend? If you are proposing an activity, what action will you take? What do you hope to find? What do you expect to develop?

In the body, continue to emphasize your methods and results. Repeat as headings the key words as they appear on the contents page. Emphasize your organization. (1) Number the main and subordinate headings. Alternatively, type main headings fully capitalized or boldface and subheadings initially capitalized or italicized. (2) Use a design that will emphasize your organization for the reader. If your purpose is to request

an action, head your last section *Action Item* or *Required Action*. If your purpose is to propose a project, summarize under the heading *Proposal*. If you are analyzing data and drawing conclusions from them without recommending any action, close with a list under *Conclusions*. By such headings, you will remind the reader why you wrote the report.

To help the reader visualize your data, reduce them to tables and figures. List names, dates, places, equipment, and measurements. Tabulated information is much easier to read than the same information in prose form. Show your information in graphs, maps, photographs, line drawings, diagrams, and flow charts. Make every table and every figure self-explanatory. Do not make your busy reader search through the text to find out what the table or figure is for or what its symbols mean. Write an informative title and explain your abbreviations and symbols (except, of course, standard ones such as units of measurement).

Within the body of any report, put your main message up front in an introductory summary. Then add background details and other information that the reader will need to accept your initial summary statement. Professor Ron Blicq at Red River Community College in Winnipeg, Canada, emphasizes what is important by the following outlines (from *Technically-Write!*, Prentice-Hall, 1981).

**Asking a question** Ask that question (what you want to know), give your reason for needing to know the answer, and close with backup information that your reader might ask for.

**Making a request** Start with a short description of your request, give the reason for asking it, list the advantages and disadvantages of putting your request into effect, and close with backup answers to questions that your reader might ask.

**Making an inquiry** Summarize what you want to know in general terms, add specific details to get you the correct information, and finish with instructions about how, when, and where to send the information.

**Describing equipment** Summarize with a brief description of it and what it does, add the purpose for using it, describe what it is made of or its parts, and explain step by step how the equipment operates.

**Describing a process** Summarize briefly its main steps and its purpose; state the equipment, tools, or materials to be used with it; and explain how the process is put into effect—what happens step by step.

**Reporting an occurrence** Summarize the event, give background information leading to the event, describe what happened, and tell the effect of the event.

**Reporting progress** Summarize what happened; then describe work done to date, work in progress, and work planned.

**Reporting an inspection** Summarize your findings and recommendations; then explain the circumstances for the inspection, what conditions you found, and deficiencies; close with recommendations if you have been asked for them.

**Reporting an investigation, a study, an experiment, or an analysis** Summarize with your purpose, the highlights major conclusions, and major recommendations; then introduce the problem and the authority for your project, discuss your

methods and results, conclude, recommend actions, and attach supporting information in appendixes.

For any literature that you cite as documentation for your statements, the busy reader will appreciate that you footnote your sources or list them at the end of your text. Giving full, accurate, bibliographic information will enhance your credibility as a technical writer and aid the reader in finding the primary document.

Put other related words together to avoid grammatical ambiguities that could confuse your reader and cause him to guess a wrong meaning that you did not intend or that could even cause him to laugh, as at these sentences from drafts of reports to be published by the U.S. Department of Agriculture:

1. We need further study in the corn field. (ambiguous meaning)
2. The height of the curve at a specified time after the peak or start of mixing is a measure of the height of the curve at a specified mixing time. (circular definition)
3. Weyland et al. continued shaking and stirring, sometimes for considerable periods. (object of verbals is missing)
4. If people want to name plants, it's their business because they'll fade away if they're no good. (ambiguous reference)
5. Drip! Drip! Drip! Isn't it horrifying to think that you may be listening to a hole in your roof? (nonsense)

#### Aural Review

Once you have written your report, before you give it to your coworker, supervisor, or editor to review, check your language with your nearest reader, the person most likely to profit by such a check—yourself. Read your report *aloud*. Listen to what you say and how you say it. By your private oral reading, you can smooth your language so that your report will both instruct and delight your reader.

During oral reading, your tongue will trip over words that sound almost alike but differ in meaning, such as *nominal* and *normal*. You can correct the spelling and prevent your intended reader from tripping, too. Your tongue will help you get out of *preforming* (*performing*) an experiment and *relegating* (*regulating*) a valve. Your ear will hear the difference between *a memo of understanding* and *a memo of undersanding* and between *delecting* faults and *detecting* them. Preventing the laugh of ridicule is worth the effort of aural alertness.

However much you expect of your reader, he might understand your subject less well than you do. For him, you need to spell out the first use of every term for which you later substitute an abbreviation or acronym. Although your eye might catch the shortened expression later in your report, hearing it will help you recall whether you defined it previously, and you will note the full rendition of the expression when it comes up again. Take *transient radiation effects on electronics* or *TREE*, for example. Your rule should be "Once *TREE*, always *TREE*, and nevermore spelled out will be."

Just as important, your hearing will force the spelling of the article *a* or *an* before the abbreviation or acronym. If you hear a consonant sound, such as the *d* of *DoD* (Department of Defense), you should write *a DoD directive*. If you hear a vowel sound, such as the *e* of *ERP* (error recovery procedure), you should write *an ERP program*. Your speech will spell for you.

#### WILL YOUR REPORT PLEASE THE READER FOR WHOM WAS INTENDED?

##### Words and Order

To please your reader, choose words with which he is comfortable. If you must use even one technical word whose meaning he might not know, define it after you first use it. Do not count on the reader's looking for it in a technical dictionary. He would rather blunder through the report with a growing list of uncertainties and maybe grow annoyed at being ignorant about the meaning or assume that the vain writer wants to impress others with his knowledge of obscure words or obscure meanings of common words. If the reader guesses wrong, he may miss important relationships in your explanations. So define unfamiliar words, or do not use them.

Be consistent in what you call a piece of equipment. For example, if you call the AN/VRC-12 series of radio sets a "radio" on one page, a "radio set" on another page, and a "family of radios" on a third page, you may mislead your reader into thinking that you have three different units when you really have only one. Use one term for one referent in a technical report.

Along with being consistent in terminology, be consistent in spelling and cross-referencing. If a word can be spelled two ways, like *insure* and *ensure*, choose one way and stick with it throughout your report if you have in mind the same meaning every time you use the word.

Make your headings in the text match exactly the table of contents. That rule applies to table and figure titles on the contents page, also. Be sure that numbers in the text are the same as those shown by the tables and the figures. If 1.319 appears in a table, do not round off to 1.32 in the text unless you warn the reader that you are rounding off the number or are stating an approximation. Do not make him guess why the numbers differ. He may guess wrong.

Pair short lists in your prose and thereby avoid using the word *respectively*. Repeat referents to avoid using *the former* and *the latter*. These three expressions force your reader to go back over what he has read, whereas your goal is to keep him moving smoothly forward. Do not make him reverse the flow; he may not find his place easily.

Link your words into sentences that are easy to read. Start with your subject, continue with your verb, and finish with the complement. Use current word order rather than stiff older word order: *should it break* sounds stilted; use the current *if it breaks*.

Keep your verb close to your subject. With too many words between the subject and the verb you might forget your subject and repeat it as your verb. One author in his draft started a sentence with *The determination*, added 54 modifying words, and ended with the verb *was determined*. *The determination was determined* is not only unpleasant but ridiculous.

You can tell by your pauses and breaths that your sentences are choppy, too long, or just right. Panting will indicate that you have too many commas, parentheses, and dashes in a sentence. To prevent your reader from respiratory exhaustion by so many breaks, you can reword your sentence for fewer modifiers and turn your parenthetical expression into full

sentences. At the other extreme, if you run out of breath before you run out of words, you can be sure that your sentence is too long even for your reader, such as this 89-word sentence that was caught before being published:

Aubuchon indicated that by optimizing in one's own laboratory process variables of standard  $\text{SiO}_2$  gate MOS processing and by being cognizant of the three C's of processing: (a) cleanliness of furnace, (b) cleanliness of wafer, and (c) good laboratory cleaning and handling techniques, that one could essentially improve the standard MOS ( $\text{SiO}_2$ ) technology so that PMOS transistors capable of operation at radiation levels of  $10^6$  rad (Si) at a negative bias of 10 V (during radiation) and with a gate threshold shift of about -2 V could be developed.

That sentence is more than a reader can remember in one mental breath. By reading aloud you can figure out how to cut it into three sentences.

Listening, you can decide whether you want to alliterate with the sound of s in *seven sites were surveyed for susceptibility to sabotage*; p in *subroutine PATT prints a polar plot of the pattern on the computer's high-speed printer*; b in *a wheel bracket with a shaft support borne on ball bearings is bolted to the two I-beams*; f in *a function of fuze frequency in figures 43 and 45*; and k in *the effects of a structure containing complicated configurations of conductors are much more complicated*.

You can decide to keep or not to keep the assonance of *dual fuel or fumigation systems* or *the system can be adapted with four-bit latches and AND gates and also by adding the appropriate address circuitry*.

Surely you will not want to worry your reader's mental tongue with twisters like these: *a flat-black background target, at least as lethal to the component, the blower powered by the*

*blower motor, friction slows the flow, and slight shifts in slot spacing*.

Reading aloud, you can sense the rhythm in your language. Since arrhythmic language can jar a reader and make him wince, *the barrier bag material was too tough to tear manually* could be smoothed to the more rhythmic *the barrier bag material was not soft enough to tear by hand*.

### Structured Text

Finally, make the technical report restful to look at. The most restful sheet of paper is blank. The least restful is a single-spaced paragraph that takes up the whole page. Rest your reader's eyes by allowing plenty of white space on the page. You can do so by using short words, short paragraphs, and headings. Break up blocks of text with figures and tables. A large type font allows more spacing within and between letters than a small type font, and both wide spacing between lines and wide margins are restful. Choose a type of paper that will not reflect glaringly if held under a lamp or in the sunlight. Glossy paper is fancy to feel but its glare forces the reader to shift the report as he reads it. Choose a binding that will let the report remain open on the desk without being held; your reader may need both hands free to write notes from it. Choose a size of paper that fits standard filing cabinets and bookshelves. Oversize reports are put in unusual places, and undersize reports slip out of sight.

In summary, analyze the needs of your reader. Write clearly so that he may understand your thoughts. Look to please your reader, for his reading is the purpose for your reporting. In your report lie all the reasonings of your activity—the search for solutions, the success of action, the growth of awareness. You had a problem yesterday. Your report well written today will let someone else act on your recommendation tomorrow.

## Put Clarity in Your Writing

DOUGLAS MUELLER

**Abstract**—Understandable messages may take the author longer to produce but they save time and effort and often money for all the readers. Ten Principles of Clear Statement can prevent written fog. For example, tie in with the reader's experience; write to express, not to impress; and avoid unneeded words.

A rod cutter examines a written order calling for valuable radioactive rods to be cut in "ten foot long pieces." The hyphen is missing. Did the order call for "ten-foot long pieces" or "ten foot-long pieces"? The cutter takes the order to mean

ten pieces each a foot long. Result: a serious misunderstanding that cost the U.S. government a bundle of money.

Some chemists tell in a thick report how they synthesized a new group of compounds that show promise as insecticides. But this important message is buried on page 24, under a bushel of extraneous words and confusing sentences. After the report is channeled to many people, the company repeats this costly research unnecessarily as it begins a search for new insecticides.

The Employee Relations Department of a company sends out a confusing overtime notice to 20 employees. Later, the office gets 18 phone calls asking for an interpretation. It takes Employee Relations nearly a week to straighten matters out.

### DAMAGING FOG

Wordy (foggy) writing accounts for millions of dollars of waste every year. It wastes the time and energy of a company's

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